IBIS Summit at DesignCon 2023 Minutes

Meeting Date: **February 3, 2023**
Meeting Location: **Hybrid Meeting hosted by The MathWorks at Mission Tower, Santa Clara CA**

VOTING MEMBERS AND 2023 PARTICIPANTS

Altair	(JuneSang Lee)
AMD (Xilinx)	(Bassam Mansour)
Analog Devices (Maxim Integrated)	(Tushar Pandey)
Ansys	Curtis Clark*, Wei-hsing Huang*
Applied Simulation Technology	(Fred Balistreri)
Aurora System	Dian Yang*, Raj Raghuram*
Broadcom	(Yunong Gan)
Cadence Design Systems	Kyle Lake*, Jared James*, John Philips*, Kristoffer Skytte*
Celestica	(Sophia Feng)
Cisco Systems	(Stephen Scearce), Hong Wu*
Dassault Systemes	Stefan Paret*
Google	(Hanfeng Wang)
Huawei Technologies	(Hang (Paul) Yan)
Infineon Technologies AG	(Christian Sporrer)
Instituto de Telecomunicações	(Abdelgader Abdalla)
Intel Corporation	Chi-te Chen, Hsinho Wu*, Michael Mirmak*
Keysight Technologies	Ming Yan*, Douglas Burns*, Fangyi Rao*, Pegah Alavi*, Hee-Soo Lee*, Heidi Barnes*
Marvell	Steven Parker*
MathWorks	Graham Kus*, Walter Katz, Kerry Schotz*
Micron Technology	Randy Wolff*, Justin Butterfield*, Akshay Shivaji Chaudhari*, Dragos Dimitriu*
MST EMC Lab	(Chulsoon Hwang)
SerDesDesign.com	John Baprawski*
Siemens EDA	Arpad Muranyi*, Weston Beal*, Matthew Leslie*, Todd Westerhoff*, Scott Wedge*, Mikael Stahlberg*
STMicroelectronics	(Olivier Bayet)
Synopsys	Ted Mido*
Teraspeed Labs	Bob Ross*
Waymo	Zhiping Yang
ZTE Corporation	(Shunlin Zhu)
Zuken	Michael Schäder*
Zuken USA	Lance Wang*

OTHER PARTICIPANTS IN 2023

Alphawave Semi	Adrien Auge*, Todd Bermensolo*
Ciena	Hugues Tournier*
Honeywell	Bavish Vazhayil
Nokia	Ramiro Guzman*
OMNIVISION	Sirius Tsang*
Signal Edge Solutions	Ben Dannan*
SI Guys	Donald Telian*
Socionext, Inc.	Raymond Yakura*
Unaffiliated	Will Hobbs*, Mike LaBonte*, Jon Powell*, Stephen Peters*

In the list above, attendees present 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
Alternate VTC dialing instructions

Or call in (audio only)
+1 267-768-8015,554664847#   United States, Philadelphia
Phone Conference ID: 554 664 847#
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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.

WELCOME
Randy Wolff, (Micron Technology, USA)
Chair, IBIS Open Forum

Note: this summit has been recorded and these minutes contain recording timestamp indices, where the recording itself is available at the following link:
https://ibis.org/summits/feb23/summit_recording.mp4

(Recording index 00:01:15)
Randy Wolff declared the start of the IBIS Summit meeting at DesignCon in Santa Clara, California on February 2, 2023 at Mission Towers and hosted by The MathWorks. Randy announced this is a hybrid meeting with in-person and online attendees. He noted that there was a healthy attendance of approximately 32 attendees on-site with 16 attending online via the Microsoft Teams application for a total of 48. These included representatives from approximately 22 organizations as well as a few unaffiliated individuals and former members of the IBIS Committee. Randy thanked The MathWorks for the training facility to host the IBIS Summit, as well as other sponsors including Keysight Technologies and Siemens for supporting catering and other assistance with the Summit. Randy went on to underscore that we would be celebrating the 30th anniversary of the founding of IBIS, and that were some original founding members to provide presentations. He outlined that the Summit also included regular papers/presentations, along with time for questions, and then an open discussion period at the conclusion of the presentations. Randy announced the IBIS.org web page has a listing of previous IBIS summit minutes. Also, to celebrate 30-year anniversary of IBIS as announced on the website Portal, there was a promise of cake.

IBIS CHAIR'S REPORT
Randy Wolff, (Micron Technology, USA)
Chair, IBIS Open Forum
(Recording index 00:03:20)

Randy Wolff reported that so far this year IBIS has 29 active members. He thanked members for participating in IBIS Open Forum and the recent ratification of IBIS 7.2 specification. He reminded attendees there is an Academic Membership category for any University that wishes to participate which is at a half-priced dues tier. Randy also thanked each of the participating Officers of the IBIS Open Forum Committee, and announced that the terms of Office run from June to June of each calendar year with an election typically held in the May timeframe. IBIS Open Forum teleconferences are held typically on a 3-week cycle, with Task Groups meeting on a weekly basis which focus on Advanced Technology, Modelling, Interconnect, and Editorial. Some of the work of each IBIS Task Group was presented at the Summit.

Randy also related that there are IBIS Summits held adjacent to other conferences as well, including IEEE SPI in Europe this May, IEEE EMC+SIPI the previous 2-3 years which moves around the United States each session, as well as some other major conferences held in Asia, typically an IBIS Summit event in Shanghai, China and another in Tokyo, Japan.

Randy announced that the parent organization is SAE ITC and expressed thanks for supporting IBIS as an official specification body and being able to meet financial expenses and operate with their organizational support.

Randy summarized the Task Group leadership where Arpad Muranyi Chairs the Advanced Technology Modelling (ATM), Michael Mirmak Chairs the Editorial, Bob Ross Chairs the Quality

Task Group. The focus of the group recently has been on ratification of the IBIS 7.2 IBISCHK Parser, and that Weston Beal would be presenting updates from the Quality Task Group.

Randy announced that the IBIS 7.2 specification was officially ratified the previous week and available for download on the IBIS website and the specification included new changes such as for PAMn support, and deferred other details as part of Michael's presentation later that day.

Randy added that other task included working on updates to the Touchstone TSCHK parser, the IBIS IBISCHK parser, with discussion about Touchstone 3.0 ongoing in the Interconnect Task Group.

Agenda for 2023:

Randy stated there were quite a few different topics, certainly looking at system level perspective and how IBIS can help address some of the challenges. For example, Clock-Data relationships in DDR5 was a presentation discussed later this session, and would include more timing information and system training, as motivated or needed. There is also currently a BIRD220 on Power Supply Induced Jitter (PSIJ) that had been submitted for consideration. There has been lengthy discussion in ATM on a chip-level standard Power Integrity model, so perhaps a BIRD on that would be submitted in 2023. We also anticipate BIRD submissions relating to models for Voltage Regulators and other power devices. ATM is holding discussion on multi-level analog buffer modelling. Interconnect and upcoming discussions on Touchstone 3, looking at topics such as pole-residue as well as long-overdue support for port mapping information in Touchstone. Also, some discussion of IBIS-ISS expansions to include some additional components. Randy asked the attendees and readers to continue to bring up ideas to the IBIS Open Forum so the organization can continue to support new technologies as they emerge, to please participate as members, and are welcome to bring new ideas to the IBIS Open Forum. Also of course, to participate in the Task Groups which meet weekly. And finally, that if assistance is needed to create or author BIRD, assistance is available from members of the group to get started and provide editorial feedback.

Randy discussed the organization of the IBIS Committee Officer positions, where he stated that the current positions of Chair, Vice Chair, Secretary, Treasurer, Librarian, Webmaster and Postmaster may be re-organized, such as to include a University-Relations Chair. We are also looking to modernize the makeup of these positions to look at really what is the work that we do in IBIS Open Forum and the Task Groups, to try and align better with the volunteer positions and does that change any of the policies and procedures which members would have to vote to ratify. So the Board will be discussing that and potentially coming up with some different names and different alignment of roles for the Board positions moving forward.

Randy reminded attendees and readers that the email reflector for IBIS is hosted by www.freelists.org, and that sign-up information and the specifications are available at the website at www.ibis.org. He also reminded attendees that the IBIS 7.2 specification would be available as well as the updated IBISCHK parser at a future date.

Randy encouraged members to consider mentoring new graduates and other colleagues in Engineering to join and participate in IBIS/IBIS-AMI modelling for Signal and Power Integrity and to participate in the Open Forum and/or the Task Groups. Weston Beal related a story about meeting someone at DesignCon where the query was whether someone needed to be expert in all-things IBIS to participate in IBIS Open Forum or its Task Groups. This is not the case- and there are benefits to those participating that hold any level of knowledge when they begin. So the message is to encourage colleagues to join and participate no matter what their level of expertise- there is no minimum level of knowledge to participate- the key is whether they

hold interest in Signal and Power Integrity modelling with IBIS. This with a view to consider IBIS has evolved over the previous 30 years, and a view towards reaching 60 years of adoption and support for Signal Integrity and Power Integrity Engineering.

ADVANCED TECHNOLOGY MODELING TASK GROUP
Arpad Muranyi, (Siemens EDA, USA)
Chair, Advanced Technology Modeling Task Group
(Recording index 00:15:30)

Arpad Muranyi reported on a quick summary of the IBIS ATM Task Group with a review of the recent activities, topics and BIRDs that we wrote since the most recent report was given.

IBIS 7.2 includes 8 BIRDs with new BIRDs listed on this page. These are BIRD221 and BIRD222. These deal with parameter route name, parameters in the input clarifications and clarifications in the clock times. The biggest of these three is the clock times clarification dealing with clocked-data input on a source-synchronous bus (e.g. DDR5). In the mechanism we discovered a few shortcomings in the IBIS 7.0 specifications that we felt should be clarified.

Arpad stated that no BIRDs had been rejected in the past year since August 5, 2022.

Arpad went on the report that current discussion topics including BIRD220 for pre-driver PSIJ sensitivity keyword. There is a similar proposal that we are discussion which would address things in the frequency domain for Power Supply Induced Jitter (PSIJ). We would wait for that to be completed so that the two PSIJ BIRDs can be compared side by side before we actually make a vote for ratification, also to prevent any possible overlaps or duplications of effort between the proposals as far as IBIS keyword development is concerned. So when the second becomes available, we will have more discussion again on the one that was submitted a while ago. We also have this topic of Standard Power Integrity Model (SPIM) that is under discussion, and that it is undergoing final edits before being submitted as a BIRD to the Open Forum.

Arpad also reported there were some additional topics that may be considered in the upcoming meetings, such as multi-level analog buffer modelling, which he presented later that session.

Arpad asked if there were any questions. There were none asked.

Note: Task group material can be found at:

   http://www.ibis.org/macromodel_wip/

INTRODUCTION TO IBIS 7.2
Michael Mirmak (Intel Corporation, USA)
Chair, Editorial Task Group and Interconnect Task Group
(Recording index 00:20:45)

Michael Mirmak presented on IBIS 7.2 and related that the Editorial Task group has recently concluded its effort, and that next week he would be changing roles to Chair the Interconnect Task Group. He went on to provide a brief introduction to IBIS 7.2, and that as Randy Wolff mentioned, was announced as ratified the previous Monday with ratification being held Friday before that by unanimous vote and expressed gratitude to participating members.

Michael reminded the attendees to please read, study and comment on BIRDs as they come to be presented to the IBIS Open Forum and provided on the website portal. He related that sometimes members wait until a standard is passed to review what is contained in each iteration.

Michael summarized his discussion would talk briefly about some of the clarifications, minor points, some topographical or another writing clarity changes that had been made to the specification and would spend most of the next 10-15 minutes on the two major technical areas. These are the workflow improvements and the PAMn feature implementation.

Michael related that some history IBIS 7.1 was approved mid-December 2021 and that usually as part of development, there would be a general consensus to get a new version of the specification delivered. There might be technical changes that are large efforts, and there might be a few others that are deemed necessary by the industry. There is some overlap between technical changes still "in-flight" as the IBIS specification is being prepared for release. As part of the process of preparing a new specification, whether it is IBIS or Touchstone, anything that is underneath the IBIS Open Forum's purview, the Editorial Task Group was reconvened in order to be able to consider all of the changes, and ensure the documentation is consistent. Especially as BIRDs are in development for long periods of time, potentially one BIRD can conflict with another BIRD. These changes can interrelate, and any technical conflict needs resolution. For those who may not have the background, the BIRD acronym stands for Buffer Issue Resolution Document: essentially the change process for IBIS.

Michael continued to state that at the time, the Editorial Task Group was reconvened in mid-August of 2022, there were already known issues document and in fact there are already known issues for IBIS 7.2. For every IBIS or other document release a list of known fixes is maintained for the next version. The final draft of IBIS 7.2 was distributed January 18th, 2022, which was 9 days later. Turn-around from IBIS 7.0 to approval was 163 days. An alternate way of looking at that turn-around is in terms of BIRDs. The point is this is lightning fast for IBIS Task Groups- 6 months turn around for a document. If you look at some of the historical versions of IBIS from the past such as IBIS 5.0, for example, there were multiple years in between when the document revision flow started and when the actual next release was approved, and this shows the process is now moving more quickly.

As Arpad Muranyi mentioned, as part of Advanced Technology Modelling (ATM) Task Group, since a lot of these BIRDs are considered that Task Group, the major technical changes in IBIS 7.2 pertain to the reference flows for IBIS AMI extending AMI for PAMn analysis and then requiring clocked receiver models to return clock times. This is part of a larger initiative to support single-ended I/O with IBIS-AMI (e.g. for source-synchronous I/O having equalization such as with DDR5). There are also clarifications to make some features more approachable for users, such as passing parameters between AMI models and EDA tools that support IBIS-AMI simulation. There were also clarifications pertaining to clock times. Also changes regarding Pin Names and Pin List associated with the overall initiative. The detailed information is contained in the BIRD text for each of these changes, then is incorporated in the specification. A lot of the history, the evolution of each one of the changes, some of the initial commentary and historical records essentially are preserved in the text of each BIRD.

Michael moved on to talk about the details of some of the technical changes and the reference flow changes. In Chapter 10, which is the AMI section, subsections describe in detail the flow used by EDA tools for AMI model processing. A lot recent focus has been on repeaters or re-timers versus re-drivers. In AMI, there is an assumption of Init (Statistical mode) and GetWave (Time Domain mode) where in Init you have Statistical Processing where everything is assumed to be LTI (Linear Time Invariant). Conversely GetWave with Time Domain processing a sequence symbols and equalization events taking place. Part of the problem noted in IBIS 7.1 for re-drivers was the fact that the channel processing can be influenced by transmitter equalization, but the LTI assumption behind processing of AMI was defeated. The purpose of that sequential processing, in other words, if there is a transmitter that has equalization that influences a channel response before it gets to the re-driver. There's a sequence of events in

time there that, under the LTI assumptions in Statistical Processing for AMI_Init would not get taken into account.

So to address that, a more sophisticated means of processing the order of operations for real-world driver flows under in it has been defined using a new reserve parameter called "TX_Impulse_Input." That part of the specification shows how to select the parameter, or the process, or what is the combination of different responses, that should be taken into account when an EDA tool processes a channel featuring a re-driver. This section shows step-by-step what the EDA tools are supposed to be doing with this information, so it helps a lot in processing of repeater flows in AMI.

The other major technical change as far as IBIS 7.2 is concerned is PAMn. In IBIS 7.1, the Pulse Amplitude Modulation support for PAM4 is a major feature or improvement and many PAM4 interfaces are supported in the industry. For example, the previous few years of DesignCon, the topic of PAM4 has been a major topic of discussion and presentations. In creating support for PAMn, there was a lot of discussion and arguments about revising language such as "bit" versus "symbol" for the IBIS 7.2 specification. For example, you can think of our normal Non-Return-to-Zero (NRZ) level signaling as PAM2 for context. PAMn is the more general case. There was discussion about as thruput increases, to support addition of more symbols into this single "bit time" or "unit interval." For example, PAM6 or PAM8 are proposed future implementations and USB4v2 implements PAM3. The goal is to instead generalize with PAMn which is to provide "future-proofing" of IBIS, at least until the next exotic technology comes along (such as QAM).

Michael continued to report that in IBIS 7.2, all the PAM4 existing parameters are still supported backward compatibility, to avoid invalidating existing AMI models or EDA tools. Instead, there are expanded alternatives for PAMn: alternate keywords, parameters, et cetera are supported. Specifically, a parameter set for modulation levels such as PAM3 or PAM6, et cetera, also individual symbol thresholds (Voltage) and offsets in time for those individual levels. One difference compared to other parameters in AMI is that the PAMn thresholds and offsets are outputs from the Receiver Model to the EDA tool. This is not done very frequently in AMI and motivated discussion about how to portray this with examples in IBIS 7.2. In essence, these parameters in IBIS 7.2 generalize PAMn for an unbounded number of levels.

Michael related a few other changes, including that Arpad Muranyi mentioned in passing during the ATM report on IBIS 7.1, clocked AMI models were introduced to support AMI for single-ended I/O with an eye towards evolving DDRx standards (and other source-synchronous bus standards), where these busses are adopting SerDes features like filtering, Transmit equalization, Receiver CTLE, DFE, et cetera as well as post-processing in order to reach a certain bit error ratio (BER).

Michael continued to report that some type of clocking concept is also required because unlike SerDes (e.g. PCI Express) that may employ Clock Data Recovery (CDR) where the clock is contained in the data stream. Conversely with source-synchronous (e.g. DDRx) a separate physical clock lanes are employed. IBIS 7.1 works to be able to define clock AMI models and define that path for clock information so that the clock could be brought into the EDA solution space as part of the same simulation and used to latch the data during that same simulation.

Michael reported that in IBIS 7.2, it was decided to ensure through a separate BIRD, a separate requirement that these new clock AMI models must provide clock time outputs. With the original definition of GetWave (Time Domain) modeling, an option whether a clock, whether a model and AMI model and GetWave is providing some sort of clock outputs. The idea being that perhaps it is very difficult to code, or perhaps the model developer would leave it up to the EDA tool to resolve the clock times. For example, what happens with latching operations

depending upon clocks? The goal of this effort was to try to model clocking; there is already a clock model present in the simulation. IBIS may as well require having clock output so an EDA tool can use that clock output to latch the data.

Michael described another change, which is a correction or clarification of an ambiguity in IBIS 7.0, regarding the clock times parameter. In the function definition of AMI GetWave, clock times is one of the parameters that is passed back and forth. It is not clear in the IBIS 7.1 text, but this means that parameter can be an IBIS-AMI Output or an Input. In fact, a recent question on the IBIS ATM reflector was about this very point. Arpad Muranyi was able to respond with the answer to refer to IBIS 7.2 where this is clarified. So the "clock_times" parameter can be an Input. As a result, we added another new parameter "RX_Use_Clock_Input" to specify what that input looks like: is it an actual wave-form, in which case there may be some additional waveform processing? Or is it clock ticks "clock_times"? There is a lot more detail in IBIS 7.2 to make understanding and using this clocked AMI single ended approach a lot easier.

Michael related a few additional clarifications and improvements. For example at the top line of an AMI file (.ami text file), this LISP-like structure, is a what we call a Root Name. This string of text is intended to be an identifier that matches text that comes out of the AMI dynamic-link library (Windows .dll or Linux .so file) or the executable itself. The EDA tool is supposed to match these two. In theory at least, there could be some future version of IBIS 8 or 9, implementing multiple trees with multiple matching capabilities between these two. Unfortunately, the specification is not necessarily well written. The fact is that there are a lot of models out there, dll/.so files that put random or different text in the parameter strings being passed back out such that it can be very confusing from models to tools to figure out whether these really match. IBIS 7.2 clarifies this to make sure that these match and may be enforced by the Parser at an upcoming revision to IBISCHK.

A few other changes were made regarding which parameters should be passed back and forth from an EDA tool to the AMI models. Not all parameters are intended to be passed. The editors also clarified two topics mentioned in the summary Pin Names that first column under the Pin Keyword. That is intended. All those entries are intended to be alphanumeric. For those using EMD, the electrical module description, which is a new expanded EBD version in IBIS where absolving the need of redescribing that same lengthy Pin list for large components over and over and over again, no need to list every single Pin when describing an EMD structure.

Michael stated that also part of the effort is to correct grammatical and typographical errors which occur with many people editing these documents.

Michael summarized that IBIS 7.2 was approved just a few days ago after about 6 months of draft development, 8 BIRDs were included. The first of these was BIRD211 that was submitted in March of 2021. The most recent was approved on September 9th, 2022. By means of expressing turn-around time, from first beginning start of changes to the final approval of the last changes was 628 days. This provides another window or another way of looking at the IBIS change process.

Michael stated the next step, as Randy mentioned in his update, is getting the IBISCHK 7.2 Parser delivered to enable verification of the quality of these models. Michael expressed thanks to all the participants, the readers, the users, and the general IBIS community for the very fast work in getting IBIS 7.2 out the door and into the community.

An attendee asked, "What's the next version?"

Michael replied, if there's some major new technical change, usually that the definition is a little subjective, but the idea is that huge changes demand a major revision number change. For

example something like an IBIS 8.0 if there are major technologies to implement or changes to be made.
The discussion concluded. Randy thanked Michael for the detailed presentation.

IBIS QUALITY CHECKLIST – LEVEL 4 ADDITIONS
Weston Beal (Siemens EDA, USA)
(Recording index 00:42:00)

Presentation Topics:

- IQ Level 4 is declared but not defined in the current version (2.0) of the quality specification, summarized as follows:

- IQ0 - No IQ checking at all

- IQ1 - Passes IBISCHK without Errors or unexplained Warnings

- IQ2 - IQ1 + data for basic simulation checked

- IQ3 - IQ2 + data for timing analysis checked

- IQ4 - IQ3 + data for power analysis checked

  o 1.1.5. IQ4 – Suitable for Power Analysis
    An IQ4 file is suitable for power analysis. The power and ground currents associated with groups of buffers are accurately modeled. This is distinct from the signal analysis capabilities addressed by IQ2 and IQ3. This is a placeholder since no IQ level 4 checks are currently defined. These checks will be defined in a future version of the IBIS Quality Specification. Currently no IBIS file can have an IQ4 level.

- Section 3.1. Component Package Requirements

- Section 3.4. (new) Component Pin Mapping Requirements

- Section 5.7. (new) Model ISSO Table Requirements

- Section 5.8. (new) Model I-T Table Requirements

- Smoothness

- Comments and Discussion

A NOVEL SIMULATION FLOW FOR DDR5 SYSTEMS WITH CLOCKED RECEIVERS
Matthew Leslie (Siemens EDA, USA)
Justin Butterfield (Micron Technology, USA)
Randy Wolff (Micron Technology, USA)
[Presented by Matthew Leslie and Randy Wolff]
(Recording index 01:24:00)
Presentation Topics:

- Clarify DDR5 topics that are sometimes confused with DDR4 and some SerDes standards
- Describe DDR5 specification from JEDEC with regard to Signal Integrity
- Discuss DDR5 Device Models
- Describe Clocked IBIS-AMI Time-Domain Simulation
- Discuss Advanced IBIS-AMI Workflow
- Key Takeaways

RIGOROUS CORRELATION METHODOLOGY FOR PCIE GEN5 & GEN6 DSP BASED IBIS-AMI MODELS
Adrien Auge (Alphaware Semi, Canada)
(Recording index 02:28:30)
Presentation Topics:

- DSP based IBIS-AMI
    - Modeling strategy
    - Model data path
    - Figure of Merit
- Correlation Challenges
- Proposal for Correlation
    - Lab/Simulation Environment Calibration
    - Correlation Regression
- Conclusion

CONDITIONAL CONTROL PROPOSAL FOR IBIS AND IBIS-ISS
Bob Ross (Teraspeed Labs, USA)
Xuefeng Chen (Synopsys, PR China)
[Presented by Bob Ross]
(Recording index 03:05:10)
Presentation Topics:

- Proposals for Syntax improvement for IBIS and IBIS-ISS
- Existing Syntax and Motivation
- Example of Param Control
- [EMD Model] and [Interconnect Model] Structures
    - Add Range for restricted continuous Param selections
    - Add List for restricted discrete Param selections
- Conditionals in IBIS-ISS add more .subckt execution flexibility
- Advantages and Limitations
- Conclusion

IBIS: 30 YEARS AND COUNTING, THE EARLY HISTORY
Donald Telian (SI Guys, USA)
Arpad Muranyi (Siemens EDA, USA)
Will Hobbs (unaffiliated, USA)
[Presented by Donald Telian, Arpad Muranyi, and Will Hobbs]
(Recording index 03:28:00)
Presentation Topics:
- A World Without IBIS
- Technical Challenge and Solution
- Execution and Expansion
- Engaging the Industry
- Subsequent Growth
- More Progress

IBIS 30 YEARS CELEBRATION
(Recording index 04:01:00)
- The Chair reported the cake had not yet arrived.

MULTI-LEVEL ANALOG BUFFER MODELING IN IBIS
Arpad Muranyi (Siemens EDA, USA)
(Recording index 04:10:00)
Presentation Topics:
- Motivation: PAM4 became PAMn
- Challenges: Algorithm for PAMn and logistics with the IBIS Specification
- Suggestion towards a solution
  - Extend stimulus
  - Multi-lingual extensions to IBIS (e.g. Verilog/HDL)
  - New IBIS keywords
  - Accommodate various threshold/Voltage levels
- Plan
  - Continue discussions in IBIS-ATM Task Group
  - Submit BIRDs as proposals become mature
- Questions/Comments on this effort are welcome

IBIS-AMI MODELING & SIMULATION FOR PAM3 SIGNALING IN USB4 V2/GEN4 SYSTEMS
Fangyi Rao (Keysight Technologies, USA)
Hongtao Zhang (AMD, USA)
Geoff Zhang (AMD, USA)
[Presented by Fangyi Rao]
(Recording index 04:27:00 – "Two Minutes to cake Time.")
Presentation Topics:
- Introduction to USB4v2 (Gen4)
- PAM3 signaling defined in USB4
- IBIS-AMI modeling and simulation for PAM3 signaling
- PAM3 eye measurements
- Examples of PAM3 simulation
- Summary

CLOSING REMARKS

(Recording index 04:58:00)

- Randy Wolff stated that with proper error correction applied, the cake had been recovered, and that the group would conclude the Summit. Arpad Muranyi asked if the cake could be shared on video. The cake was displayed through the Teams Portal. Randy Wolff thanked the sponsors and wished IBIS a Happy Anniversary. The Summit concluded.

NEXT MEETING

The next IBIS Open Forum meeting date would be February 17, 2023. The following IBIS Open Forum meeting would be scheduled for March 10, 2023.

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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 or unsubscribe from the official ibis@freelists.org and/or ibis-users@freelists.org email lists (formerly ibis@eda.org and ibis-users@eda.org):
    - https://www.freelists.org/list/ibis
    - https://www.freelists.org/list/ibis-users
- To subscribe to or unsubscribe from one of the task group email lists: ibis-macro@freelists.org, ibis-interconn@freelists.org, ibis-editorial@freelists.org, or ibis-quality@freelists.org:
    - https://www.freelists.org/list/ibis-macro
    - https://www.freelists.org/list/ibis-interconn
    - https://www.freelists.org/list/ibis-editorial
    - https://www.freelists.org/list/ibis-quality
- 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 (attendee X; absent -)

Organization	Interest Category	Standards Ballot Voting Status	Dec. 9, 2022	Jan. 6, 2023	Jan. 27, 2023	Feb. 3, 2023
Altair	User	Inactive	-	-	-	-
AMD (Xilinx)	Producer	Inactive	-	-	-	-
Analog Devices (Maxim Integrated)	Producer	Inactive	-	-	-	-
Ansys	User	Active	X	X	X	X
Applied Simulation Technology	User	Inactive	-	-	-	-
Aurora System	User	Inactive	-	-	-	X
Broadcom Ltd.	Producer	Inactive	-	-	-	-
Cadence Design Systems	User	Active	-	X	X	X
Celestica	User	Inactive	-	-	-	-
Cisco Systems	User	Inactive	-	-	-	X
Dassault Systemes	User	Inactive	-	-	-	X
Google	User	Inactive	-	-	-	-
Huawei Technologies	Producer	Inactive	-	-	-	-
Infineon Technologies AG	Producer	Inactive	-	-	-	-
Instituto de Telecomunicações	User	Inactive	-	-	-	-
Intel Corp.	Producer	Active	X	X	X	X
Keysight Technologies	User	Inactive	-	-	-	-
Marvell	Producer	Active	X	X	-	X
MathWorks	User	Active	-	X	X	X
Micron Technology	Producer	Active	X	X	X	X
MST EMC Lab	User	Inactive	-	-	-	-
SerDesDesign.com	User	Inactive	-	-	-	X
Siemens EDA	User	Active	X	X	X	X
STMicroelectronics	Producer	Inactive	-	-	-	-
Synopsys	User	Active	X	X	X	X
Teraspeed Labs	General Interest	Active	X	X	X	X
Waymo	User	Inactive	-	-	-	-
ZTE Corp.	User	Inactive	-	-	-	-
Zuken	User	Active	X	X	X	X

= Temporarily not a voting member

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.