IBIS Open Forum Minutes

Meeting Date: November 12, 2021
Meeting Location: **Virtual Asian IBIS Summit (Japan)**

VOTING MEMBERS AND 2021 PARTICIPANTS

ANSYS	Curtis Clark, Wei-Hsing Huang, Miyo Kawata*
Applied Simulation Technology	(Fred Balistreri)
Broadcom	(Yunong Gan)
Cadence Design Systems	Zhen Mu, Ryo Sato*, Takuya Moriya*, Tadaaki Yoshimura*, Morihiro Nakazato*, Masahiro Nakahara*
Celestica	(Sophia Feng)
Cisco Systems	(Stephen Scearce)
Dassault Systemes (CST)	Stefan Paret, David Duque, Longfei Bai
Ericsson	(Guohua Wang)
Google	Zhiping Yang*, Songping Wu
Huawei Technologies	(Hang (Paul) Yan)
Infineon Technologies AG	(Christian Sporrer)
Instituto de Telecomunicações	(Abdelgader Abdalla)
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Yamaha Corporation	Hiroyuki Kai*, Tetsuya Kakimoto*
Yazaki Parts Co., Ltd.	Kenichi Fujisawa*
Yokogawa Electric Corporation	Daisuke Kamezawa*

In the list above, attendees at the meeting are indicated by *. Those submitting an email ballot for their member organization for a scheduled vote 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 connection information for future IBIS teleconferences is as follows:

Microsoft Teams meeting

Join on your computer or mobile app
Click here to join the meeting

Join with a video conferencing device
106010980@teams.bjn.vc
Video Conference ID: 114 666 897 5
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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 Virtual Asian IBIS Summit (Japan) took place on Friday, November 12, 2021, as an online virtual meeting. About 148 people representing 77 organizations attended.

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

> https://ibis.org/summits/nov21a/

Start times and durations listed in these minutes refer to the meeting recording linked at:

> https://ibis.org/summits/nov21a/summit_recording.mp4

(Start time: 13:50, Duration: 11:25)

Meeting facilitator Shiratori Takayuki gave instructions for using WebEx features, and how questions would be addressed. Unaddressed questions would be handled by email later.

Randy Wolff (IBIS Open Forum) welcomed everyone to the 16th IBIS summit in Japan. He thanked JEITA members for organizing the meeting, and the IBIS board members for assisting with organization and reviewing. The meeting would be recorded. Randy thanked the sponsors: Japan Electronics and Information Technology Industries Association (JEITA), ANSYS, Inc, Apollo Giken Co., Ltd., Keysight Technologies Japan K.K., Ricoh, Toshiba Corporation, and Zuken Inc.

Satoshi Nakamizo (JEITA) presented by video recording the history and status of the JEITA EDA Model Special Committee. There would be a new website and YouTube channel. One use of these would be to present information about IBIS.

> https://www.youtube.com/channel/UC6FZyi9_IGD3cC9h2M6HMng

IBIS CHAIR'S REPORT
Randy Wolff (Micron Technology, USA)
(Start time: 25:15, Duration: 15:00)

Randy Wolff, IBIS Open Forum Chair, presented by video recording on the history and status of the IBIS Open Forum. Most of the current work was in completing the IBIS 7.1 specification. A new Touchstone 2.0 parser had been released. Some specification change BIRDs were not to be included in IBIS 7.1. Future work would include expanding the system level perspective, PAMn, and PDN modeling and analysis improvements. Randy encouraged participation by all in the IBIS development process, showing the website features that could be used for collaboration.

EXPECTATIONS FOR IBIS 7.1
Randy Wolff (Micron Technology, USA)
(Start time: 40:30, Duration: 27:00)

Randy Wolff presented by video recording an overview of the new changes to be expected in IBIS 7.1. The presentation was an update to one previously given by Michael Mirmak of Intel. Randy described the process used by the Editorial Task Group to merge the changes specified by each BIRD into the IBIS 7.0 specification to produce IBIS 7.1. The work was very close to completion. A vote by the IBIS Open Forum was expected this year. Randy described changes in C_comp modeling, on-die Power Distribution Networks (PDNs), Electrical Module Descriptions (EMD), DC offset, back-channel statistical optimization, IBIS-AMI sampling

position, and IBIS-AMI clock forwarding support. He encouraged all to review the draft IBIS 7.1 documents found on the IBIS website.

Randy showed an update slide prepared after the video recording was made. He said the Editorial Task Group work had completed, and a final draft had been released for approval. Voting would take place in the December 10 IBIS Open Forum meeting. He encouraged IBIS members who could not attend to vote by email.

Ted Mido asked who could comment and vote. Randy said IBIS Open Forum members could vote. Comments could be sent by anyone to Randy, or to ibis@freelists.org (subscription required). Tadashi Arai asked if there were plans to update the IBIS Cookbook to handle complex models such as on-die C_comp models. Randy said that was a good idea, but there were no plans. He felt some helpful examples could be published.

MODELING AND SIMULATION OF SINGLE-ENDED PAM4 SIGNALS IN MEMORY INTERFACES
Fangyi Rao (Keysight Technologies, USA)
(Start time: 1:09:20, Duration: 30:00)

Fangyi Rao described the data rates and use of PAM4 signaling for GDDR6X. The reduced level separation of PAM4 required comprehensive modeling and analysis. Analysis of single-ended signals and source-synchronous clocking was required. Modeling the correct DC offset was important for single-ended signal analysis. Simulating the difference between rising and falling waveform edges, as well as non-linear transmitter behavior, were also important. Fangyi described the use of Signal-to-Noise-and-Distortion-Ratio (SNDR) for further analysis. He showed the effects of various equalization techniques, and how IBIS had been extended to model clock forwarding, which interacted with the ability of a receiver to track jitter.

Ted Mido asked if the Rx model should recover DC offset instead of the EDA tool doing that. Fangyi said it would not matter much. Ted was concerned that both the EDA tool and Rx model would apply the offset, double counting it. Fangyi said it was important for the Rx model to know what it was receiving. The Rx output could in theory have a DC component, which the EDA tool would have to accept. Randy Wolff said IBIS 7.1 would state that the Rx output would swing around zero volts. Fangyi asked if it was sufficient for the EDA tool to apply the offset. Ted said it might not be for some customers. There could be problems presenting the eye diagram. Fangyi said it had to be clear what was measured at the Rx latch.

DDR MEMORY SYSTEM SIMULATION METHOD
Shinichi Maeda (KEI Systems, Japan)
(Start time: 1:44:25, Duration: 26:00)

Shinichi Maeda presented by video recording on the advancement of DDR and LPDDR memory technologies over 5 generations, describing the key changes and required simulation method updates. The demand for LPDDR memory had increased due to their use in cellphones, which functioned increasingly like PCs. Shinichi described a process involving both pre-layout and post-layout simulation. He discussed the use of corner analysis and slew rate based JEDEC derating tables to account for operating variations with DDR3. IBIS 5.0 power-aware models made power noise analysis possible. DDR4 eliminated derating tables and added training functions. DDR5 added equalization, but IBIS-AMI models were required for that. Those had been developed for differential signals but would have to be used for single-ended signals. Also, they would have to support crosstalk and power noise analysis.

INSIDE AN IBIS PROVIDER
Tadashi Arai (AMD, Japan)
(Start time: 2:10:50, Duration: 27:00)

Tadashi Arai said he had transitioned from being an IBIS user to an IBIS provider. Early IBIS models allowed interoperable simulation, but availability, quality, and accuracy were issues. He described a case study showing the difficulties of providing IBIS models, from the IC vendor's perspective. Test reports provided with models were helpful. For one I/O buffer it was necessary to produce an IBIS model from SPICE. A third buffer required "loop back" testing since the interfacing part model was not available. An input model was difficult to convert from SPICE. For one buffer, combining slow, typical, and fast I-V curves into a single table was challenging. For package models, S-parameters were sometimes too large, but the basic IBIS RLC formats were not suitable. A power-aware buffer project was eventually abandoned due to cost. Help from silicon designers was needed to produce some IBIS models, but they tended to not be very knowledgeable about IBIS. IBIS model production was best handled by a dedicated team, or in some cases by outsourcing. Model testing, correlation, and ongoing support were important. Tadashi made recommendations for IBIS users, IBIS providers, and the IBIS Open Forum.

Mike LaBonte commented that the challenges summarized were quite familiar, noting that there seemed to be a request for more cookbook material from the IBIS Open Forum.

Kazunori Yamada commented that we had difficulty creating and providing the IBIS model. Engineers and organizations needed help. It would be helpful if JEITA were to show a reference case.

Kensuke Yoshijima asked what the IBIS model providers thought about creating and providing IBIS models; should that be a paid service or should models be provided free of charge as an added value to the product? Tadashi Arai answered that it depended on the relationship with the customer. In his opinion, like the semiconductor vendor's datasheets, the IBIS model should be provided free of charge. From the designer's point of view, it would be great if the SPICE model could be released, but for IP protection, we were taking the time to instead provide IBIS models. However, the expansion of the IBIS specification has made that more time consuming.

WHY ARE MODEL Issues STILL ALIVE? (MP4)
Kazuhiko Kusunoki (WADOW, Japan)
(Start time: 2:49:50, Duration: 20:00)

Kazuhiko Kusunoki presented by video recording, describing the challenges of becoming an IBIS model engineer. He had interviewed IBIS experts, mid-level experts, and non-experts. The number of issues reported seemed inversely proportional to the level of experience. Several questions and problem reports about IBIS had been expressed. JEITA had developed a portal and a cookbook to help. "Crosstalks" events provided venues for engineers to collaborate to solve issues, but COVID-19 had impacted that. Kazuhiko hoped to provide new venues for such cooperation. Activities would include creating IBIS models for pseudo-verification of standard protocols, adding AC/DC specifications and eye masks to IBIS models, and helping with the use of tools. IBIS Summit meetings could provide a venue, and "Crosstalks" could be resumed.

Makoto Matsumuro commented that, from his mid-expert experience, he thought that it was possible to judge whether the simulation results were far from the operating voltage or whether the waveform was abnormal. But it was difficult to judge whether the slew rate was correct, and

it might have been the same for an engineer mentioned in Tadashi Arai's presentation. He said that he wanted to increase his skill level in that area.

Ted Mido asked if the IBIS Open Forum would join Crosstalks. Randy Wolff said that might be possible. He agreed it took a long time to learn how to make IBIS models. He said it would be a large project to update the IBIS Cookbook, which was written for IBIS 4.2.

3D PACKAGE MODEL FOR ELECTROMAGNETIC FIELD SOLVER USED IN MORE HIGH-SPEED CHANNEL SIMULATION (MP4)
Masaki Kirinaka (Fujitsu Interconnect Technologies Limited, Japan)
(Start time: 3:10:30, Duration: 37:20)

Masaki Kirinaka presented by video recording on the verification and challenges of 3D package models. He showed the physical arrangement of and simulation results for multi-board systems for optical transmission. S-parameter extraction methods had to be improved to achieve good simulation results. Better results were obtained by extracting S-parameters for the package and boards together, requiring a 3D field solver. Comparisons were made using simulations at several operating speeds. A TDR spike at 14GHz Nyquist frequency was reduced using the 3D model. Eye diagrams were more open at higher frequencies using the 3D model, agreeing with insertion and return loss results. Masaki recommended adding 3D package modeling support to IBIS, by adding a File_3D IBIS-AMI parameter. He said simulation times would increase due to the 3D field solution time.

Masaki Kunii said he was aware that IBIS-AMI based analysis needed to be simulated with an equalizer, asking how Masaki Kirinaka had handled the equalizer in his PAM4 analysis. Masaki Kirinaka answered that for that case, he had shown the eye diagram, but he had not shown the waveform through the equalizer, just the Rx input waveform. He had used a simple behavioral input buffer model. His current issue was that inconsistencies occurred in the connections between the package and board models. He had found the problem by analyzing the package and board together. The idea was that as the frequency increases, by connecting the 3D model of the package and the 3D model of the board and doing the electromagnetic field analysis together, we could eliminate the inconsistency at the connection and get more accurate simulation results.

Masaki Kunii asked if it was correct that the proposal was to describe a 3D model in IBIS. Masaki Kirinaka said it would be ideal if the 3D model could be described in the package part of IBIS.

Ted Mido asked if the 3D models of the package and board should be included together in IBIS for better accuracy. Masaki Kirinaka answered yes, that was correct. He had proposed the keyword, but he did not yet have any concrete ideas about the content. He expected the keyword and their contents to be proposed as IBIS specifications in the future. He thought it would be better to define them in a 3D model, instead of the traditional S-parameter or LCR model on the device side.

Ted said he thought an S-parameter extracted from the results of 3D analysis would be sufficient, asking why Masaki Kirinaka thought a 3D model was necessary. Masaki Kirinaka said he thought a standardized 3D model should be used to describe the package in IBIS, not an S-parameter.

Ted said it would deviate from IBIS policy if the 3D model were in a proprietary vendor format. It would be necessary to standardize the 3D structural representation first. He understood that it would be described in IBIS.

Randy Wolff asked if the request was for full package layout information. A standard would have to be chosen, and IBIS files could then reference those files. Signal integrity simulators would need access to the 3D solvers.

Randy could imagine having a link from IBIS to the 3D structure file. He said we probably would not standardize on the 3D structure file format. Supporting 3D structure files was complicated by the need to consider field solver support on the simulation side. Randy understood the need for finding ways to analyze signals of increasing speed. Showing the quality of S-parameters would be a good first step.

Ted Mido said he thought that the inclusion of 3D structures was indeed significant, but we needed to discuss what kind of organizational structure and content to consider. He thought that LPB was close to what Masaki Kirinaka was imagining.

Masaki Kirinaka understood the difficulty. He asked that we please continue the discussion, as it became more important with higher frequency signals.

A FURTHER STUDY ON THE APPLICATION OF IBIS TO CISPR25 BASED EMI ANALYSIS OF DCDC CONVERTER ~RESOLVING UNEXPECTED RINGING IN THE WAVEFORM~
Kazuyuki Sakata*, Koji Ichikawa**, Miyoko Goto***, Toshiki Kanamoto****
(Renesas Electronics Corporation*, Denso Corp.**, Ricoh Corp.***, Hirosaki University****; Japan)
(Start time: 3:48:00, Duration: 35:40)

Kazuyuki Sakata presented by video recording, saying that it would be better to provide power device models as IBIS models, extracted from data measured in a CISPR25 chamber. He showed an example of producing an IBIS model for a DC-to-DC convertor. Results for different loads were shown. Both IBIS and SPICE simulations showed more ringing than measurements showed. The dead time during pullup and pulldown transistor switching was examined. Simplified models using SPICE macro-models were tested. Determining the correct diode forward voltage was a challenge. The SPICE macro-models were modified to represent multiple transistors for each side. That improved the observed ringing in the simulation. It was found that the slew rate of the driving force waveform was important. Future work would include EMI analysis using the modified macro-model.

Ted Mido said it was interesting that the current was dispersed, and ringing was suppressed by dividing the buffer, asking if it was possible to apply that mechanism to the IBIS model. Kazuyuki answered that it was possible to divide the buffer and shift the timing, but it may be a problem to turn it on gently. In his presentation, the driving capacities were selected as 10%, 30%, and 60%.

Ted Mido said he understood the problem to be that we couldn't handle changes to the turn-on input to the IBIS B-Element, asking if there was a good way to do that. Kazuyuki answered that he did not think it was possible now. In the present case it was divided into 3 parts, but there might possibly be a solution if it was divided into more parts and each has a delay, something like [Driver Schedule]. If we set the measured waveform to the [Rising Waveform], the EDA tool would be able to know the correct answer. He hoped that EDA tools would automate that.

Ted Mido asked if they had considered whether the inductance that causes ringing exists as one lumped component in the device or was the sum of the inductances distributed in the device. Kazuyuki answered that it depended on the frequency. Since the frequency was not so high in the present case, they thought that a lumped component was sufficient. However, they believed that the route depended on the PCB. For example, the resonance frequency changed depending on the placement and capacitance of decoupling capacitors.

Mike LaBonte said IBIS seemed appropriate for high speed devices due to their linearity at those speeds, wondering if extra detail was warranted in this case because power devices ran at lower speeds.

Bob Ross said he would be presenting the following week on using [Driver Schedule] for simulating PAM4, and that would give an example of using multiple B elements.

DISCUSSION AND CONCLUDING ITEMS
(Start time: 4:23:50, Duration: 2:30)

Randy Wolff thanked all attendees and presenters. He looked forward to developing new technologies, once again encouraging all to vote. He took note of the suggestions about improving the IBIS Cookbook. He hoped the next Japan IBIS summit could be held in person. The summit concluded.

NEXT MEETING

The next meeting would be the Virtual Asian IBIS Summit (China), to be held November 19. The next IBIS Open Forum teleconference meeting would be held on November 19, 2021.

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NOTES

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This meeting was conducted in accordance with SAE ITC guidelines.

All inquiries may be sent to info@ibis.org. Examples of inquiries are:
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

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

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

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

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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	September 17, 2021	October 8, 2021	October 29, 2021	November 12, 2021
ANSYS	User	Active	X	X	X	-
Applied Simulation Technology	User	Inactive	-	-	-	-
Broadcom Ltd.	Producer	Inactive	-	-	-	-
Cadence Design Systems	User	Active	-	X	X	X
Celestica	User	Inactive	-	-	-	-
Cisco Systems	User	Inactive	-	-	-	-
Dassault Systemes	User	Inactive	-	-	-	-
Ericsson	Producer	Inactive	-	-	-	-
Google	User	Active	X	X	X	-
Huawei Technologies	Producer	Inactive	-	-	-	-
Infineon Technologies AG	Producer	Inactive	-	X	-	-
Instituto de Telecomunicações	User	Inactive	-	-	-	-
Intel Corp.	Producer	Active	X	X	X	-
Keysight Technologies	User	Active	X	X	-	X
Luminous Computing	General Interest	Inactive	-	-	-	-
Marvell	Producer	Inactive	X	-	X	-
MathWorks (SiSoft)	User	Active	X	X	X	X
Maxim Integrated	Producer	Inactive	X	X	X	-
Micron Technology	Producer	Active	X	X	X	X
MST EMC Lab	User	Inactive	-	X	-	-
NXP	Producer	Inactive	-	-	-	-
SerDesDesign.com	User	Inactive	-	-	-	-
Siemens EDA (Mentor)	User	Active	X	X	X	X
Synopsys	User	Active	-	-	-	X
Teraspeed Labs	General Interest	Active	X	X	X	X
Xilinx	Producer	Inactive	X	X	X	-
ZTE Corp.	User	Inactive	-	-	-	-
Zuken	User	Active	-	-	-	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 (voting by email counts as attendance)

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.