

Subckt Package Model in IBIS

Dr. Wenliang Dai (wldai@cadence.com)

Cadence Design Systems, Inc.

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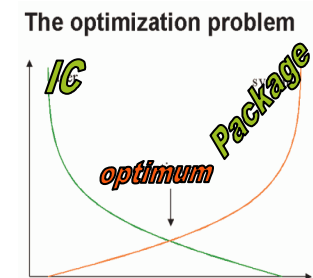
Agenda

- **Standard IBIS Package Model Overview**
- **Requirements on IBIS Package Model in High Speed Circuit Analysis**
- **Proposed IBIS Subckt Package Model**
- **Summary**



Standard IBIS Package Model Overview

- Existing Simplified IBIS Package Model
 - Single RLC value
- Customized IBIS Package Model
 - Segmented/Forked RLC value
- Coupled IBIS Package Model
 - RLC Matrix value
- Pin Mapping in Pin Numbers and Model Data Section
 - 1:1 mapping of die pins to package pins
 - Simple RLC for each signal, power and ground pin



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Extracted Package Model by Field Solvers & Measurements

- Current Standard IBIS Package Model Format
 - Very simple RLC value with 1:1 mapping of BGA pins to Die pins
 - It makes little sense for each pwr/gnd pins
- Subckt Model for Coupling Signal, Power and Ground Nets from Field Solvers
 - Complex Spice subckt with high accuracy & efficiency by pwr/gnd pins group process
- Touchstone Format S Parameter Model from Field Solvers or Measurement
 - S/Y/Z parameter model and related Subckt model can be obtained conveniently
- Today's power & SSN analysis with lower voltage and higher current require high accurate power, ground (including decaps) and signal nets coupling circuit model for higher simulation accuracy and efficiency
 - *Subckt or S parameter models are required*
 - *Pin-Port Mappings are required by full system high speed circuit analysis*

Notes: Current IBIS Package Model is **NOT ENOUGH** for high speed circuit analysis, especially for Power analysis & SSN simulation



How to Use the Extracted Subckt Package Model

- Create the Whole Circuit Netlist by Editing the Connection between the Extracted Spice Package Model and S Parameter Model in **Text File Format**
 - Good
- Create the Connection between the Package Model and other Models in GUI with additional **Pin-Node Mapping file** Manually
 - Better
- Create the Connection between Package Model and other Model automatically through **Enhanced IBIS Package Model**
 - Best and it's a Standard

Notes: Consume complicated/coupled signal & power net subckt in IBIS models

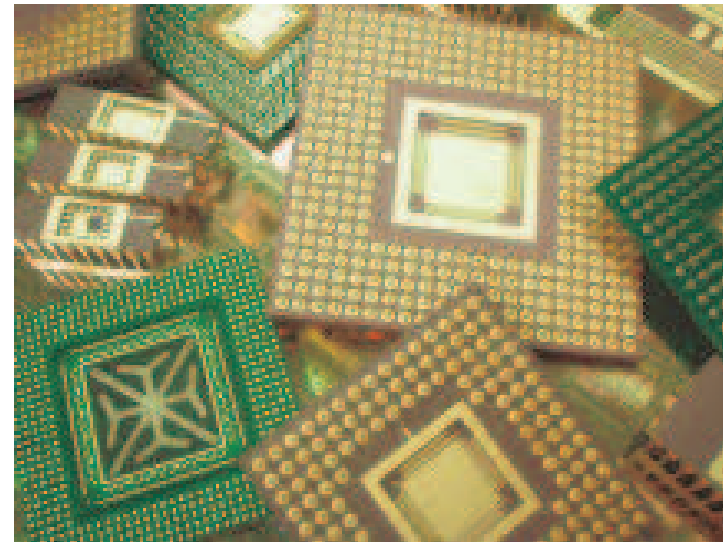
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Existing IBIS Package Model in V5.0

```
• [Define Package Model]
• -----
• | |-- [Manufacturer]
• | |-- [OEM]
• | |-- [Description]
• | |-- [Number Of Sections]
• | |-- [Number Of Pins]
• | |-- [Pin Numbers]          Len, L, R, C, Fork, Endfork
• | |-- [Model Data]
• | -----
• | | |-- [Resistance Matrix]  Banded_matrix, Sparse_matrix,
• | | | -----              Full_matrix
• | | | |-- [Bandwidth]
• | | | |-- [Row]
• | | |
• | | |-- [Inductance Matrix]  Banded_matrix, Sparse_matrix,
• | | | -----              Full_matrix
• | | | |-- [Bandwidth]
• | | | |-- [Row]
• | | |
• | | |-- [Capacitance Matrix] Banded_matrix, Sparse_matrix,
• | | | -----              Full_matrix
• | | | |-- [Bandwidth]
• | | | |-- [Row]
• | | |
• | | |-- [End Model Data]
• | |
• | |-- [End Package Model]
```





What's New in the Enhanced IBIS Package Model

- [Define Package Model]
- [Manufacturer]
- [OEM]
- [Description]
- [Number Of Sections]
- [Number Of Pins]
- [Pin Numbers]
- [Model Data]
- [End Model Data]
- [End Package Model]

It also supports multiple Subckt models in one package with its pin node mapping

[Define Package Model]
[Manufacturer]
[OEM]
[Description]
[Number Of Pins]
[Number Of Sections]
[Pin Numbers]
[Model Data]
[End Model Data]
[Subckt Package Model]
[Pin-Node Mapping]
[End Pin-Node Mapping]
[Subckt Model Data]
[End Subckt Model Data]
[End Subckt Package Model]
[End Package Model]

Keywords for Proposed IBIS Package Model

- Keywords:
- |
- [Subckt Package Model]
- |=====
- | Keyword: [Subckt Model Data]
- | Required: Yes
- | Description: Indicates the beginning of the formatted subckt package model data,
• | that can include the spice subckt or s parameter model keywords.
- |-----
- [Pin-Node Mapping]
- [End Pin-Node Mapping]
- [Subckt Model Data]
- [End Subckt Model Data]
- |=====
- | Keyword: [End Subckt Package Model]
- | Required: Yes
- | Description: Indicates the end of the formatted model data.
- | Other Notes: In between the [Subckt Package Model] and [End Subckt Package Model]
• | keywords is the pin node mapping, data itself of subckt package model.
- |-----
- [End Subckt Package Model]
- |

Notes: The goal is to specify a complicated spice-like subckt package model instead of standard simple RLC package model to be used by the keyword Subckt Package Model.

Keywords for Proposed IBIS Package Model

- Keywords:
- =====
- | Keyword: [Pin-Node Mapping]
- | Required: Yes
- | Description: Indicates the beginning of the formatted Pin Node mapping data for
- | subckt package model data.
- |-----
- [Pin-Node Mapping]
- |
- |=====
- | Keyword: [End Pin-Node Mapping]
- | Required: Yes
- | Description: Indicates the end of the formatted pin port mapping data.
- | Other Notes: In between the [Pin-Node Mapping] and [End Pin-Node Mapping]
- | keywords is the pin port mapping data itself. The data is a set of subckt node
- | name like N001, pin name like VDD01 and net name like Net1 as below
- | N001 VDD01 Net1
- | N002 VDD02 Net1
- | N003 VDD03 Net2
- | N004 VSS01 Net3
- | The net name like Net1 is "OPTIONAL"
- |-----
- [End Pin-Node Mapping]
- |

Keywords for Proposed IBIS Package Model

- Keywords:
- |
- [Subckt Model Data]
- |=====
- | Keyword: [Subckt Model Data]
- | Required: Yes
- | Description: Indicates the beginning of the formatted subckt package model data,
- | that can include the subckt or s parameter model keywords.
- |-----
- |=====
- | Keyword: [End Subckt Model Data]
- | Required: Yes
- | Description: Indicates the end of the formatted subckt model data.
- | Other Notes: In between the [Subckt Model Data] and [End Subckt Model Data]
- | keywords is the data itself for subckt package model.
- | The data is a set of spice subckt or S parameter model as below
- | Spice: “.subckt PowerModel N001 N002 N007 N008ends PowerModel”
- | Or S parameter: “.MODEL name sp [DATA=(npts ...)] [DATAFILE=filename]
- |-----
- [End Subckt Model Data]
- |

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Summary

- Requirements on IBIS Package Model
 - Accurate Power/SSN analysis with a complex package model
- Proposed Subckt Type in IBIS Package Model
 - Spice circuit or S parameter data
- Applications for IBIS Subckt Package Model
 - IC-Package-Board co-design flow and Design Link



Action items

- Add the proposed subckt package model keywords into standard IBIS package part
- IBIS parser parses the subckt package keywords
 - Similar use model to existing lumped package model
- EDA tools consume the subckt package model to create circuit netlist



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