IBIS Open Forum Minutes

Meeting Date: **November 13, 2017**
Meeting Location: **Shanghai, China**

VOTING MEMBERS AND 2017 PARTICIPANTS

ANSYS	Curtis Clark, Toru Watanabe, Baolong Li
Applied Simulation Technology	(Fred Balistreri)
Broadcom	[Bob Miller], (Cathy Liu)
Cadence Design Systems	Brad Brim, Sivaram Chillarige, Debabrata Das Ambrish Varma, Kumar Keshavan, Ken Willis Brad Griffin, Aileen Chen*, Lanbing Chen* Guoyu Cui*, Wei Dai*, Zhiyu Guo*, Henry He* Jinsong Hu*, Liang Jiang*, Skipper Liang* Ping Liu*, Feng Miao*, Zuli Qin*, Haisan Wang* Hui Wang*, Yitong Wen*, Clark Wu*, Janie Wu* Susan Wu*, Benny Yan*, Haidong Zhang* Alex Zhao*, Zhangmin Zhong*
Cisco Systems	Lei (Jason) Liu*, Cassie (Xu) Yan*
CST	Stefan Paret, Matthias Troescher, Burkhard Doliwa Danilo Di Febo, Alexander Melkozerov
Ericsson	Zilwan Mahmod, Guohua Wang*, Amy X Zhang*
GLOBALFOUNDRIES	Steve Parker
Huawei Technologies	Haiping Cao*, Wei (Richard) Gu*, Zhenxing Hu* Peng Huang*, Hongxing Jiang*, Longfang Lv* Luya Ma*, Guangjiang Wang*, Huichao Weng* Zhengrong Xu*, Hang (Paul) Yan*, Chen (Jeff) Yu* Xiaojun (Steve) Zhou*, Zhengyi Zhu*, Huajun Chen* Shengli Wang*, Zen Wei*
Huawei Technologies (Hisilicon)	Fangxu Yang*
IBM	Luis Armenta, Adge Hawes, Greg Edlund
Infineon Technologies AG	(Christian Sporrer)
Intel Corporation	Michael Mirmak, Hsinho Wu, Eddie Frie Gianni Signorini, Barry Grquinovic Masashi Shimanouchi
IO Methodology	Lance Wang*
Keysight Technologies	Radek Biernacki, Pegah Alavi, Fangyi Rao Stephen Slater, Jian Yang, Heidi Barnes
Maxim Integrated	Joe Engert, Don Greer, Yan Liang, Hock Seow
Mentor, A Siemens Business (formerly Mentor Graphics)	Arpad Muranyi, Nitin Bhagwath, Praveen Anmula Fadi Deek, Raj Raghuram, Dmitry Smirnov Bruce Yuan, Carlo Bleu, Chao Jiang*, David Xu*

Micron Technology	Randy Wolff, Justin Butterfield, Jeff Shiba, Harry Shin
NXP	(John Burnett)
Qualcomm	Tim Michalka, Kevin Roselle
Raytheon	Joseph Aday
SiSoft	Mike LaBonte*, Walter Katz, Todd Westerhoff Steve Silva
Synopsys	Kevin Li, Ted Mido, John Ellis, Scott Wedge Wonsae Sim, Xuefeng Chen*, Jinghua Huang* Yijiang Huang*, Deng Shi*, Yuyang Wang*
Teraspeed Labs	Bob Ross
Xilinx	(Raymond Anderson)
ZTE Corporation	Rongxing Ban*, Xinjian Chen*, Fengling Gao* Tao Guo*, Lili Wei*, Yangye Yu*, Shunlin Zhu*
Zuken	Ralf Bruening, Michael Schaeder, Alfonso Gambuzza

OTHER PARTICIPANTS IN 2017

Accton	Raul Lozano
Amphenol	Fred Shen*, Holly Wang*
ASR Microelectronics	Lili Dia*, Shulong Wu*
ASUS	Nick Huang, Bin-chyi Tseng
Aurora System	Murong Lu*, Jiaxin Sun*
BasiCAE	Kiki Li*, Darcy Liu*, July Tao*, Lisa Wu*
Brite Semiconductor	Haonan Wang*
Celestica	Wilson Chen*, Sophia Feng*, Lurker Li* Weiqing Liiu*, Vincent Wen*
Continental AG	Stefanie Schatt
eASIC	David Banas
Edadoc	Deheng Chen*, Bruce (Jun) Wu*, Hong Zhang*
Extreme Networks	Bob Haller
Flextronics	Renjun Sun*
Ghent University	Paolo Manfredi
H3C	Xinming Hu*
Hamburg University of Technology	Torsten Revschel, Torsen Wendt
IdemWorks	Michelangelo Bandinu
Ilia State University	Nana Dikhaminjia
Independent	Dian Yang, Lawrence Der
John Baprawski, Inc.	John Baprawski
KEI Systems	Shinichi Maeda
Lattice Semiconductor	Maryam Shahbazi, Dinh Tran
Leading Edge	Pietro Vergine
Lenovo Group	Shaogao Zheng*
Lexington Consulting	Mike Barg
Missouri Science and Technology EMC Lab	Giorgi Maghlakelidze

Mostec	Nelly Li*, Clark Zhang*
Politecnico di Torino	Claudio Siviero, Stefano Grivet-Talocia, Igor Stievano
Rockchip	Junming Shi*
SAE-ITC	(Thomas Munns), Jose Godoy
SAIC Motor Corp.	Weng Yang*
Samsung	Jung Hwan Choi
Shanghai Fudan Microelectronics Group	Zhenghui Chen*, Liu Lu Fang*, Xin Li*, Yuezhi Liu* Xiao Lei Luo*, Canghai Tang*
Signal Metrics	Ron Olisar
SMICS	Sheral (Xuejiao) Qi*
SPISim	Wei-hsing Huang*
Spreadtrum Communications	Junyong Deng*, Ganyue Wang*, Shiqing Si*
Stanford University	Tom Lee
STMicroelectronics	Fabio Brina, Olivier Bayet
Teledyne Lecroy	Facun Li*, Yifeng Wu*
TopBrain	Ye Li*
Toshiba	Yasuki Torigoshi
U-Creative	Amber Wu*
Université Blaise Pascal	Mohamed Toure
Université de Bretagne Occidentale	Mihai Telescu
Xpeedic	Tuhui Gui*
Yi Chuan Technology	Wei Ming Lu*
Zhaoxin	Liam Li*, Eddrick Wang*
Zhejiang Uniview Technologies	Busen Cai*, Jilun Fang*

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 15, 2017	Taipei IBIS Summit – no teleconference	
November 17, 2017	Tokyo IBIS Summit – no teleconference	
December 1, 2017	624 999 876	IBISfriday11

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

http://tinyurl.com/zeulerr

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 Monday, November 13, 2017 at the Parkyard Hotel in Shanghai. About 107 people representing 33 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/nov17a/

Hang (Paul) Yan of Huawei welcomed the participants to the 13th annual Asian IBIS Summit (China).

Mike LaBonte welcomed participants on behalf of the IBIS Open Forum and convened the meeting.

Mike continued by thanking all the co-sponsors. The primary sponsor was Huawei Technologies, and the co-sponsors were Cadence Design Systems, IO Methodology, Mentor, a Siemens Business, MostecEDA (SPISim), Synopsys, Teledyne LeCroy, and ZTE Corporation.

IBIS UPDATE

Mike LaBonte (SiSoft, USA)

Mike LaBonte detailed the activities of the IBIS Open Forum over the past year. He showed a possible timeline for the passage of IBIS 7.0, as well as the status of all current BIRDs that may or may not be part of IBIS 7.0. Mike gave a brief summary of the changes in three BIRDs likely to become part of IBIS 7.0.

IBIS INTERCONNECT MODELING USING IBIS-ISS AND TOUCHSTONE

Michael Mirmak (Intel Corporation, USA)
[Presented by Mike LaBonte (SiSoft, USA)]

Mike LaBonte presented on behalf of Michael Mirmak. The concepts found in BIRD189.x were summarized. The new format is an improvement over existing IBIS [Define Package Model] in several ways, allowing for both cascaded model sections as well as coupling in any combination. The Touchstone format and the ability to separately model buffer to pad and pad to pin connections would be helpful for the high speed signals used today. The addition of die pads for rails allowed for circuit topologies suitable for modeling the power and ground rails in chips.

SIGNAL INTEGRITY ANALYSIS FOR 56G-PAM4 CHANNEL OF 400G SWITCH

Sophia Feng, Vincent Wen (Celectica, PRC)
[Presented by Sophia Feng (Celectica, PRC)]

Sophia Feng noted that switch bandwidth is moving from 100G to 400G, with data rates moving from 25G NRZ SerDes to 56G PAM4 SerDes. She showed simulation results from analyses of a 200GBASE-KR4, a 400GAUI-8 CSM/200GBASE-CR4, and a CEI-56G-VSR-PAM4 channel.

THINK PAM4 SERDES

Xiaojun Zhou (Huawei Technologies, PRC)

Xiaojun Zhou introduced the PAM4 SerDes architecture and described equalization options including CTLE, FFE, and DFE. More receivers are changing from analog to digital architectures to leverage DSP technology. The presentation illustrated the need for a more general PAM4 simulator to support digital RX equalization. The current IBIS-AMI specification is suited for analog based RX, but it lacks support for the digital architectures.

A participant stated that on page 19, it is noted the IBIS-AMI API doesn't work for digital equalization. Is there any other method for analysis for digital equalization? Xiaojun answered that they are only using measurement for now.

COMPARISON OF TIME DOMAIN AND STATISTICAL IBIS-AMI ANALYSES

Mike LaBonte (SiSoft, USA)

Mike LaBonte noted that a dual IBIS-AMI model has an AMI file with GetWave_Exists set to true and Init_Returns_Impulse set to true. This is the best option for running both time domain and statistical analysis. Mike reviewed some fundamentals of channel simulation including inputs and outputs of time-domain and statistical simulations, channel impairments, step response and pulse response analysis, eye height prediction from pulse response cursor analysis, and methods for all the ISI in a given channel. He then discussed jitter and noise impairments and equalization methods. He concluded that IBIS-AMI time domain simulation with AMI_GetWave can model non-linear effects such as DFE and saturation, but it can be impossible to simulate enough bits to prove the low BER requirements of some technologies. IBIS-AMI statistical simulation can quickly evaluate low BER, but it cannot see time-variant effects such as DFE and saturation. So, dual IBIS-AMI models are required.

A WAY TO EVALUATE POST-FEC BER BASED ON IBIS-AMI MODEL

Yanye Yu, Tao Guo, Shunlin Zhu (ZTE Corporation, PRC)
[Presented by Yanye Yu (ZTE Corporation, PRC)]

Yanye Yu noted that Forward Error Correction (FEC) is being used in SerDes systems to increase serial link system budgets and relax BER requirements. FEC is found in 100GE/400GE/800GE specifications. FEC is a forced function in 400GE and 800GE systems, but there is no FEC function model in IBIS-AMI yet. Yanye proposed a solution to evaluate the post-FEC BER using an FEC model. Yanye described details of the model based on error propagation theory and showed results of a simulation using the model.

CHARACTERIZING AND MODELING OF A LINEAR CTE
Skipper Liang (Cadence Design Systems, ROC)

Skipper Liang noted that when creating an IBIS-AMI model for an RX, it is necessary to divide the buffer between the analog part and the algorithmic part. He showed a method in which modelers no longer need to model the RX IBIS (analog part) model. A dummy IBIS model is used, and the buffer characteristics are put in the AMI model. The CTE is modeled using a step response time domain characterization. The method is only valid when the equalizer is purely linear.

USING DATA FILES FOR IBIS-AMI MODELS
Lance Wang (IO Methodology, USA)

Lance Wang noted that creating IBIS-AMI models can require making executables for many platforms and OS's. He presented the concept of creating a single DLL/SO file that references external data files, allowing reuse of code for different transceivers by only modifying the data file. If using data files, the DLL/SO contains AMI standard functions, data processing functions and data file processing functions that might include decryption of the data file. The data file can contain code, data, parameters, and it could be encrypted. With this approach, the DLL/SO file could be developed by professional programmers and used for many different data files. The data file can then be created by designers or modelers and would not require compilation. A test case was shown that pointed to the data file through a Model_Specific parameter.

IBIS-AMI MODELING USING SCRIPTS AND SPICE MODELS
Wei-hsing Huang (SPISim, USA)

Wei-hsing Huang investigated the creation of IBIS-AMI models using scripting languages and existing SPICE models. The flow could reduce AMI modeling time and serve as an intermediate step towards full C/C++ implementation. Considerations include performance and the redistribution and use of models that could rely on an external SPICE simulator.

A question was asked: "For the GetWave function, when you use the on-the-fly method to simulate the SPICE circuit to get the modified waveform, will it be very slow also?" Wei-hsing responded that it will be slower than an algorithm-based GetWave function. But, since it is using a high impedance load for the SPICE circuit, it will be a lot faster than just using the SPICE circuit for simulations.

LEVERAGING IBIS CAPABILITIES FOR MULTI-GIGABIT INTERFACES
Ken Willis (Cadence Design Systems, USA)
[Presented by Zuli Qin (Cadence Design Systems, PRC)]

Zuli Qin noted that the presentation related to the EDI CON paper "Signal Integrity Methodology for Double-Digit Multi-Gigabit Interfaces". Use of Spice [External Model]s makes it easy to write simple parameterized Spice subcircuits for I/O buffers when IBIS availability does not align with a project schedule. The EDA tool user can select parameter values from a GUI using the

[External Model] “Parameters” and “Converter_Parameters” syntax.

Zuli described the typical modules of an Rx AMI model including gain, CTLE and DFE. These modules typically adapt at different rates, and the initial modules like gain and CTLE usually adapt more slowly than the DFE. Zuli showed how adjusting the adaptation algorithms of the AMI model led to better adaptation and a significant difference in final eye height. Zuli showed details of the backchannel flow from BIRD147. Zuli went on to show the application of IBIS-AMI modeling and simulation techniques to DDR4/5. Cadence developed an IBIS-AMI model for a DDR4 controller that included equalization. Zuli showed correlation between an IBIS-AMI model-based channel simulation and a transistor-level circuit simulation.

CLOSING REMARKS

Mike LaBonte thanked the co-sponsors, presenters and attendees for their participation and support.

NEXT MEETING

The next IBIS Open Forum teleconference meeting will be held December 1, 2017. The following IBIS Open Forum teleconference meeting is tentatively scheduled on December 15, 2017.

The Asian IBIS Summit in Taipei will be held November 15, 2017. The Asian IBIS Summit in Tokyo will be held November 17, 2017. No teleconferences will be available for the Summit meetings.

==========

NOTES

IBIS CHAIR: Mike LaBonte
mlabonte@sisoft.com
IBIS-AMI Modeling Specialist, SiSoft
6 Clock Tower Place, Suite 250
Maynard, MA 01754

VICE CHAIR: Lance Wang (978) 633-3388
lwang@iometh.com
President/CEO, IO Methodology, Inc.
PO Box 2099
Acton, MA 01720

SECRETARY: Randy Wolff (208) 363-1764
rrwolff@micron.com
Principal Engineer, Silicon SI Group Lead, Micron Technology, Inc.
8000 S. Federal Way
P.O. Box 6, Mail Stop: 01-711
Boise, ID 83707-0006

TREASURER: Bob Ross (503) 246-8048
bob@teraspeedlabs.com
Engineer, Teraspeed Labs
10238 SW Lancaster Road
Portland, OR 97219

LIBRARIAN: Anders Ekholm (46) 10 714 27 58, Fax: (46) 8 757 23 40
ibis-librarian@ibis.org
Digital Modules Design, PDU Base Stations, Ericsson AB
BU Network
Färögatan 6
164 80 Stockholm, Sweden

WEBMASTER: Mike LaBonte
mlabonte@sisoft.com
IBIS-AMI Modeling Specialist, SiSoft
6 Clock Tower Place, Suite 250
Maynard, MA 01754

POSTMASTER: Curtis Clark
curtis.clark@ansys.com
ANSYS, Inc.
150 Baker Ave Ext
Concord, MA 01742

This meeting was conducted in accordance with ANSI guidance.

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:

http://www.ibis.org/bugs/icmchk/
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/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

Other trademarks, brands and names are the property of their respective owners.

SAE STANDARDS BALLOT VOTING STATUS

Organization	Interest Category	Standards Ballot Voting Status	October 6, 2017	October 18, 2017	October 27, 2017	November 13, 2017
ANSYS	User	Active	X	X	X	-
Applied Simulation Technology	User	Inactive	-	-	-	-
Broadcom Ltd.	Producer	Inactive	X	-	-	-
Cadence Design Systems	User	Inactive	X	-	-	X
Cisco Systems	User	Inactive	-	-	-	X
CST	User	Inactive	X	-	-	-
Ericsson	Producer	Inactive	-	-	-	X
GLOBALFOUNDRIES	Producer	Inactive	X	-	X	-
Huawei Technologies	Producer	Inactive	-	-	-	X
IBM	Producer	Inactive	X	-	-	-
Infineon Technologies AG	Producer	Inactive	X	-	X	-
Intel Corp.	Producer	Active	X	X	X	-
IO Methodology	User	Active	X	-	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	-
NXP	Producer	Inactive	X	-	-	-
Qualcomm	Producer	Inactive	-	X	-	-
Raytheon	User	Inactive	X	-	-	-
SiSoft	User	Active	X	-	X	X
Synopsys	User	Active	X	X	X	X
Teraspeed Labs	General Interest	Active	X	X	X	-
Xilinx	Producer	Inactive	X	-	-	-
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.