

The Application of IBIS-AMI Model Cascaded Simulation for 10 Gigabit Repeater Serial Link Analysis

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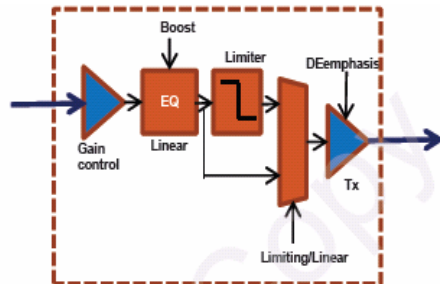


Agenda

- **Where repeaters might be applied**
- **The application of repeater in 10G channel**
- **Needs for repeater simulation**
- **Repeater topology**
- **IBIS-AMI data flow and APIs**
- **Test and simulation correlation**
- **How to select the repeater parameter**
- **Summary**

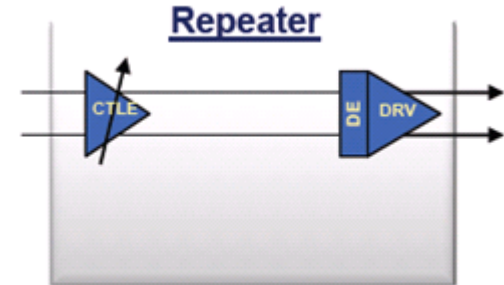
Where repeaters might be Applied

Linear Loss, ISI Jitter

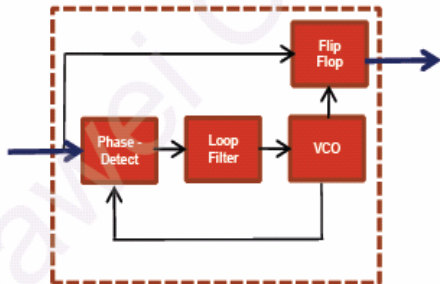


CTLE – Continuous Time Linear EQ

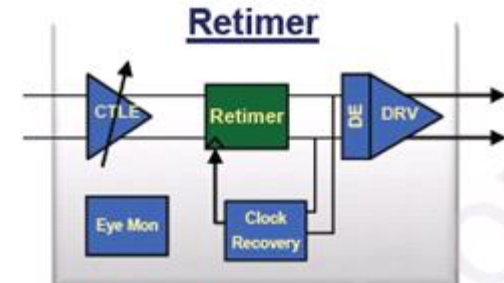
DE – Output Deemphasis



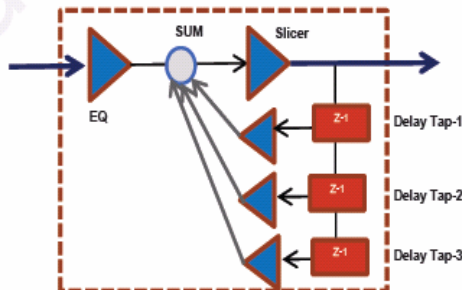
Jitter



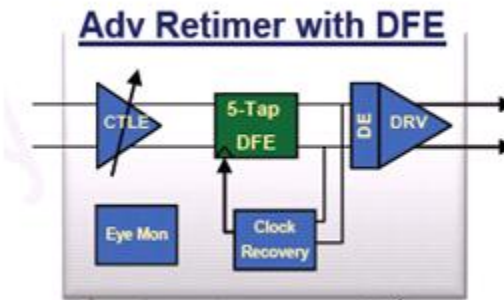
CDR – Clock and Data Recovery



Discontinuities, Crosstalk



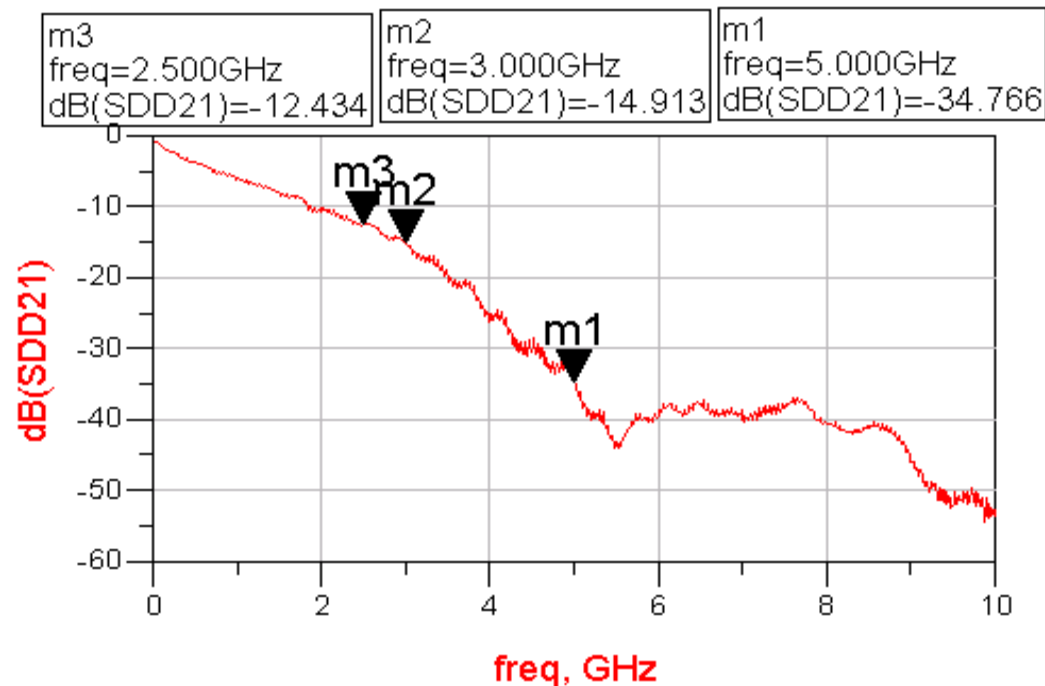
DFE – Decision Feedback Equalization



Note: All these devices are referred as "repeaters" in this presentation

The application of repeater in 10G channel

- Insertion loss increase with data rate up to 10G at the same channel
- Need repeater to enhance the transmission distance for 10G-SR SerDes IP



The application of repeater in 10G channel (cont.)

- SFF 8431 defines 10G SFP+ module electrical interface specification
- Hardly meet the channel spec. if FR4 trace is longer than 5 inch
- Repeater reduce ISI jitter to meet the eye mask requirement when trace length is longer than 5 inch

Table 25 SFI Host Interconnect Budget

Parameter	Symbol	Conditions	Min	Max	Units
Channel Transfer Including Connector measured with Host Compliance Board (see Appendix C)	SDD21	at 5.5 GHz, see 1	-6.5	-2.25	dB

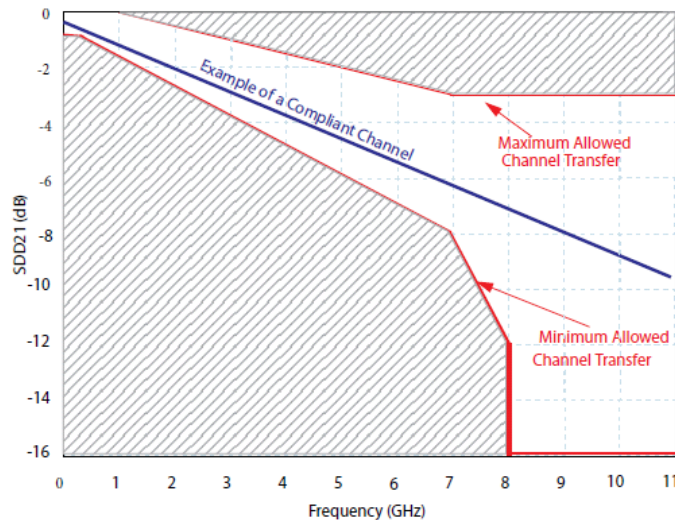


Figure 33 Example of SFI Recommended Channel

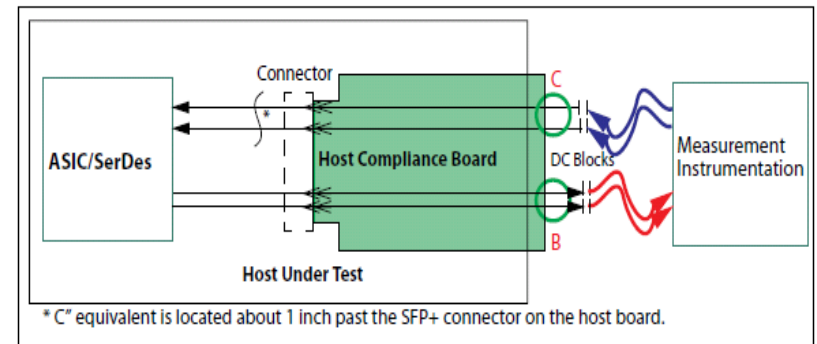


Figure 13 Host Compliance Board

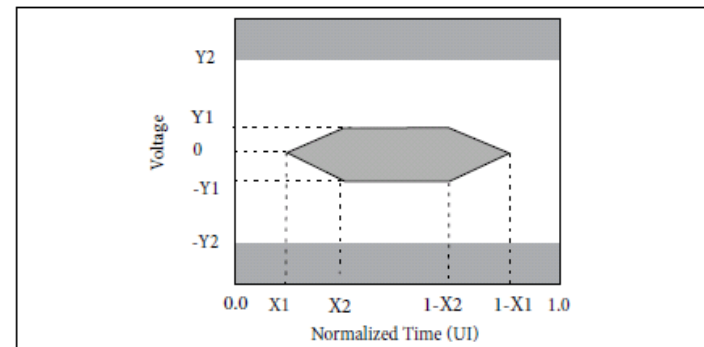
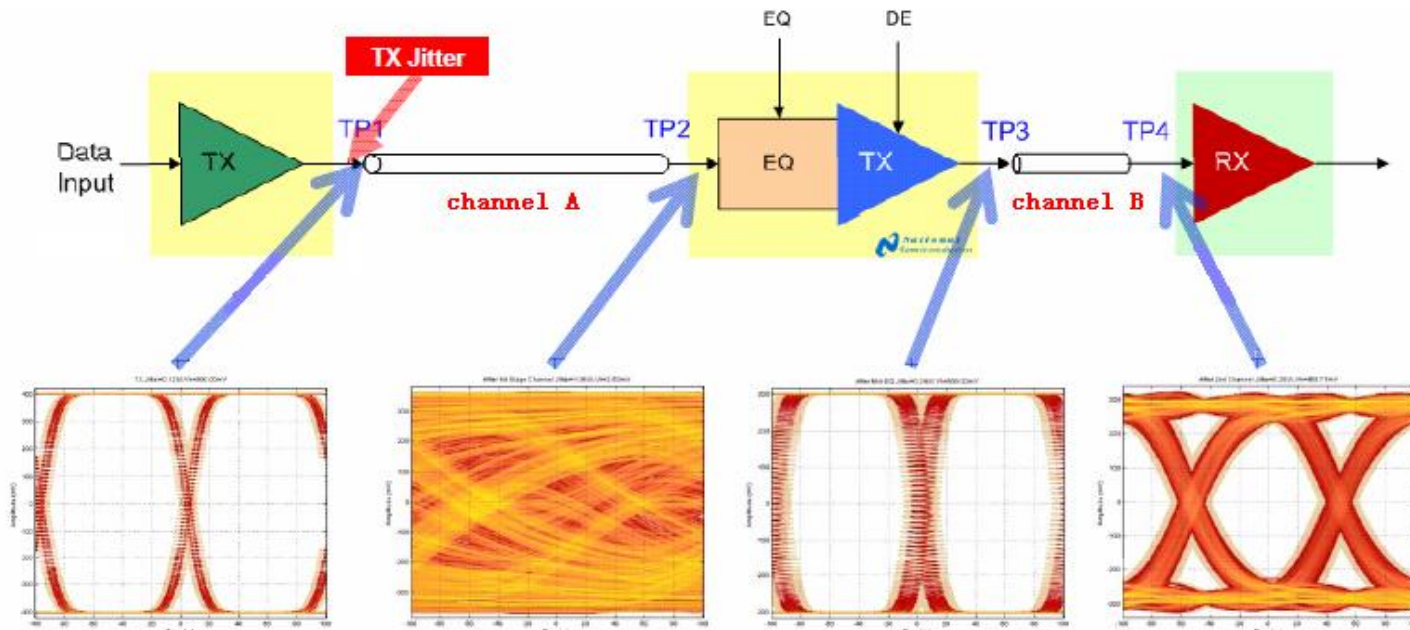


Figure 19 Transmitter Differential Output Compliance Mask at B and B'

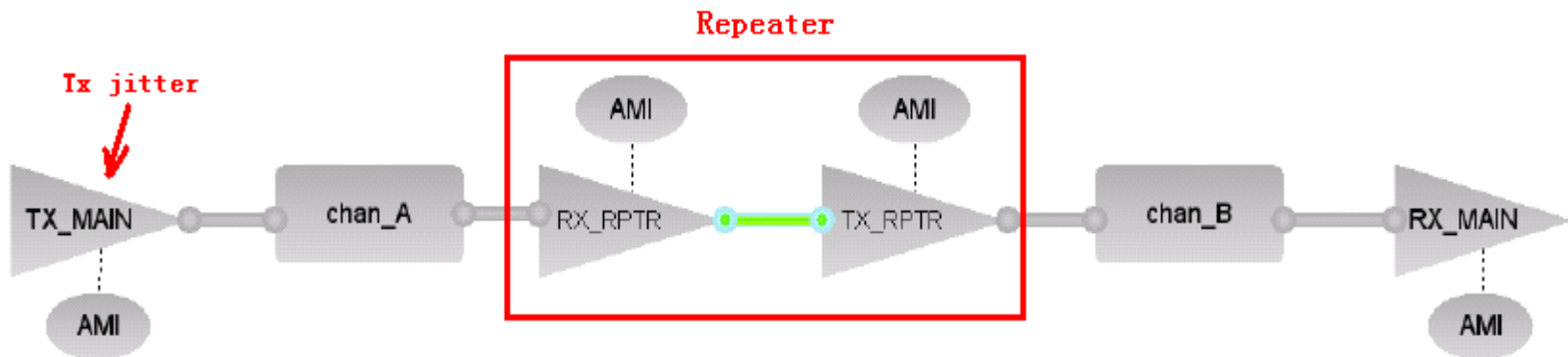
Needs for repeater simulation

- Industry high speed specification just for point to point application, not suitable for repeater channel
- Jitter transfer in the whole channel and need simulation to estimate
- Parameter setting and combination for the whole channel become more complicated. Simulation is a good assistance to select parameter

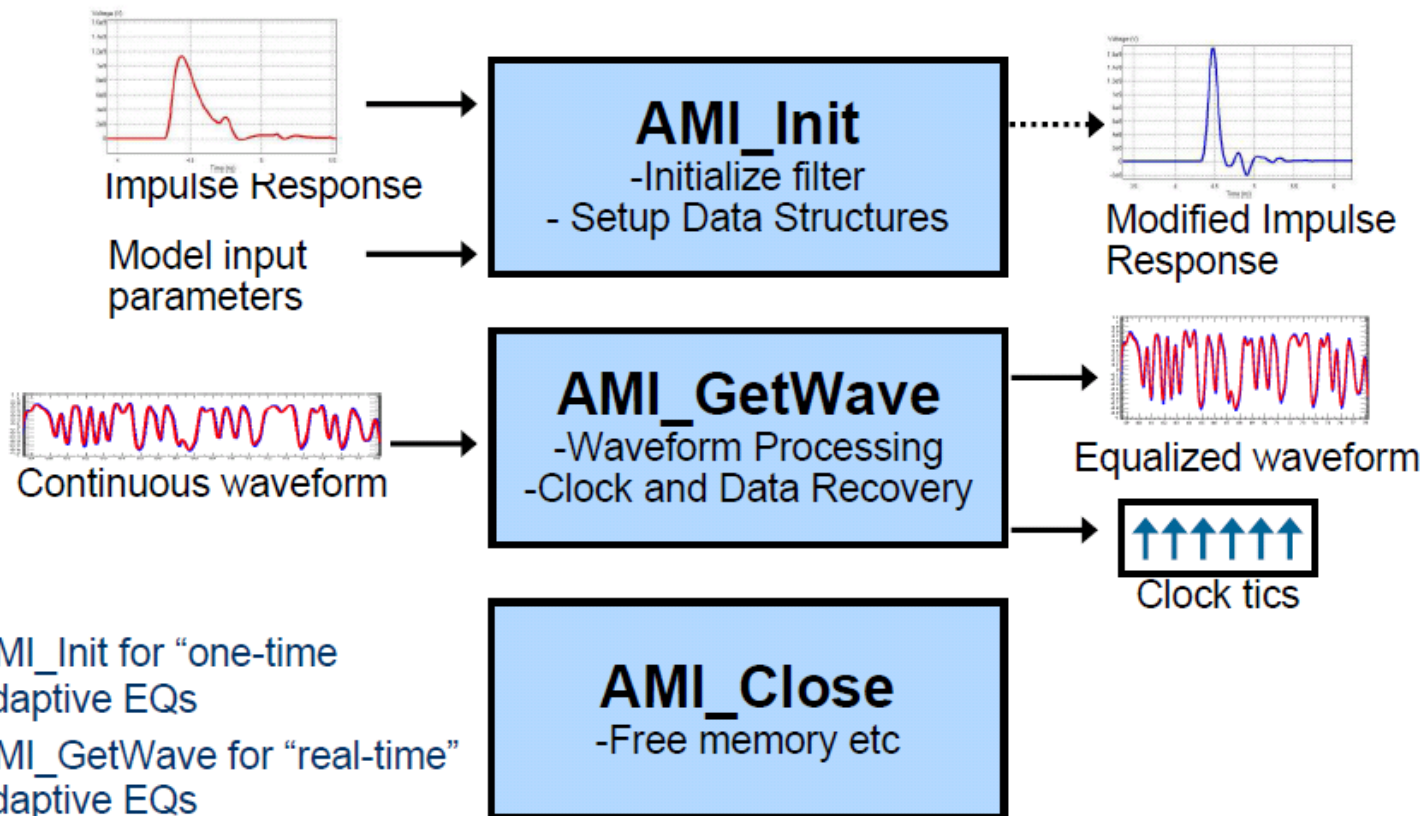


Repeater topology

- There's four IBIS-AMI model in the whole channel
- Model repeater by adding intermediate Rx and Tx models between channels "A" and "B"
- Need EDA tools to support cascaded "N" channels simulation together

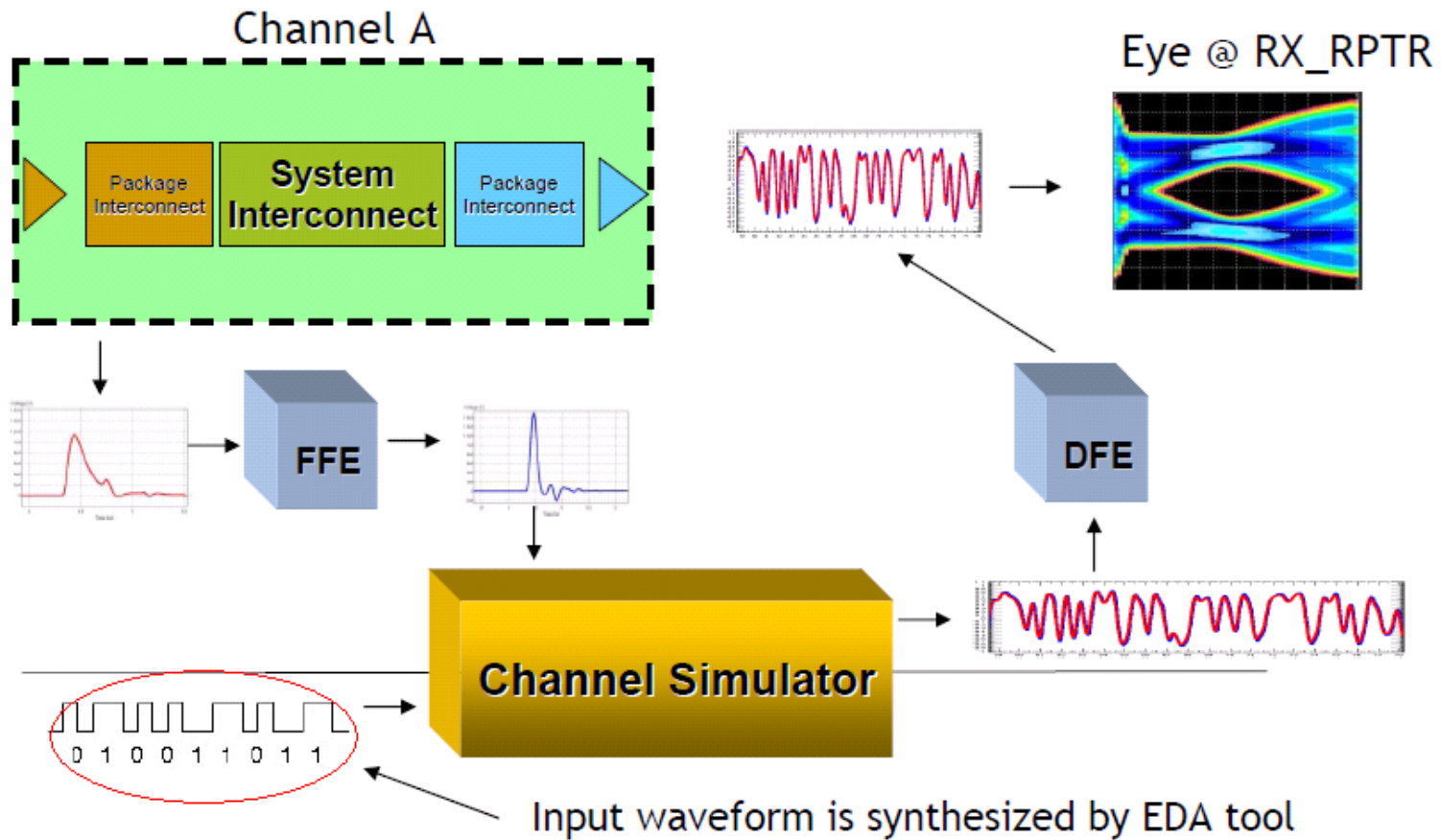


IBIS-AMI data flow and APIs

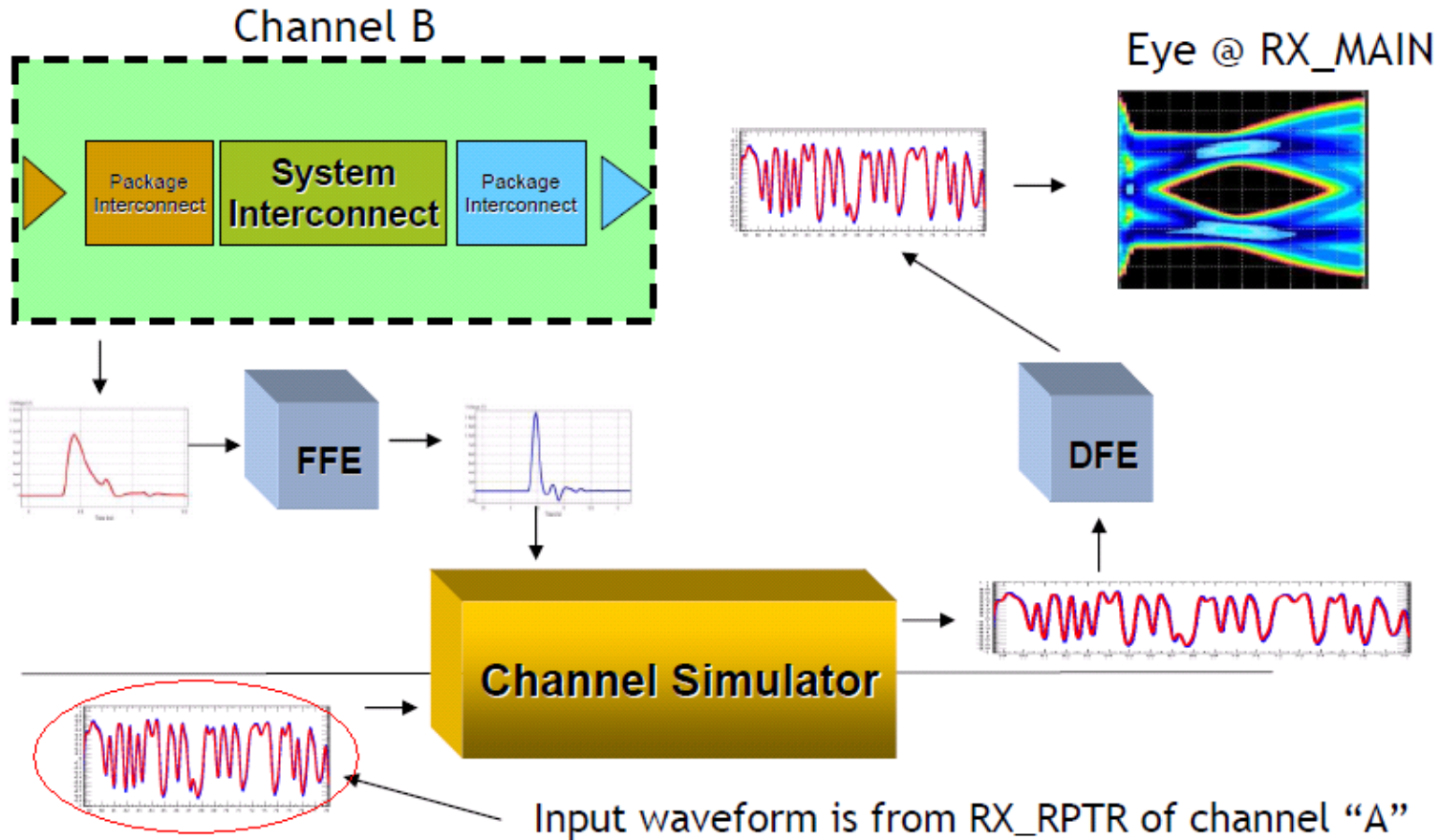


- AMI_Init for “one-time adaptive EQs
- AMI_GetWave for “real-time” adaptive EQs

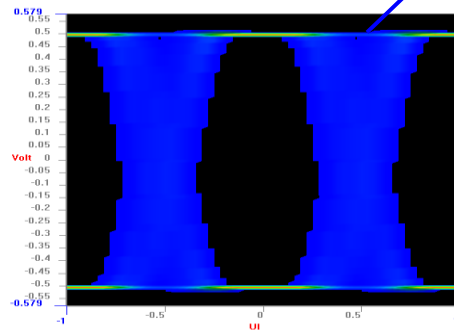
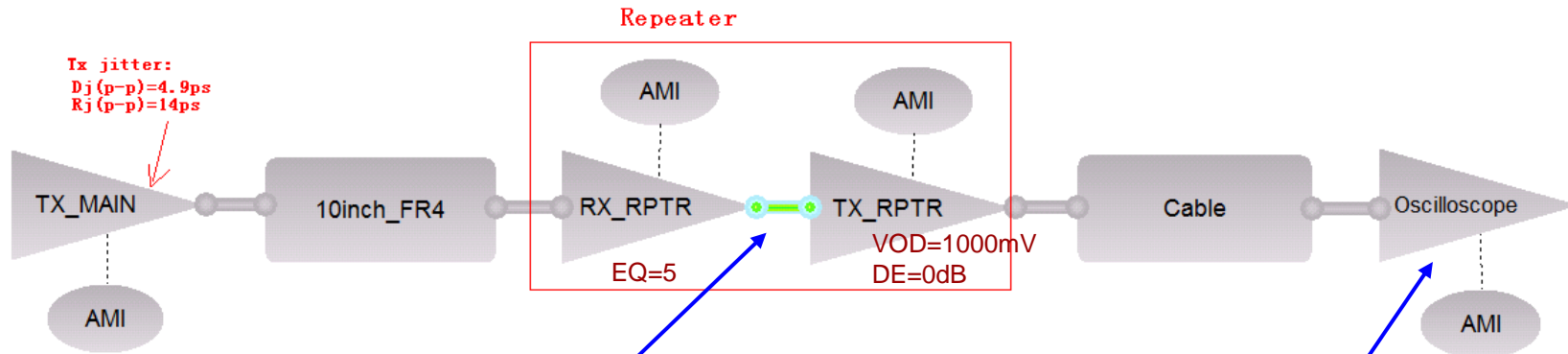
Channel "A" simulation



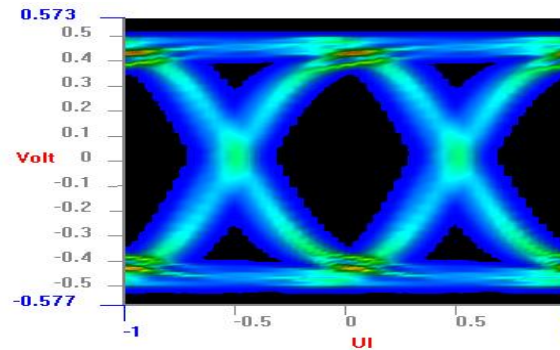
Channel "B" simulation



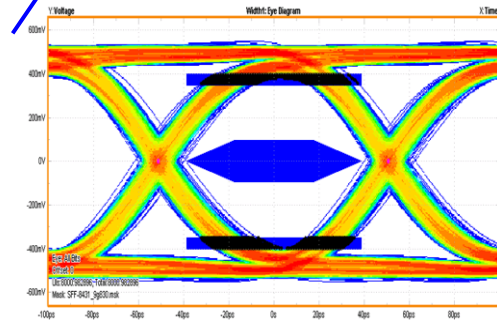
Test and simulation correlation



Eye diagram after EQ and limiter



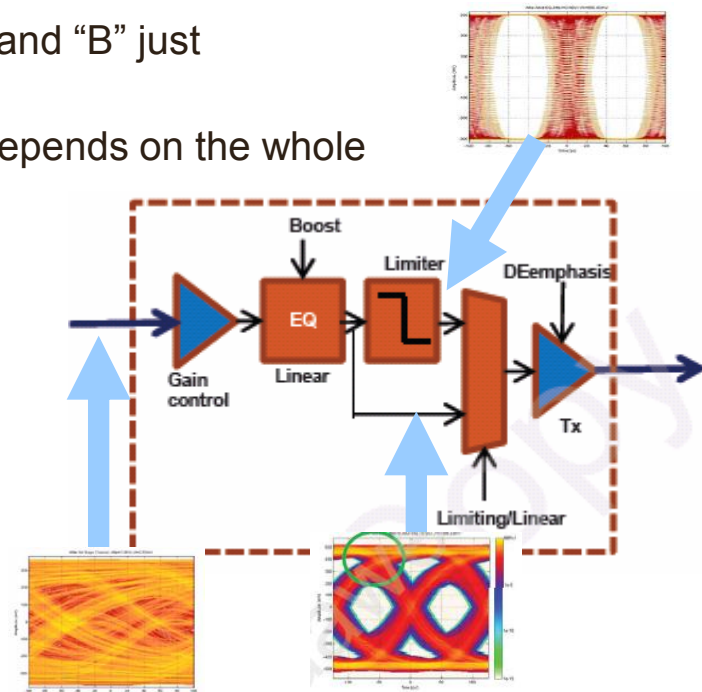
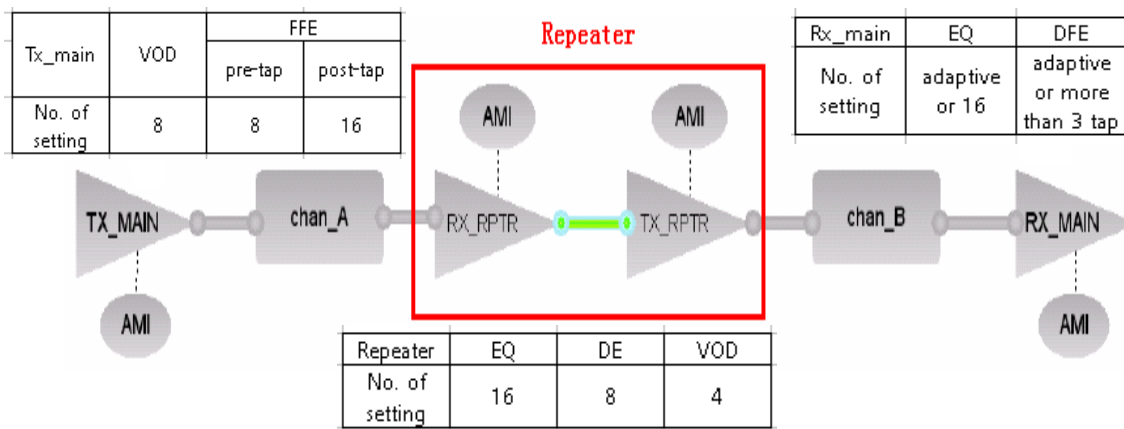
$T_j = 0.31UI$
 Height=696mV



$T_j = 0.33UI$
 Height=719mV

How to select repeater parameter

- Sweeping all parameter in simulation is still a time-consuming work for large number of combinations
- Methods need to simplify the combinations
- Retimer can be treated as an independent receiver
- **Repeater: limiting mode vs. non-limiting mode**
- Limiting mode cut the relationship between channel “A” and “B” just compensating for the loss of channel “A”
- Non-limiting mode still connect “A” and “B”, so setting depends on the whole channel loss budget



Summary

- **Repeater is a good solution for 10G over-spec. application**
- **Standard IBIS-AMI models can be used for modeling repeaters. No additional change in IBIS-AMI expression**
- **The IBIS-AMI models must contain all repeater functionally like EQ, linear/limiting, DE, VOD, DFE, CDR and so on. Accurate IBIS-AMI models are important for analysis results**
- **EDA tools can handle the cascading of multiple channels during simulation**
- **Knowledge about repeater help select parameters more efficiently. Simulation is a good assistance**

Thank you!