IBIS Open Forum Minutes

Meeting Date: **February 3, 2011**
Meeting Location: **DesignCon IBIS Summit, Santa Clara, CA, USA**

VOTING MEMBERS AND 2011 PARTICIPANTS

Agilent	Radek Biernacki*, Fangyi Rao*
AMD	(Nam Nguyen)
Ansys (Ansoft Corporation)	Samuel Martens*
Apple Computer	(Matt Herndon)
Applied Simulation Technology	Norio Matsui*
ARM	(Nirav Patel)
Cadence Design Systems	Terry Jernberg*, Ambrish Varma*, Dennis Nagle*
Cisco Systems	Syed Huq*, Mike LaBonte, Luis Boluna*, Ashwin Vasudevan*, Zhiping Yang*
Ericsson	Anders Ekholm*
Freescale	(Jon Burnett)
Green Streak Programs	Lynne Green*
Hitachi ULSI Systems	(Kazuyoshi Shoji)
Huawei Technologies	Xiaoqing Dong*
IBM	Adge Hawes*, Greg Edlund
Infineon Technologies AG	(Christian Sporrer)
Intel Corporation	Michael Mirmak*, Udy Shrivastava*
IO Methodology	Lance Wang*
LSI	Brian Burdick
Mentor Graphics	Arpad Muranyi*, Ed Bartlett*, Vladimir Dmitriev-Zdorov*, Steve Kaufer*, Chuck Ferry*
Micron Technology	Randy Wolff
Nokia Siemens Networks GmbH	Eckhard Lenski*
Signal Integrity Software	Walter Katz*, Todd Westerhoff*, Mike Steinberger*, Barry Katz*
Sigrity	Raymond Chen*, Kumar Keshavan*
Synopsys	Andy Tai*, Ted Mido*, Scott Wedge*
Teraspeed Consulting Group	Bob Ross*, Kellee Crisafulli*, Tom Dagostino*, Scott McMorrow*
Texas Instruments	Casey Morrison, Alfred Chong*
Toshiba	(Yasumasa Kondo)
Xilinx	(Raymond Anderson)
ZTE	(Huang Min)
Zuken	(Michael Schaeder)

OTHER PARTICIPANTS IN 2011

AET	Mikio Kiyono*
Altera	Hui Fu*, Zhuyuan Liu*, Julia Nekrylova*

Avago	Weiping He*, Minh Quach*, Sari Tocco*
Bayside Design	Elliot Nahas*
Broadcom	Mohammad Ali*
Exar Corporation	Helen Nguyen*
Granite River Labs	Johnson Tan*, Mike Engbretson*, Quintin Anderson*
High Speed Design Center	Ben Chia*
ICT-Lanto	Steven Wong*
KEI Systems	Shinichi Maeda*
Maxim Integrated Products	Hassan Rafat*
National Semiconductor	Hsinho Wu*, Pegah Alavi*, John Goldie*
Oracle	Gustav Blando*
Pristine Signals	AbdulRahman (Abbey) Rafiq*
Renesas Electronics	Takuji Komeda*
Simberian	Yuriy Shlepnev*
TechAmerica	(Chris Denham)
Vitesse Semiconductor	Sirius Tsang*
Independent	Yoichi Niioka*

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
February 18, 2011	601 116 211	IBIS

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

https://cisco.webex.com/cisco/j.php?J=601116211

All teleconference meetings are 8:00 AM to 9:55 AM 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. When calling into the meeting, follow the prompts to enter the meeting ID. For new, local international dial-in numbers, please reference the bridge numbers provided by Cisco Systems at the following link:

http://www.cisco.com/web/about/doing_business/conferencing/index.html

NOTE: "AR" = Action Required.

OFFICIAL OPENING

The IBIS Open Forum Summit was held in Santa Clara, California at the Santa Clara Convention Center during the 2010 DesignCon conference. About 65 people representing 34 organizations attended.

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

http://www.eda.org/ibis/summits/feb11/

IBIS CHAIR'S REPORT
Michael Mirmak, Intel

Michael Mirmak presented a brief overview of current IBIS activities and accomplishments in 2010, including the IBIS Summit series in Asia and release of new specifications and software.

Arpad Muranyi inquired about how the KAVI system might change how the IBIS community uses the current IBIS website. Michael replied that the exact division was yet to be determined.

Lynne Green volunteered to assist with FAQ contributions.

Kellee Crisafulli asked about what kinds of IBIS-AMI checking is now performed by the ibischk5 parser. Michael explained that the .ami text file is parsed today; but that the BUG reports on-line specify where the checks are incomplete. No checking of the compiled routines is performed today, though third-party public test kits are available on the IBIS website.

[EXTERNAL TEST LOAD/DATA CONCEPTS]
Anders Ekholm*, Mike LaBonte**, Ericsson*, Cisco Systems**

Anders Ekholm presented a brief update on IBIS Quality Task Group activities around the [Test Load] and [Test Data] keywords. A proposal for [External Test Load] and [External Test Data] keywords was discussed, showing how external files could be used to express more complex structures and stimuli. Anders clarified that the proposed stimulus patterns would not be considered an analog input or waveform to a buffer, as is used in SPICE tools. Instead, the proposed stimulus would consist of edge times.

Lynne Green asked about whether all the relevant test files can be consolidated into one. In some cases, test data can be received without any idea how it was created.

Arpad Muranyi asked whether the test data is a result or not. Is the stimulus intended to indicate when the buffer is to switch?

Walter Katz suggested that (a) patterns such as PRBS7 be specified, possibly through a separate language definition and (b) that eye masks, insertion loss waveforms and the like be included. Anders responded that the Quality Task Group is talking about all these, plus IEEE FSV support.

Kellee Crisafulli asked who the intended user base is to be. Anders replied that this would be

targeted initially at model makers, and possibly end-users for testing their own simulators' performance. Kellee followed up by noting that demand will control IBIS adoption and features.

Lynne suggested that quality control be performed by IBIS librarians at various companies, as part of quality assurance testing. Walter added that most companies should not be using or issuing models without some sort of checking or correlation; these checks could be part of procurement requirements. Kellee suggested that EDA vendors, in addition to IC vendors, could use this data as a result.

Todd Westerhoff asked whether this applied to IBIS or IBIS-AMI. Anders noted that these requirements should be easy to fulfill, as this improves and confirms quality just by existing.

Kellee continued by suggesting that a system of files be used. ZIP or similar archives would be an option. Anders replied that this could end up missing files, particularly if test files were distributed separately. Walter replied that BIRD121 proposes a list of files for EDA tools to check, for encapsulation. Todd added that ZIP archives do not, by themselves, ensure that all files were properly supplied. Arpad suggested that the parser can check for missing files.

Norio Matsui suggested that arbitrary inputs be accepted (to include files for voltage, current, etc.). Anders replied that this was not specified today, but that a time points/data points format was assumed and is under consideration. Norio replied that ESD discharge waveforms will have an arbitrary shape. Anders replied that IBIS doesn't support purely analog inputs. Further, testing receive buffers is an open question. A suggested solution requires using another IBIS buffer as a receiver. Norio suggested providing some sort of equivalent circuit representation, particularly if test data included frequency-dependence. Anders replied that this was still an effort in progress.

IBIS-ISS INTRODUCTION AND FUTURES

Michael Mirmak, Intel Corporation

Michael Mirmak presented a summary of the IBIS-ISS (Interconnect SPICE Subcircuits) proposal, outlining the industry issues the proposal addresses. He formally introduced the IBIS-ISS document to the IBIS Open Forum for consideration and an eventual approval vote. He recognized and thanked Synopsys for their donation of documents and concepts from HSPICE* as the core of the document. He also recognized and thanked Walter Katz for his work in creating the original draft from the Synopsys documents.

The draft document itself is available through http://www.eda.org/ibis/ibis-iss_wip/.

Lynne Green inquired about internal independent voltage sources. If no global nodes are permitted, then no universal power or ground nodes are permitted, which could cause issues with existing simulators. Arpad reiterated that all nodes are local and would therefore require explicit linking as ports through subcircuit definition.

Arpad Muranyi thanked Michael Mirmak for his contributions to IBIS-ISS development, to a round of applause.

Scott Wedge stated that some small features may conflict with all existing simulators. Was this intended? Michael responded that the specification was meant as a subset of existing SPICE implementations and that some tweaks may be required both to the document and to the supporting simulators for full compliance.

Lynne noted that the documentation is not consistent with Berkeley SPICE 3F5, which may confuse some readers if proprietary variants are not familiar.

Scott thanked Walter Katz for his contributions, to a round of applause.

REFLECTIONS ON S-PARAMETER QUALITY
Yuriy Shlepnev, Simberian

Yuriy Shlepnev presented an overview of frequently-seen issues with creation and checking of S-parameter data, including requirements of causality and passivity for interconnect structures, touching also on reciprocity. He gave an example of a non-reciprocal model: a magnetized ferrite. His presentation included hints for mathematical checks on the specific matrix elements, giving a common-sense violation example, where S21 is closer to 0 than to 1. He also noted that particular structures or topologies may appear to be non-causal in a visual inspection of a step response, but the structure itself may create the response validly.

He added that passivity can only be checked at discrete points of a model, but the rule must be true from DC to an unlimited maximum frequency. True passivity enforcement should result in causality by definition. Rational approximation forms one path to checking and confirming quality. He noted Howard Johnson's observation that the "real world is Gaussian" and that step responses or edges should be filtered using a Gaussian filter.

During the question period, Walter Katz asked whether a Touchstone quality report could be generated using these metrics, similar to what is available for IBIS quality. This would involve a test simulation with a measured or defined input pattern. Yuriy replied that this would be useful, but some standardization would be a good idea, as the simulator's calculations may not always be known by the user. Lynne Green suggested raising this in the Quality Task Group.

Arpad Muranyi asked how someone might check topologies that could appear non-causal in a data-only format. Yuriy noted that this should be part of the delivered information, but is also covered in his presentation.

Vladimir suggested that skin effect makes some conclusions noted here tricky. Yuriy replied that the skin effect must converge as you approach DC, but not all solvers do this properly (this will sometimes lead to infinite inductance at DC). Vladimir also noted that W-element table models have similar issues to what is shown here for S-parameters. Renormalization helps with cleanup of data from solvers (e.g., change the reference impedance).

Ted Mido noted that RFA is one of the most powerful techniques available but it's difficult to execute for long, complex delay characteristics (e.g., HDMI cables). Sometimes a "shortcut" has to be applied in order to account for crosstalk.

T-COIL TOPICS
Bob Ross, Teraspeed Consulting Group

Bob Ross noted that this presentation may be somewhat of a stretch for an IBIS summit, but that other DesignCon presentations and IBIS-AMI discussions had raised the issue. He reviewed T-coil development as an internal design method at Tektronix that slowly became familiar to the rest of the industry. The T-coil provides a constant resistance network that is ideal as a termination or can be used to drive a capacitive load. Generally, a T-coil can clean up a step response in a real circuit, at the cost of added delay. Closed form equations have been derived over time for T-coil structures, including by Bob Ross. Applications include color TV set equalization of the luminance channel.

Michael Mirmak asked whether, if T-coils are used to minimize capacitance as shown in DesignCon papers, that they need to be represented in traditional IBIS C_comp at all. He added that a frequency- and/or voltage-dependent model using T-coils would need IBIS-ISS or something similar. Bob stated that the idea is to eliminate the capacitance entirely, but that the actual model could be a SPICE subcircuit or S-parameters.

Scott Wedge asked whether the bandwidth extensions hold up as the Q of the inductors is changed. Bob replied that this is not clear, but that the effect shows up in T-coil S-parameters.

IBIS-ATM TASK GROUP REPORT
Arpad Muranyi, Mentor Graphics

Arpad Muranyi reviewed recent accomplishments of the IBIS-ATM Task Group, including 14 BIRDs making both small and large-scale changes to the IBIS-AMI portions of IBIS 5.0. He also noted new challenges in analog circuit and jitter modeling, plus questions stemming from the parser developer and the task tracking list maintained by the IBIS-ATM Task Group.

During the question period, Lynne Green noted lots of AMI interest during DesignCon and asked how close tools are to being able to implement it. Arpad replied that six to seven EDA vendors are already regular participants in discussions. Todd Westerhoff added that lots of cross-tool activities are taking place now. He suggested that the last time a completely new IBIS specification was brought up in industry was over ten years ago.

Kellee Crisafulli suggested that IBISCHK have tests showing both the stimulus and expected response. Todd and Walter Katz replied that public test programs from SiSoft and Cadence were already available on the IBIS website. Kellee asked whether these could be rolled into IBISCHK, with “official assurance.” Todd replied that the user must bring his or her own impulse response to the checking tool, which requires additional channel simulation outside the test programs.

Zhiping Yang asked whether PAM4 was supported in IBIS-AMI. Walter replied that any waveform is converted to signal levels by IBIS-AMI programs. Some EDA tool limitations may apply. Todd added that nothing precludes PAM4 treatments using IBIS-AMI.

MODELING ANALOG REPEATERS IN IBIS-AMI
Walter Katz, Mike Steinberger, Signal Integrity Software

Walter Katz presented an introduction to repeaters in SerDes designs and how they may be simulated in a signal integrity context. He defined repeaters as buffers or amplifiers without clock recovery. These are useful when high-speed interfaces are used with cables or older backplanes. These are modeled as non-passive amplifiers that are otherwise LTI. This makes S-parameters or other passive channel models inappropriate for treating repeaters; devices can saturate, while channel models won't.

Walter proposed changes to IBIS to include repeater pins explicitly defined.

During the question period, Kumar Keshavan asked about regenerators. Walter noted that this would require two algorithmic "boxes" in order to take care of clock recovery and model jitter. Luis Boluna inquired about latency. Walter suggested this would not be present without a retime. Some discussion resulted on the need for multiple DLLs in the repeater device.

Todd Westerhoff noted that today's tools can't avoid the saturation problem. Adge Hawes added that, if clock ticks are optionally added, we can support both repeaters and re-timers. Scott McMorrow suggested generalizing to a TX-RX path transfer function, not dependent on whether the path is a device or a channel. If cascading were supported, this could be a general purpose solution for standardization, rather than a BIRD change to IBIS.

Fangyi Rao suggested transition and clock tick information may be required to be transported across the link. Arpad Muranyi added that adjustments to the IBIS-AMI flow as currently understood may be required.

IBIS-AMI ANALOG MODELING AND MUCH NEEDED IMPROVEMENTS FOR IBIS
Arpad Muranyi, Mentor Graphics

Arpad Muranyi repeated a plea from the 2010 summit, showing C_comp as an example of traditional IBIS limitations. He proposed linking IBIS-ISS and IBIS-AMI concepts in a revised IBIS, to provide a complete solution to behavioral high-speed simulation, including packages, buffers and on-die interconnect. He thanked Scott McMorrow for his improvements to the high-impedance link concept as shown in the slides.

During the question period, Kumar Keshavan stated that he thought IBIS-ISS was just passing parameters back and forth to the IBIS model in this proposed treatment. Arpad replied that IBIS-ISS defines an entire structure here. Kellee Crisafulli suggested embedding the IBIS-ISS file inside a package or the IBIS file. Arpad replied that this could be considered.

Walter Katz stated that today's package modeling approaches are not supported by the current IBIS formats. Most modern packages are only a slice of the overall package, for a selection of signals rather than the entire device. Walter also noted that the [External Model] approach includes lots of indirection and parsing issues, which introduces more complexity than required. He suggested putting the information into the IBIS-AMI files for efficiency.

EXTENDING IBIS-AMI TO ENABLE BACK-CHANNEL COMMUNICATION

Kumar Keshavan*, Marcus Van Ierssel**, Ken Willis*, Sigrity*, Gennum**

Kumar Keshavan presented a summary of IBIS and IBIS-AMI concepts, before defining backchannel communications for adaptive equalization as used in today's SerDes interfaces. He then proposed additions to the IBIS-AMI portions of IBIS to address adaptive backchannel communications for equalization. Kumar noted that support for backchannel is not in the current IBIS-AMI flow parameters and is not in the EDA tool flow defined for IBIS-AMI. He proposed making the training pattern part of the .ami file.

During the question period, Adge Hawes asked about how training is turned on or off. Kumar answered that a Boolean switch would be part of the tool control. Todd Westerhoff noted that this proposal would require at least two modes to be defined for operation, with training patterns part of one of them. Kumar replied that the EDA tool would supply part of the training pattern. Walter Katz asked whether the .ami file would include definitions per the interface standards. Kumar replied that the EDA tool would have to know what to use. Ambrish Varma inquired whether the training sequence is binary. Kumar noted that this was to be defined at the interface specification level.

Michael Mirmak asked whether the number of bits for data exchange would be defined for each device. Kumar replied that the standards would define this.

Adge Hawes noted that the receiver puts information in the Params_out field, but asked how the transmitter receives the information. Kumar replied that the tool would do this. Walter added that this field is a pointer, so we can pass parameters in by pointing to the receiver's parameters out field.

Zhiping Yang noted that in-band communications are what are used in the industry; there is no EDA tool in real interfaces. Can in-band communications be simulated, in order to compare link performance? Kumar replied that the duration of this might be more than a simulation would allow (e.g., 1 second). Luis Boluna noted that this may not happen often. If the channel does not change, why should the data exchange be simulated? Scott McMorrow noted that latency and time to converge would be a concern.

Zhiping suggested that training would be on at the beginning of the simulation, and then the receiver would tell the tool to turn it off.

AMI BACKCHANNEL CO-OPTIMIZATION

Walter Katz, SiSoft

Walter Katz introduced the concepts of backchannels and adaptation for determining optimum equalization settings automatically in a SerDes system. He showed two methods for simulating adaptation for signal integrity (statistical and time-domain or bitstream). Walter noted that many parameters in IBIS-AMI are overloaded, in order to support features like backchannel equalization. He proposed that a standards group determine reserved parameters for each

interface (for example, that the PCI-SIG determine the IBIS-AMI reserved parameters to be used for PCI Express*). In contrast to Kumar's presentation, Walter suggested adding statistical support for backchannel equalization to IBIS-AMI, and introduced the new backchannel e-mail reflector on freelists.org.

During the question period, Fangyi Rao asked whether a statistical implementation will call AMI_Init iteratively. If the transmitter has AMI_Getwave, does this mean that AMI_Init for the transmitter has already been called? This proposal would also mean that the receiver would return the optimum transmitter taps. How would this be passed back to the transmitter? Walter replied that it depends. The EDA tool or transmitter is told via the standard tap mechanism, as defined in the interface specification. For iteration, the iteration would be implemented through a call, then closing and reopening the relevant routine.

Zhiping Yang raised the question of whether this would address interactions between different vendors' designs. Walter responded that this only addresses one layer of communication. In IEEE 802.3ap 10GBASE-KR, there's just a small window of time available for tuning.

Kellee Crisafulli asked whether the backchannel is in plaintext or binary. Walter responded that plaintext exchange was expected. Kellee followed up with a question regarding whether this would force inclusion of protocol details at the signal integrity tool level; Luis Boluna suggested this would require an HDL. Walter replied that he intends to discuss this with standards groups such as the IEEE and the PCI-SIG. He also noted that communication and messaging formats are defined by the standards committees. Scott McMorrow added that algorithms are not defined by the committees but instead by the IC designer. Additional discussion focused on whether coefficients were communicated between components (this depends on the specification), whether pointers could be used to communicate directly between DLLs and whether eye height or some other metric is used for deciding on equalization value quality (this also depends on the specification and the device designs used).

OPEN DISCUSSION AND AD HOC PRESENTATIONS

Lynne Green presented a brief appeal to the attendees regarding the Model Review Committee. She noted that the membership changes every year, as EDA vendor participants retire or otherwise leave. She also noted that models are only submitted every 6-8 weeks, so model makers are requested to submit more models. She ended her summary by noting that users, model makers and EDA vendors all have an investment in better models.

Several questions were raised regarding confidentiality of the models. Michael Mirmak noted that there is no formal assumption of non-disclosure, but that the Model Review Committee members review models separately from each other to prevent cross-disclosure of tool features or issues. IC vendors are not part of the Model Review Committee for similar reasons.

Michael raised a number of issues for open discussion, starting with whether IBIS data should be distributed in a single file, or whether a group of files should be officially enabled, as brought up by Kellee Crisafulli. Todd Westerhoff suggested that distributing either a single file or a ZIP archive is acceptable. Kellee additionally asked whether IBIS-ISS would be embedded into IBIS files. Michael suggested that an embedded option, similar to PKG files, could be considered. Lynne noted that large file distributions will be rejected by some e-mail programs, while Todd added that IBIS-AMI distributions have the most pieces. Walter Katz noted that an earlier

proposal of his suggested dividing IBIS formally into pieces, with a single, simple file tying together the parts. IBIS then becomes a directory, which can include various support files.

Michael asked whether IBIS "special guests" from standards groups should be invited to present on issues such as backchannel architecture, for further education and discussion. Lynne replied that perhaps IBIS members should directly participate in standards meetings themselves.

CONCLUDING ITEMS

Michael Mirmak asked for a motion to adjourn, which was made and seconded. The meeting concluded at approximately 4 PM.

NEXT MEETING

The next IBIS Open Forum teleconference will be held February 18, 2011 from 8:00 to 10:00 AM US Pacific Standard Time. A vote is scheduled on BIRD126 at this teleconference meeting. The following Open Forum teleconference will be held March 11, 2011.

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NOTES

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This meeting was conducted in accordance with the GEIA Legal Guides and GEIA Manual of Organization and Procedure.

The following e-mail addresses are used:

majordomo@eda.org

In the body, for the IBIS Open Forum Reflector:
subscribe ibis <your e-mail address>

In the body, for the IBIS Users' Group Reflector:
subscribe ibis-users <your e-mail address>

Help and other commands:
help

ibis-request@eda.org

To join, change, or drop from either or both:
IBIS Open Forum Reflector (ibis@eda.org)
IBIS Users' Group Reflector (ibis-users@eda.org)
State your request.

ibis-info@eda.org

To obtain general information about IBIS, to ask specific questions for individual response, and to inquire about joining the EIA-IBIS Open Forum as a full Member.

ibis@eda.org

To send a message to the general IBIS Open Forum Reflector. This is used mostly for IBIS Standardization business and future IBIS technical enhancements. Job posting information is not permitted.

ibis-users@eda.org

To send a message to the IBIS Users' Group Reflector. This is used mostly for IBIS

clarification, current modeling issues, and general user concerns. Job posting information is not permitted.

ibis-bug@eda.org

To report ibischk parser BUGs as well as tschk2 parser BUGs. The BUG Report Form for ibischk resides along with reported BUGs at:

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

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

http://www.eda.org/ibis/tschk_bugs/
http://www.eda.org/ibis/tschk_bugs/bugform.txt

icm-bug@eda.org

To report icmchk1 parser BUGs. The BUG Report Form resides along with reported BUGs at:

http://www.eda.org/ibis/icm_bugs/
http://www.eda.org/ibis/icm_bugs/icm_bugform.txt

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

http://www.eda.org/ibis/bugs/s2ibis/bugs2i.txt
http://www.eda.org/ibis/bugs/s2ibis2/bugs2i2.txt
http://www.eda.org/ibis/bugs/s2iplt/bugsplt.txt

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

http://www.eda.org/ibis

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

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

IBIS CURRENT MEMBER VOTING STATUS

I/O Buffer Information Specification Committee (IBIS)

Organization	Interest Category	Standards Ballot Voting Status	December 10, 2010	January 7, 2011	January 28, 2011	February 3, 2011
Advanced Micro Devices	Producer	Inactive	-	-	-	-
Agilent Technologies	User	Active	-	X	X	X
Ansys	User	Inactive	-	-	-	X
Apple Computer	User	Inactive	-	-	-	-
Applied Simulation Technology	User	Inactive	-	-	-	X
ARM	Producer	Inactive	-	-	-	-
Cadence Design Systems	User	Active	-	-	X	X
Cisco Systems	User	Active	X	X	X	X
Ericsson	Producer	Active	X	X	X	X
Freescale	Producer	Inactive	-	-	-	-
Green Streak Programs	General Interest	Inactive	-	-	-	X
Huawei Technologies	Producer	Inactive	-	-	-	X
Hitachi ULSI Systems	Producer	Inactive	-	-	-	-
IBM	Producer	Active	X	X	X	X
Infineon Technologies AG	Producer	Inactive	-	-	-	-
Intel Corp.	Producer	Active	-	X	X	X
IO Methodology	User	Active	X	X	X	X
LSI	Producer	Inactive	X	X	-	-
Mentor Graphics	User	Active	X	X	X	X
Micron Technology	Producer	Active	X	X	X	-
Nokia Siemens Networks	Producer	Inactive	-	X	-	X
Signal Integrity Software	User	Active	X	X	X	X
Sigrity	User	Inactive	-	-	-	X
Synopsys	User	Inactive	-	-	-	X
Teraspeed Consulting	General Interest	Active	X	X	X	X
Texas Instruments	Producer	Inactive	-	X	-	X
Toshiba	Producer	Inactive	-	-	-	-
Xilinx	Producer	Inactive	-	-	-	-
ZTE	User	Inactive	-	-	-	-
Zuken	User	Inactive	-	-	-	-

CRITERIA FOR 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 TECHAMERICA 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.