Interconnect Task Group Update – Package Modeling

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Package and On-Die Interconnect Modeling

Where we started 3 months ago (Walter Katz's DesignCon IBIS Summit presentation describing what interconnect to model in the .ibs file):

Decisions Made	In .ibs	In EMD
Connectors	No	Yes
Cables	No	Yes
Broadband EBD	No	Yes
MCM	No	Yes
Interposers	No	Yes
3-D structures	No	Yes
Stacked Memory	No	Yes
Splits/Joins of Signal (I/O) in Package or Die	No	Yes
RDL as separate element	No	Yes
New list of supply (PDN) die pads	Yes	Yes
Separate package and on-die interconnect model	Yes	Yes
Package model can include on-die model	Yes	Yes
Broadband I/O Package Modeling	Yes	Yes
Package PDN	Yes	Yes
Broadband I/O On-Die Modeling	Yes	Yes
On-Die PDN	Yes	Yes
Interconnect coupling (crosstalk) between I/O and I/O	Yes	Yes
Interconnect coupling between I/O and PDN	Yes	Yes
Optical Interconnect	No	No

Interconnect Task Group Progress February – April 2014

Two proposals presented and debated

- SiSoft proposal creates new keywords under [Define Package Model]
- Mentor/Cadence proposal expands capabilities of [External Circuit]

Each proposal created syntax examples covering package model formats requested by Micron and others (S-parameter and IBIS-ISS)

- Signal connections from pin to buffer (may include on-die interconnect)
- Power connecting from multiple pins to all buffers (no on-die interconnect)
- Power connecting from pins to individual buffers (includes on-die PDN)
- Generic 2 and 4-port signal models connecting to all [Model]s

Proposals were voted on in the April 30 meeting

- The task group will focus on developing the SiSoft proposal

Proposal Details

Current BIRD proposal draft found at:

- http://www.eda.org/ibis/interconnect_wip/PackageBIRD_3.docx

IBIS package modeling is enhanced to support broadband and coupled package and on-die interconnect using IBIS-ISS and Touchstone models

[ISS Model Data] begins new section under [Define Package Model]

[Begin ISS Model] defines a unique model name

- This section contains all the model data and can reference external files
- Subparameters defined so far include:
  - Language, File, Subckt, Parameter, Unused_Port_Termination, Number_of_Ports, Port

* All keyword and subparameter names subject to change

Proposal Details - Ports

The Ports subparameter defines information on each port (or terminal) of an IBIS-ISS subckt (or Touchstone) file

Port <Field 1><Field 2><Field 3><Field 4>{<Field 5><Field 6><Field 7>}

- Field 1: port number
- Field 2: describes if port is at the pin, die pad or buffer
- Field 3: Pin_name, Signal_name, Model_name or Default
- Field 4: valid Pin, Signal or Model name, or NA if Default in Field 3
- Field 5: Optionally used as Diff_pos, Diff_neg or SE if Field 3 is Model_name or to indicate connection as a buffer supply terminal
- Field 6: Channel number used with defining victim/aggressor for xtalk
- Field 7: Aggressor or NA, defines xtalk modes

Ports Examples

Port 1 Pin	Pin_name	M8	NA	NA	NA
Port 1 Pin	Pin_name	M8			
Port 1 Pad	Pin_name	M8			
Port 1 Buffer	Pin_name	M8			
Port 1 Buffer	Pin_name	M8	Pullup_Reference		
Port 1 Pin	Model_name	DQ			
Port 1 Pin	Model_name	DQS	Diff_pos		
Port 1 Pin	Default	NA	SE		
Port 1 Pin	Model name	DQ	SE		
Port 1 Buffer	Pin_name	M8	NA	2	
Port 1 Buffer	Pin_name	M8	NA	3	Aggressor
Port 1 Buffer	Signal_name	VDDQ			

Syntax Examples – Single Nets

S-Parameter vs. IBIS-ISS

```
[Define Package Model]
[ISS Model Data]

[Begin ISS Model] IOA3
Language Touchstone
File Value ioA3.s2p
Number_of_Ports 2
Port  1  Pin      Pin_name  A3
Port  2  Buffer Pin_name  A3
[End ISS Model]

[End ISS Model Data]
[End Package Model]
```

```
[Begin ISS Model] IOA3
Language IBIS_ISS
File Value io.iss
Subckt io
Parameter Length Value 10.0    | 10mm
Number_of_Ports 2
Port  1  Pin      Pin_name  A3
Port  2  Buffer Pin_name  A3
[End ISS Model]
```

Syntax Example – Generic Differential Package

[Begin ISS Model] DQS

Language Touchstone

File Value DQS.s4p

Number_of_Ports 4

Port 1 Pin Model_name DQS Diff_pos

Port 2 Buffer Model_name DQS Diff_pos

Port 3 Pin Model_name DQS Diff_neg

Port 4 Buffer Model_name DQS Diff_neg

[End ISS Model]

Syntax Example – Victim Net With Agressors

```
[Begin ISS Model] IOA3
Language Touchstone
File Value ioA3.s10p
Number_of_Ports 10
Port  1  Pin     Pin_name    A3
Port  2  Buffer  Pin_name    A3
Port  3  Pin     Model_name  DQ   NA        1  Aggressor
Port  4  Buffer  Model_name  DQ   NA        1  Aggressor
Port  5  Pin     Model_name  DQ   NA        2  Aggressor
Port  6  Buffer  Model_name  DQ   NA        2  Aggressor
Port  7  Pin     Model_name  DQS  Diff_pos  3  Aggressor
Port  8  Buffer  Model_name  DQS  Diff_pos  3  Aggressor
Port  9  Pin     Model_name  DQS  Diff_neg  3  Aggressor
Port  10 Buffer  Model_name  DQS  Diff_neg  3  Aggressor
[End ISS Model]
```


Next Steps

Defining model hierarchy

- Model precedence similar to [Package], [Pin], [Package Model]

Refining Unused_Port_Termination subparameter definition

Are more subparameters needed?

Will victim/aggressor crosstalk simulations be supported fully?

Co-develop syntax for EBD specification overhaul

Complete BIRDs and get them into the next release of IBIS (later this year?)


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