Using IBIS-AMI Model for 25Gbps Retimer Simulation

Wei Maoxiang , YinChanggang , Zhu Shunlin

Wei.maoxiang@zte.com.cn, yin.changgang@zte.com.cn

Zhu.shunlin@zte.com.cn

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Agenda

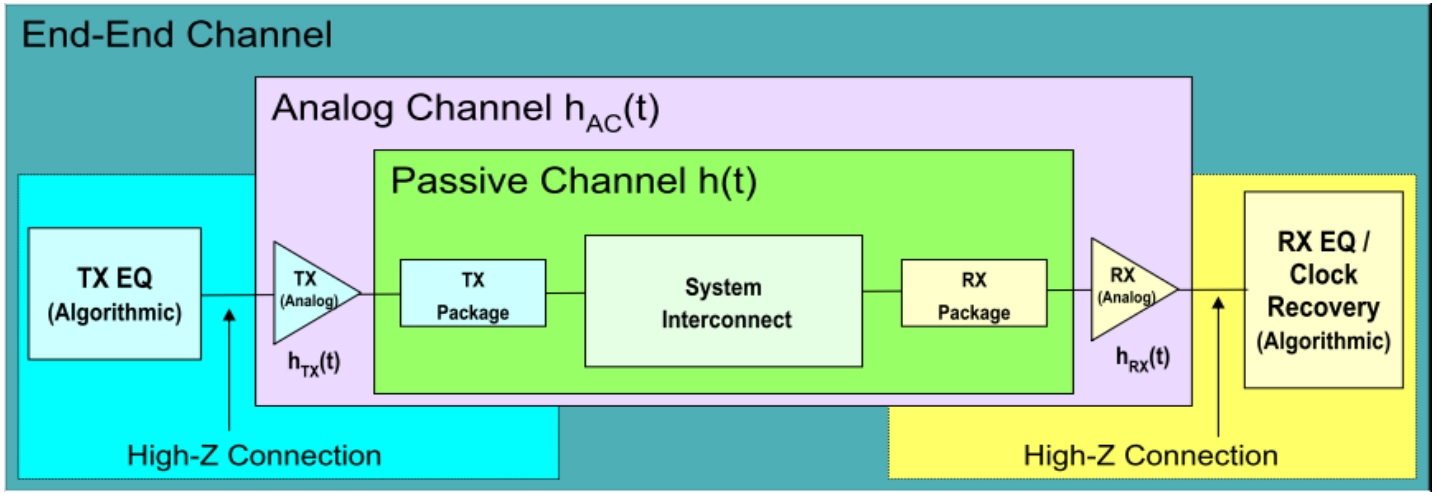
- Introduction to IBIS-AMI Model
- Repeater in SerDes System
- Lab Correlation for AMI Models
- The Application of Retimer in 25Gbps Channel
- Summary

Introduction to IBIS-AMI Model

- Accuracy simulation and fast run time
- IP Protection
- Supported by most EDA tools
- AMI model to provide adaptive DFE, CDR, jitter and other simulation

Introduction to IBIS-AMI Model

- Combination of analog & algorithmic elements
- Analog part can be considered linear and time-invariant
- Equalization and CDR can be modeled in the algorithmic part



Picture reference from "IBIS-AMI Terminology Overview" at DAC 2009 IBIS Summit

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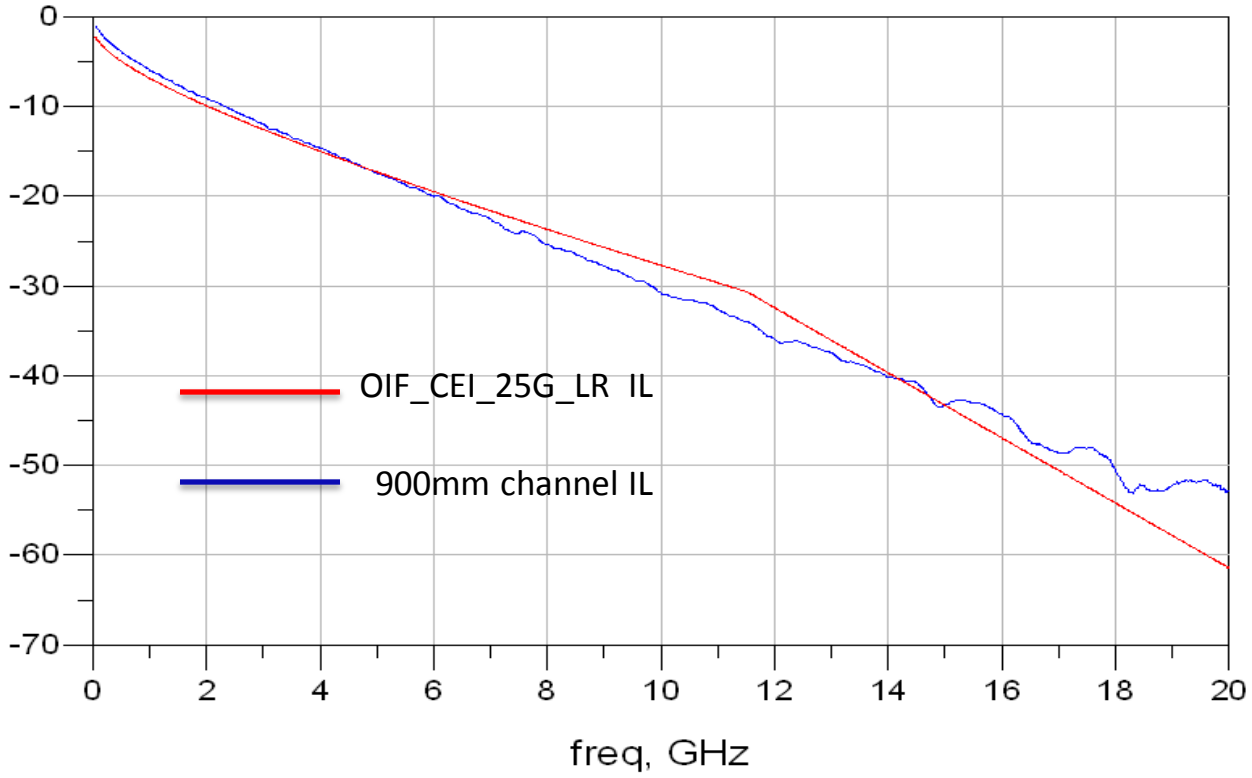
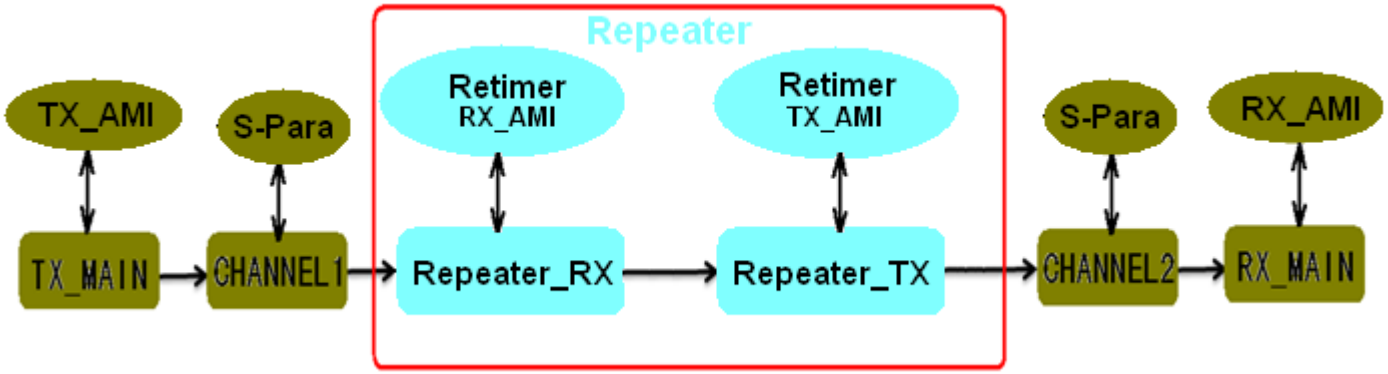
Repeater in SerDes System

- Insertion loss increase rapidly with data rate up to 25Gbps
- When system channel is above 30inches，the IL exceed the standard of OIF/IEEE



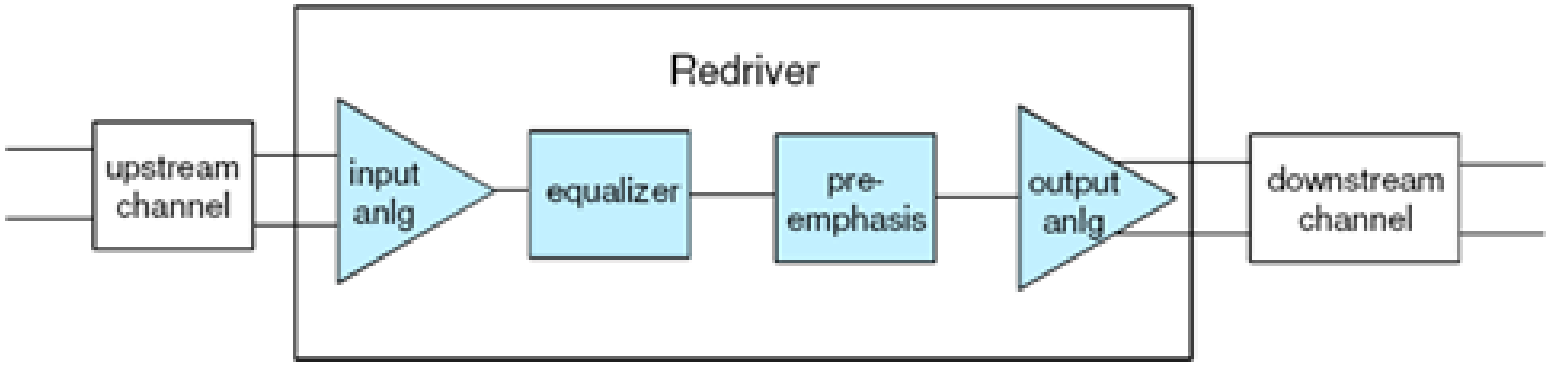
Repeater in SerDes System

- Full Channel Serdes System Including Repeater



Repeater Device1 — Redriver

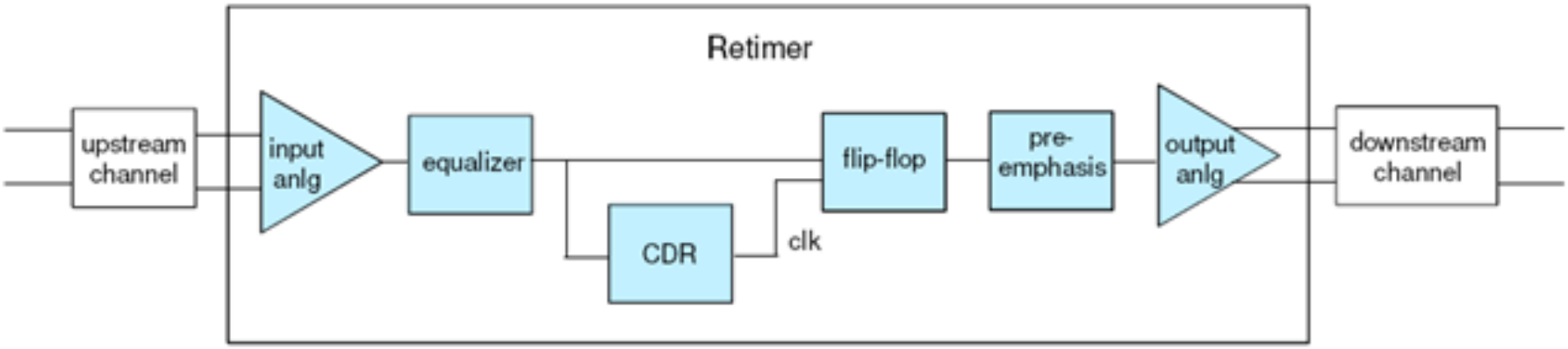
- Provide additional equalization pre-emphasis capability for high-speed transceiver system
- Recover data from the high loss and high reflection transmission medium



- Redriver output circuit is driven continuously by input signal
- No retiming is performed
- Application：10Gbase-KR, e.g.

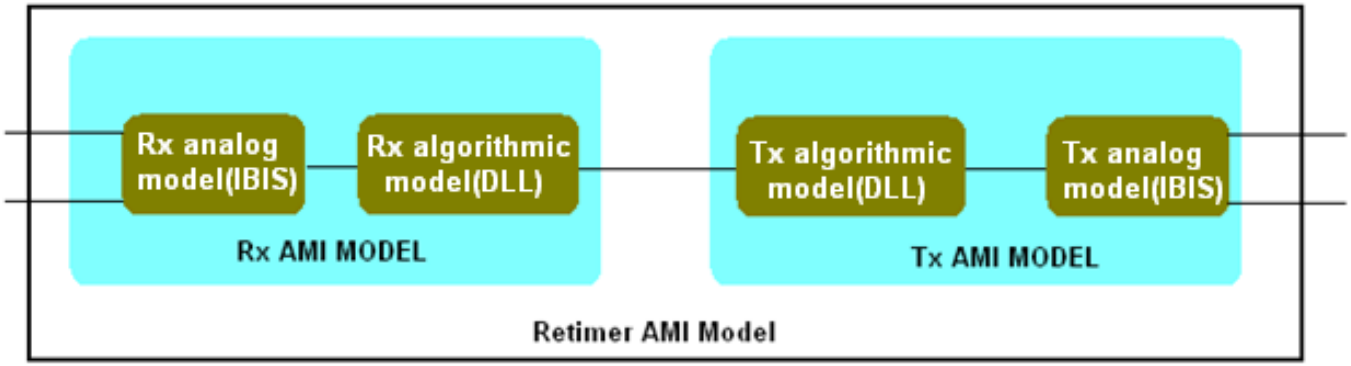
Repeater Device2 — Retimer

- CDR：Clock Data Recovery, recover the clock from the input data, triggers a limiter and driver to optimally equalize signal



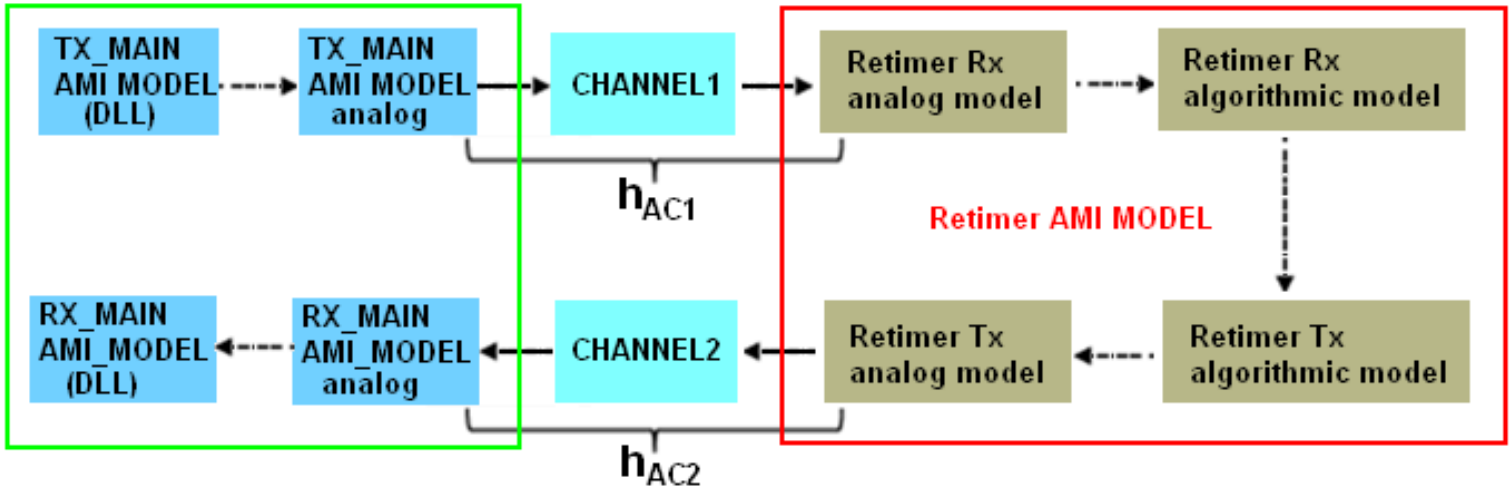
- Retimer output buffer is driven by switching events of flip-flop
- Digital data is recovered
- Jitter in clock is passed down to downstream channel
- Application：100Gbase-KR4, e.g.

Retimer AMI Model



- A retimer model includes two back-to-back AMI Rx and Tx models
- Rx and Tx analog model represents the device input termination and the output impedance respectively
- Rx and Tx algorithmic models represent equalization, CDR and pre-emphasis

Retimer AMI Simulation



- Tx_main analog model, channel1 and the retimer Rx analog model are linear and time-invariant, represented by combined impulse response, h_{AC1}
- The retimer Tx analog model, channel2 and Rx_main analog model are also linear and time-invariant, represented by combined impulse response, h_{AC2}
- Tx_main algorithmic model's output is convolved with h_{AC1} to produce the signal to retimer Rx algorithmic model
- The retimer Tx algorithmic model's output is convolved with h_{AC2} to produce the signal to the Rx_main algorithmic model

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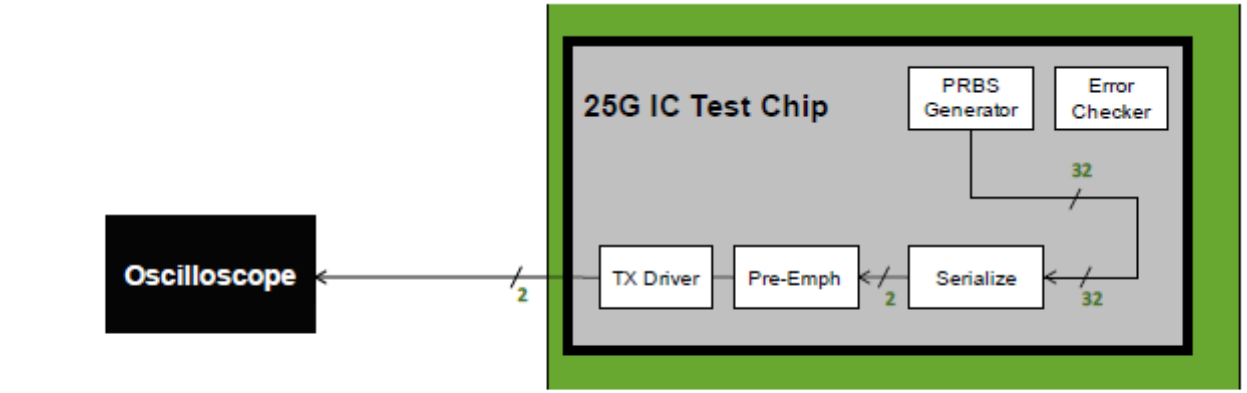
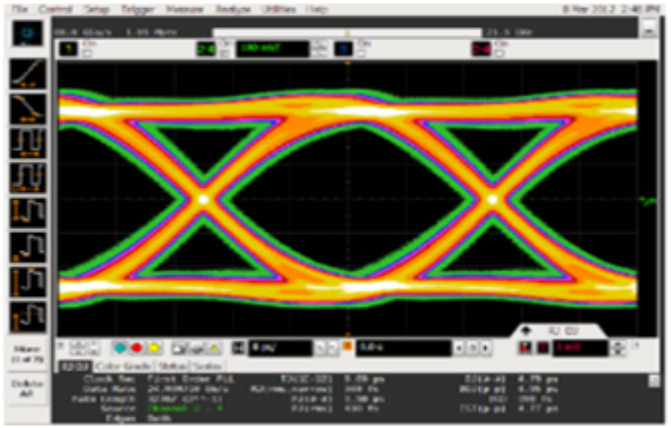
Lab Correlation for AMI Models

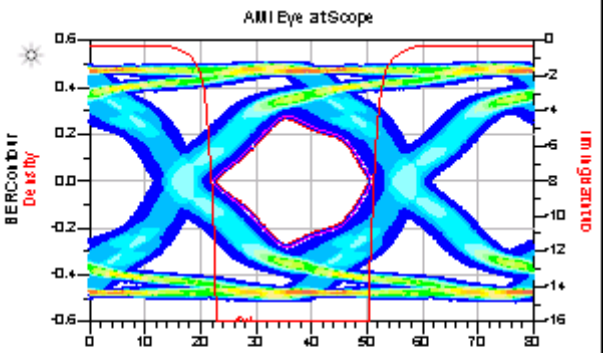
- Passive Simulation & measurement
  - Extracting S-Parameters using 2D/3D EM solver
  - Correlation based on VNA and TDR/TDT measurements
- Active Simulation
  - AMI simulation setup
  - Eye diagram analysis and design margin budget
- Correlate with laboratory measurements

Lab Correlation for AMI Models





Index	...le (JitterPP)	...kthAtBER)	...ghtAtBER)
0.000	9.203E-12	2.820E-11	0.549



	TJ	EYE_WIDTH	EYE_HEIGHT
SIM	0.23UI	28.2ps	549mV
MEAS	0.24UI	30.4ps	576mV

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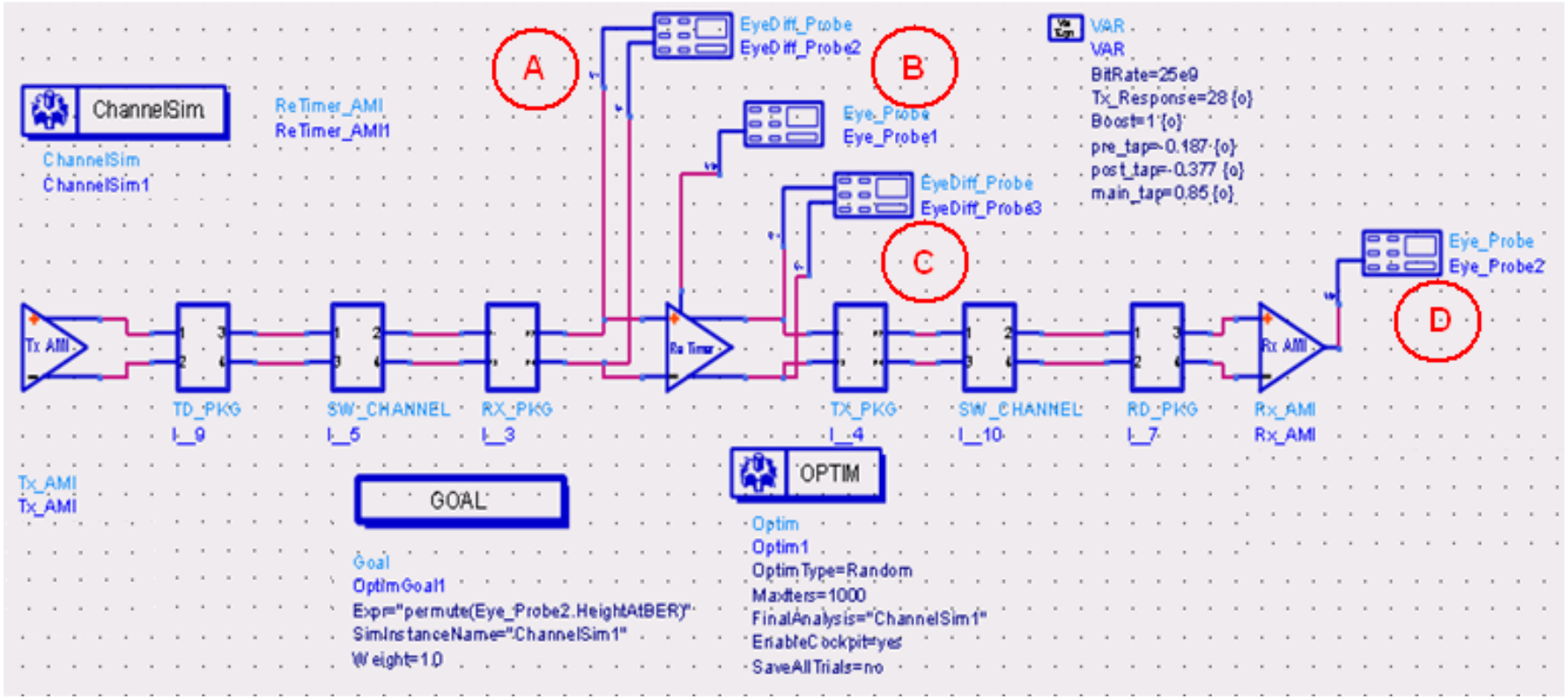
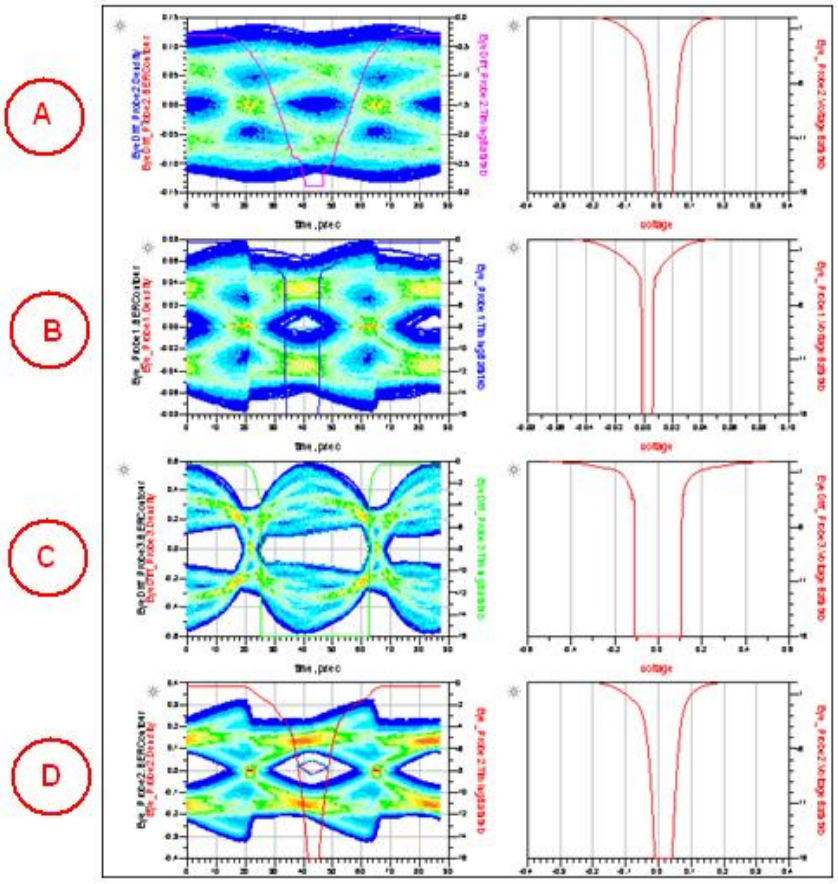
The Application of Retimer in 25Gbps Channel



The Application of Retimer in 25Gbps Channel



- Five Optimizing Variables
  - Broadcom Tx:
    - tap_filter_-1 (-0.187,0)
    - tap_filter_0 (0.6,1)
    - tap_filter_1 (-0.387,0)
  - Retimer
    - Tx_Response:(1-42)
    - Boost:(1-8)

- PRBS15 1Mbit 20-30 minutes

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Summary

- IBIS-AMI model can be used to provide adaptive DFE, CDR, jitter and other simulation
- Retimer is a good solution for long channels of high-speed SerDes system（>30 inches）
- As data rate increases, system design margin decreases; Need more accurate simulation model; AMI model accuracy need to be verified
- Retimer AMI model help us to estimate channel margin, pre-emphasis and equalization parameter in 25Gbps serial link simulation

Bringing you Closer

Thanks!