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Signal Integrity Software, Inc.

LVDS IBIS Models @ 1.25GHz

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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 in using IBIS to model LVDS

- 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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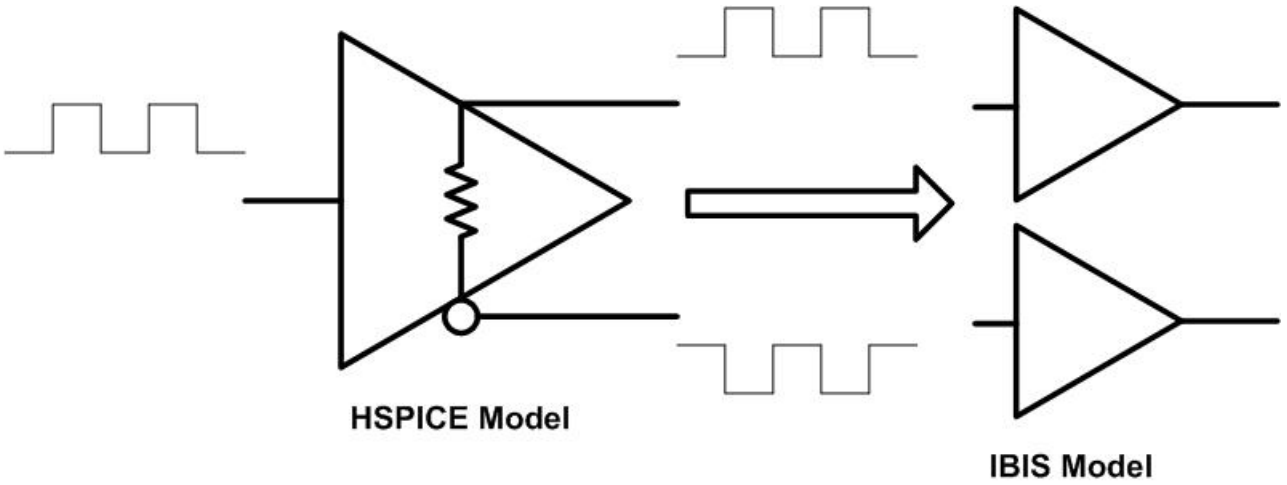
Extracting & Using LVDS IBIS Models



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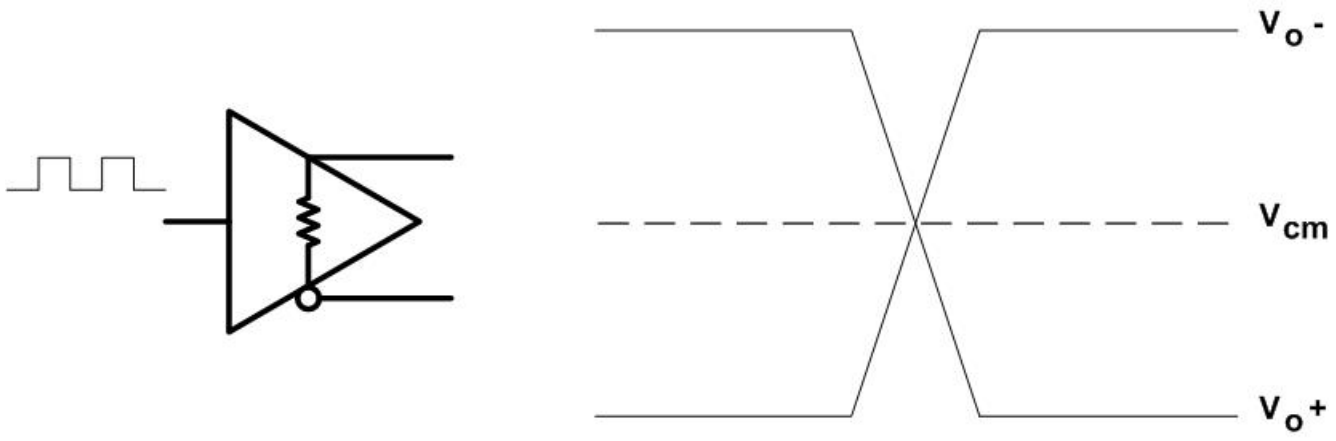
Generating an LVDS IBIS Model

- Step 1: Find v_{cm} of device



Drive into expected loading conditions & topology to obtain

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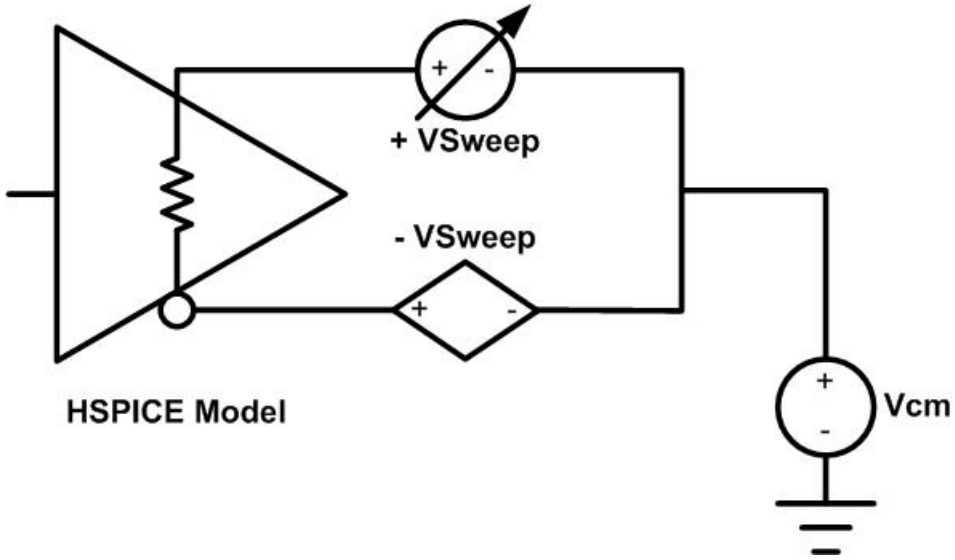
Generating an LVDS IBIS Model

- 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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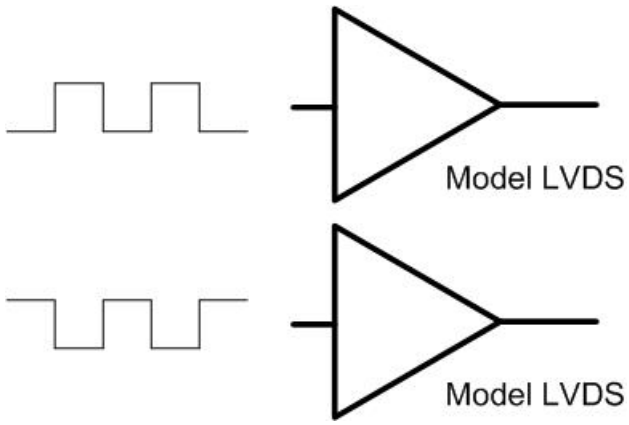
Using an LVDS IBIS Model

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



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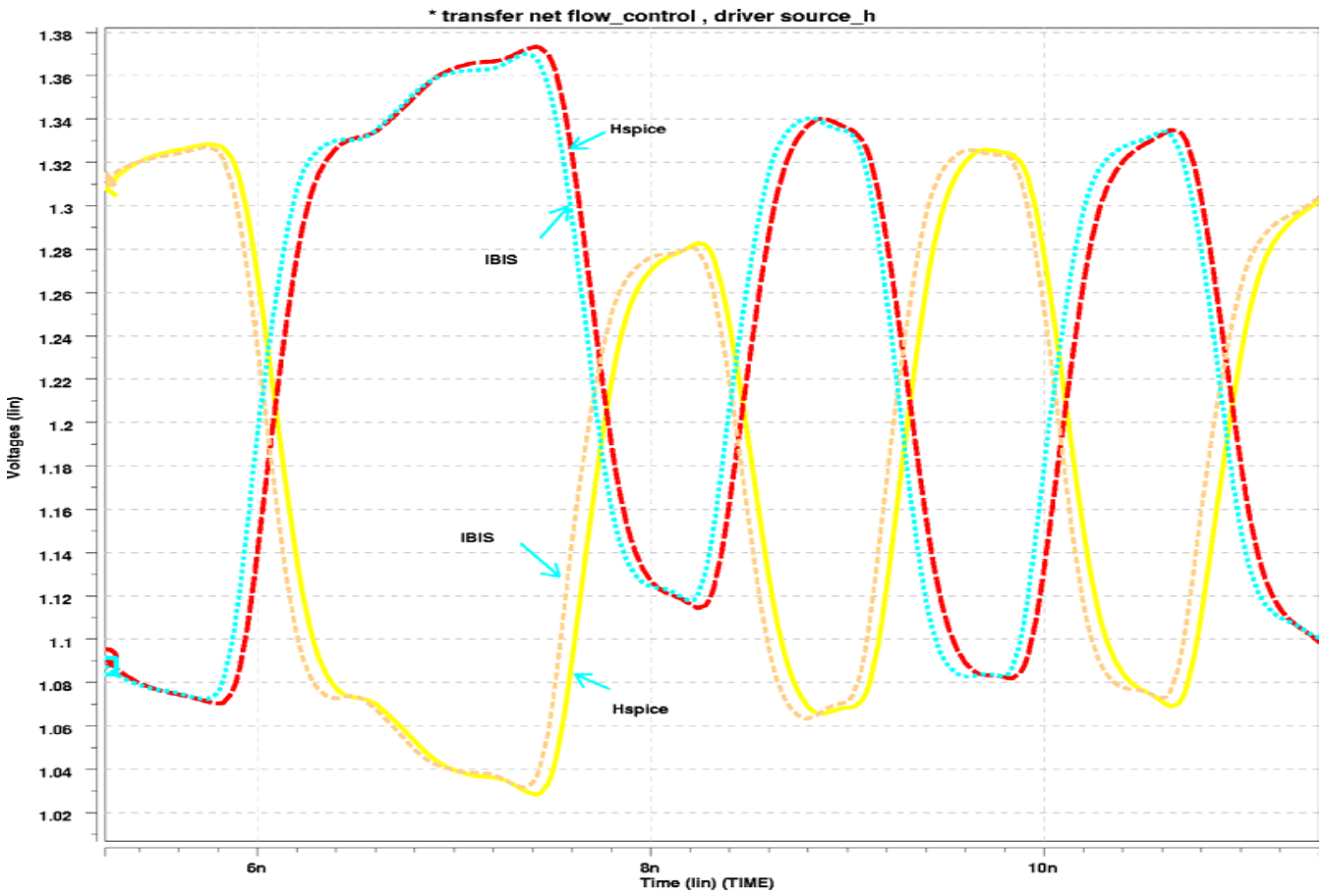
Accurate LVDS IBIS Model @ 1.25GHz



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

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Potential Issues

- Some simulators may modify LVDS's "non-traditional" IV curves
  - Some versions of Hspice modify IV curves not passing through (0, 0) if IV table does not have entry at i=0
- LVDS IBIS models are accurate only when same VDDQ model was generated with is used
  - Changing VDDQ leads to very inaccurate results

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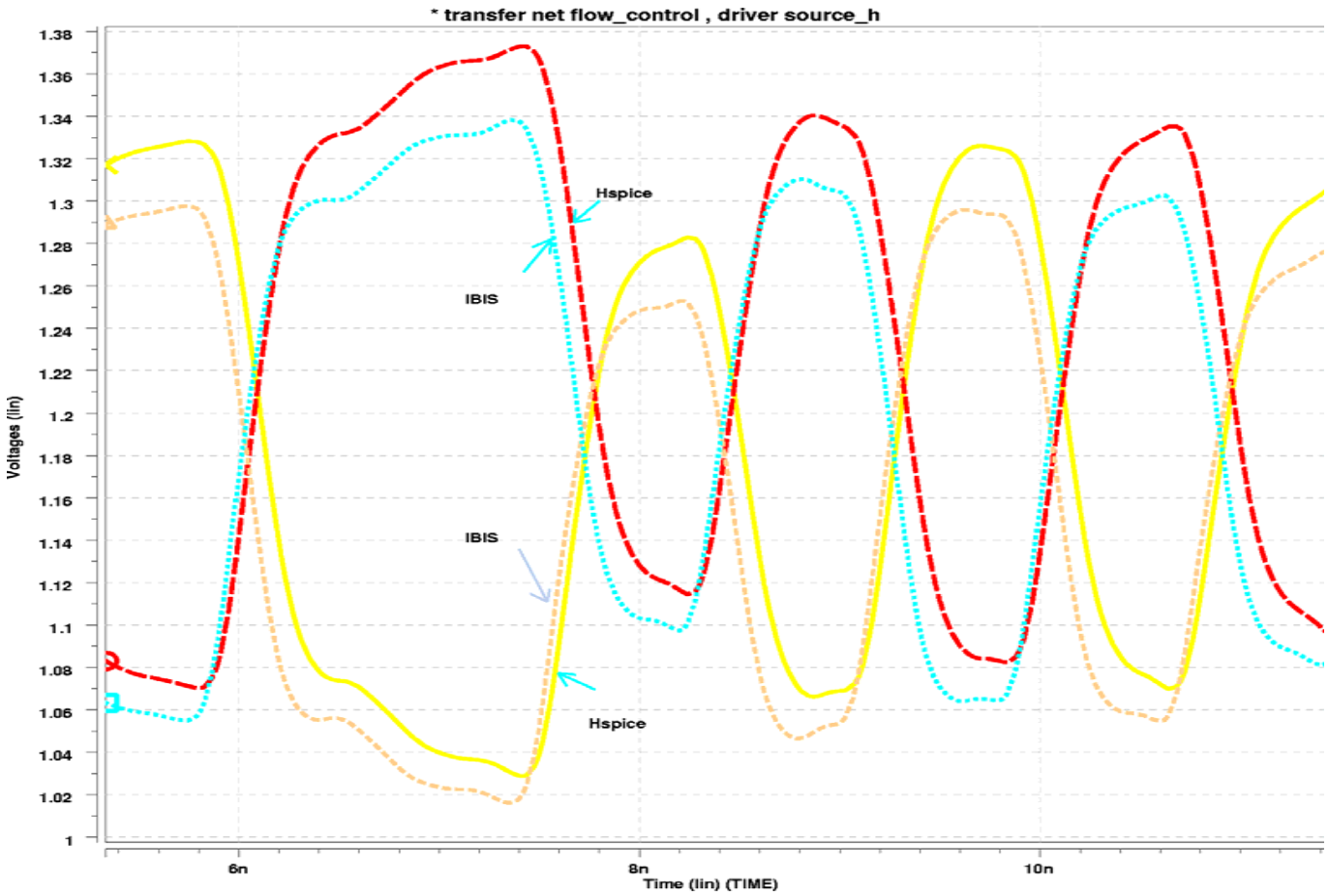
Effects of Changing VDDQ



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

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Potential 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

- It is possible to generate IBIS models for LVDS devices and obtain accurate results at speeds exceeding 1GHz
- Improper use of properly generated LVDS IBIS models can & will lead to inaccurate results
- Issues with LVDS IBIS models do exist, but can be avoided with proper knowledge of:
  - Device and application of device
  - How target simulator handles these models

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