Snowbush IP
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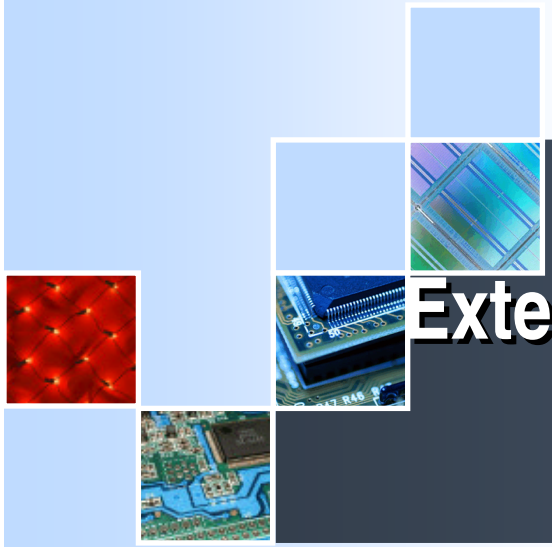

Extending IBIS-AMI to Support Back-Channel Communications

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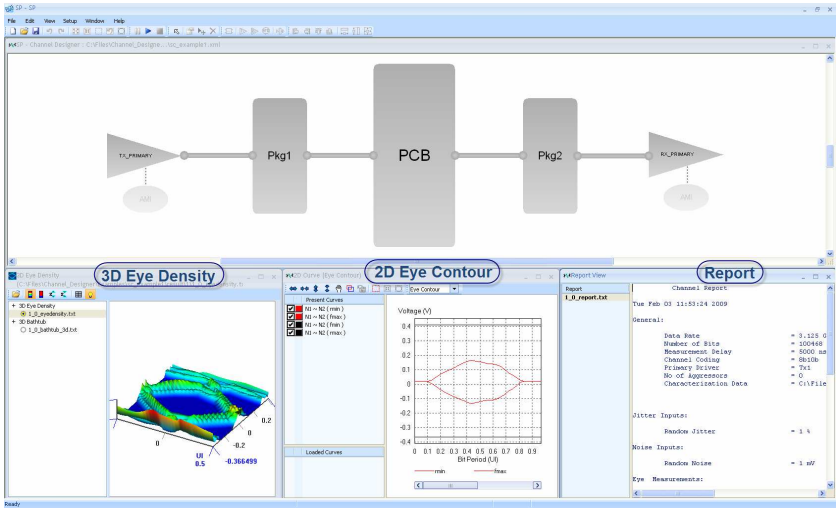
Agenda

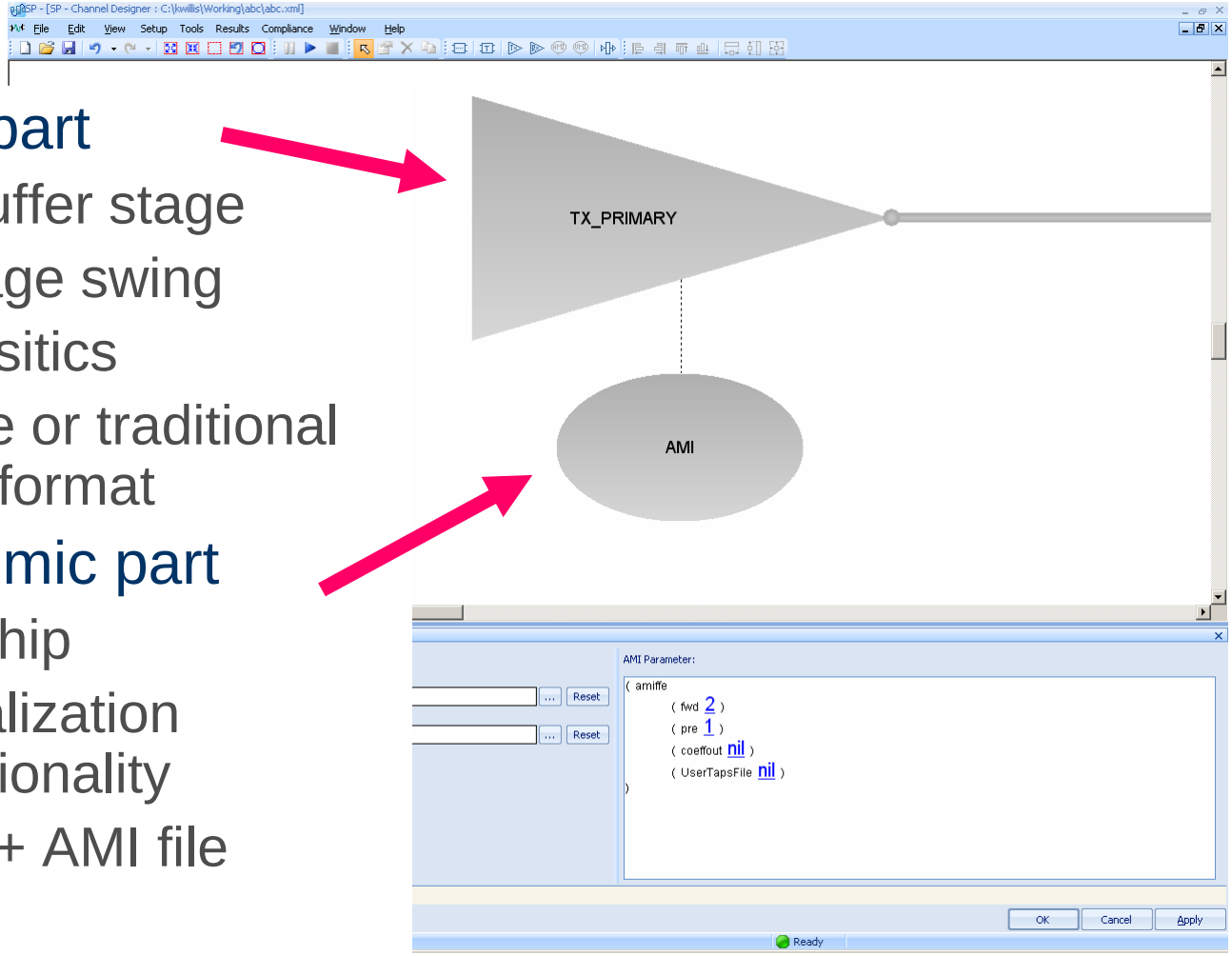
- IBIS-AMI overview
- What is back-channel communication?
- Q&A



IBIS-AMI Overview

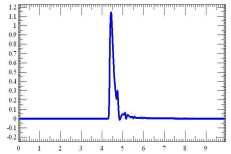
IBIS-AMI Model Sub-Components

- Circuit part
  - IO buffer stage
  - Voltage swing
  - Parasitics
  - Spice or traditional IBIS format
- Algorithmic part
  - On-chip
  - Equalization functionality
  - DLL + AMI file

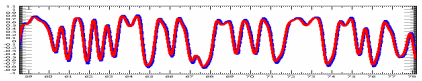


AMI Standard Interfaces Defined by IBIS

- AMI_Init



  - Takes in the impulse response of the channel
  - Algorithm in DLL decides how to best filter it
  - The modified impulse response is passed back to the tool
  - Typically used for “one-time” adaptive EQ



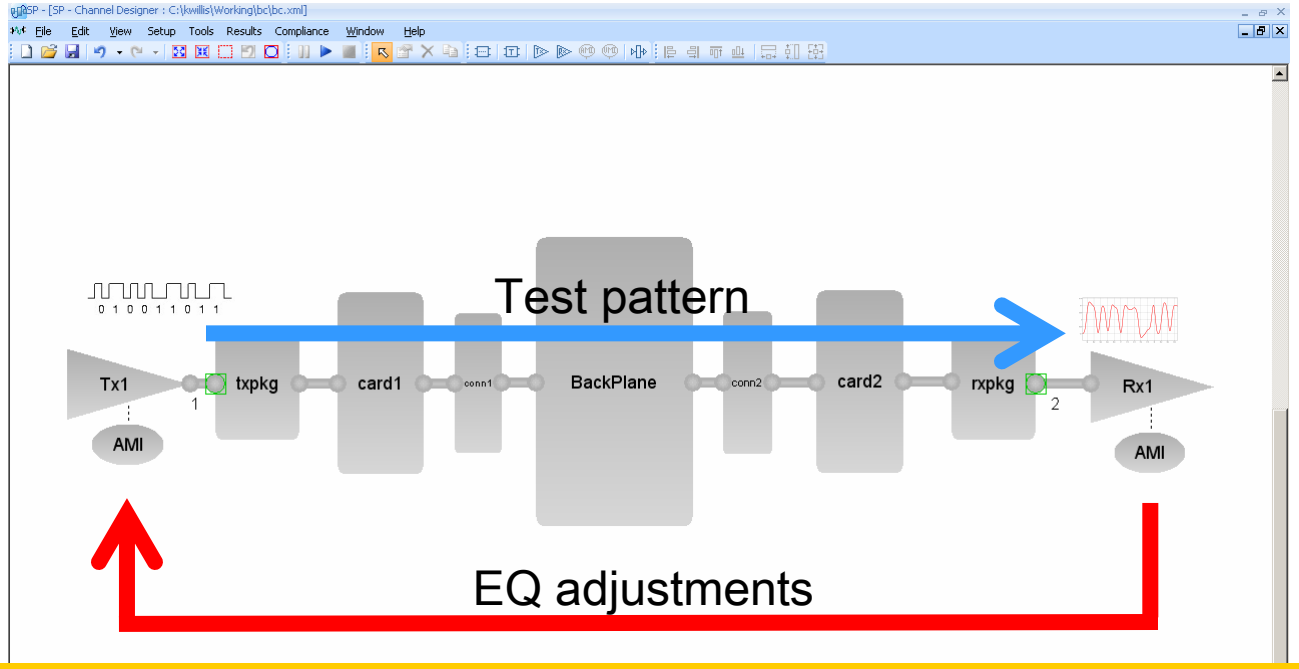
- AMI_GetWave
  - Takes in raw waveforms of the channel
  - Algorithm in DLL decides how to best filter it, “real time”
  - The modified waveform is passed back to the tool, along with the clock ticks (sampling information)
  - Typically used for “real-time” adaptive EQ

IBIS-AMI and Back-Channel Communications

- Back-channel communication is ***not*** currently supported by IBIS-AMI
- IBIS-AMI can be easily extended to support this capability
- This has been proven by Snowbush implementation for their PCI Express Gen. 3 IBIS-AMI model kit
  - See webinar at:
  - http://www.sigrity.com/company/events/2010webcast/Webcast2.htm

What is back-channel communication?

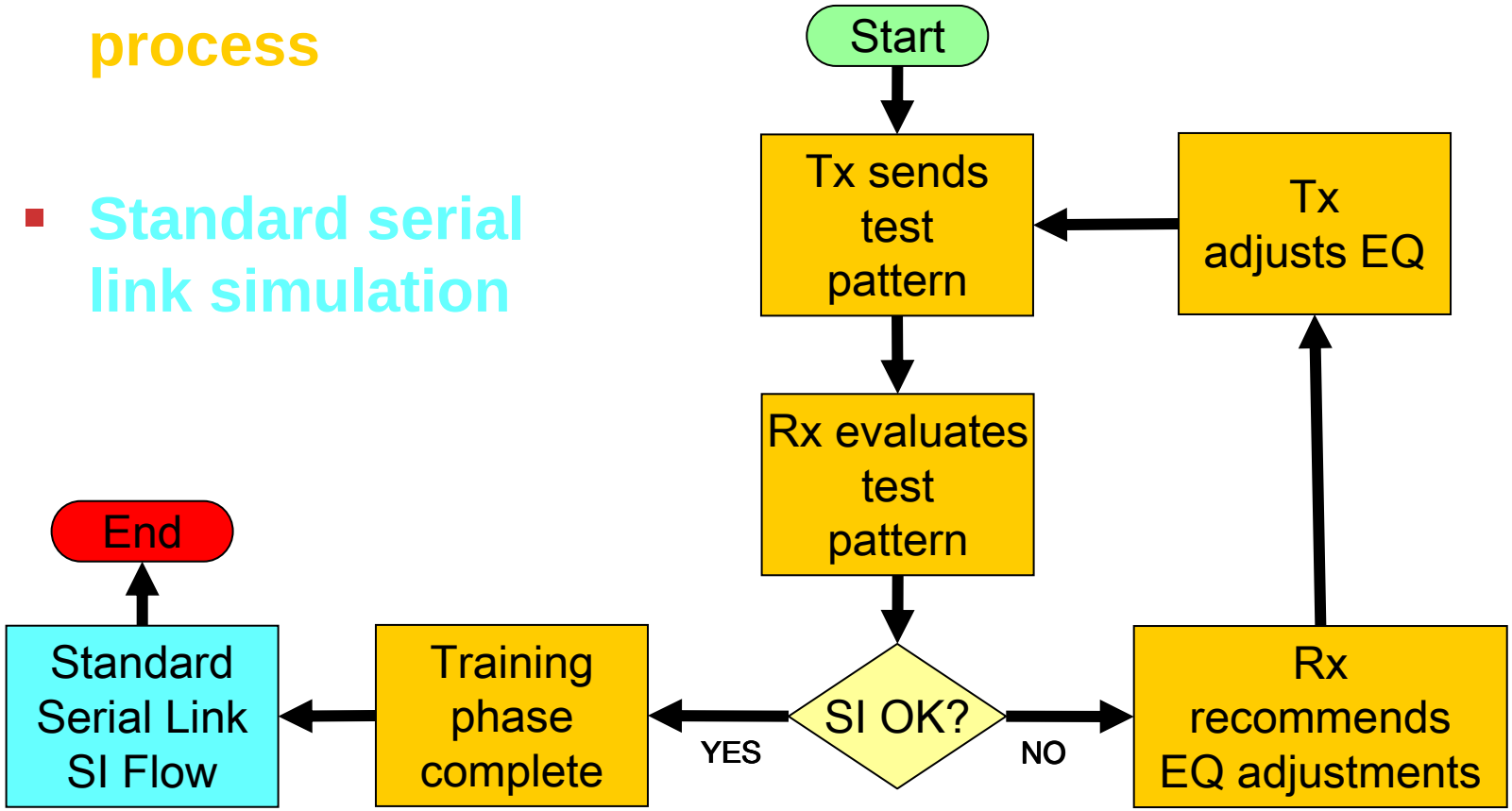
Back-Channel Definition



- Back-Channel: means by which a SerDes receiver (Rx) provides feedback to its SerDes transmitter (Tx) regarding how to optimize Tx equalization (EQ) settings for signal quality
- Typically achieved by the Tx sending a test pattern to the Rx

Typical Back-Channel Flow

- **Back-Channel process**
- **Standard serial link simulation**



Receiver vs. Transmitter EQ Adaptation

- EQ adaptation in the Receiver
  - Real time adaptation
  - Evaluation of raw waveforms at the Rx
  - Signal processing using CTLE and DFE
  - Standard IBIS-AMI functionality
- EQ adaptation in the Transmitter
  - Evaluation of raw waveforms still done at the Rx
  - Rx passes info to Tx on how to modify EQ settings through back-channel
  - ***Functionality above and beyond IBIS 5.0***

Back-Channel Support Overview

- Standard IBIS AMI_GetWave function extended to enable back-channel parameters to be passed between Tx and Rx AMI models
- Transmitter:
  - When initialized, AMI model reads in Increment/Decrement/Hold instructions from Rx for each of its tap coefficients
  - When closed, AMI_GetWave writes out the status of its coefficients
- Receiver:
  - When initialized, AMI model reads in the coefficient status info from Tx
  - When closed, AMI model writes out its coefficient Increment/Decrement/Hold request to Tx
- SystemSI_Channel Designer facilitates the communication between Tx and Rx AMI models
  - Back-channel communications enabled when both Tx and Rx AMI models specify the same file with the “Train” parameter

Back-Channel Details

- Training standards
  - Tx and Rx have to support same standards
    - E.g pcix3/ieee802_ap
- The standard file specifies (in .ami format):
  - What data streams Tx can send to Rx during training
  - How long the training can be
  - What constitutes success or failure for training
- Tx communicates to Rx the status of its coefficients:
  - They are adjustable OR
  - Reached the maximum limit (only can be “decremented”)
  - Reached the minimum limit (only can be “incremented”)
- Rx Communicates to the Tx
  - Increment/decrement/no change for each of the Tx coefficients
- Rx tells the EDA tool when training is done
  - Also tells whether training was success or failure

Tx->Rx and Rx->Tx Communication Enabled by EDA Tool

- Parameters “Train” and “TrainOn” are in both Tx and Rx
  - (Train (Type String) (List “pcix3.tme” “ieee803_ap.tme”))
    - Pcix3.tme , ieee803_ap.tme are standards-specific training files
    - In this case device supports multiple standards
  - “TrainOn” controls whether training mode is on or off
- EDA tool determines whether training is supported
- EDA tool uses parameters_out in AMI_GetWave to facilitate Tx->Rx and Rx->Tx communication
  - Takes parameters_out from Tx(Rx) and sends that address to Rx(Tx)
- Parameters_out has training-specific variable “tapincdec”

Tapincdec Structure

- From Tx
  - (<tap_id> -1|0|1)
    - -1 – has reached “low” limit
    - +1 – reached “high” limit
    - 0 – can be incremented/decremented
- From Rx
  - (<tap_id> -n|0|+m)
    - -n – decrement by ‘n’ units
    - 0 – do nothing
    - +m – increment by m units

Summary

- Advanced serial link standards utilize back-channel communication
  - PCI Express Gen. 3
  - 10GBASE-KR

- IBIS-AMI can be easily extended to support this
- Snowbush has introduced an IBIS-AMI model kit in which back-channel communication has been implemented
- Sigrity and Snowbush will introduce a BIRD to extend the IBIS-AMI standard with back-channel support

Q&A

Thank You!