**BUFFER ISSUE RESOLUTION DOCUMENT (BIRD)**

**BIRD ID#: 155.2**

**ISSUE TITLE:** *New AMI API to Resolve Dependent Model Parameter*

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**ANALYSIS PATH/DATA THAT LED TO SPECIFICATION:**

AMI model parameters that are used by EDA tools can depend on other model parameters and simulation parameters including data rate, IBIS corner and IBIS model name. The form of such dependency relation varies from IC vendor to IC vendor and from device to device. The number of possible variations among vendors and devices is infinite. Model vendors need a flexible mechanism to implement parameter dependency according to their proprietary formula and pass the dependent parameter values to EDA tools. It’s foreseeable that certain vendors need to conceal the dependency formula.

The proposed approach does not require any ad hoc syntax or rule to be added for new dependency forms. The same executable model can resolve dependent parameters for different IBIS models according to the new reserved parameter Model\_Name. The API is a sensible partition between EDA tool and model, allowing model vendors to have full control on dependency definition as well as implementation.

Two new functions are added to the AMI API, and two new reserved parameters are introduced.

In Section 10.2.1, replace

“The executable model file of a Serializer-Deserializer (SERDES) transmitter or receiver contains up to three functions: “AMI\_Init”, “AMI\_GetWave” and “AMI\_Close”.”

with

“The executable model file of a Serializer-Deserializer (SERDES) transmitter or receiver contains up to five functions: “AMI\_Resolve”, “AMI\_Resolve\_Close”, “AMI\_Init”, “AMI\_GetWave” and “AMI\_Close”.”

Replace

“These functions (AMI\_Init, AMI\_GetWave and AMI\_Close)”

with

“These functions (AMI\_Resolve, AMI\_Resolve\_Close, AMI\_Init, AMI\_GetWave and AMI\_Close)”

Replace

“The three functions can be included in the executable model file in one of the following two combinations:

Case 1: Executable model file has AMI\_Init, AMI\_GetWave and AMI\_Close.

Case 2: Executable model file has AMI\_Init and AMI\_Close.”

with

“The five functions can be included in the executable model file in one of the following four combinations:

Case 1: Executable model file has AMI\_Init, AMI\_GetWave and AMI\_Close.

Case 2: Executable model file has AMI\_Init and AMI\_Close.

Case 3: Executable model file has AMI\_Resolve, AMI\_Resolve\_Close, AMI\_Init, AMI\_GetWave and AMI\_Close.

Case 4: Executable model file has AMI\_Resolve, AMI\_Resolve\_Close, AMI\_Init and AMI\_Close.”

In Section 10.2.3 add:

*Function:* **AMI\_Resolve**

*Required:* No

*Declaration:* AMI\_Resolve (double bit\_time,

 char \* AMI\_parameters\_in,

 char \*\* AMI\_parameters\_out);

*Arguments:*

**bit\_time**

Input argument, in second, equals 1/data rate.

**AMI\_parameters\_in**

Input argument. The format and content of this string are the same as that of the AMI\_parameters\_in argument in AMI\_Init.

**AMI\_parameters\_out**

Output argument, pointer to a string that contains name-value pairs of dependent parameters of Usage Dep. The format of this string is the same as that of the AMI\_parameters\_out argument in AMI\_Init.

*Function:* **AMI\_Resolve\_Close**

*Required:* Yes if AMI\_Resolve exists

*Declaration:* AMI\_Resolve\_Close (char \* AMI\_paramters\_out);

*Arguments:*

**AMI\_parameters\_out**

The AMI\_parameters\_out pointer returned by AMI\_Resolve.

In Section 10.3, add:

Add under “Usage”

**Dep**

Parameter value is to be assigned by the AMI\_Resolve function

Also in Section 10.3, replace

**Out**

Parameter value is coming from the AMI model

**InOut**

Parameter value is a required input to the AMI model. The AMI model may return a different value.

with

**Out**

Parameter value is coming from the AMI\_Init and/or AMI\_GetWave functions

**InOut**

Parameter value is a required input to the AMI model. The AMI\_Init and/or AMI\_GetWave functions may return a different value.

Add to “**RESERVED PARAMETERS REFERENCE”**

*Parameter:*      **Resolve\_Exists**

*Required:*        No

*Descriptors*:

Usage:                   Info

Type:                     Boolean

Format:                  Value

Default:<Boolean\_literal*>*

Description:<string>

*Definition:*       Tells EDA tool whether the model implements the AMI\_Resolve/AMI\_Resolve\_Close function pair

*Usage Rules:*   If omitted, the default is False.

*Other Notes:* Independent parameters must be of Usage In or InOut. Dependent parameters must be of Usage Dep. Reserved parameters with allowed usage of Out can have Usage Dep.

Usage Dep is allowed in .ami files in which the parameter “Resolve\_Exists” is True.

Usage Dep distinguishes parameters returned by AMI\_Resolve, which are of Usage Dep, from those by AMI\_Init and/or AMI\_GetWave, which are of Usage Out or Usage InOut, preventing a parameter from being returned by both AMI\_Resolve and AMI\_Init/AMI\_GetWave.

*Example:*

(Resolve\_Exists (Usage Info) (Type Boolean) (Value True)

 (Description "Tells EDA tool to use AMI\_Resolve function")

)

[The actual implementation in the tables is left to the editorial committee. For example, the current column Out can be renamed to Out/Dep.]

[Tables 17-19 will be modified to add Resolve\_Exists and to include Dep in allowed usage types of jitter parameters.]

*Parameter:*      **Model\_Name**

*Required:*        No

*Descriptors*:

Usage:                   In

Type:                     String

Format:                  Value

Default:*<*string\_literal>

Description:<string>

*Definition:*       Name of the IBIS [Model] keyword that is being used.

*Usage Rules:* Value specified in the .ami file is ignored. The EDA tool must pass the name of the IBIS [Model] keyword that is being instantiated by the EDA tool through the input parameter strings to AMI\_Resolve and AMI\_Init functions as the value of this parameter.

*Example:*

(Model\_Name (Usage In) (Type String) (Value "placeholder")

 (Description "The name of the instantiated IBIS model")

)

The usage of the new API is described below.

1. User selects ibis model and specifies corner and data rate.
2. EDA tool initializes AMI\_parameters\_out to NULL.
3. If Resolve\_Exists is False, go to step 9.
4. If Resolve\_Exists is True, EDA tool allocates memory for the AMI\_parameters\_in string and writes to it name-value pairs of all parameters of Usage type In.
5. EDA tool calls AMI\_Resolve before analog channel impulse characterization.
6. The executable model computes dependent parameter values according to independent parameter values in AMI\_parameters\_in, bit\_time, corner and model\_name.
7. The executable model allocates memory for the AMI\_parameters\_out string and writes to it name-value pairs of dependent parameters.
8. EDA tool sets/adjusts analog model parameters if their values are returned by AMI\_Resolve in AMI\_parameters\_out. EDA tool calls AMI\_Resolve\_Close to release the memory allocated by the executable model in AMI\_Resolve.
9. EDA tool characterizes analog channel impulse responses and finishes the rest of the simulation.

Note that dependent parameters are of Usage Dep, and their values used in the simulation are set by the call to AMI\_Resolve before the call to AMI\_Init. Values of parameters of Usage InOut returned by the AMI\_Init and AMI\_GetWave functions shall not affect the dependent parameter values used in the simulation.

Two occurrences, one in page 99 under “Parameters:” and the other one in page 100 under “Converter\_Parameters:” (IBIS Version 6.0 Draft – ver6.0-wip4.pdf of Sep 8, 2013) - replace

When the extension of the external parameter‘s file name ends with “.ami”:

a) only Usage In or Usage Info are allowed for parameters which are to be passed into models instantiated by the [External Model] or

When the extension of the external parameter’s file name does not end with “.ami”:

a) the parameter tree must not contain the Reserved\_Parameters branch but must contain the Model\_Specific branch

b) only Usage Info is allowed

with

The following rules apply to parameter trees located in parameter files whose file name extension is not “.ami”.

1. The parameter tree must not contain the Reserved\_Parameters branch.
2. The parameter tree must contain the Model\_Specific branch.
3. The parameter tree may only contain Usage Info parameters.

The following rules must be observed when [External Model] parameters or converter parameters reference parameters located in external parameter files.

1. Usage Info parameters may be referenced in any external parameter file with or without the “.ami” extension.
2. Usage In parameters may be referenced in any parameter file whose file name extension is “.ami”.
3. Usage Dep parameters may also be referenced in an “.ami” parameter file under the following conditions:
* the [External Model] keyword is located under a [Model] keyword which also contains an [Algorithmic Model] keyword,
* the [External Model]'s parameter and the [Algorithmic Model] keyword point to the same “.ami” file,
* the “.ami” parameter file contains the parameter AMI\_Resolve\_Exists with a value of True.

If all of these conditions are satisfied, the EDA tool must execute the AMI\_Resolve function in the executable model defined by the [Algorithmic Model] keyword to resolve the value of any Usage Dep parameter before passing its value to the [External Model] (see Section 10.2.3).

Two occurrences, one in page 119 under “Parameters:” and the other one in page 120 under “Converter\_Parameters:” (IBIS Version 6.0 Draft – ver6.0-wip4.pdf of Sep 8, 2013) - replace

When the extension of the external parameter‘s file name ends with “.ami”:

a) only Usage In or Usage Info are allowed for parameters which are to be passed into models instantiated by the [External Model] or the [External Circuit] keywords

When the extension of the external parameter’s file name does not end with “.ami”:

a) the parameter tree must not contain the Reserved\_Parameters branch but must contain the Model\_Specific branch

b) only Usage Info is allowed

with

The following rules apply to parameter trees located in parameter files whose file name extension is not “.ami”.

1. The parameter tree must not contain the Reserved\_Parameters branch.
2. The parameter tree must contain the Model\_Specific branch.
3. The parameter tree may only contain Usage Info parameters.

The following rules must be observed when [External Circuit] parameters or converter parameters reference parameters located in external parameter files.

1. Usage Info parameters may be referenced in any external parameter file with or without the “.ami” extension.
2. Usage In parameters may be referenced in any parameter file whose file name extension is “.ami”.

The new API provides model vendors infinite scalability, extensibility and flexibility to implement dependency relations. It also conceals the dependency formula. It allows any complex dependency relation. A few examples are listed below.

Examples:

Example 1: multi-dimensional functions such as y = f(x1, x2, x3)

Example 2: various interpolation methods

Example 3: various extrapolation methods

Example 4: expression in condition statement such as

 

Example 5: advanced functions such as

 y(tap1, tap2, tap3) = FIR(tap1, tap2, tap3) spectrum at data rate

Example 6:

(Rx\_model

 (Reserved\_Parameters

 (Resolve\_Exists (Usage Info) (Type Boolean) (Value True)

 (Description “Indicates whether the executable model implements AMI\_Resolve.”))

 (Model\_Name (Usage In) (Type String) (Value “ignore\_me”)

 (Description “IBIS model name”))

 (Rx\_Receiver\_Sensitivity (Usage Out) (Type Float) (Range 0.0 0.0 0.01)

 (Description “Value depends on OP\_mode and data rate”)) …

 )

 (Model\_Specific

 (Tstonefile (Usage Dep) (Type String) (Value “ignore\_me.s4p”)

 (Description “Rx analog model. Value depends on OP\_mode”))

 (my\_corner (Usage In) (Type String) (Corner “Typ” “Min” “Max”)

 (Description “Informs the executable model what corner is selected by user”)) (OP\_mode (Usage In) (Type Integer) (List 0 1 2 3)

 (Description “Operation mode”))

 …

 )

)

In this example, the Rx analog model is represented with a 4-port touchstone file specified by parameter Tstonefile, Both Rx\_Receiver\_Sensitivity and Tstonefile depend on the legacy IBIS model name, parameter my\_corner, and parameter OP\_mode, which specifies the device operation mode. Rx\_Receiver\_Sensitivity also depends on bit\_time. Parameters Model\_Name, my\_corner and OP\_mode, having usage type In, are included in both input parameter strings to AMI\_Resolve and AMI\_Init. Tstonefile is of usage type Dep, and its dependency on Model\_Name, my\_corner and OP\_mode is resolved in AMI\_Resolve, which returns the value of Tstonefile. Rx\_Receiver\_Sensitivity is of usage type Out, and its dependency on Model\_Name, my\_corner, OP\_mode and bit\_time is resolved in AMI\_Init, which returns the value of Rx\_Receiver\_Sensitivity.

This BIRD was accepted on Oct. 11, 2013.