IBIS Update and Parsers

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Yokohama, Japan
November 18, 2011
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Presentation Topics

• Updates
• ibischk5
  – Operation
  – Spread sheet for messages
  – Some new checks
• tschk2
  – Operation
  – Messages
• Conclusions
Welcome to the IBIS Open Forum
Home of

IBIS (I/O Buffer Information Specification) (Version 5.0)
  • ANSI/EIA-656-B (Version 4.2)
  • IEC-62014-3 (Version 3.2)

IBIS Interconnect Modeling Specification (ICM) (Version 1.1)
  • ANSI/GEIA-STD-0001 (Version 1.1)

IBIS Interconnect SPICE Subcircuit (IBIS-ISS) Specification (Version 1.0)

Touchstone® File Format Specification (Version 2.0)
IBIS Organization

- TechAmerica (www.techamerica.org)
  - Top level organization (offices around the world)
  - Merger of several standards and trade organizations
  - IBIS under SSTC (Standards and Technology Council)

- IBIS Officers 2011 - 2012
  - Chair: Michael Mirmak, Intel Corporation
  - Vice-Chair: Lance Wang, IO Methodology
  - Librarian: Anders Ekholm, Ericsson
  - Secretary: Randy Wolff, Micron Technology
  - Webmaster: Mike LaBonte, SiSoft
  - Postmaster: Mike LaBonte, SiSoft

  - (Past Chair): Bob Ross, Teraspeed Consulting Group
Accomplishments and Projects

• **IBIS-ISS** (IBIS-Interconnect Spice Subcircuit) Specification
  – Version 1.0 released October, 2011
  – HSpice subset with Synopsys permission

• **IBIS Version 5.1** (ongoing current project for 2012)
  – IBIS BIRDs (Buffer Issue Resolution Documents)
    • Standard IBIS, about 5 BIRDs
    • IBIS-AMI (IBIS-Algorithmic Model Interface) cleanup, about 15 BIRDs
  – Reformatting into Word document with true graphics

• Quality Committee focusing on IBIS-AMI checks to be added to the Quality Specification (ongoing for 2012)
Current and Future Projects

• IBIS Version 5.2 (or 6.0) – (future under discussion)
  – Analog models
  – Jitter parameters
  – Multi-lingual links
  – Back-channel modeling
  – IBIS linkage to IBIS-ISS through [External Model] and [External Circuit]
    • Allows using parameterized IBIS-ISS subcircuits
  – And more …

• Touchstone Version 2.1 (future for 2012)
  – Sparse matrix mapping
  – Binary format

• Ongoing ibischk5 and tschk2 parser maintenance
“ibischk5” Parser

• Ibischk5, Version 5.0.7
  – Supports IBIS Version 5.0 (ratified 2008)
    • Algorithmic model interface for Serdes analysis
    • Power delivery system SSO and gate modulation
    • EMI parameters
    • Other – (area based thresholds)

• Checks all [IBIS Ver]s of IBIS files
  – (1.1, 2.1, 3.2, 4.2, 5.0)

• Over $114,000 of contracted work since 1993

• Supports .ibs, .pkg, .ebd, and .ami formats
  – directly or through linkages from top level file
New 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
# New: Message Number File

(1155 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>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>MDL_ERR_0</td>
<td>Unable to Allocate Memory: %s %d filename, line number</td>
<td>The code failed to allocate memory in &lt;filename&gt; at &lt;lineNumber&gt;</td>
<td>Internal Error</td>
<td></td>
<td>E</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>
<td>E</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>Error with IBIS file Line number</td>
<td>E</td>
</tr>
<tr>
<td>103</td>
<td>MDL_ERR_3</td>
<td>Illegal Digital Port &lt;&amp;s&gt; (not allowed in SPICE Ports section) portname</td>
<td>Improper use of Digital port &lt;portname&gt;</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>MDL_ERR_4</td>
<td>D_switch not allowed with D_drive,D_receive,D_enable in Ports/A2D/D2A Section</td>
<td>Improper use of D_switch</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></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 IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>106</td>
<td>MDL_ERR_6</td>
<td>Reserved Digital Port %s used as portname</td>
<td>Improper use of Reserved Digital port &lt;portname&gt;</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>MDL_ERR_7</td>
<td>Orphan data line keyword.</td>
<td>portname</td>
<td>Improper use of Reserved Digital port &lt;portname&gt;</td>
<td>Error with IBISfile 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>A Model related data line was found where none was expected</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>MDL_ERR_9</td>
<td>TTgnd Min value should be &gt; 0</td>
<td></td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>MDL_ERR_10</td>
<td>TTgnd Max value should be &gt; 0</td>
<td></td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>MDL_ERR_11</td>
<td>TTgnd typvalue is not in between</td>
<td></td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>MDL_ERR_12</td>
<td>TPower Typical value should be &gt; 0</td>
<td></td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>MDL_ERR_13</td>
<td>TPower Min value should be &gt; 0</td>
<td></td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>MDL_ERR_14</td>
<td>TPower Max value should be &gt; 0</td>
<td></td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>MDL_ERR_15</td>
<td>TPower typvalue is not in between</td>
<td></td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>MDL_ERR_16</td>
<td>[ModelSpec] should be specified immediately after all the subparameters of a model and</td>
<td>Improper positioning of [ModelSpec]</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>117</td>
<td>MDL_ERR_17</td>
<td>[Receiver Thresholds] should not be specified for model type %s modaltype</td>
<td>Receiver thresholds are not allowed for a &lt;modaltype&gt; which is not an Input or I/O model type</td>
<td>Warning with IBIS file Line number</td>
<td>W</td>
<td></td>
</tr>
<tr>
<td>118</td>
<td>MDL_ERR_18</td>
<td>[Add Submode] should be specified before other keywords for a model</td>
<td>Improper positioning of [Add Submodel]</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>MDL_ERR_19</td>
<td>%s Already Defined For Model %s* sub parameter/keyword, modelname</td>
<td>A model &lt;sub-parameter or keyword&gt; was already defined for &lt;modelname&gt;</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></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>Improper positioning of [Receiver Thresholds] keyword</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>MDL_ERR_21</td>
<td>ExpectingKeyword. Invalid Line</td>
<td>An invalid line was found where a keyword was expected</td>
<td>Error with IBISfile Line number</td>
<td>E</td>
<td></td>
</tr>
</tbody>
</table>
Message Columns
(for documentation and sorting)

- **Number** (printed message number)
- **Symbol in Code** (by module grouping)
  - Example: ALGMODERR_25 (message 25 of 36 AMI module messages)
- **Message String** (all unique message strings)
- **Parameters** (if applicable for printed % arguments)
  - For line numbers, keywords, subparameters, etc.
- **Comment** (brief description)
- **Category** (Error, Warning Notes, Caution, etc.)
- **Classification** (E, W, N, C added for easier sorting)
Recent ibischk5 Fixes

• dV of [Ramp] dV/dt_r, dV/dt_f Caution checks
  – BUG104, BUG123, BUG130 (case-sensitivity crash)
  – Can be used to find the exact dV values based on I-V tables and specified ramp load conditions
  – Calculated value reported if wrong value entered

• [Model Spec] timing test load entries
  – BUG122 for waveform crossing Vmeas test

• [ISSO PU] and [ISSO PD] table time entry mismatches
  – BUG115, BUG116
  – BUG129 time alignment test from Error to Caution
# Bug List for Filed BUG Reports

http://www.eda.org/ibis/bugs/ibischk/

## IBISCHK Parser Issue Reports (BUGs)

<table>
<thead>
<tr>
<th>ID#</th>
<th>Title</th>
<th>Requester</th>
<th>Date Submitted</th>
<th>Severity</th>
<th>Priority</th>
<th>Status</th>
<th>Date Closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>130</td>
<td>Program Closure with Case Sensitive Errors in Ramp Subparameters</td>
<td>Lance Wang, IO Methodology, Randy Wolff, Micron Technology</td>
<td>October 14, 2011</td>
<td>SEVERE</td>
<td>HIGH</td>
<td>CLOSED</td>
<td>(October 28, 2011)</td>
</tr>
<tr>
<td>128</td>
<td>Repetition of Reserved Parameters and Model Specific Sections Not Checked</td>
<td>Bob Ross, Teraspeed Consulting Group</td>
<td>March 29, 2011</td>
<td>ANNOYING</td>
<td>MEDIUM</td>
<td>OPEN</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>IBIS-AMI Fatal Error with Root Parameter Spurious Text</td>
<td>Bob Ross, Teraspeed Consulting Group</td>
<td>March 13, 2011</td>
<td>SEVERE</td>
<td>HIGH</td>
<td>OPEN</td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>Illegal Text After IBIS-AMI Parameters Not Reported</td>
<td>Walter Katz, SiSoft and Bob Ross, Teraspeed Consulting Group</td>
<td>March 9, 2011</td>
<td>MODERATE</td>
<td>HIGH</td>
<td>OPEN</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>Missing Basic Checks on .ami Files</td>
<td>Walter Katz, SiSoft and Bob Ross, Teraspeed Consulting Group</td>
<td>January 6, 2011</td>
<td>MODERATE</td>
<td>HIGH</td>
<td>OPEN</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Incorrect WhiteSpace Requirement in .ami Files</td>
<td>Curtis Clark, Ansys, Inc</td>
<td>January 4, 2011</td>
<td>MODERATE</td>
<td>MEDIUM</td>
<td>OPEN</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>Wrong Cautions for [Ramp] dV</td>
<td>PRABHAT RANJAN, STMicroelectronics Pvt Ltd</td>
<td>December 14, 2010</td>
<td>MODERATE</td>
<td>MEDIUM</td>
<td>CLOSED</td>
<td>March 17, 2011</td>
</tr>
<tr>
<td>121</td>
<td>Broken Missing [Component] Test</td>
<td>Atul Agarwal, Advent Software Avenues</td>
<td>September 1, 2010</td>
<td>SEVERE</td>
<td>MEDIUM</td>
<td>CLOSED</td>
<td>November 5, 2010</td>
</tr>
<tr>
<td>120</td>
<td>Unused [Model Selector] Cautian</td>
<td>Bob Ross, Teraspeed Consulting Group</td>
<td>July 27, 2010</td>
<td>ENHANCEMENT</td>
<td>LOW</td>
<td>NOT A BUG</td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>Waveform Test Missing Results with Version 4.2.1 and Beyond</td>
<td>Bob Ross, Teraspeed Consulting Group</td>
<td>July 5, 2010</td>
<td>SEVERE</td>
<td>MEDIUM</td>
<td>CLOSED</td>
<td>November 5, 2010</td>
</tr>
<tr>
<td>118</td>
<td>Vmeas Check with Version 4.2.1 and Beyond Failure</td>
<td>Bob Ross, Teraspeed Consulting Group</td>
<td>July 5, 2010</td>
<td>SEVERE</td>
<td>MEDIUM</td>
<td>CLOSED</td>
<td>November 5, 2010</td>
</tr>
<tr>
<td>117</td>
<td>Debug Error with Missing Pin Numbers and Other Conditions</td>
<td>Bob Ross, Teraspeed Consulting Group and Arpad Muranyi, Mentor Graphics</td>
<td>June 3, 2010</td>
<td>SEVERE</td>
<td>MEDIUM</td>
<td>CLOSED</td>
<td>February 13, 2011</td>
</tr>
</tbody>
</table>
“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
• Thanks to contractor Agilent Technologies
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
tschk2 {-describe} FILE
(header comments, RI format)

[Network Data]

```
! freq S11re S11im S12re S12im S13re S13im S14re S14im S15re S15im S16re S16im 
  ! S21re S21im S22re S22im S23re S23im S24re S24im S25re S25im S26re S26im 
  ! S31re S31im S32re S32im S33re S33im S34re S34im S35re S35im S36re S36im 
  ! S41re S41im S42re S42im S43re S43im S44re S44im S45re S45im S46re S46im 
  ! S51re S51im S52re S52im S53re S53im S54re S54im S55re S55im S56re S56im 
  ! S61re S61im S62re S62im S63re S63im S64re S64im S65re S65im S66re S66im 
  
  10000 -0.665574600466 -0.0006609751214130001 0.333068101839 0.333100908672 -0.0006633295929 
  0.000663504688568 0.333100908672 -0.0006633295929 

Etc.
```
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_KEYWORD (2014) - Raised when an unrecognized keyword is found.
- INVALID_KEYWORD_IN_VI_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_KEYWORD (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_KEYWORD (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_KEYWORD (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_OF_REFERENCE_IMPEDANCES (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_PARAMS (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 Frequencies] is given but no [Noise Data] is found.
- NOISE_FREQUENCY_EXCEEDS_RANGE (2029) - Raised when the first noise-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.
Message Groupings

• Message chart in source code package

• Message categories (starting number)
  – Full Error (1000)
  – Options Error (2100)
  – Keyword Order (2200)
  – Data Format (2300)
Conclusions

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

• Parser development also checks specification for accuracy and clarity

• BUG process helps maintain integrity of parsers with latest fixes

• Parsers are critical to IBIS success
Useful Links Under IBIS
Home Page: www.eda.org/ibis/

ver5.0/
ibischk5/

IBIS Version 5.0 (August 29, 2008)
ibischk5 Version 5.0.7 (Pending 2011)

touchstone_ver2.0/
tschk2/

Touchstone Version 2.0 (April 24. 2009)
tschk2 Version 2.0.0 (December 2009)

quality_ver2.0/
ibis-iss_ver 1.0/

IBIS Quality Specification (Oct. 30, 2009)
Interconnect SPICE Subcircuit Specification
Version 1.0 (New - October 7, 2011)

editorial_wip/
interconnect_wip/
maccomodel_wip/
quality_wip/

Editorial Task Group (wip)
Interconnect Task Group (wip) - suspended
Advanced Technology Task Group (wip)
Quality Task Group (wip)

(wip: work in progress)