

IBIS Interconnect BIRD

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Overview

- IBIS Interconnect Task Group
- Models Represent Package and On-Die Interconnect
- On Die, Package, Supply and Signal Interconnect can be Combines or Kept Separate
- Similar Approach for Both IBIS and EBD
- Pre and Post Layout IBIS Files
- IBIS Interconnect Model Terminals
- Differential Signal (I/O) Model Terminals
- Supply Model Terminals
- Post Layout Combined Package and On-Die Models
- Post Layout Separate Package and On-Die Models
- Pre Layout Combined Package and On-Die Models
- Graphics Showing Model Terminals
- Corners
- Reconciling Legacy IBIS Models and [External Model]
- Other issue to discuss/resolve
- Next Steps

IBIS Interconnect Task Group

- Meets Wednesdays 8AM PDT
- http://www.eda.org/ibis/interconnect_wip/
- Major Contributors
 - Altera
 - Cadence Design Systems
 - Intel Corp
 - Keysight Technologies
 - Mentor Graphics
 - Micron Technology
 - Signal Integrity Software
 - Synopsys
 - Teraspeed Labs
 - David Banas
 - Bradley Brim
 - Michael Mirmak
 - Radek Biernacki
 - Arpad Muranyi
 - Justin Butterfield, Randy Wolff
 - Walter Katz
 - Rita Horner
 - Bob Ross

Models Represent Package and On-Die Interconnect

- Languages Supported
 - IBIS-ISS
 - Touchstone
- Model Terminals
 - Pins
 - Die Pads
 - Buffer Signals
 - Buffer Supplies

On Die, Package, Supply and Signal Interconnect can be Combined or Kept Separate

- Supports separate on-die and package interconnect models and combined on-die and package interconnect models
- Independent Supply and Signal Interconnect Models
- Coupled Supply and Signal Interconnect Models
- Singled Ended and Differential Interconnect Models

Similar Approach for Both IBIS and EBD

- IBIS (.ibs) Interconnect Model Terminals
 - Pins ([Pins])
 - Die Pads
 - Buffers
- EBD (.ebd) Interconnect Model Terminals
 - Pins ([Pin List])
 - reference_designator.pin
 - Enhancing EBD will be a separate BIRD based on the IBIS interconnect model BIRD when completed
 - May be a new section Electronic Module Description (EMD) instead of enhancing EBD

IBIS Interconnect Model Terminals

- Pins
- Die Pads
 - Signal (I/O)
 - Supply (POWER and GND)
- Buffers
 - Signal (I/O)
 - Supply
 - Pullup Reference
 - Pulldown Reference
 - Power Clamp Reference
 - Ground Clamp Reference
 - External Reference

Pre and Post Layout IBIS Files

- Post Layout
 - Signal (I/O) Terminals
 - Pin, Die Pad and Buffer terminals referenced by Pin_name
 - Supply Terminals
 - Pin terminals referenced by Pin_name or Signal_name
 - Die Pad terminals referenced by Die_Pad_name or Signal_name
 - Buffer terminals referenced by Pin_name or Signal_name
- Pre Layout
 - Signal (I/O) Terminals
 - Referenced by Model_name
 - Supply Terminals
 - Referenced by Signal_name

Interconnect Model Examples

```
[Interconnect Model]  A1  | Post Layout Interconnect Model
File_TS  A1.s2p
Number_of_Terminals 3
Terminal 1 Pin_A_signal  A1
Terminal 2 A_signal A1
[End Interconnect Model]
```

```
[Interconnect Model]  DQ  | Pre Layout Interconnect Model
File_ISS  DQ.iss DQ
Param Length .1 .05 .15
Number_of_Terminals 2
Terminal 1 Pin_A_signal  DQ Model_name
Terminal 2 A_signal DQ Model_name
[End Interconnect Model]
```

Interconnect Model Terminals

- Terminal <terminal number> <At Pin|DiePad|Buffer> <ID>
<What ID is>
- One line per terminal
- Supports both Pre and Post Layout
- Example Signal (I/O) Terminal records
 - Post Layout
 - Terminal 1 Pin_A_signal M8
 - Terminal 2 Pad_A_signal M8
 - Terminal 3 A_signal M8
 - Pre Layout
 - Terminal 1 Pin_A_signal DQ Model_name
 - Terminal 2 Pad_A_signal DQ Model_name
 - Terminal 3 A_signal DQ Model_name

Differential Signal (I/O) Model Terminals

– Post Layout

- Terminal 1 Pin_A_signal M8
- Terminal 2 Pin_A_signal M7
- Terminal 3 Pad_A_signal M8
- Terminal 4 Pad_A_signal M7
- Terminal 5 A_signal M8
- Terminal 6 A_signal M7

– Pre Layout

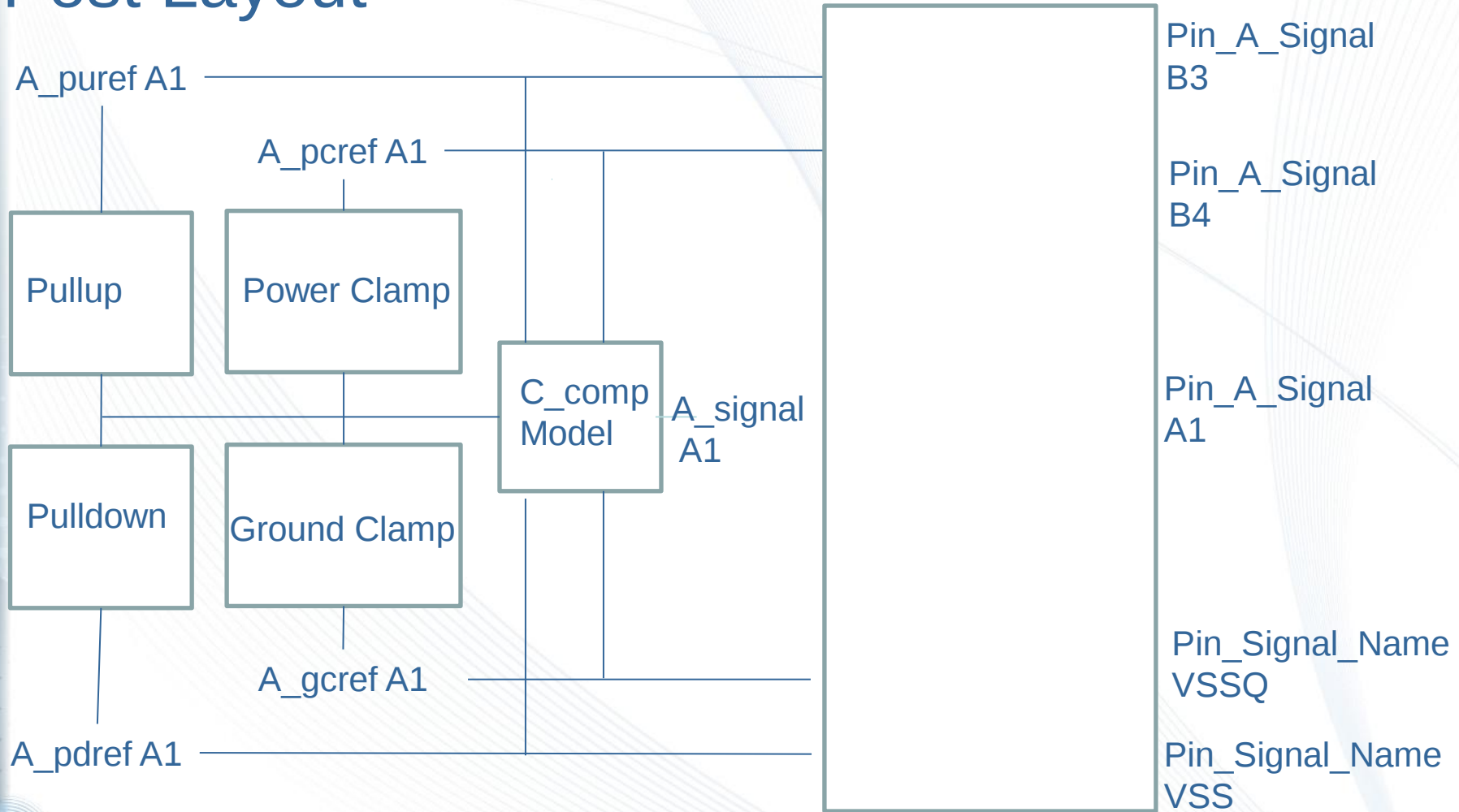
- Terminal 1 Pin_A_signal_pos DQS Model_name
- Terminal 2 Pin_A_signal_neg DQS Model_name
- Terminal 3 Pad_A_signal_pos DQS Model_name
- Terminal 4 Pad_A_signal_neg DQS Model_name
- Terminal 5 A_signal_pos DQS Model_name
- Terminal 6 A_signal_neg DQS Model_name

Supply Model Terminals

- Post Layout
 - Using Pins, Pads and Buffers
 - Terminal 1 Pin_A_Signal B1
 - Terminal 2 Pin_A_Signal B2
 - Terminal 4 A_puref M3
 - Using Signal_name and Buffers
 - Terminal 1 Pin_A_Signal VDD Signal_name
 - Terminal 3 A_puref M3
- Pre and Post Layout
 - Using Signal_name and “Pin mapping”
 - Terminal 1 Pin_A_Signal VDD Signal_name
 - Terminal 3 A_Signal VDD Signal_name
 - Using Signal_name and “Model_name”
 - Terminal 1 Pin_A_Signal VDD Signal_name
 - Terminal 3 A_puref DQ Model_name

Package Terminals Post Layout

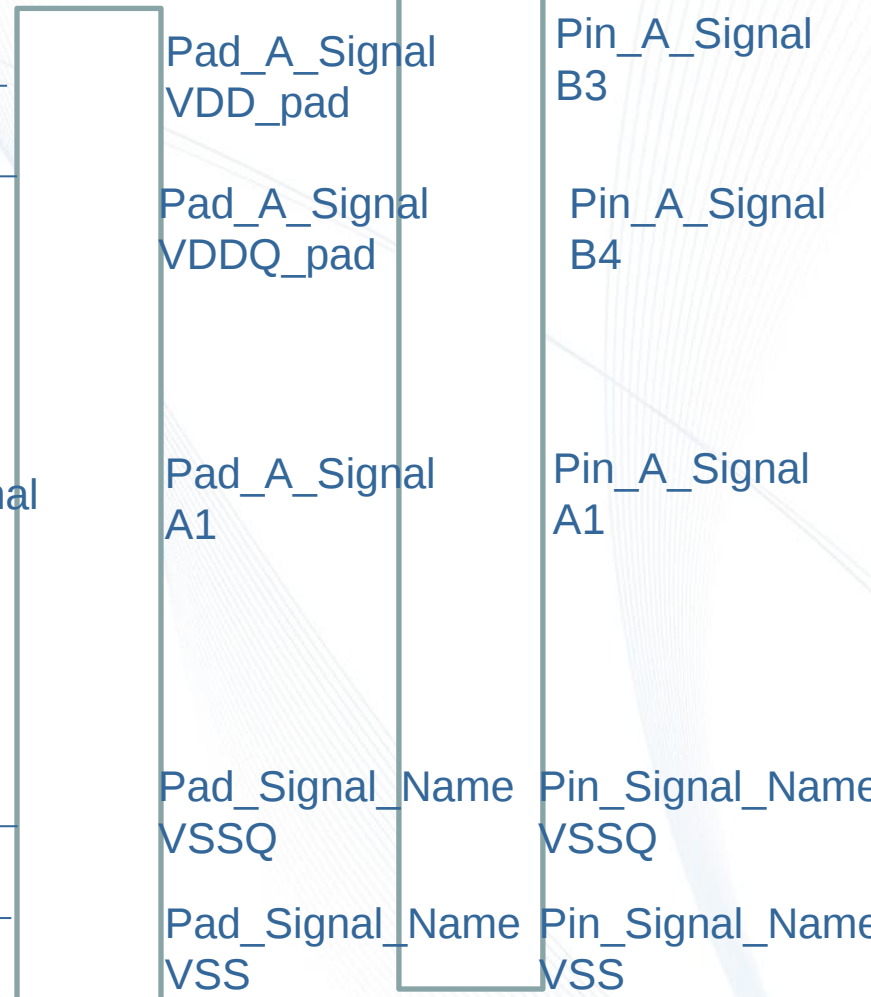
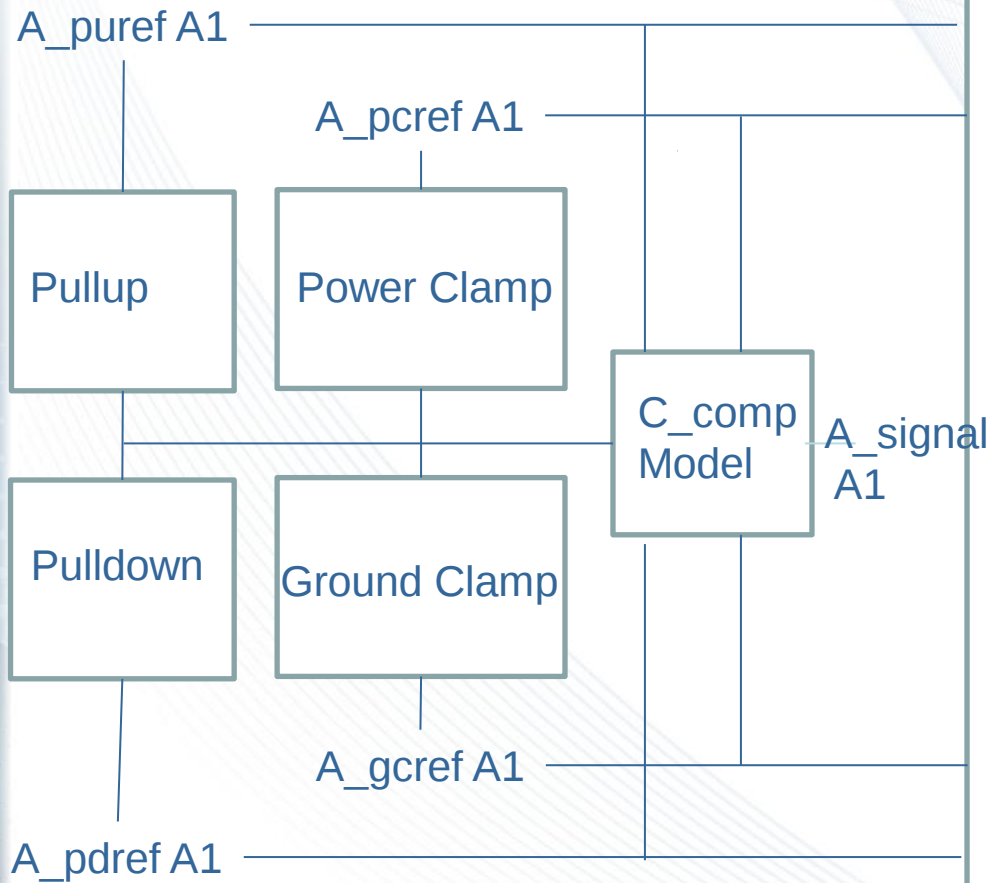
Combined Package
and On-Die Model



Package Terminals Post Layout

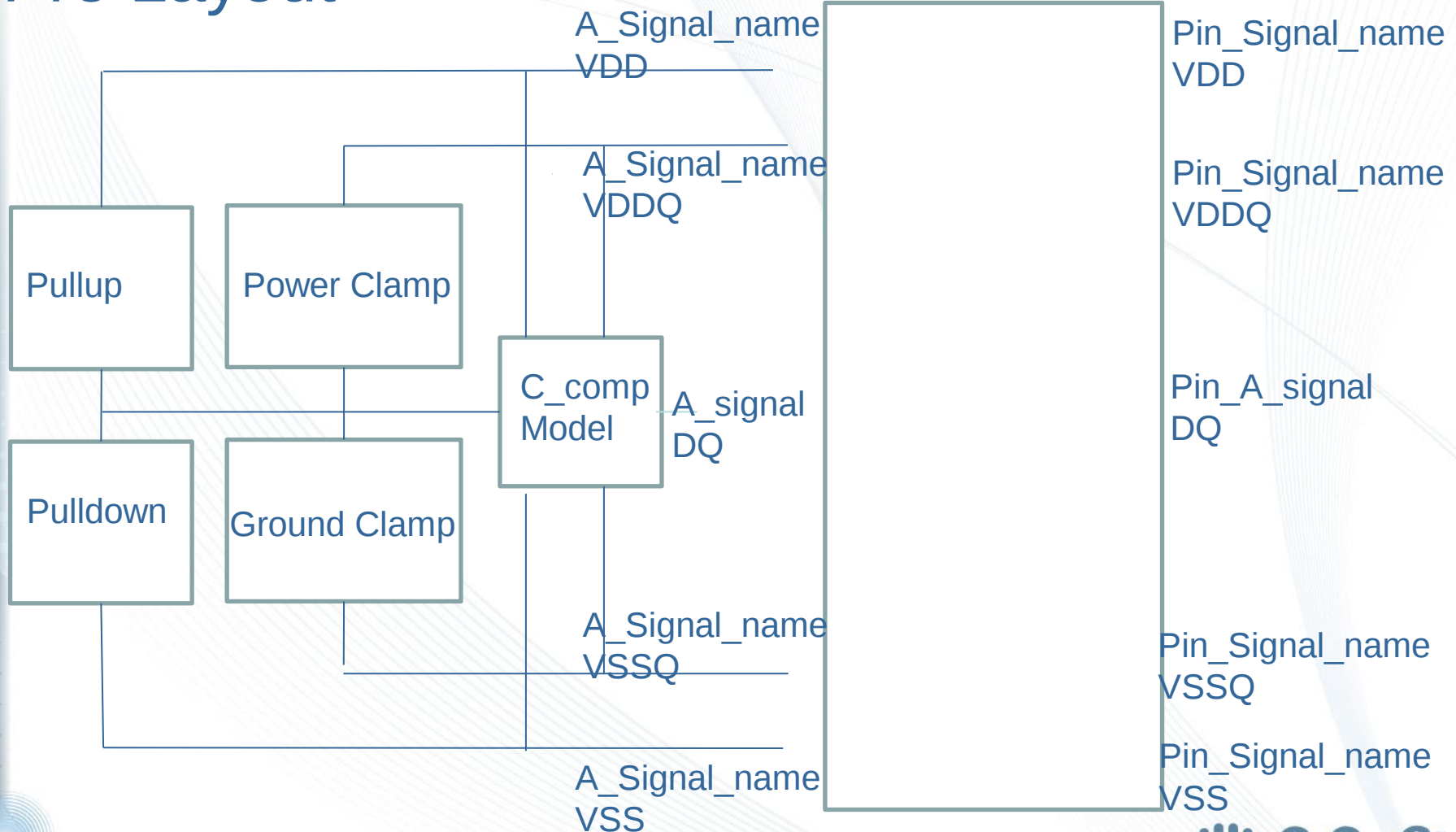
On-Die
Model

Package
Model



Package Terminals Pre Layout

Combined Package
and On-Die Model



Corners

- Parameters can have either a single value or three corner values
- It is not clear if we will have a clear definition of the three corners Typ, Min, Max
 - If a parameter is a length then Typ, Fast, Slow
 - If a parameter is a delay then Typ, Slow, Fast
 - If a parameter is an impedance then Typ, Min, Max
- Expect it will inherit the existing usage of Typ, Min and Max and will be up to EDA tool on how to apply these corners.
- Some “Corner” conditions (e.g. crosstalk) will be handled by [Interconnect Model Selector].

Reconciling Legacy IBIS Models and [External Model]

- [External Model] supports an A_extref terminal which has no analog in legacy models (models that use the IV).
- If a new interconnect models has a terminal to an [External Model] A_extref, how should the EDA tool terminate this terminal when using a legacy model?

Other issue to discuss/resolve

- Reconciling [External Circuit] with new interconnect models
- Reconciling global reference node “0”, “A_Gnd” and “Gnd” with both IBIS models and new interconnect models.

Next Steps

- The goal is to complete the new interconnect model BIRD and formally submit it to the Open Forum by mid Q2, 2015
- Shortly thereafter with a BIRD to enhance EBD to support IBIS-ISS subckts.