



## IBIS Open Forum Minutes

Meeting Date: **November 14, 2018**

Meeting Location: **Shanghai, China**

### VOTING MEMBERS AND 2018 PARTICIPANTS

ANSYS	Curtis Clark, Miyo Kawata
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Broadcom	(Yunong Gan)
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ZTE Corporation  
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#### **OTHER PARTICIPANTS IN 2018**

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Apollo Giken Co.  
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Credo  
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Denso Corp.  
Eizo Corp.  
Finnhan  
Fuji Xerox Manufacturing Co.  
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Fujitsu Interconnect Technologies  
Fujitsu Ltd.  
Fujitsu Optical Components  
Gifu University  
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Hitachi ULSI Systems Co.  
Hitachi Ltd.  
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Hiroshi Ishikawa, Fumiyo Kawafuji

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Keihin Corp.	Takayuki Ota
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Toshiba Development & Engineering Corp.	Nobuyuki Kasai
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Zhejiang Uniview Technologies	Fang Yang*
Zhejiang YUSHI Technology	E. Deng*

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 16, 2018	Asian IBIS Summit (Taipei) – no teleconference	
November 30, 2018	624 227 121	IBISfriday11

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

<http://tinyurl.com/y7yt7buz>

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.

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## OFFICIAL OPENING

The Asian IBIS Summit took place on Wednesday, November 14, 2018 at the Parkyard Hotel in Shanghai. About 58 people representing 25 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/nov18b/>

Mike LaBonte opened the summit by welcoming everyone and thanking primary sponsor Huawei. He invited Paul Han of Huawei to give a welcome address, which was followed by Mike's welcome address. Each emphasized the importance of IBIS to the industry. Mike also thanked sponsors Mentor, a Siemens Business, Synopsys, Teledyne LeCroy, and ZTE Corporation. He noted that minutes of the meeting would be posted. There would be two breaks for refreshments and vendor interaction, and free lunch.

## IBIS UPDATE

Mike LaBonte (SiSoft, USA)

The status and activities of the IBIS Open Forum were described. Mike showed the progress on development of the IBIS 7.0 specification, which he estimated might be ratified in March of 2019, if all goes well. Mike noted that few BIRDS were currently in the pipeline for further development, encouraging the audience to consider submitting their own ideas for IBIS. He planned to give a short walk-through of the BIRD submission and adoption process during final discussion, if time would permit.

## HOW TO FIX DDR4 SIGNAL INTEGRITY ISSUE ABOUT "PIN" AND "DIE"

Liqiang Meng, Shunlin Zhu (ZTE Corporation, PRC)  
 [Presented by Liqiang Meng (ZTE Corporation, PRC)]

Liqiang gave an overview of trends in the evolution from DDR4 to DDR5. He showed the relationship between [Package] and [Pin] package model data in IBIS, noting that only [Package] has typ/min/max data. He then explained the Si\_location and Timing\_location subparameters of [Component]. Liqiang showed the differences between pin and die location eye diagrams for both read and cmd operations. As expected, setting package RLC to zero results in identical die and pin waveforms. At 667Mbps, using an equivalent transmission line gave results similar to the lumped RLC model, at the die. At 3200Mbps, the lumped RLC package model appears to give distorted results. Replacing the single section lumped RLC with an n-section distributed RLC produced results that compared well with the transmission line model. Recommendations regarding the next generation of DDR were made for system designers, model creators, and EDA tool vendors.

There was some discussion from the audience about how IBIS already supported most of the recommendations for chip vendors, but there were questions about how PDN analysis would be incorporated, especially if IBIS-AMI models were used.

### **MODEL CORRELATION FOR IBIS-AMI**

Wenyan Xie\*, Guohua Wang\*, David Zhang\*, Anders Ekholm\*\* (Ericsson, \*PRC, \*\*Sweden)  
[Presented by Wenyan Xie (Ericsson, PRC)]

Step by step procedures were outlined for correlating both TX and RX IBIS-AMI models. Correlation results for a TX testcase were shown. For the RX it is a challenge to measure the waveform at the latch, which is not physically exposed. Some SerDes buffers have the ability to measure internally and report accumulated results, but it is difficult to use that with accuracy. Correlation results for an RX were shown. Feature Selective Validation (FSV) was recommended over Figure of Merit (FOM), but FSV should have more metrics and they should be carefully weighted. It was also recommended that IBIS add a statistical distribution representation for data, replacing typ/min/max corners. Experiments showed that a simulator would use [Pin] RLC only to override the typ corner of [Package] data, but [Package] values would be used, if present, for min and max simulations.

A question was asked about how measurements can be made with sufficient accuracy at GHz frequencies. A number of laboratory techniques are required to improve accuracy, and careful attention must be paid.

### **SI TEST AND SIMULATION CORRELATION OF 56G PAM4 EYE DIAGRAM FOR 400G SWITCH**

Bowen Shi, Sophia Feng (Celestica, PRC)  
[Presented by Bowen Shi (Celestica, PRC)]

Bowen gave an overview of PAM4 signaling. Three channel topologies were tested, comparing simulations to measurements. Frequency domain characterizations of the three testcases showed observable differences between the topologies. Eye widths and heights were compared. In all three cases, simulation results were optimistic, compared to measurement. Further studies to improve accuracy were planned. A question was asked about the suitability of the simulation results for design sign-off. Simulations were being used to determine the

trends of design choices, with previous results used as a reference.

### **A PRACTICAL METHODOLOGY FOR SERDES DESIGN**

Amy Zhang\*, Guohua Wang\*, David Zhang\*, Zilwan Mahmud\*, Anders Ekholm\*\* (Ericsson, \*PRC, \*\*Sweden)

[Presented by Anders Ekholm (Ericsson, Sweden)]

Analyzing a SerDes channel to find the best case operation involves not only many combinations of driver and receiver settings, but also a significant number of interconnect characteristics that must be explored under typ/min/max conditions. Simulating 1 million bits across all possible variations for one example would take 506.25 days. The challenge is to make satisfactory design decisions without running many simulations. Ideally, we would create an equation that quickly models system performance, given all of the system condition inputs that can vary. This can be done using Design of Experiments (DOE) methods to statistically sample the parameter space, producing a Response Surface Model (RSM) using relatively few simulations. A CEI-28g example was shown, with the quality of the RSM fit evaluated. Sensitivity analysis was used to assign a different sampling distribution to each factor. Millions of conditions were then evaluated very quickly. Increasingly, we will find that the best/worst case analysis supported by typ/min/max data will not suffice for design closure. Adding an option for IBIS-AMI to represent a full distribution of data would help with DOE analysis, and would allow for predicting performance confidence intervals.

### **STUDY OF DDR ASYMMETRIC RT/FT IN EXISTING IBIS-AMI FLOW**

Wei-kai Shih\*, Wei-hsing Huang\*\* (SPISim, \*Japan, \*\*USA)

[Presented by Wei-hsing Huang (SPISim, USA)]

Wei-hsing described how statistical and time domain IBIS-AMI flows worked. For asymmetric rise/fall, Wei-kai described a method for deriving a fall edge from the rise edge, or vice-versa, using a transfer function. He noted it would still be necessary for IBIS-AMI to know the common mode DC offset for single-ended signals. Wei-kai showed example pseudo-code for the transfer function to recover a fall response from the rise response. This could be used to construct eye diagrams with rise/fall asymmetry. A recursive algorithm for calculating eye PDF with asymmetric rise/fall was described. Simulating bit-by-bit with Tx and Rx AMI\_GetWave should work well, but there would be glitches if convolution was involved at the Rx. Pseudo-code for the AMI\_GetWave process was shown.

### **CHARACTERIZING AND MODELING OF A CLAMPED NON-LINEAR CTE/AGC**

Skipper Liang (Cadence Design Systems, ROC)

Skipper summarized his 2017 presentation describing a Thevenin equivalent circuit method for characterizing a Continuous Time Equalizer (CTE). The Device Under Test (DUT) could include an Automatic Gain Control (AGC), as long as the condition of linearity was met. The technique involved scaling voltages, so it was important that the DUT have the same characteristics at any voltage, since scaled results would be normalized to actual. In reality, clamping diodes were usually present, causing non-linear effects. One approach is to use a small signal input of

20mV, which captures the high frequency behavior well, but misses the DC behavior. The large signal approach would be to use a 100mV input, but that fails to capture the high frequency response while successfully capturing the DC behavior. To produce a single model that performs well in all cases, a model was constructed in which separate code blocks captured the small signal and large signal behaviors. A method to find the linear voltage range was described. It was found that a hyperbolic tangent function could be used to model the non-linear behavior of clamping diodes, and iterating to find the best coefficients would yield acceptable results for mapping input voltage to output voltage. This was suitable for use in AMI\_GetWave. However, the frequency response of the hyperbolic tangent function model could not be directly derived, because the function fails one of the criteria to be Fourier transformable. A solution to that involved using an equivalent hyperbolic cosecant function to derive the Fourier transform, for use in statistical analysis. Two examples using CTE and AGC were shown, each with good correlation to measurement.

## **OPEN DISCUSSION**

During the time for open discussion, Mike LaBonte showed the IBIS website to explain the process by which the IBIS specification is developed. BIRD documents are written by people from one or more organizations using a template, and submitted to the IBIS Chair. Often there are multiple authors, from different companies. The BIRD includes a statement of the issue to be addressed, particular requirements for the solution, and proposed changes to the current IBIS specification to meet the requirements. Anyone may submit a BIRD, but only official IBIS members may vote. The BIRD is discussed in meetings, sometimes over an extended period, and finally a vote to accept it is taken in an IBIS Open Forum meeting. If it passes, the BIRD eventually will be incorporated into a future IBIS specification produced by the IBIS Editorial Task Group.

## **CLOSING REMARKS**

Mike LaBonte 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 30, 2018. The following IBIS Open Forum teleconference meeting is tentatively scheduled on December 21, 2018.

The Asian IBIS Summit in Taipei will be held November 16, 2018. No teleconference will be available for the Summit meeting.

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## **NOTES**

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This meeting was conducted in accordance with ANSI guidance.

All inquiries may be sent to [info@ibis.org](mailto: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](mailto:ibis@freelists.org) and/or [ibis-users@freelists.org](mailto:ibis-users@freelists.org) email lists (formerly [ibis@eda.org](mailto:ibis@eda.org) and [ibis-users@eda.org](mailto:ibis-users@eda.org)).
- To subscribe to one of the task group email lists: [ibis-macro@freelists.org](mailto:ibis-macro@freelists.org), [ibis-interconn@freelists.org](mailto:ibis-interconn@freelists.org), or [ibis-quality@freelists.org](mailto: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:

<http://www.ibis.org/bugs/icmchk/>  
[http://www.ibis.org/bugs/icmchk/icm\\_bugform.txt](http://www.ibis.org/bugs/icmchk/icm_bugform.txt)

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

<http://www.ibis.org/bugs/s2ibis/bugs2i.txt>  
<http://www.ibis.org/bugs/s2ibis2/bugs2i2.txt>  
<http://www.ibis.org/bugs/s2iplt/bugspl.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](http://www.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	November	November	November
			12, 2018	2, 2018	12, 2018	14, 2018
ANSYS	User	Active	X	X	X	-
Applied Simulation Technology	User	Inactive	-	-	-	-
Broadcom Ltd.	Producer	Inactive	-	-	-	-
Cadence Design Systems	User	Active	X	X	X	X
Cisco Systems	User	Inactive	-	-	-	-
CST	User	Inactive	-	-	-	-
Ericsson	Producer	Active	-	X	X	X
GLOBALFOUNDRIES	Producer	Inactive	X	X	-	-
Huawei Technologies	Producer	Inactive	-	-	-	-
IBM	Producer	Inactive	-	X	-	-
Infineon Technologies AG	Producer	Inactive	-	-	-	-
Intel Corp.	Producer	Active	X	X	-	X
IO Methodology	User	Inactive	X	-	-	X
Keysight Technologies	User	Active	X	X	X	-
Maxim Integrated	Producer	Inactive	-	-	-	-
Mentor, A Siemens Business	User	Active	X	X	X	X
Micron Technology	Producer	Active	X	X	X	-
NXP	Producer	Inactive	-	-	-	-
Raytheon	User	Inactive	-	-	-	-
SiSoft	User	Active	X	X	X	X
Synopsys	User	Active	X	X	X	X
Teraspeed Labs	General Interest	Inactive	X	X	-	-
Xilinx	Producer	Inactive	-	-	-	-
ZTE Corp.	User	Inactive	-	-	-	X
Zuken	User	Inactive	-	-	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.