New Reference Flow

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The IBIS 5.0 Original Flow has the side effect of not being able to handle Use_Init_Output correctly

The new Proposed Flow (Channel inserted after Tx AMI_GetWave instead of before Tx AMI_GetWave) allows us to simplify the AMI Reference Flow

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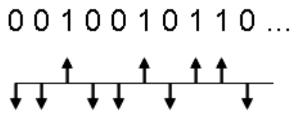
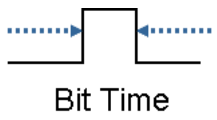
IBIS-AMI Terminology

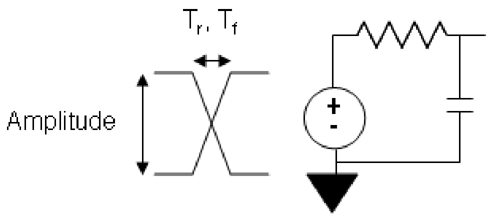
- Bit stream b(t)
  - Sum of delta functions



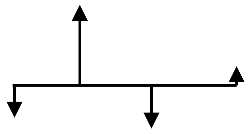
- Data symbol p(t)
  - Single bit width pulse



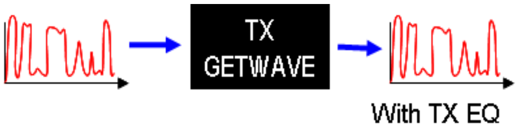
- TX analog characteristic $h_{TX}(t)$ *
  - Rise/fall time
  - Voltage swing
  - Drive impedance
  - Capacitance



- TX “Init” equalization $h_{TEI}(t)$ *
  - Sum of weighted delta functions
    - Coefficients & delays

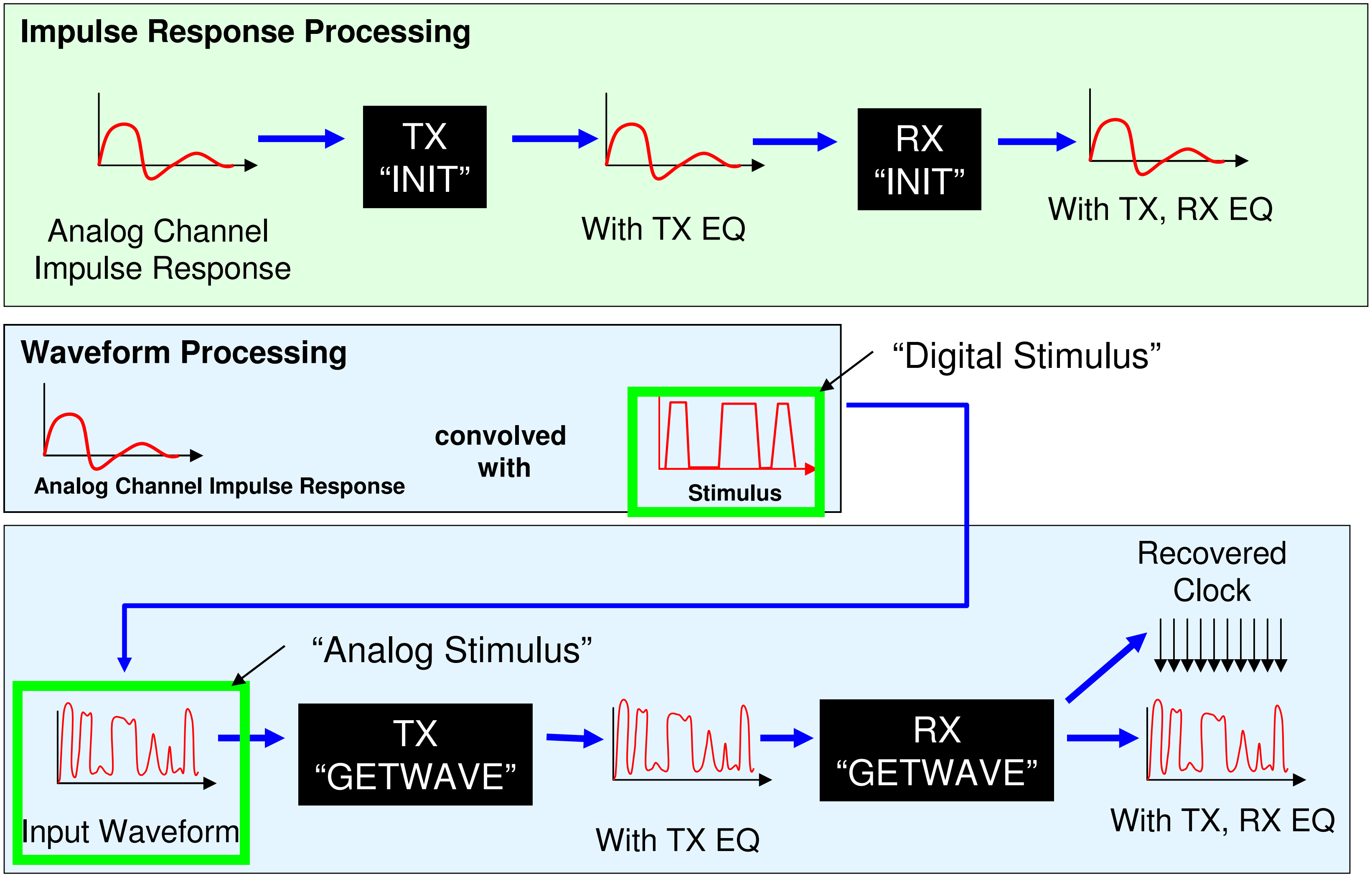


- TX “Getwave” equalization $g_{TEQ}()$ *
  - Not considered LTI
  - Waveform in, waveform out



IBIS_Summit_2009_DAC_IBIS_AMI_Terminology.pdf

IBIS-AMI Tx GetWave Flow



Impulse Response Processing

Analog Channel Impulse Response

TX "INIT"

With TX EQ

RX "INIT"

With TX, RX EQ

Waveform Processing

Analog Channel Impulse Response

convolved with

Stimulus

"Digital Stimulus"

"Analog Stimulus"

Input Waveform

TX "GETWAVE"

With TX EQ

RX "GETWAVE"

Recovered Clock

With TX, RX EQ

IBIS_Summit_2009_DAC_IBIS_AMI_Terminology.pdf

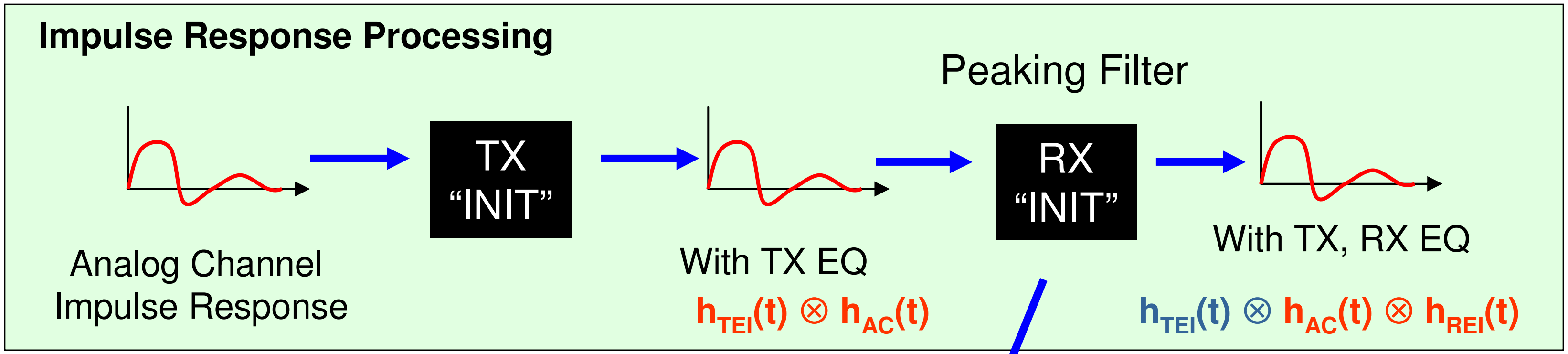
How IBIS 5.0 describes Use_Init_Output

“Use_Init_Output is of usage Info and type Boolean. When Use_Init_Output is set to "True", the EDA tool is instructed to use the output impulse response from the AMI_Init function when creating the input waveform presented to the AMI_Getwave function.”

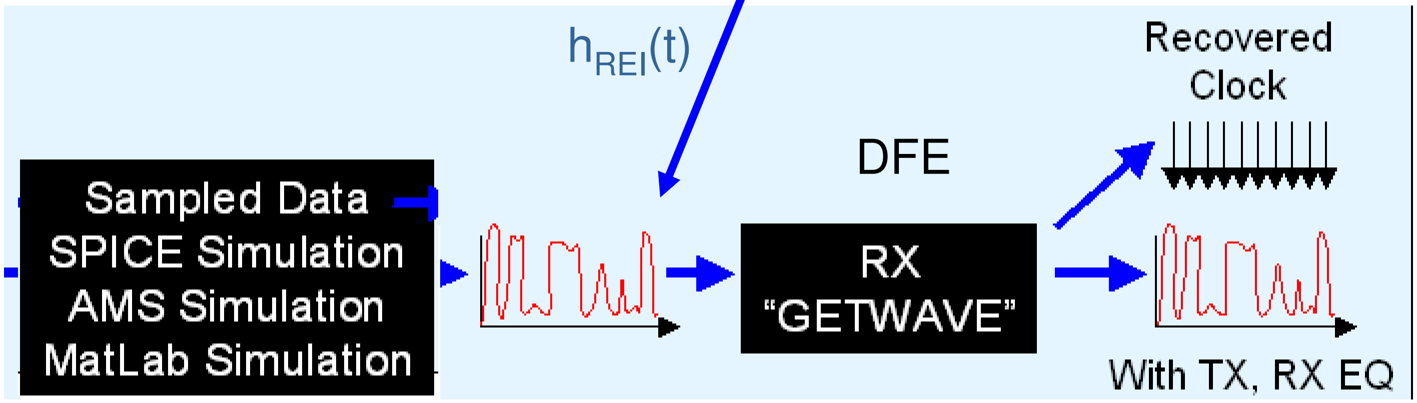
There is good reason for Rx Use_Init_Output True

IC Vendors use different tools to develop Rx Peaking Filters, and DFE Equalization Circuits. It is convenient for them to wrap the Peaking Filter model into an Impulse Response in Rx Init, and wrap the DFE and Clock Recovery model into Rx GetWave. There is every reason that we should support this flow.

IBIS-AMI Rx GetWave Flow


Impulse Response Processing
Peaking Filter
TX "INIT"
RX "INIT"
Analog Channel Impulse Response
With TX EQ
$h_{TEI}(t) \otimes h_{AC}(t)$
With TX, RX EQ
$h_{TEI}(t) \otimes h_{AC}(t) \otimes h_{REI}(t)$

How does one add Rx INIT?



Includes p(t) b(t) $h_{TEI}(t)$ $h_{AC}(t)$

Why Init should return just equalization of buffer

Problem is when using sampled or simulated data that already includes the losses incurred from the channel.

In order to not double count the channel loss, the impulse response of the Rx filter must be calculated from the input to Rx Init and the output of Rx Init.

The simulated waveform at the Rx Pad includes the Tx Equalization and the channel is $g_{TEG}(\mathbf{x(t)}) \otimes \mathbf{h_{AC}(t)}$. The waveform at the Rx decision point is $(g_{TEG}(\mathbf{x(t)}) \otimes \mathbf{h_{AC}(t)}) \otimes \mathbf{h_{REI}(t)}$. The output of Rx Init is $\mathbf{h_{TEI}(t)} \otimes \mathbf{h_{AC}(t)}) \otimes \mathbf{h_{REI}(t)}$. In the current flow the EDA tools needs to extract $\mathbf{h_{REI}(t)}$ from $\mathbf{h_{TEI}(t)} \otimes \mathbf{h_{AC}(t)}) \otimes \mathbf{h_{REI}(t)}$.

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Init should return Impulse Response of equalization

IC vendors developing AMI models think it is unnecessary for them to convolve the impulse response of the filter with the impulse response of the channel to output a modified impulse response.

It is also good numerical practice to return just the filter impulse response

What about Tx When GetWave Exists and Init_Returns_Impulse is True?

Example: An N-Tap FIR filter that is LTI with no DCD and non LTI with DCD.

- •Rx Init input should be Tx_Init output that includes Tx Filter combined with Channel (independent of Use_Init_Output).
- •Rx_GetWave should be the output of Tx_GetWave combined with Channel
- •Current Flow does not support this

Example: Model that has a non-LTI component and an LTI component.

- •Rx Init input should be the Tx_Init output that includes Tx LTI Filter combined with Channel (independent of Use_Init_Output).
- •Rx_GetWave should be output of Tx_GetWave combined with Channel, and with Tx LTI Filter if Use_Init_Output is True.
- •Current Flow does not support this

New Reserved Parameter Init_Returns_Filter

This parameter is optional, and defaults to False.

(Init_Returns_Filter (Type Boolean) (Usage In) (Format List True False) (Description “If True then Init returns impulse response of filter”)

Flows below in Red require EDA tool to determine filter impulse response.

Proposed Reference Flow
Tx and Rx AMI_GetWave Exist

- **Input to TX AMI_Init**
  - $h_{AC}(t)$
- **Output of TX AMI_Init**
  - $h_{TEI}(t)$
- **Input to RX AMI_Init**
  - $h_{TEI}(t) \otimes h_{AC}(t)$
- **Output of RX AMI_Init**
  - $h_{REI}(t)$
- **Input to Tx AMI_GetWave**
  - $x(t)$
- **Output of Tx AMI_GetWave**
  - $g_{TEG}(x(t))$
- **Input to Rx AMI_GetWave (if both Tx and Rx Use_Init_Output True)**
  - $g_{TEG}(x(t)) \otimes h_{AC}(t)$
  - $\otimes\, h_{TEI}(t)$ **if Tx Use_Init_Output True**
  - $\otimes\, h_{REI}(t)$ **if Rx Use_Init_Output True**
- **Output of Rx AMI_GetWave**
  - **Waveform at Rx Decision Point**