IBIS Models @ 1.25GHz and Beyond

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IBIS models @ 1.25 Ghz

- System designs challenges
  - Interconnect
    - Etch
    - Connectors
  - Return path
    - SSO
    - Vias
    - Splits and Swiss cheese planes
  - **High Speed Links**
    - **For example - LVDS**
- Can IBIS be utilized ?

LVDS
Low Voltage Differential Signaling

- Higher signaling speeds
- Lower voltage swing
- Lower power consumption
- Less susceptible to common-mode noise
- Reduced EMI

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Challenges creating IBIS model @1.25Ghz and Beyond

- IBIS specifically designed for single-ended I/O buffers
- Behavioral (IV) curves show current as a function of voltage applied to pad
- Current of LVDS buffer dependent on voltage at both pads, and common-mode voltage (v_{cm})

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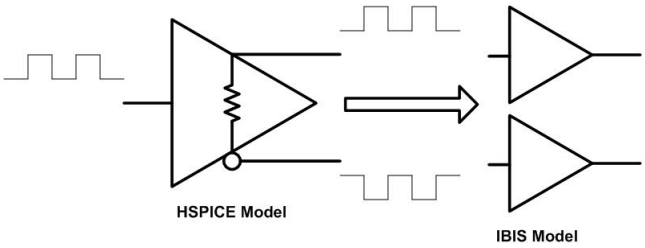
Extracting & Using LVDS IBIS Models



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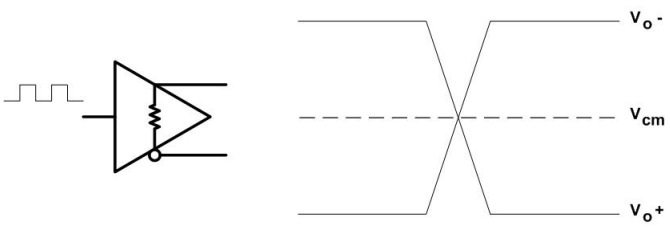
Generating an LVDS IBIS Model

- Step 1: Find v_{cm} of device



Drive into expected loading conditions & topology to obtain

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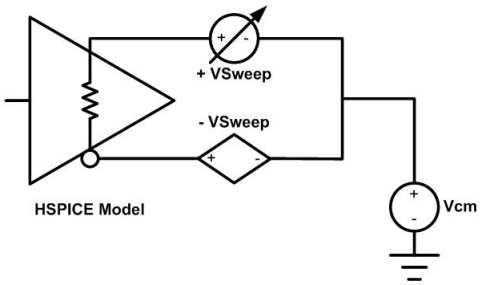
Generating an LVDS IBIS Model

- Step 2: Sweep v_{out} on one output pad, keeping v_{cm} constant throughout sweep



- Step 3: Extract the curves, convert to IBIS format

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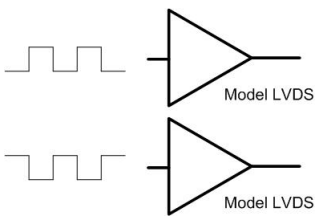
Using an LVDS IBIS Model

- Two instantiations of extracted model: one for true, one for complement
- Complement stimulus 180° out of phase with true stimulus



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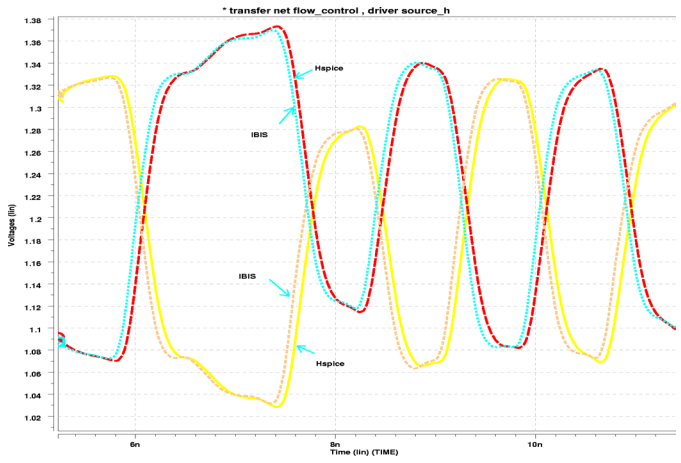
Accurate IBIS Model @ 1.25GHz HSPICE vs. IBIS



SPI4 interface: 1.25GHz, target pad, VDDQ=2.375

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Issues

- Some simulators modify "non-traditional" IV curves
  - IV curves not passing through (0, 0)
- LVDS IBIS models are accurate only when same VDDQ model was generated with is used
  - Changing VDDQ leads to inaccurate results
- Some LVDS IBIS models accurate only under same Load conditions (i.e. 100 Ohms)

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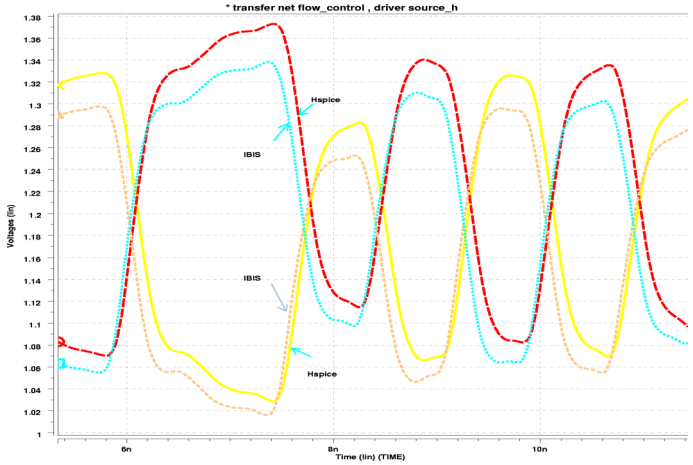
Inaccurate IBIS Model
Effect of Changing VDDQ



SPI4 interface: 1.25GHz, target pad, VDDQ=2.325,
Model generated w/VDDQ=2.375

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Issues

- LVDS IBIS models assume constant V_{cm}
  - Must generate multiple models for different values of v_{cm} to obtain consistent accuracy driving different loads and topologies
- Device asymmetry will affect accuracy of model
  - Model generated for both pads assumes perfect driver symmetry
  - Etch lengths of nets in differential pair matched

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Conclusion

- We can generate accurate IBIS models @ 1.25 Ghz and beyond !
- It takes significant effort and attention to detail
  - You must know operating conditions and application (I.e. VDDQ and termination values).
  - You must understand and test in target simulator
- Improper use of IBIS models can & will lead to inaccurate results
- Improper built IBIS models exist & will lead to inaccurate results.

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