Questions about Usage Out parameters

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IBIS-ATM teleconference
June 12, 2018

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Format <data_format> <data> or <data_format><data>:

Required, except for the <data_format> selection of Value as noted below. The word "Format" as part of the Format <data_format> <data> sequence is optional. Valid entries for the <data_format> and <data> fields are:

Corner <typ value> <slow value> <fast value>

Corner is not allowed with Usage Out parameters. The selection of one value is automatically carried out by the EDA tool based on its internal simulation corner setting

For Usage Out and InOut, the number of rows returned by the executable model file may differ from the number of rows documented in the AMI parameter definition file, but a minimum of one row shall be returned. Multiple AMI_GetWave calls are not required to return the same number of rows. For Usage Out, a one-row Table is required in the AMI parameter definition file to serve as a template for single and multi-row tables. This can be used by the EDA tool to reconstruct a sequence of data values returned by the executable model file into a table with as many rows as needed, and optionally for parameter initialization before being replaced by the actual Table data returned by the executable model file.

Default <value>:

When used with single value data, Default and Value are mutually exclusive, and shall not be used together for the same parameter. In these situations, Default is a synonym of Value and does not imply any additional meaning or actions. Default is not allowed for any Usage Out parameter types, and Table, Gaussian, Dual-Dirac and DjRj. Default is optional for Range, List, Corner, Increment and Steps. When Default is specified for any of these parameter types, it shall be used by the EDA tool to pick one value from all the possibilities for that parameter if the user does not make such a selection.

COMBINATION AND CORNER RULES

For Usage Out parameters, ({Format} <data_format> <data>) may be ignored by the EDA tool, except when <data_format> is Table where at least a one-row Table is required in <data> to serve as a template for single and multi-row tables.

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The EDA tool shall process the content of the AMI parameter definition file such that

1) the "Reserved_Parameters" and "Model_Specific" branch names and their associated open and close parentheses "()" are not included in the AMI_parameters_in string, and
2) the AMI parameter branches with Usage In or Usage InOut are converted to leaves for the AMI_parameters_in string, possibly incorporating user selections. In this conversion each AMI parameter branch name becomes a leaf name in the AMI_parameters_in string and each leaf name is followed by a white space, a value and a closing parenthesis ")"

For Usage In, the value in the AMI parameter leaves are determined by the EDA tool based on the AMI parameter branches in the AMI parameter definition file. For Usage Out, the value in the AMI parameter leaves are determined by the Algorithmic Model. For Usage InOut, the value in the AMI parameter leaves are first determined by the EDA tool based on the AMI parameter branches in the AMI parameter definition file and passed into the Algorithmic Model which may return a new value in the AMI parameter leaves after some processing.

Note:
If the Jitter and Noise parameters are Usage Info, the EDA tool shall obtain their values from the AMI parameter (.ami) file, optionally through a user interface if user selections are available or needed.

If these parameters are Usage Out, the EDA tool shall use only the values returned by the AMI_Init function, unless otherwise noted. It is the model maker's responsibility to make sure that the AMI_Init function returns the appropriate value in these parameters to the EDA tool to achieve successful simulations.

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1) The order of the leaf entries within an AMI parameter branch is not important.
2) The word Format is optional as indicated by the curly braces "{" and "}" and may be ignored by EDA tools (the examples do not show the word Format).
3) Certain Reserved Parameter names allow only certain <data_format> selections, as described below.
4) The <data_format> selection of Value and Default are always mutually exclusive. Certain parameters may require Value or Default, but Value and Default are not allowed to be present together for the same parameter.
5) <data_format> is always required for selections other than Value.
6) Default is optional for <data_format> Range, List, Corner, Increment and Steps.
7) Default is not allowed for Usage Out parameters.
8) Default is not allowed for <data_format> Table, Gaussian, Dual-Dirac and DjRj.
9) Additional rules apply when <data_format> is Table. The format for <data> describes a set of rows containing data values. Each row has its set of column data values enclosed by parentheses "(" and ")". Each row contains the same number of column values. Any or all of these columns may have different data types. For this case the <data_type> argument is either a list of data types (one for each column), or a single data type. If it is a single data type then this type shall be applied to all of the columns in each row.
10) <data_format> Corner is not allowed for Usage Out.
11) Description is optional.

Note that the purpose of Usage Out or InOut is to provide a mechanism for the algorithmic model to return values to the EDA tool to be used as described by this specification.

The specification does NOT explain what the EDA tool can or should do with the values provided in the .ami file with Usage Out parameters.

Why is {Format} <data_format> <data> required if

- **it "may be ignored" by the EDA tool?**
- **if only Usage In and Usage InOut parameters are converted to leaves for the AMI_parameter_in string?**
- **if the EDA tool shall only use the values returned by the AMI model**

If we spelled out the rules that

- **Default is not allowed for Usage Out parameters**
- **Corner is not allowed for Usage Out parameters**

we could just as well state that Value, Range, List, etc. are not allowed for Usage Out parameters

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```
(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"))
    …
  )
)
```

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Examples:

```
(PAM4_LowerThreshold (Usage Info) (Value -0.333) (Type Float)
         (Description "Lower eye voltage threshold for waveform and eye
         processing.")
)
 (PAM4_CenterThreshold (Usage Info) (Value 0.0) (Type Float)
         (Description "Center eye voltage threshold for waveform and eye
         processing.")
)
 (PAM4_UpperThreshold (Usage Info) (Value 0.333) (Type Float)
         (Description "Upper eye voltage threshold for waveform and eye
         processing.")
)
```

```
(PAM4_LowerThreshold (Usage Out) (Type Float)
         (Description "Lower eye voltage threshold returned by AMI_Init.")
)
 (PAM4_CenterThreshold (Usage Out) (Type Float)
         (Description "Center eye voltage threshold returned by AMI_Init.")
)
 (PAM4_UpperThreshold (Usage Out) (Type Float)
         (Description "Upper eye voltage threshold returned by AMI_Init.")
)
```

Note that this Usage Out example OMITS the values! Is this legal?

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Examples:

```
(PAM4_UpperEyeOffset (Usage Out) (Value 2.5e-12) (Type Float)
        (Description "The Upper eye sampling offset.")
)

(PAM4_CenterEyeOffset (Usage Out) (Value 0.0) (Type Float)
        (Description "The center eye sampling offset.")
)

(PAM4_LowerEyeOffset (Usage Out) (Value 2.5e-12) (Type Float)
        (Description "The lower eye sampling offset.")
)
```