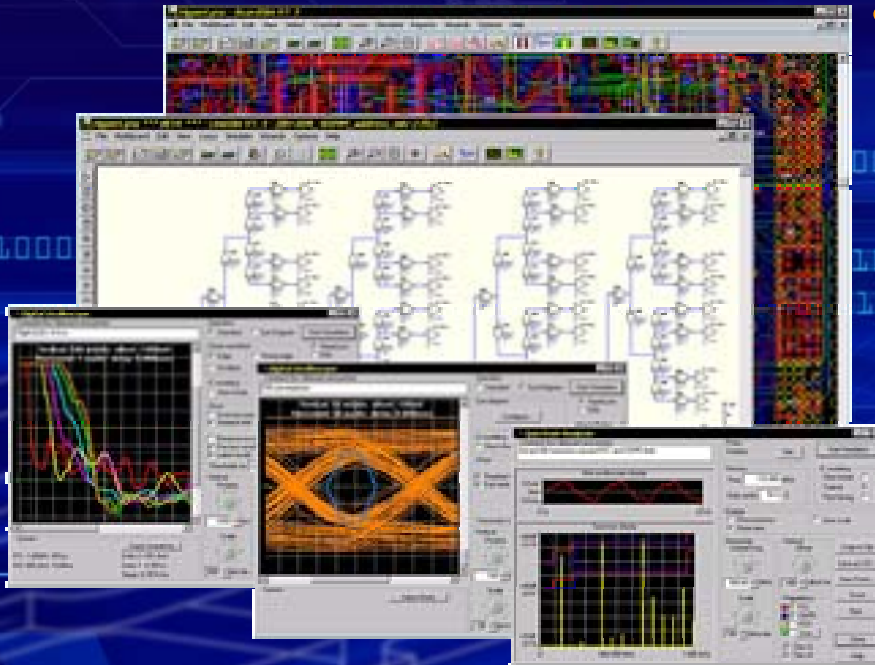


# *IBIS modeling of DDR2 in conjunction with linear channel analysis*



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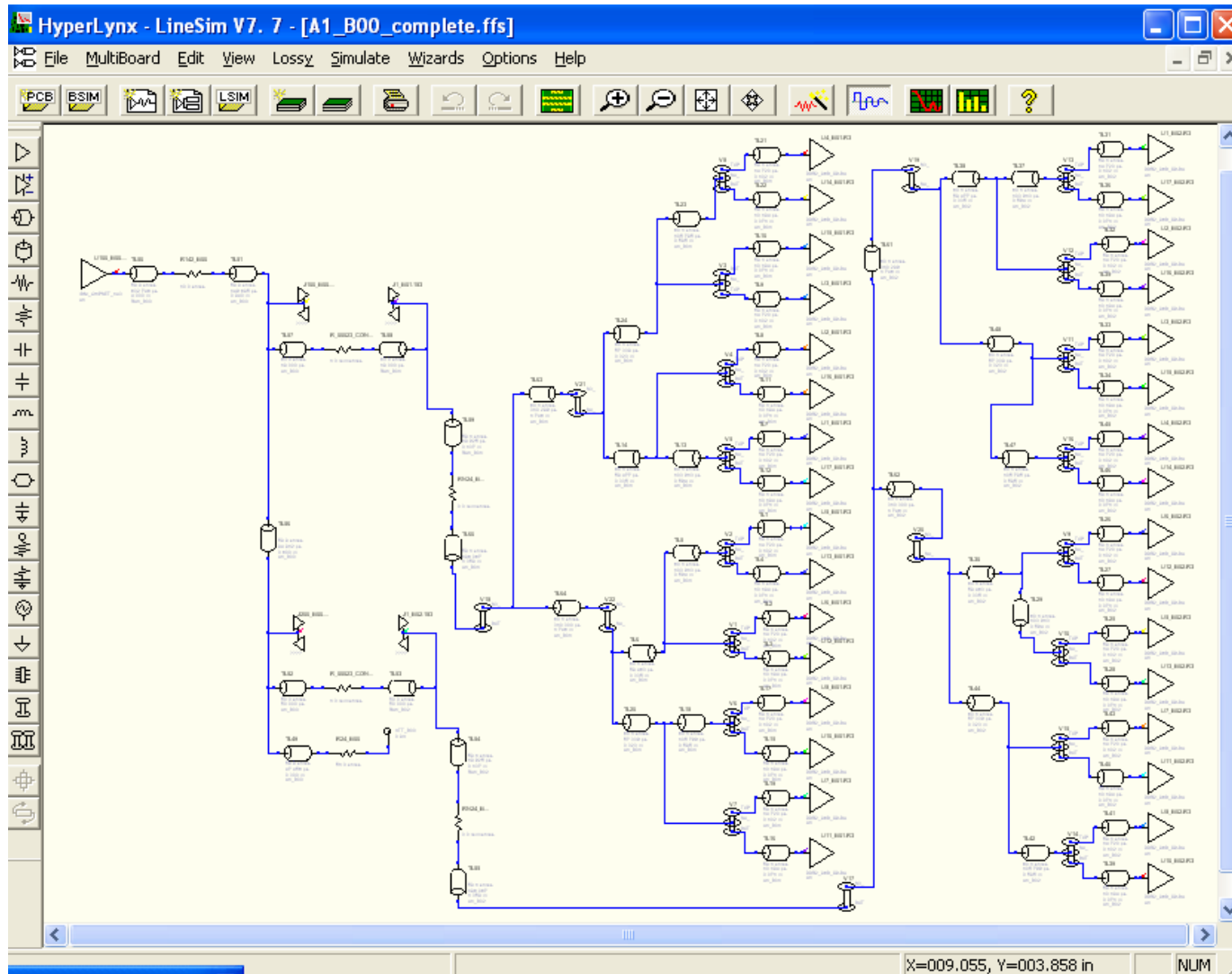
# Overview

- **High performance source synchronous buses, including DDR2 are known to be susceptible to resonances**
  - Established solution is to add compensation capacitors
- **It is difficult to demonstrate these resonances in traditional time domain SI simulators**
  - Resonance only occurs with specific repeated bit sequences
- **Linear channel analysis can identify the resonances but has limitations in its ability to determine if they are harmful**
  - DDR2 drivers exhibit non-linearity's which may affect characteristics such as overshoot
- **This paper describes the early results of our analysis of resonances in DDR2 buses using of both tradition circuit simulation using IBIS 4.2 models and linear channel analysis**

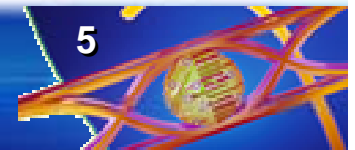
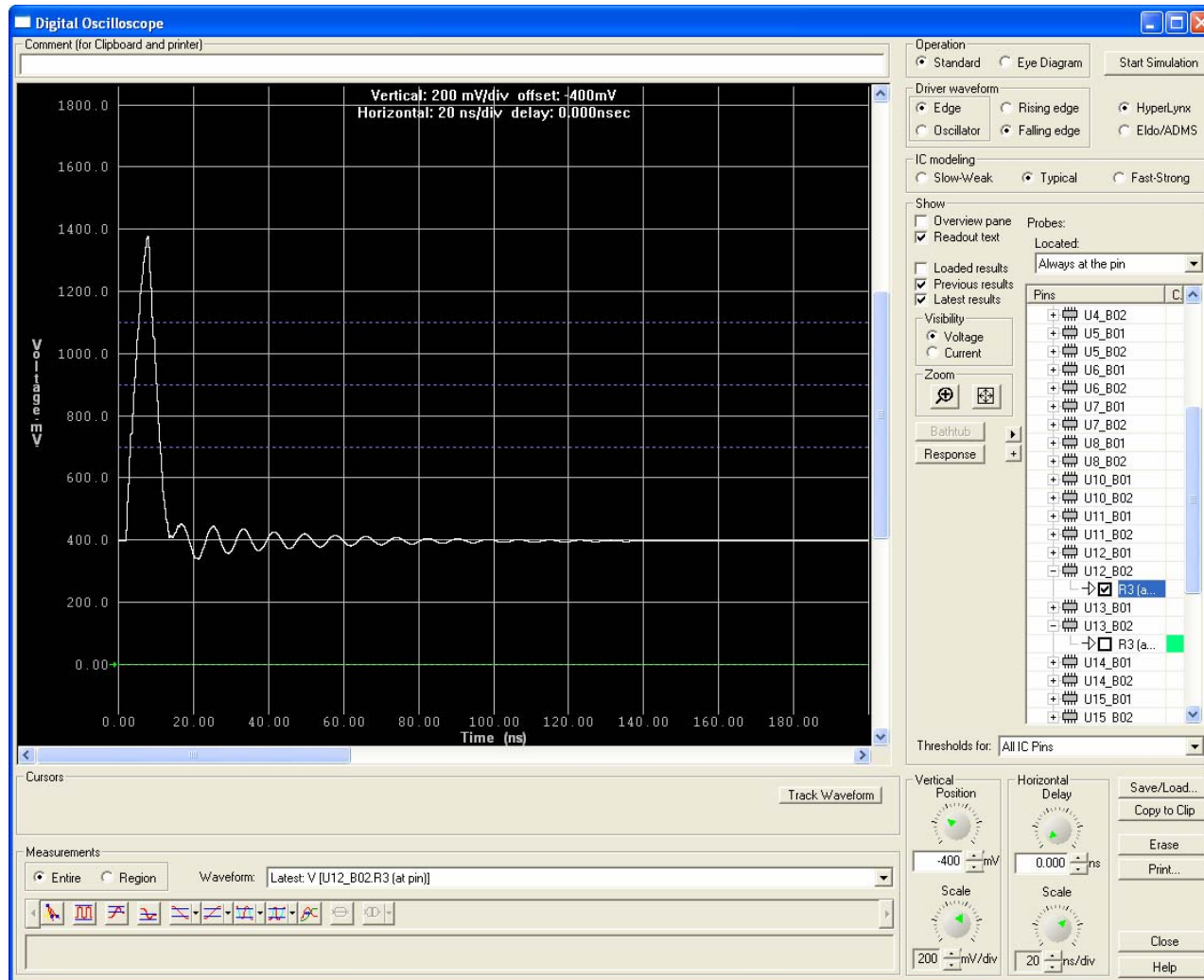
# Analysis Steps

1. **Extract DDR2 Address net from layout**
  - Example has motherboard, 2 DDR2 modules and connectors
2. **Measure pulse response of the net using standard circuit simulation**
  - IBIS 4.2 driver and receiver models
  - Simulating multiple pulses allows the degree of non-linearity to be determined
3. **Linear channel analysis**
  - Determine worst case bit sequence
  - Create eye diagram with linearized drivers and receivers
4. **Standard circuit simulation using worst case bit sequence**
  - Create eye diagram without linearization

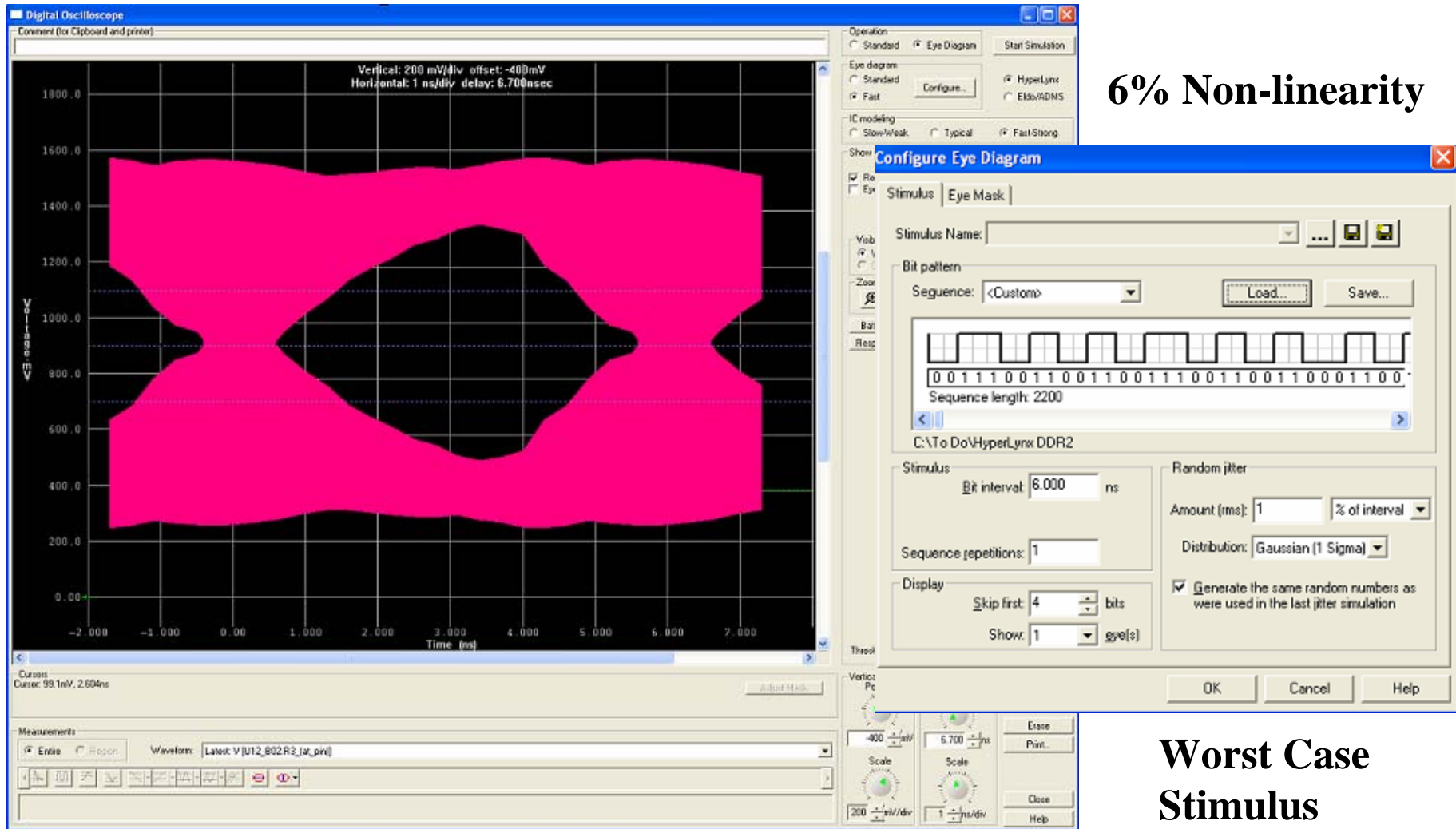
# 1. DDR2 address net extracted from layout



## 2. Full non-linear simulation to establish pulse response



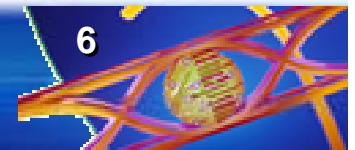
# 3. Linear Channel Analysis



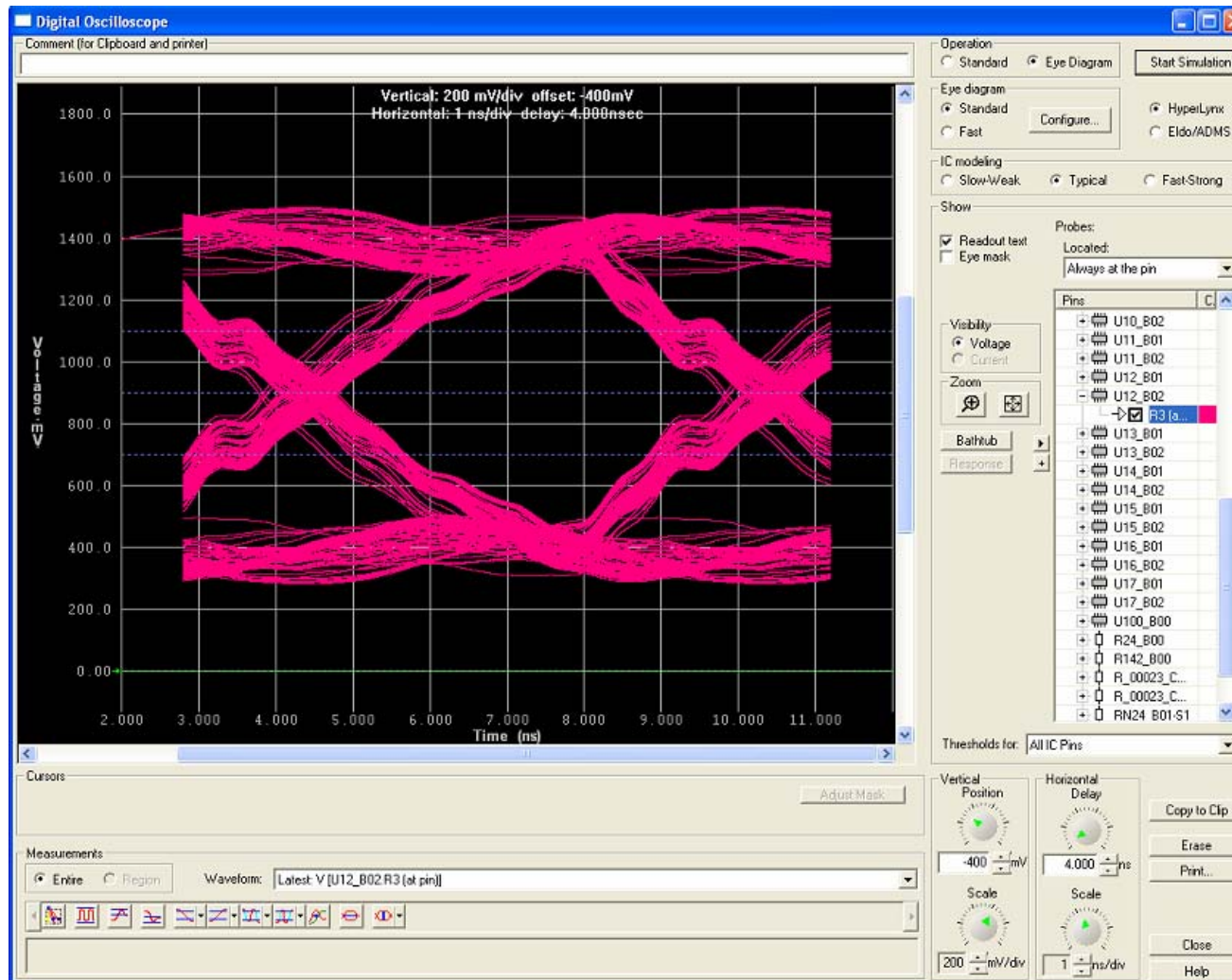
6% Non-linearity

Worst Case Stimulus

Eye Diagram



# 4. Full Non-linear simulation using Worst Case Stimulus



# Further Work

- This paper is based on the early results of this investigation into resonances on DDR2 buses
- We plan to further examine the detailed affects of channel layouts, connector characteristics and the optimization of compensation capacitors



The background is a vibrant blue with a complex pattern of white and light blue lines. These lines form various geometric shapes, including rectangles, circles, and spirals, reminiscent of a circuit board or a data visualization. The overall aesthetic is high-tech and digital.

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