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DDR IBIS-AMI Non-Linear Effect Modeling in Statistical Simulations

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Agenda

- Motivation
- Proposed DDR5 IBIS-AMI Modeling Methodologies
- Statistical IBIS-AMI vs. SPICE circuit simulations
- Summary

Motivation

- LTI (Linear Time-Invariant) model is used in statistical simulation
- Disadvantages in LTI model
 - LTI model typically does not include non-linear gain compression effect
 - LTI model is less accurate comparing with NLTV models
- Aim to include gain compression effect in LTI model, make it as close to NLTV (Non Linear Time-Variant) model as possible

Proposed DDR5 IBIS-AMI Modeling Methodologies

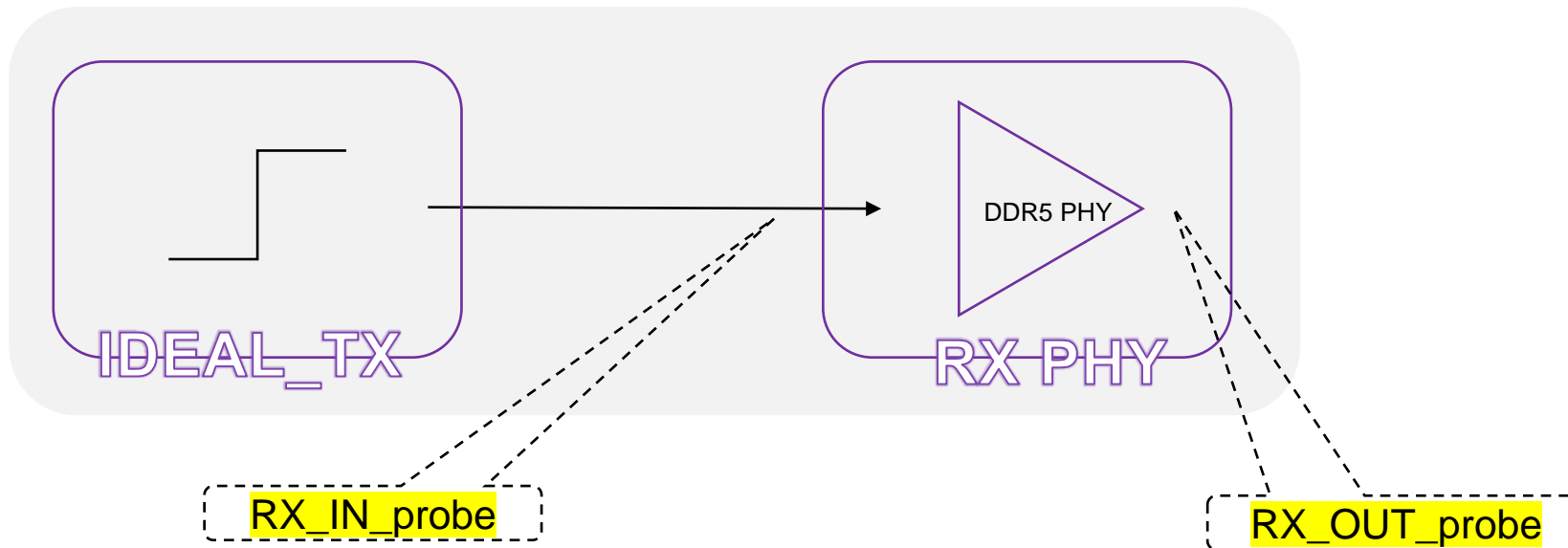
Make step response

- Testbench topology

- TX -> RX
- TX transmit the ideal step pattern

- Parameter setup follow these conditions

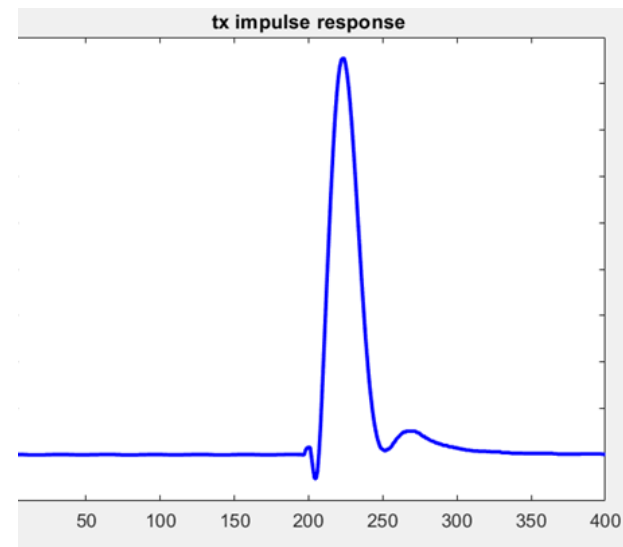
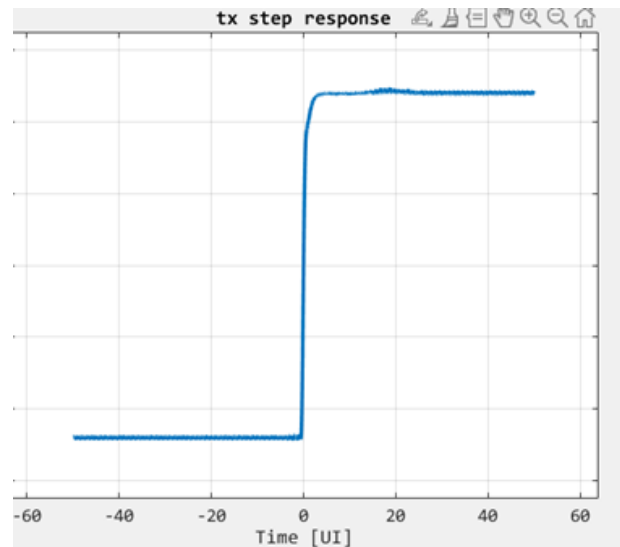
- Sweep PVT and RX EQ controls
- Sweep different TX launching voltage amplitude



Proposed DDR5 IBIS-AMI Modeling Methodologies

Make impulse response(IR)

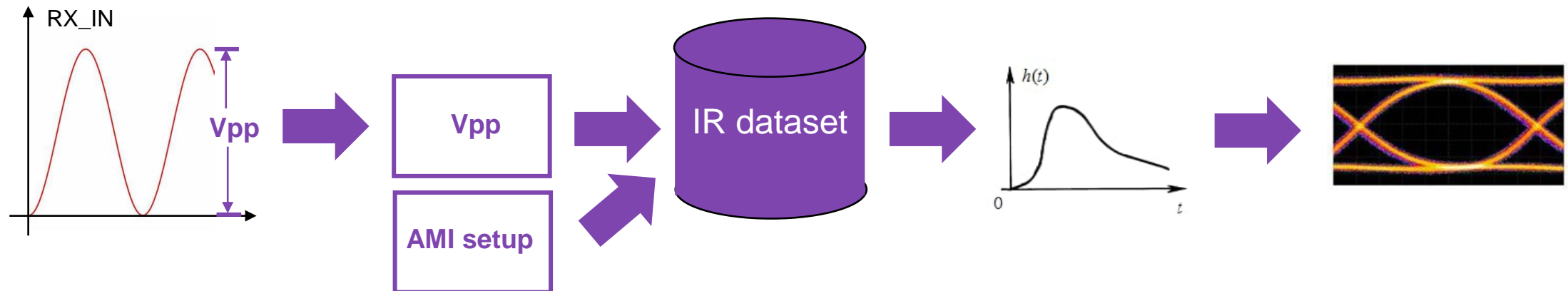
- Convert step response to impulse response
- Normalize the impulse response



Proposed DDR5 IBIS-AMI Modeling Methodologies

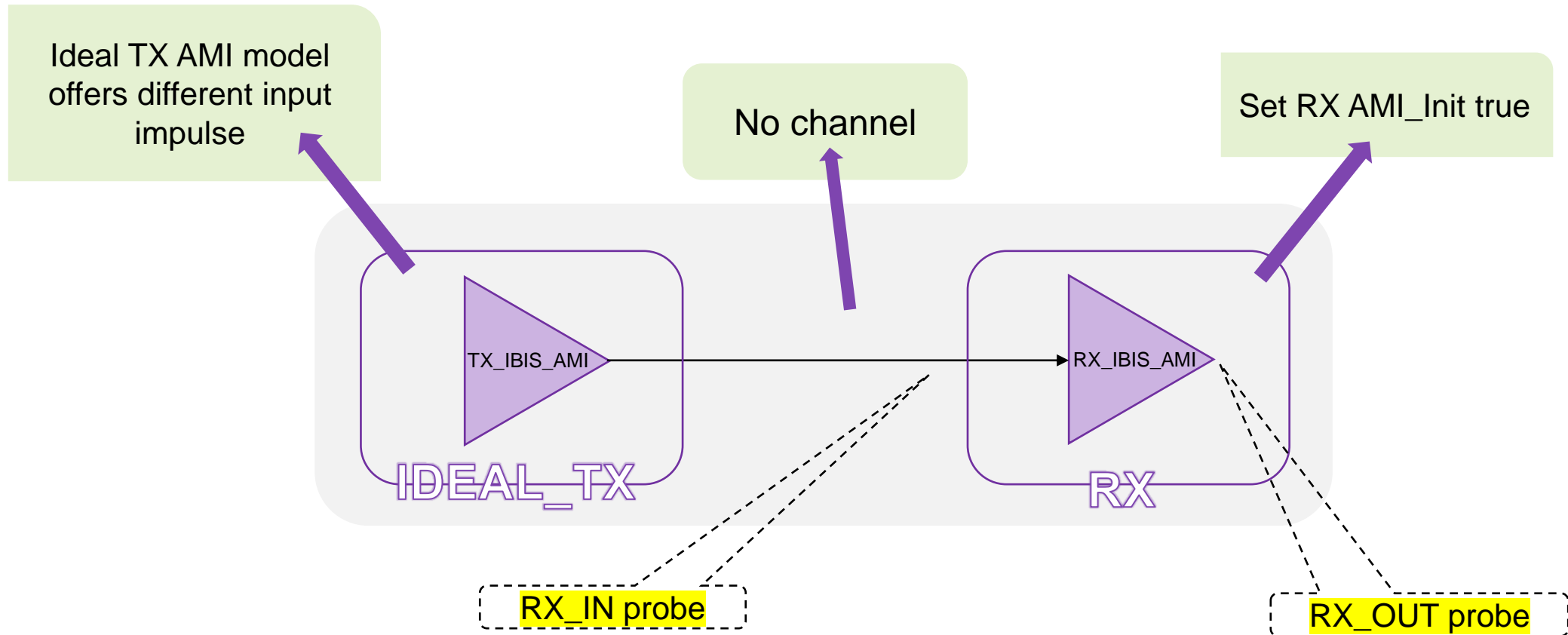
Choose the impulse response(IR)

- Calculate the Vpp according to the RX input
- Select the corresponding IR and generate the eye

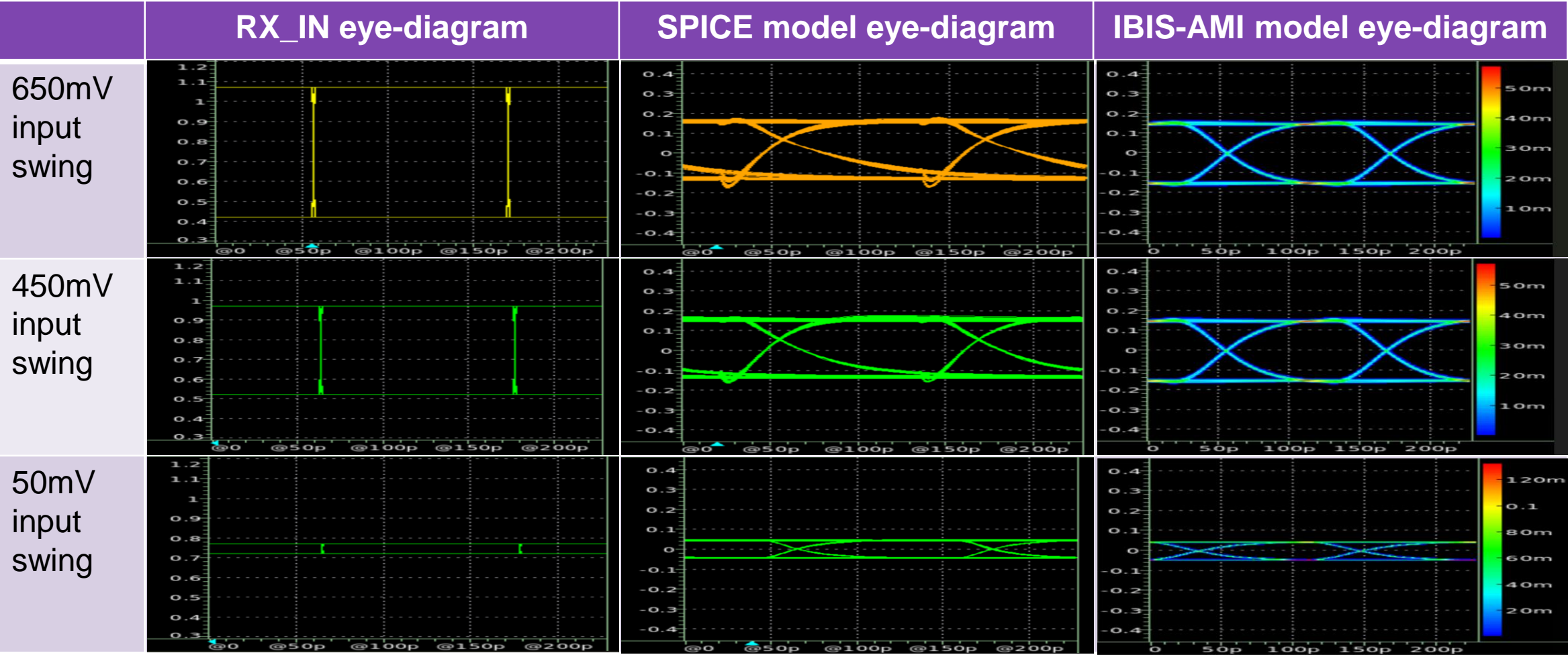


Statistical IBIS-AMI vs. SPICE circuit simulations

Statistical Simulation topology

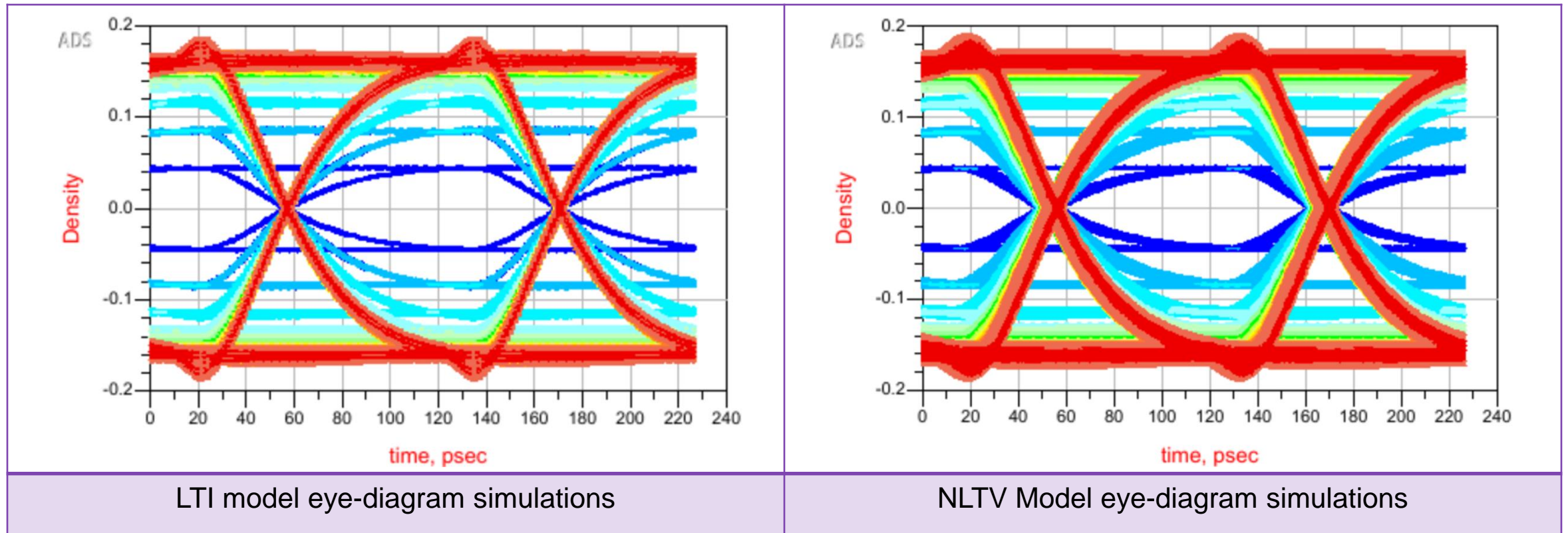


Statistical IBIS-AMI vs. SPICE circuit simulations



Statistical IBIS-AMI vs. SPICE circuit simulations

Comparison between LTI model and NLTV model



Summary

- Model gain compression effect in LTI model correctly
- Statistical (LTI) simulation results can correlate well with both SPICE circuit simulations and bit-by-bit (NLTV) results



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