IBIS Parser Update

Bob Ross
Asian IBIS Summit
Yokohama, Japan
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bob@teraspeed.com

(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

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
  - Free executables:
    http://www.eda.org/ibis/ibischk5/
  - 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

Usage: ibischk5       <IBS filename>
: ibischk5       -ebd <EBD filename>
: ibischk5       -pkg <PKG filename>
: ibischk5       -ami <AMI filename>

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
ibischk5 {–numbered} –ami  file4.ami

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_driver, D_receive, or D_enable) in Ports/A2D/D2A Section</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>TTgnd Typical value should be &gt; 0</td>
<td></td>
<td>Improper TTgnd typical value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>109</td>
<td>MDL_ERR_9</td>
<td>TTgnd Min value should be &gt; 0</td>
<td></td>
<td>Improper TTgnd minimum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>110</td>
<td>MDL_ERR_10</td>
<td>TTgnd Max value should be &gt; 0</td>
<td></td>
<td>Improper TTgnd maximum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>111</td>
<td>MDL_ERR_11</td>
<td>TTgnd typical value is not in between</td>
<td></td>
<td>Error with IBIS file Line number</td>
<td>E</td>
</tr>
<tr>
<td>112</td>
<td>MDL_ERR_12</td>
<td>TTPower Typical value should be &gt; 0</td>
<td></td>
<td>Improper TTPower typical value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>113</td>
<td>MDL_ERR_13</td>
<td>TTPower Min value should be &gt; 0</td>
<td></td>
<td>Improper TTPower minimum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>114</td>
<td>MDL_ERR_14</td>
<td>TTPower Max value should be &gt; 0</td>
<td></td>
<td>Improper TTPower maximum value</td>
<td>Error with IBIS file Line number</td>
</tr>
<tr>
<td>115</td>
<td>MDL_ERR_15</td>
<td>TTpower typ value is not in between</td>
<td></td>
<td>Error with IBIS file Line number</td>
<td>E</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>Error with IBIS file Line number</td>
<td>E</td>
</tr>
<tr>
<td>117</td>
<td>MDL_ERR_17</td>
<td>[Receiver Thresholds] should not be specified for model type %s</td>
<td>modelttype</td>
<td>Receiver thresholds are not allowed for a &lt;modelttype&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/keywodo, modeltname</td>
<td>A model &lt;sub-parameter or keyword&gt; was already defined for &lt;modeltname&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>

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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
tchk2 \{-canonical\} FILE

• \{-canonical | -canonical-v2\}
  – TSI, TS2 → TS2
  – Provides number of ports, frequencies and other information
  – Un-normalizes TSI Y-, Z-, G- and H-parameters and effective noise resistance

• \{-canonical-v1\}
  – TSI, TS2 → TSI 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 is found to contain only 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_KEY (2014) - Raised when an unrecognized keyword is found.
- INVALID_KEYWORD_IN_V2_FILE (2015) - Raised when a keyword is found in a Touchstone v1 file.
- INVALID_SYMBOL_NAME (2016) - Raised when the [Symbol Name] argument is not a valid identifier.
- INVALID_BINARY_PORT_TYPE (2017) - Raised when the [Binary Port Type] argument is given for a file that does not describe 2-port data.
- MISSING_TWO_PORT_DATA_ORDER (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_OSCILLATORS (2021) - Raised when the [Number of Oscillators] argument is not a positive integer.
- ERROR_OCCURED_ON_MORE_THAN_ONCE (2022) - Raised when the number of reference impedances does not match the number of ports.
- INVALID_PORT_IDENTIFIER (2023) - Raised when an unrecognized argument is found for the [Port Identifier] keyword.
- INVALID_PORT_PAIR (2024) - Raised when an invalid port pair 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 [Noise Data] is included but no [Noise Data] is found.
- NOISE_FREQUENCY_EXCEEDS_RANGE (2029) - Raised when the first 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/

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

(wip: work in progress)