IBIS Parser Update

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(presented by Anders Ekholm, Ericsson)
Outline, Specifications and Parsers

• IBIS through Version 5.1
  – ibischk5

• Touchstone Version 2.0
  – tschk2

• Conclusions
Valid IBIS Versions
and Latest ibischk Versions

1.0 1.1
2.0 2.1
3.0 3.1
4.0 4.1
5.0 5.1

ibis_chk ibischk2 ibischk3 ibischk4 ibischk5
V1.1a V2.1.17 V3.2.9 V4.2.2 V5.1.2
IBIS Parser Major Version Logic

• Subversions upgraded to last major version
  – V5.1 upgrades V5.0
  – V4.2 upgraded V4.0 and V4.1
  – V3.2 upgraded V3.0 and V3.1
  – V2.1 upgraded V2.0
  – V1.1 upgraded V1.0

• V5.1 checks V1.1, V2.1, V3.2, V4.2, and V5.1 levels for features and corrections
Downward Compatibility

• Current IBIS **downward compatible** with all earlier features and syntax
  – Prior EDA implementations supported
  – Existing models remain valid
  – Specification includes all features
  – Earlier specification mistakes corrected

• Specification well tested and corrected
IBIS-AMI Version Exception

- IBIS-AMI subversions supported by the .ami format
- **AMI_Version** required for “5.1” files and **later**
  - First Reserved Parameter
  - Use_Init_Output not legal
- **Omission** of **AMI_Version** implies “5.0” level
  - Use_Init_Output legal
  - All other **AMI_Version** “5.1” rules apply
- Later **AMI_Version** levels will have more features and possible deprecation at the subversion level
- Later Specification will track all subversion changes
“ibischk5” Parser

• Ibischk5, Version 5.1.2
  – Bug reports: http://www.eda.org/ibis/bugs/ibischk/
• Checks all [IBIS Ver]s of IBIS files
• Over $117,000 of contracted work since 1993
• Supports .ibs, .pkg, .ebd, and .ami formats
  – directly or through higher level linkages
## Flags in ibischk5

<table>
<thead>
<tr>
<th>Usage: ibischk5</th>
<th>&lt;IBS filename&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>: ibischk5</td>
<td>-ebd &lt;EBD filename&gt;</td>
</tr>
<tr>
<td>: ibischk5</td>
<td>-pkg &lt;PKG filename&gt;</td>
</tr>
<tr>
<td>: ibischk5</td>
<td>-ami &lt;AMI filename&gt;</td>
</tr>
</tbody>
</table>

**Usage:**

- `ibischk5 -caution -numbered <IBS filename>`
- `ibischk5 -caution -numbered -ebd <EBD filename>`
- `ibischk5 -caution -numbered -pkg <PKG filename>`
- `ibischk5 -caution -numbered -ami <AMI filename>`

The flags prior to the file name can be in any order, and the `-caution` and/or `-numbered` flags are optional.

- **–ami** for `<file_name>.ami` (algorithmic model interface control file)
- **–numbered** for numbered Error, Warning, Notes and Caution messages
Checking file4.ami for IBIS 5.0 Compatibility...

ERROR - Illegal Usage value A specified for Param1
ERROR - Illegal Type value B specified for Param1
ERROR - Illegal Format value C specified for Param1
ERROR - No Reserved_Parameters found

Errors : 4

File Failed

Checking file4.ami for IBIS 5.0 Compatibility...

E4627 - Illegal Usage value A specified for Param1
E4627 - Illegal Type value B specified for Param1
E4627 - Illegal Format value C specified for Param1
E4622 - No Reserved_Parameters found

Errors : 4

File Failed
Message Number File Being Updated
(Over 1150 unique message strings)

<table>
<thead>
<tr>
<th>Number</th>
<th>Symbol in Code</th>
<th>Message string</th>
<th>Parameters</th>
<th>Comment</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>MDL_ERR_0</td>
<td>Unable to Allocate Memory: %s %d</td>
<td>filename, line number</td>
<td>The code failed to allocate memory in &lt;filename&gt; at &lt;linenumber&gt;</td>
<td>Internal Error</td>
</tr>
<tr>
<td>101</td>
<td>MDL_ERR_1</td>
<td>Unable to get IBIS structure</td>
<td></td>
<td>Program data structures are corrupt</td>
<td>Internal Error</td>
</tr>
<tr>
<td>102</td>
<td>MDL_ERR_2</td>
<td>Orphan Model keyword.</td>
<td></td>
<td>Model keyword found but not within a Model declaration</td>
<td>Internal Error</td>
</tr>
<tr>
<td>103</td>
<td>MDL_ERR_3</td>
<td>Illegal Digital Port &lt;%s&gt; (not allowed in SPICE Ports section)</td>
<td>portname</td>
<td>Improper use of Digital port &lt;portname&gt;</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>104</td>
<td>MDL_ERR_4</td>
<td>D_switch not allowed with (D_drive, D_receive, or D_enable) in</td>
<td></td>
<td>Improper use of D_switch</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>105</td>
<td>MDL_ERR_5</td>
<td>%s not allowed with D_switch in Ports/A2D/D2A Section</td>
<td></td>
<td>Error with IBIS file Line number</td>
<td>E</td>
</tr>
<tr>
<td>106</td>
<td>MDL_ERR_6</td>
<td>Reserved Digital Port &lt;%s&gt; used as Orphan data line keyword.</td>
<td>portname</td>
<td>Improper use of Reserved Digital port &lt;portname&gt;</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>107</td>
<td>MDL_ERR_7</td>
<td></td>
<td></td>
<td>Error with IBIS file Line number</td>
<td>E</td>
</tr>
<tr>
<td>108</td>
<td>MDL_ERR_8</td>
<td>TGnd Typical value should be &gt; 0</td>
<td></td>
<td>Improper TGnd typical value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>109</td>
<td>MDL_ERR_9</td>
<td>TGnd Min value should be &gt; 0</td>
<td></td>
<td>Improper TGnd minimum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>110</td>
<td>MDL_ERR_10</td>
<td>TGnd Max value should be &gt; 0</td>
<td></td>
<td>Improper TGnd maximum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>111</td>
<td>MDL_ERR_11</td>
<td>TGnd typ value is not in between</td>
<td></td>
<td>Improper range for TGnd</td>
<td>Warning</td>
</tr>
<tr>
<td>112</td>
<td>MDL_ERR_12</td>
<td>TPower Typical value should be &gt; 0</td>
<td></td>
<td>Improper TPower typical value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>113</td>
<td>MDL_ERR_13</td>
<td>TPower Min value should be &gt; 0</td>
<td></td>
<td>Improper TPower minimum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>114</td>
<td>MDL_ERR_14</td>
<td>TPower Max value should be &gt; 0</td>
<td></td>
<td>Improper TPower maximum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>115</td>
<td>MDL_ERR_15</td>
<td>TPower typ value is not in between</td>
<td></td>
<td>Improper range for TPower</td>
<td>Warning</td>
</tr>
<tr>
<td>116</td>
<td>MDL_ERR_16</td>
<td>[Model Spec] should be specified immediately after all the subparameters of a model and</td>
<td></td>
<td>Improper positioning of [Model Spec]</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>117</td>
<td>MDL_ERR_17</td>
<td>[Receiver Thresholds] should not be specified for model type %s</td>
<td>modetype</td>
<td>Receiver thresholds are not allowed for a &lt;modetype&gt; which is not an Input or I/O model type</td>
<td>Warning with IBIS file Line number</td>
</tr>
<tr>
<td>118</td>
<td>MDL_ERR_18</td>
<td>[Add Submodel] should be specified before other keywords for a model</td>
<td></td>
<td>Improper positioning of [Add Submodel]</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>119</td>
<td>MDL_ERR_19</td>
<td>%s Already Defined For Model %s'</td>
<td>subparameter/keyword, modelname</td>
<td>A model &lt;sub-parameter or keyword&gt; was already defined for &lt;modelname&gt;</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>120</td>
<td>MDL_ERR_20</td>
<td>[Receiver Thresholds] should be specified immediately after all the subparameters of a model and before the other keywords of a</td>
<td></td>
<td>Improper positioning of [Receiver Thresholds]</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>121</td>
<td>MDL_ERR_21</td>
<td>Expecting Keyword. Invalid Line</td>
<td></td>
<td>An invalid line was found where a keyword was expected</td>
<td>Error with IBIS file Line number</td>
</tr>
</tbody>
</table>
Recent ibischk5 Version 5.1.2

- Major IBIS-AMI syntax implementation
  - IBIS Version 5.1 – rules clarified and CHECKED
  - Table-syntax defined and now parsed
  - **Major Errors now detected** (versus not being checked in the older Version 5.0.7)
- 23 BIRDS on IBIS and IBIS-AMI syntax
- 13 BUG reports on file testing for specification compliance closed through BUG138
- Source code checked with 44 new test files since V5.0.7
- Unfortunately, some new BUGs may be discovered with more usage
“tschk2” Parser

• Checks Touchstone Version 1.0 (TS1) and Version 2.0 (TS2)
  – Error and Warning numbers
  – Free executables: http://www.eda.org/ibis/tschk2/

• Converts TS1 to TS2, TS2 to TS1 where practical with -canonical* flags

• Provides comment headers and real, imaginary format (RI) with -describe flag

• Source code package includes 440+ test cases

• C++, well documented

• Only one mixed mode BUG found so far
tschk2 \{-canonical\} FILE

- \{-canonical | -canonical-v2\}
  - TS1, TS2 \(\rightarrow\) TS2
  - Provides number of ports, frequencies and other information
  - Un-normalizes TS1 Y-, Z-, G- and H-parameters and effective noise resistance

- \{-canonical-v1\}
  - TS1, TS2 \(\rightarrow\) TS1 where practical
  - Applies column formatting rules and 2-port 21_12 ordering
  - Normalizes TS2 Y-, Z-, G- and H-parameters and effective noise resistance
  - No mixed mode or selectable reference resistance processing
71 tschk2 Messages

FILE_ERROR_CATEGORY (1000)
Errors in opening or reading the Touchstone file.
- FILE_NOT_FOUND (1001) - Raised when the file cannot be opened through the path provided. Also raised when the filename is empty.
- UNREADABLE_FILE (1002) - Raised when the file is found, but cannot be opened for reading.
- EMPTY_FILE (1003) - Raised when the file is found to be empty.

FORMAT_ERROR_CATEGORY (2000)
Errors in the structure of the Touchstone file format.
- NO_USEFUL_CONTENT (2001) - Raised when the file does not contain any comments and blank lines.
- NOT_A_TOUCHSTONE_FILE (2002) - Raised when the file does not start in either the Touchstone v1 format or the Touchstone v2 format.
- INVALID_CHARACTER (2003) - Raised when an invalid character is found in the file.
- EXPECTED_NEWLINE (2004) - Raised when an end-of-line termination is expected.
- EXPECTED_NEWLINE_BEFORE_EOF (2005) - Warning raised when the last line of the file is found to lack an end-of-line termination.
- EXPECTED_WHITESPACE (2006) - Raised when a space or tab is expected.
- EXPECTED_NUMERIC_DATA (2007) - Raised when a real number is expected.
- EXPECTED_INTEGER (2008) - Raised when an integer is expected.
- KEYWORD_NOT_AT_FIRST_COLUMN (2009) - Raised when whitespace is found on a line preceding a keyword.
- HASH_MARK_NOT_AT_FIRST_COLUMN (2010) - Raised when whitespace is found on a line preceding a # mark.
- FREQUENCY_NOT_AT_FIRST_COLUMN (2011) - Raised when whitespace is found on a line preceding a frequency value.
- UNTERMINATED_KEYWORD (2012) - Raised when a keyword is missing the closing bracket.
- UNSUPPORTED_VERSION (2013) - Raised when an unsupported argument is found for the [Version] keyword.
- UNRECOGNIZED_KEYWORD (2014) - Raised when an unrecognized keyword is found.
- INVALID_KEYWORD_IN_V1_FILE (2015) - Raised when a keyword is found in a Touchstone v1 file.
- INVALID_NUMBER_OF_PORTS (2016) - Raised when the [Number of Ports] argument is not a positive integer.
- INVALID_TWO_PORT_DATA_ORDER_KEY (2017) - Raised when the [Two-Port Data Order] keyword is given for a file that does not describe 2-port data.
- MISSING_TWO_PORT_DATA_ORDER_KEY (2018) - Raised when the [Two-Port Data Order] keyword is not found in a file that describes 2-port data.
- EXPECTED_TWO_PORT_DATA_ORDER (2019) - Raised when an unrecognized argument is found for the [Two-Port Data Order] keyword.
- INVALID_NUMBER_OF_FREQUENCIES (2020) - Raised when the [Number of Frequencies] argument is not a positive integer.
- INVALID_NUMBER_OF_NOISE_FREQUENCIES (2021) - Raised when the [Number of Noise Frequencies] argument is not a positive integer.
- WRONG_NUMBER_OFREFERENCEIMPEANCE (2022) - Raised when the number of reference impedances does not match the number of ports.
- EXPECTED_MATRIX_FORMAT (2023) - Raised when an unrecognized argument is found for the [Matrix Format] keyword.
- EXPECTED_MIXED_MODE_DESCRIPTOR (2024) - Raised when an invalid mixed-mode port descriptor is found.
- MIXED_MODE_ONLY_FOR_SYZ_PARAMETERS (2025) - Raised when mixed-mode data is given for G- or H-parameter data.
- G_PARAMETERS_ONLY_DEFINED_FOR_TWO_PORTS (2026) - Raised when G-parameters are given for a file that does not describe 2-port data.
- H_PARAMETERS_ONLY_DEFINED_FOR_TWO_PORTS (2027) - Raised when H-parameters are given for a file that does not describe 2-port data.
- NOISE_DATA_ADVERTISED (2028) - Raised when [Number of Noise Data] is given but no [Noise Data] is found.
- NOISE_FREQUENCY_EXCEEDS_RANGE (2029) - Raised when the first data frequency is greater than the largest network-data frequency.
- FOUND_EXTRA_LINES_AT_END (2030) - Raised when extra lines are found at the end of the file.

OPTIONS_FORMAT_ERROR_CATEGORY (2100)
Errors in Touchstone options line.
Conclusions

• ibischk5 and tschk2 parsers - officially check files for specification compliance

• Parsers helps test specification rules for clarity and accuracy

• BUG process continues to improve the parsers and eliminate mistakes

• **Parsers are critical to IBIS success**
Useful Links Under IBIS

Home Page: www.eda.org/ibis/

- ver5.1/ IBIS Version 5.1 (August 24, 2012)
- ibischk5/ ibischk5 Version 5.1.2 (October 2012)
- touchstone_ver2.0/ Touchstone Version 2.0 (April 24, 2009)
- tschk2/ tschk2 Version 2.0.0 (December 2009)
- quality_ver2.0/ IBIS Quality Specification (Oct. 30, 2009)
- ibis-iss_ver1.0/ Interconnect SPICE Subcircuit Specification Version 1.0 (October 7, 2011)
- editorial_wip/ Editorial Task Group (wip)
- interconnect_wip/ Interconnect Task Group (wip)
- macromodel_wip/ Advanced Technology Task Group (wip)
- quality_wip/ Quality Task Group (wip)

(wip: work in progress)