Creating IBIS Models for Stacked-Die Packages

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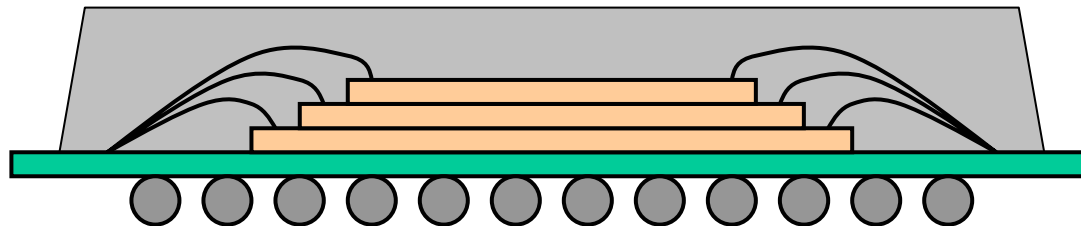
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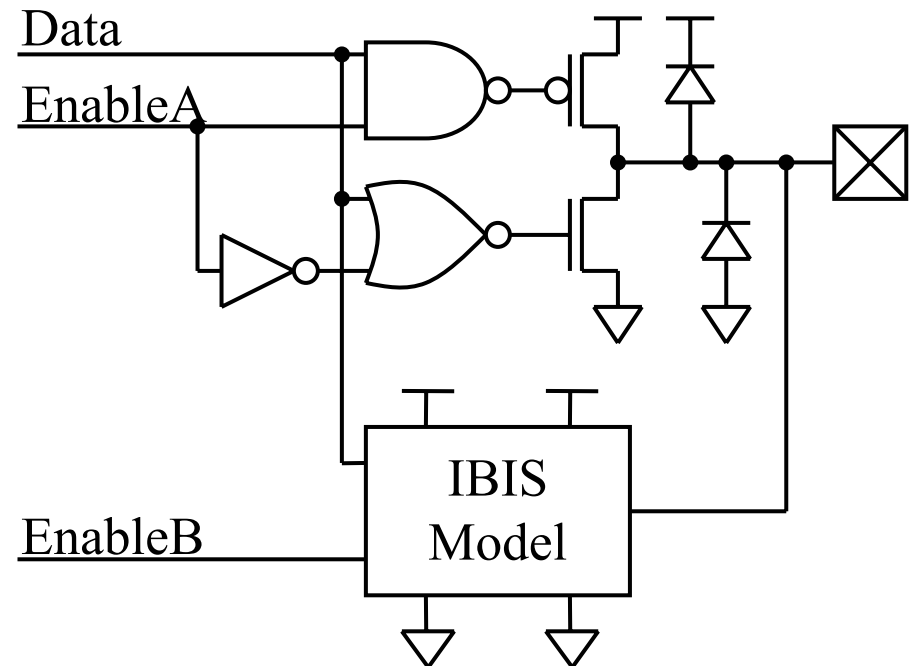**intel** ®

Problem Statement

- Intel sells memory with several devices stacked inside a single package

- We receive bare die from several vendors
  - We receive IBIS models but no schematics

- Customers require IBIS models for new stacked-die package

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Solution

- Use internal schematics plus vendor IBIS models to create a new netlist

- Simulate to generate IV and VT curves for new IBIS model

Data
EnableA

IBIS
Model

EnableB

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Methodology

- Generate two sets of IV and VT curves
  - Device A is active while device B is tri-stated
  - Repeat with device B active and A tri-stated
- Build new IBIS model using both curves
  - Assign D[0] to A active (with B tri-stated)
  - Assign D[7:1] to B active (with A tri-stated)
- Edit IBIS model to add model_selector
  - Change D[7:0] to use model_selector
  - Requires IBIS version 3.2 or higher

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Data Bus Example

- BEFORE

```
[IBIS Ver]    2.1
...
[Pin] signal_name model_name
B1     DQ0       Ab_output
B2     DQ1       Ba_output
B3     DQ2       Ba_output
B4     DQ3       Ba_output
```

- AFTER

```
[IBIS Ver]    3.2
...
[Pin] signal_name model_name
B1     DQ0              DQ
B2     DQ1              DQ
B3     DQ2              DQ
B4     DQ3              DQ
...
[Model Selector] DQ
Ab_output Device A DQ
Ba_output Device B DQ
```
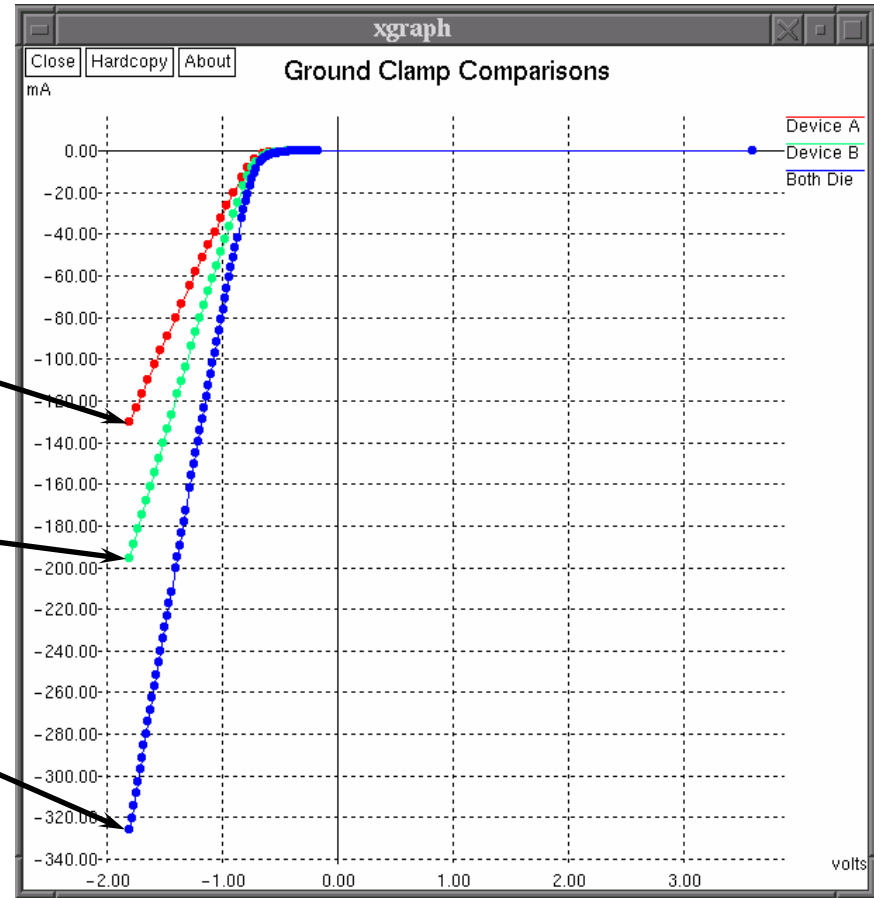
At least one instance of each buffer

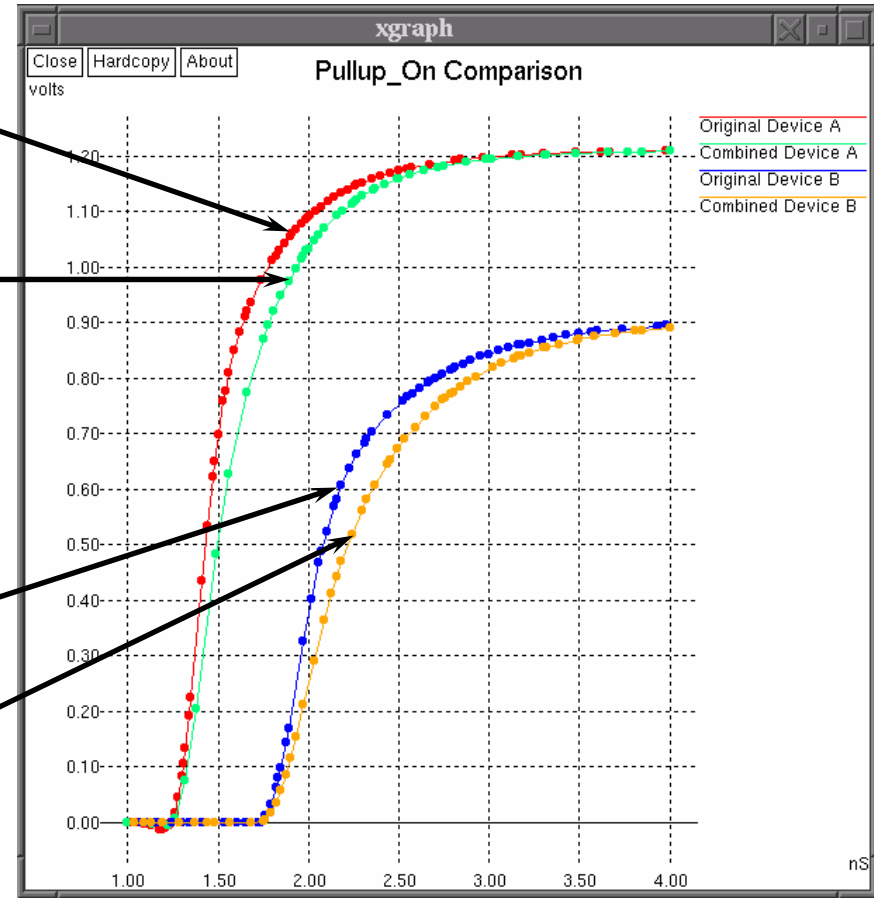Manually add Model Selector

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Ground Clamp Comparison

- New IBIS model reflects behavior of both die

- Device A ground clamp (-130mA)

- Device B ground clamp (-195mA)

- Combined ground clamp (-325mA)

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AC Timing Comparison

- Original (single-die) pullup_on for device A

- Combined curve showing additional loading from device B

- Original device B

- Combined device B

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Conclusion

- This document describes a methodology of generating a multi-die IBIS model from transistor netlists plus IBIS models

- Effects of multiple loads are accounted for
  - Power clamps for all devices are combined
  - Vt behavior accounts for additional loading

- Package parasitics can be handled using worst case loading or EBD format

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