IBIS Interconnect Specification (ICM): Status and Proposed Changes

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Desktop Platforms GROUP

Agenda

- ICM Review
  - Purpose
  - History
  - Structure
- Need for Changes in Draft 1.0
- Proposed Changes
- Parser Overview & Status
- Next Steps
  - IBIS Futures Sub-committee Review
  - Open Forum Review
- Future Updates
  - Potential technical improvements?
- Backup: Example Model Text

What is ICM?

- ICM = IBIS Interconnect Specification
- Purpose: to establish a human-readable standard format for exchanging interconnect modeling data
  - "Interconnect" can be connector, cable, PCB traces or even an IC package
  - Format is designed to be:
    - Consistent & easily parsed by software
    - Compatible with current means of representing data
      - *S-parameters*
      - *R, L, G & C matrices*
      - *"Swaths," trees, node lists*
    - IBIS-like (keyword-driven)

ICM History

- Initial concept developed from 1995 - 1997
  - Kellee Crisafulli, Hyperlynx
  - Augusto (Gus) Panella, Molex
  - Others through IBIS Connector Sub-committee
- Revision 0.31 issued in Jan. 1999
  - Outlined in Jan. 1999 IBIS Summit
  - Shift from connectors to interconnects began
- Revision 0.92 issued in Nov. 1999
- Revisions 0.93 - 0.99901 issued 2000 - 2002
  - Added “Argument,” Even & Odd Modes, etc.
  - Revised Swath treatments
  - Editorial changes
- Draft 1.0 released Sept. 19, 2002

ICM Structure

- Header Information
  - [Begin Header] & [End Header] keywords
  - Spec. Version
  - Filename & Revision
  - Date
  - Source, Notes, Disclaimer & Copyright

- ICM Family
  - Description of model “family” or group
  - List of models in the “family”

ICM Structure (continued)

- ICM Model Description
  - Type (SLM, S-parameter, MLM_*, etc.)
  - Signal-to-ground ratio & (optionally) reference Z
  - Tree Path Description
    - Links groups of signals through cascaded “sections” of model data
    - Intended to describe one-to-one connections between sections and ports or endpoints of the interconnect
    - Allows “forks” with same number of conductors
  - Nodal Path Description
    - Links sections of model data through input & output nodes per section
    - Connections need not be one-to-one
      - *Allows internal “dangling nodes”*
  - Note that Nodal and Tree Path Descriptions ***are mutually exclusive***

ICM Structure (continued)

- Additional ICM Constructs
  - ICM Pin Map
    - Maps connector pins to Tree Path Descriptions
  - ICM Node Map
    - Maps connector pins to Nodal Path Descriptions
  - ICM Section
    - Data block for model sections
    - Data is in RLGC matrix or s-parameter format
      - *Matrices include self-inductance, capacitance, conductance, loss, etc.*
      - *Similar format to IBIS package models*
    - Each section is referenced by at least one Tree or Nodal Path Description

ICM Structure (continued)

- ICM Swath
  - Allows minimal, economical description to be used for larger connectors or interconnects
    - Smaller electrical parameter matrices can be repeatedly mapped over a larger structure
  - Includes the [ICM Swath Description] and [ICM Swath Pin Numbers] keywords

- *Sample ICM model is included in Backup*
  - *Data is taken from ICM specification examples*

Need for Changes in Draft 1.0

- Draft 1.0 text needs improvement
  - To increase readability & understanding
    - Some small errors have survived revision process
    - The writing style of several sections may produce confusion in readers
  - To ease software parsing
    - Several structures are defined in an ambiguous way and create a risk of conflicting “interpretations” by individual vendor software tools
    - Some structures are not compliant with the Lex/YACC format used as the standard for creating compilers and parsers

Summary of Proposed Changes

- **42 Proposed Changes in All**
  - **18 Editorial Changes**
    - **No impact to functionality of specification**
    - **Examples**
      - *Grammatical and spelling corrections*
      - *Correction of keyword misuse in examples*
      - *Inconsistent spelling: "Un-ordered“ vs. Un_ordered”*
  - **24 Clarifications**
    - **Provide stricter interpretation of content**
    - **Examples**
      - *Enforce consistent use of white space & tabs*
      - *Enforce consistent use of “=“ with subparameters*
      - *Allow use of non-one denominator in SGR*
- **Technical changes to be considered only after Draft 1.0 approved by Open Forum**

Parser Overview & Status

- ANSI C prototype in development
  - Find issues with 1.0 specification EARLY
- Exploiting widely available tools
  - Lexical processor (FLEX) – COMPLETED
  - Grammar (YACC/BISON) – IN PROGRESS
  - Semantic analysis – NOT STARTED
- Already operational at level of grammar
- Schedule pending approval of proposed changes, but expect golden code by May
- Unencumbered Open Source delivery
- Realistic Test Models available?

Short-Term Future

- Changes to be presented to IBIS Futures Sub-committee
  - Each change is numbered and can be considered and voted upon independently
  - Next meeting likely in early February (shortly before IBIS Open Forum teleconference)
- IBIS Open Forum Review
  - New document, with changes, is presented
  - Open Forum votes to approve or disapprove
  - Next meetings: Feb. 14, March 7

Future Improvements

- Several technical issues may be considered after Draft 1.0 is approved
  - Allow multiple types of data within a single [Begin ICM Model]/[End ICM Model] pair
    - Example: Include S-parameter AND matrix data
  - Include frequency-dependence in matrix data
    - Example: Matrix parameters for 1 MHz, 100 MHz, etc.
  - Allow mixed-mode S-parameters
    - Example: SDC12 vs. S12 – coupled pair insertion loss is described in terms of common-mode excitation and differential response
- Discussion point: on-die interconnect?

Questions & Free Discussion

BACKUP

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ICM Example

```
[Begin Header]
[IBIS ICM Model Ver]   1.0
[File Name]            iconm_hdi_202.icm
[File Rev]             1.0
[Date]                 January 20, 2003
[Source]               Results from field simulation
[Notes]                This is a test model only.
[Disclaimer]           This information is for modeling
                       purposes only, and is not guaranteed.
[Copyright]            Copyright 2003, XYZ Corp.,
                       All Rights Reserved
[Support]              http://www.VendorNameIbisModels.com
[Redistribution]       Yes
[Redistribution Text]  This file is freely redistributable.
[End Header]
```

ICM Example (2)

```
[Begin ICM Family]     High_Speed_Interconnect
[Manufacturer]         XYZ Incorporated
[ICM Family Description]
High Density square pin connector for use on IEEE 99999 buses.
|=============================================================
[Begin ICM Model List]
|   Name                   Mating       Min_Slew_Time          Image
|-------------------------------------------------------------
HDI_202                  Mated           100ps  HDI_202_Mated.jpg
HDI_202_UnMatedA         Unmated_side_A  100ps  HDI_202_UnMatedA.jpg
HDI_202_SMT_to_Cable     Mated            25ps  HDI_TEST_202_Mated.jpg
HDI_202_SMT_to_ThruHole  Mated            25ps  HDI_202_Mated.jpg
|=============================================================
```

ICM Example (3)

```
[Begin ICM Model Description]
High Density 0.1 center square pin with PCB effects
|================================================================
[Begin ICM Model] MyModelExample3          | Has a stub fork!
  ICM_Model_Type MLM
[Tree Path Description]
  Model_PinMap MyModelPinMapA
  Section Mult=1 SectionA
  Fork
    Section Mult=1 StubSection1
  End_fork
  Section Mult=1 SectionB
  Model_PinMap MyModelPinMapB
|   .
|   .
[End ICM Model]
```

ICM Example (4)

```
[ICM Pin Map] Baseboard_side
Pin_order = row_ordered
Num_of_columns = 4
Num_of_rows = 2
|Pin  Type
  A1  SIG
  A2  SIG
  A3  SIG
  A4  SIG
  B1  SIG
  B2  SIG
  B3  SIG
  B4  SIG

[End ICM Family]
```

ICM Example (5)

```
[Derivation Method] Lumped
|-----------------------------------------------------------
[Begin ICM Section] ExampleMatrix01
[Inductance Matrix] Full_matrix
[Row]   1
3.04859e-07      4.73185e-08      1.3428e-08      6.12191e-09
1.74022e-07      7.35469e-08     2.73201e-08      1.33807e-08
[Row]   2
3.04859e-07      4.73185e-08      1.3428e-08      7.35469e-08
1.74022e-07      7.35469e-08     2.73201e-08
|.
|.
|.
```

ICM Example (6)

```
|The capacitance matrix has sparse coupling:
[Capacitance Matrix] Sparse_matrix
[Row]    1
1        2.48227e-10
2        -1.56651e-11
5        -9.54158e-11
6        -7.15684e-12
[Row]    2
2        2.51798e-10
3        -1.56552e-11
5        -6.85199e-12
6         -9.0486e-11
|.
|.
[End ICM Section] ExampleMatrix01
[End]
```