Macromodeling, AMS and the Future of IBIS

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A Disclaimer

- **The following information is presented as the opinion of one person at Intel.**
- **This is not presented “under color of authority” of the IBIS Open Forum and does not represent an official IBIS Open Forum direction.**

Current Status

- **IBIS chose a path for the future in 2003: AMS**
  - **BIRD75/77 – proposed 2002**
- **IBIS is now offered an opportunity to add another approach: SPICE Macromodeling**
  - **Modeling Complex IO for IBIS 4.1 – Donald Telian**
- **Many believe these to be competing proposals**
  - **Syntactically, AMS & Macromodeling can be integrated**
  - **Is Macromodeling a "right hand turn" for IBIS?**

The BIG Questions for IBIS

What is the *best long-term modeling strategy* for our segment of the electronics industry?

- **From a semiconductor vendor perspective?**
- **From a tool vendor perspective?**
- **From a user or system builder perspective?**

- **How do we convince the industry to adopt the path we decide?**

- **I believe "AMS vs. macromodeling" is not our primary decision to make…**

Behavioral vs. EPTL Modeling

- **The real industry conflict is between**
  - **Behavioral models**
  - **"Encrypted proprietary transistor-level" (EPTL) models**
    - **The name is a necessary euphemism**

- **From EDA vendor polling…**
  - **A: Of several hundred distributors/users of models today, *all* use EPTL externally in some way**
    - **Only a minority (~5%) use exclusively IBIS, AMS or Macromodeling**
  - **B: Majority of users report 20% of models received by system builders are EPTL… and trend is increasing!**

The Problem with Polling

- **Polls ask what individuals' opinions are on specific questions**
- **People can only answer questions *based upon their context of knowledge* at the time**
- **A lack of knowledge will be reflected in the answers**
  - **e.g., "Most interviewed at this point are unfamiliar with AMS"**
  - **Can AMS be "a good solution"? "4 unsure, 1 said no"**
  - **Can someone endorse something unfamiliar?**
- **Polling doesn't educate those polled**
  - **Only passes on the perceptions to the questioner**

Behavioral vs. EPTL Modeling

- **Key Question: What has IBIS done to excite the industry on behavioral modeling *per se*?**
  - **Our concentration lately has been on technical issues**
  - **Where is our marketing of our approach, *as a product*?**
- **In 2003, we assumed AMS was the right path because "behavioral modeling had won"**
  - ***The data does not support this conclusion!***
  - ***EPTL is still the majority solution for the industry***
- ***IBIS is not succeeding in part of its (implied) mission: marketing behavioral modeling***

Behavioral vs. EPTL Modeling

- **Why do people stick with EPTL?**
  - **Familiarity: resembles what they learned in school**
  - **Level of detail seen as "equal" to accuracy**
  - **Behavioral requires thought and understanding!**
    - **EPTL enables "dump and distribute" – just include everything and send files to customers**
    - **Behavioral modeling requires essentializing the design plus conversion steps**
  - ***Increases in computing power/speed keep it viable***
    - ***PI, SSO still very difficult at transistor-level***
  - ***No convincing case has been made to switch to a new behavioral method, when the burden of change is high and the benefits are unclear…***

The First Challenge

Are we still, as the SI subset of the electronics industry, still committed to behavioral modeling over EPTL?

The Second Challenge

Evaluate the modeling format options ourselves

Market “the right answer” to the industry in a concerted way

Build buzz around behavioral modeling!

Evaluating Our Options

- **Recall a basic tenet of economics**
  - **There are three basic desires for any product or service**
    - **“I want it to be high-quality”**
    - **“I want it delivered soon”**
    - **“I want it to be cheap”**
  - **You can only have two of these at the same time!**
    - **E.g., high-quality delivered soon will be expensive**
    - **E.g., high-quality for cheap will not be delivered soon**

AMS, IBIS 4.0 and Macromodeling

- **SI Buffer Modeling follows a similar path**
  - **There are *seven* basic desires for a modeling solution**
    - **“I want it to be accurate”**
    - **“I want it to be fast in my simulator”**
    - **“I want it to protect my IP”**
    - **“I want it to be standard” (works for more than one tool)**
    - **“I want it available soon”**
    - **“I want it easy to use/implement/automate”**
    - **“I want maximum flexibility”**
- **At most, we can only have six at the same time**
- **Most non-IBIS solutions today deliver only three or four**

Which solutions satisfy the 7 Rules?

Parameter	EPTL Models	IBIS 3.2/4.0	IBIS + AMS	IBIS + Macromodeling
Accuracy				
Tool Support	One tool each		*	Proprietary
Ease of use/implementation				
Flexibility (Syntax/Features)		FATAL		
IP Protection				
Speed			**	**
Standardized?				*

* can change, depending on tool support/committee efforts

** depends on model implementation

Accuracy is dependent on feature set support

- **Accuracy and flexibility (“Positive correlation”)**
  - **With more features (equations), accuracy is less limited**
- **Flexibility and ease of model creation (“Negative correlation”)**
  - **More features make model creation, automation harder**
- **Standardization and universal tool support (“Negative correlation”)**
  - **Standardization is a gate**
  - **To standardize anything delays wide availability to the industry**

DETAILS UNDER “BACKUP”

Final Questions

- Is either AMS or Macromodeling more compelling than EPTL?
- Does Macromodeling replace AMS or is this an addition to AMS?
- Is Macromodeling a short- or long-term solution?
  - New features still require new keywords, with standardization delays
  - Isn't SPICE also "running out of steam"?
    - Code (Equation) Based Models, T. Secasiu (Sept. 2000)
- Can Macromodeling support AMS's positive features?
  - Alternately, does Macromodeling eliminate the AMS negatives?
  - Could Macromodeling support true mixed-signal designs?
- Can we deliver a quality Macromodeling spec. in the near-term?
  - Available soon enough to be viable alternative to AMS?
  - Isn't Macromodeling really SPICE standardization? Not trivial!
- Is AMS adoption harder than Macromodeling standardization?
  - Are we assuming code-level access by model author?
  - Would making templates help with either/both of the above?
  - Do libraries and GUIs change our answers to the above?

BACKUP

On Encryption

- *Are we making fundamentally wrong assumptions?*
- **Originally, encryption assumed for…**
  - **Protection of process and netlist details**
  - **Behavioral modeling naturally shields this information**
- **Today, is this still the objective?**
  - **Multi-tap pre-emphasis algorithms may be most valuable IP to protect**
  - **Equation-based approach exposes algorithms!**
- **What is our encryption policy?**
  - **Hostility to encryption partially stems from proprietary solutions in use today (EPTL)**
  - **Poll data suggests even AMS users want encryption**
  - **Wouldn't macromodeling also need it?**
- **Will encryption help drive behavioral approach away?**
  - **Speed vs. "accuracy" (detail) tradeoff – who wins?**
  - **Standardizing encryption helps only a little…**

For what is IBIS still useful?

- **IBIS originally consisted of two aspects**
  - **Device model behavioral data: V-t, I-V tables, etc.**
    - *"Snapshot" at certain conditions (Temp, etc.)*
  - **Interface specs, for user automation: Vinh, Vmeas, etc.**
  - **Power supply information fits in both categories**
- **With AMS or Macromodeling, some of IBIS redundant**
  - **Behavioral modeling under IBIS very limited (no equations)**
  - **Both alternatives are much more flexible than IBIS**
- **Second aspect of IBIS still very useful**
  - **AMS, Macromodeling describe device design behavior**
  - **Still a need for a standard SI "wrapper" around behavior**
    - **Includes evaluation criteria**
    - **Would help user judge device performance in system**
    - **IBIS serves this need! Evaluation parameters for SI**
    - **Need IBIS-based user-defined specs, measurements**

Which solutions satisfy the 7 Rules?

- **IBIS 3.2/4.0**
  - **Advantages**
    - **Fast, IP protecting, standard, easy to use/implement**
    - **Available immediately in tools**
  - **Disadvantages**
    - **Not accurate for certain functions (e.g., freq. dep. C)**
    - **Not maximally flexible (table-based, not equation-based)**
- **AMS + IBIS**
  - **Advantages**
    - **Flexible, standard, can be fast**
    - **Can be accurate, depending on correlation effort**
  - **Disadvantages**
    - **High barriers to implementation**
    - **High learning curve for users, model authors**
      - Templates would mitigate this
    - **Not available in tools yet**
    - **IP protection?**

Which solutions satisfy the 7 Rules?

- **Advantages:**
  - Low barriers to EDA tool entry
  - Low barriers to use by *behavioral* experts
  - Has flexibility beyond native IBIS
- **Disadvantages:**
  - High barriers to standards development
    - We're writing our own, standardized SPICE syntax
    - Can this be done is less than two years?
  - New features still require creation of new keywords
    - All the delays seen with new keywords in native IBIS
    - Can all equations be expressed through controlled sources?
  - Still behavioral!
    - It may be SPICE, but it faces same barriers as AMS
      - Behavioral modeling expertise is not common!
    - How is this going to "win" vs. EPTL if we aren't actively selling behavioral modeling *first*?