BioCTS for AN-2011 and AN-2011 Update: 2013 User Guide

NIST/ITL CSD Biometric Conformance Test Software for ANSI/NIST-ITL 1-2011 and ANSI/NIST-ITL 1-2011 Update: 2013

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Dylan Yaga
NIST/ITL CSD Lead Software Designer

Fernando Podio
NIST/ITL CSD Project Manager

Christofer J. McGinnis
ID Technology Partners (NIST Associate) Software Developer

National Institute of Standards and Technology (NIST)

Information Technology Laboratory (ITL)

Computer Security Division (CSD)

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2. Disclaimer

NIST/ITL BioCTS

For AN-2011 and AN-2011 Update: 2013

October 2010

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3. Overview

This document describes the features of the Biometric Conformance Test Software (BioCTS) for ANSI/NIST-ITL 1-2011 and ANSI/NIST-ITL 1-2011 Update: 2013 (AN) developed by NIST/ITL Computer Security Division.

BioCTS for AN-2011 and AN-2011 Update: 2013 is a desktop application which tests biometric transactions (files) for conformance to *NIST Special Publication (SP) 500-290 Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information* [1], and *NIST Special Publication 500-290 Rev1 (2013) Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information* [2]. AN-2011 Update: 2013 and related information on the standard can be found at the ANSI/NIST-ITL Standard Homepage [3].

BioCTS for AN-2011 and AN-2011 Update: 2013 can be used to test a significant number of transactions (1,000s+) in a single batch test; evaluate the results at a high level, and load files into the BioCTS Editor to drill down to errors found on specific Records, Fields, Subfields and Information Items which comprise a transaction. Test Results from each transaction tested are logged and saved to a user-specified folder, with a time stamp.

BioCTS for AN-2011 and AN-2011 Update: 2013 supports four Conformance Test Suites (CTS):

- **CTSs for AN-2011**
  - CTS for AN-2011 Traditional Encoded Transactions
  - CTS for AN-2011 NIEM XML Encoded Transactions
- **CTSs for AN-2011 Update: 2013**
  - CTS for AN-2011 Update: 2013 Traditional Encoded Transactions
  - CTS for AN-2011 Update: 2013 NIEM XML Encoded Transactions

The **CTSs for AN-2011** implements all test assertions specified in *DRAFT NIST SP 500-295 Revision 1 - Conformance Testing Methodology for ANSI/NIST-ITL 1-2011, Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information* [4]. The Record Types for the CTS for AN-2011 supported[1] in this CTS are:

- Transaction Level Assertions
- Type 1, Transaction Information Record
- Type 4, High-resolution grayscale fingerprint image
- Type 10, Facial and SMT image
- Type 13, Variable-resolution latent image
- Type 14, Variable-resolution fingerprint image
- Type 15, Palm print image
- Type 17, Iris image

[1] Note: The CTS for AN-2011 will accept transactions containing Record Types other than those listed, however, minimal testing is performed on them. Basic tests, such as testing for the correct format of a Field, Record Length, and IDC value are performed.

The initial release of the **CTSs for AN-2011 Update: 2013** implements the test assertions specified in *DRAFT NIST SP 500-295 Revision 1* where appropriate, as well as additional required test assertions on new mandatory and optional fields specific to the 2013 Update (e.g., new fields within Record Type 10) for the following Record Types[2]:

- Transaction Level Assertions
- Type 1, Transaction Information Record
- Type 4, High-resolution grayscale fingerprint image
- Type 10, Photographic body part imagery (including face and SMT)

Future releases will add additional support for more record types.

During the development of the new CTSs, test assertions have been updated as needed to be conformant to *NIST Special Publication 500-290 Rev1 (2013).*

There are several new features included in the BioCTS User Interface since the last release:

- **Graphical Statistic Display** – BioCTS provides multiple types of Graphical Charts to visualize the locations of errors within a Transaction. The user can choose to save the chart as an image file to their computer.
- **Advanced Editor Features** – BioCTS has improved the editor with two new features: Add and Remove Fields, allowing users to edit Transactions from within the BioCTS Editor for Traditional Transactions. Fields are added via a powerful Add Field Dialog that graphically displays the layout of the Field being added.
- **User Defined Field Override** – The ANSI/NIST-ITL standards allows for User-Definable Fields in several Record Types (e.g., Type 02). In previous versions of BioCTS, these Fields would be labeled as "User-defined Field" making it difficult to quickly tell one "User-defined Field" from another "User-defined Field". The latest release of BioCTS allows a user to specify in an external file an Override Name for User Defined Fields, to provide a name that would be meaningful to the user.

In addition to new User Interface features, BioCTS has included new features within the Test Output Logs. BioCTS now reports within every Test Output Log the SHA2 512 bit (also known as SHA 512) [5] [6] hash value for the following information:

- The File Under Test's data – which allows a user to later match a Test Output Log to a file, regardless of filename.
- Every XML Schema File Used – this allows for verification of which XML Schema files are used, or if the user had modified them prior to testing.

[2] Note: The CTS for AN-2011 Update: 2013 will accept transactions containing Record Types other than those listed, however, minimal testing is performed on them. Basic tests, such as testing for the correct format of a Field, Record Length, and IDC value are performed.

A new high-level Test Summary file is also generated on a per-batch test basis, providing the list of files that were tested, the SHA2 512 bit hash value for the file, the overall result (pass/fail) of the file, as well as the statistics for the results.

3.1. Requirements

- Supported Microsoft® Operating Systems
    - Windows® XP ™ Service Pack 3
    - Windows® Vista ™ Service Pack 2
    - Windows® 7 ™ Service Pack 1
- Microsoft® .NET 4.0 Framework
    - Microsoft® .NET 4.0 Web Installer (http://www.microsoft.com/en-us/download/details.aspx?id=17851)
    - Microsoft® .NET 4.0 Stand Alone Installer (http://www.microsoft.com/en-us/download/details.aspx?id=17718)
    - Links working as of 7/22/2014

4. Guide

4.1. Download and Installation

Download the installer from the website http://www.nist.gov/itl/csd/biometrics/biocta_download.cfm .

After the download completes, run the install program Programs and follow the on screen instructions presented in the dialog boxes.

4.2. Running the Conformance Test Architecture

To run the CTA software from the Start menu:
Select **All Programs** then select **NIST BioCTS**, then select **ANSI NIST ITL** and click on **BioCTS for AN-2011 and AN-2011 Update 2013.**

After starting the BioCTS for AN-2011 and AN-2011 Update 2013 Conformance Test Architecture, specific Conformance Test Suites may be selected from the Options Tab (See Section 4.3.4 for more details). Four Conformance Test Suites are present, and are separated into two categories:

- Traditional Encoding Conformance Test Suites
  - ANSI/NIST-ITL 1-2011 Traditional Encoding Conformance Test Suite
  - ANSI/NIST-ITL 1-2011 Update: 2013 Traditional Encoding Conformance Test Suite
- NIEM XML Encoding Conformance Test Suites
  - ANSI/NIST-ITL 1-2011 NIEM XML Encoding Conformance Test Suite
  - ANSI/NIST-ITL 1-2011 Update: 2013 NIEM XML Encoding Conformance Test Suite

Within the Options Tab, a single Conformance Test Suite can be selected for each category.

4.3. Conformance Test Architecture Features

4.3.1. Traditional transaction Batch Testing

The “Traditional Transaction Batch Test” tab allows multiple traditionally encoded transactions (files) to be tested in groups, and displays the overall results for each transaction in the “Files Under Test” pane.

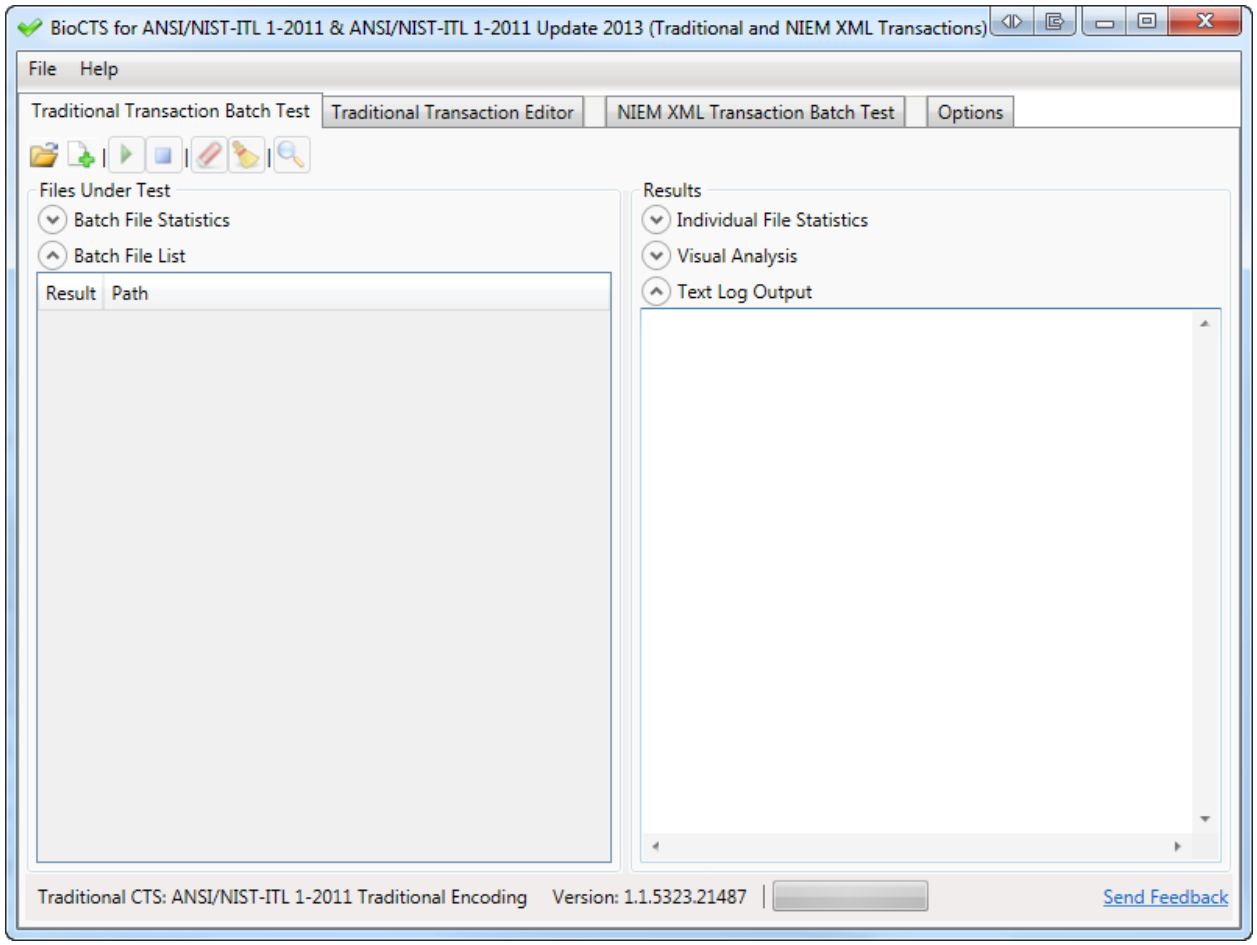

Figure 1 - Empty Batch Test Tab

A Significant number of files (1,000s+) can be loaded at in a single batch. The more powerful the hardware used, more files that can be tested in batch mode. BioCTS Team members perform the tests on conventional Desktop Computers (e.g., Intel® Xeon® Processors, 8 GB of Memory).

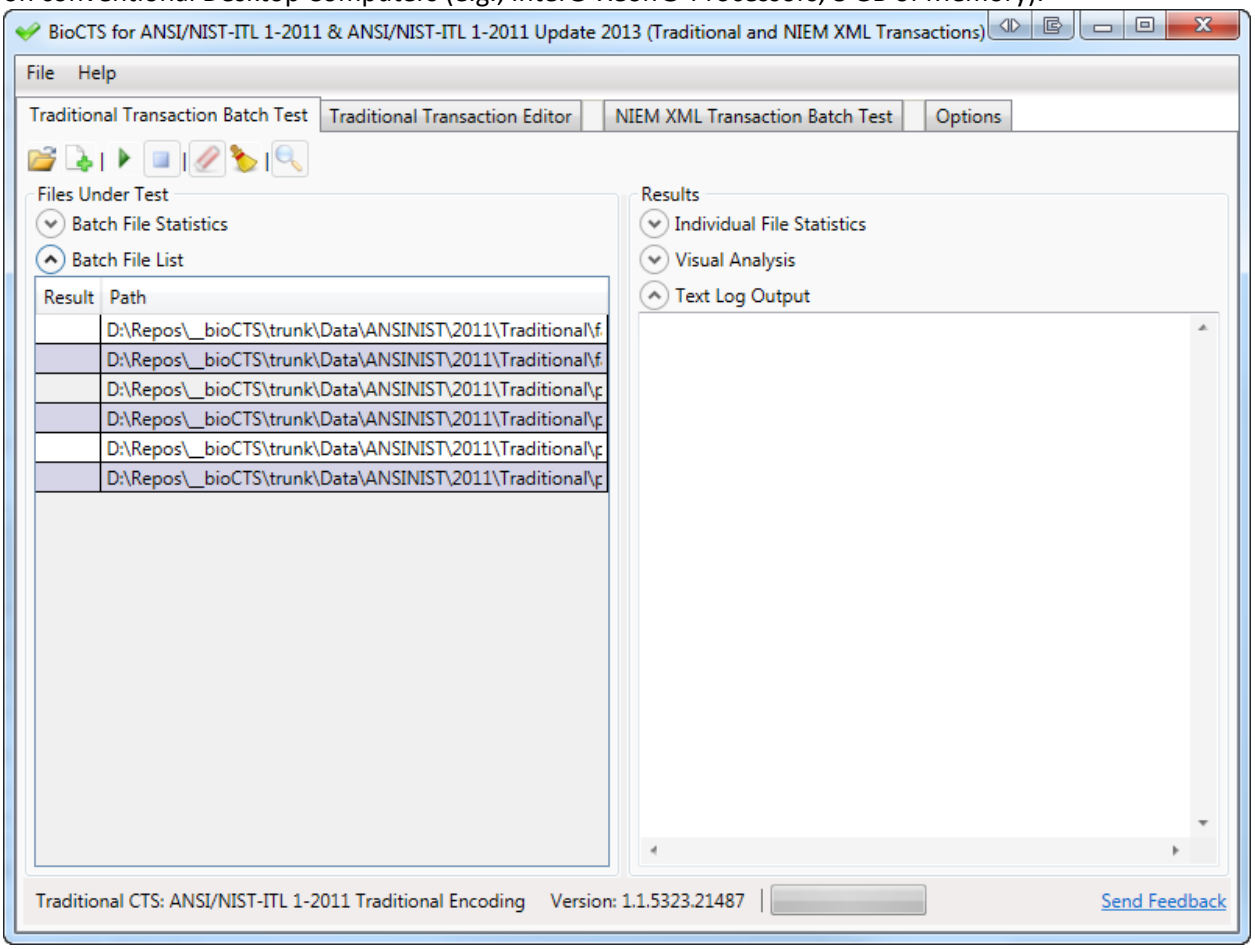

Figure 2 - Files Loaded into the Batch Test Tab

The “Batch Test” tab will display the transaction’s overall result with either:

- - Overall Result of Fail
- - Overall Result of Pass

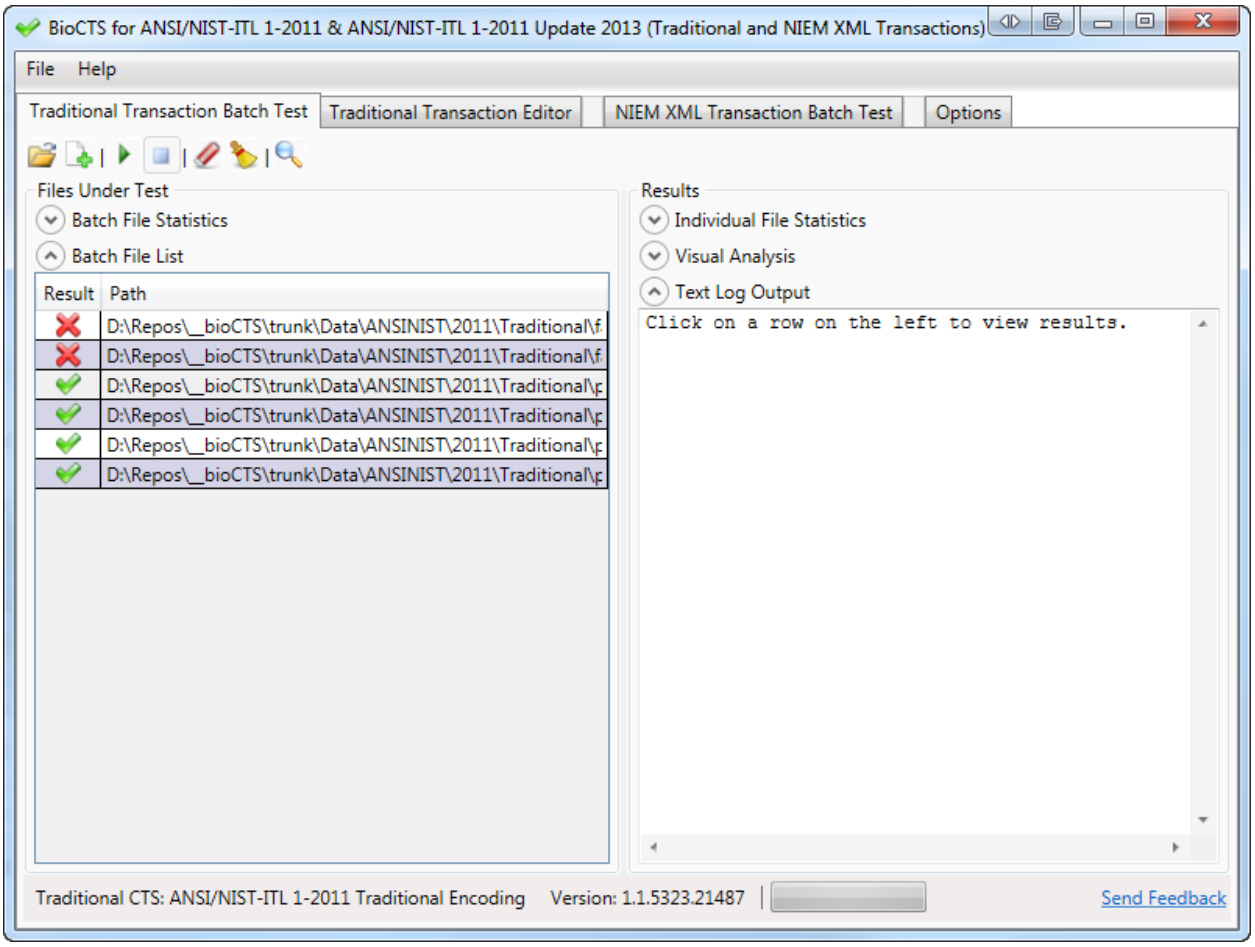

Figure 3 - Batch Test tab showing Overall Results

Textual output results for each transaction can be viewed by clicking on the desired filename in the “File Under Test” pane. The complete textual results are displayed in the pane to the right.

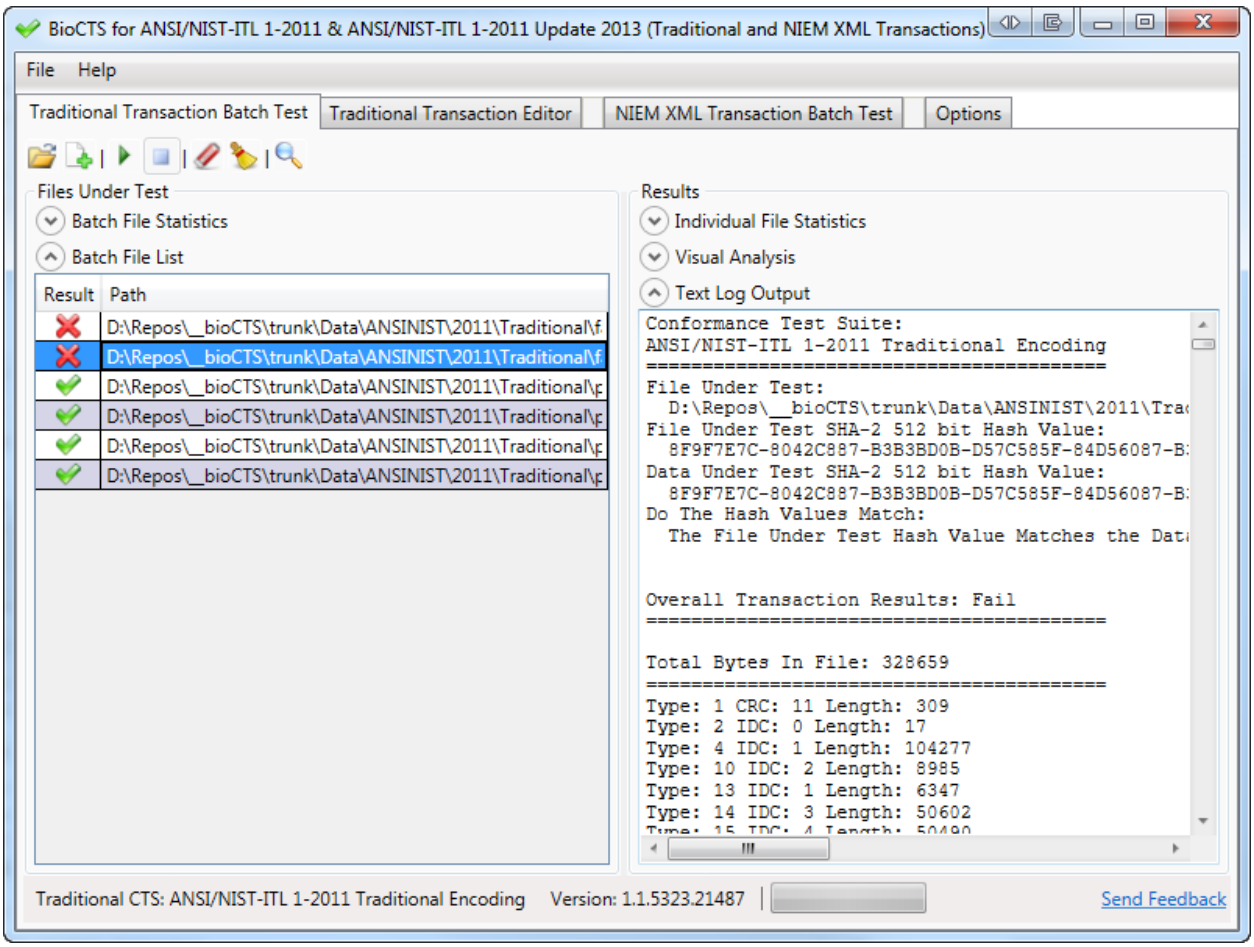

Figure 4 - Batch Test Tab with a Transaction Selected and Results Displayed in Right Pane

In addition to the detailed Textual Output Log, each file has a statistical breakdown of the results.

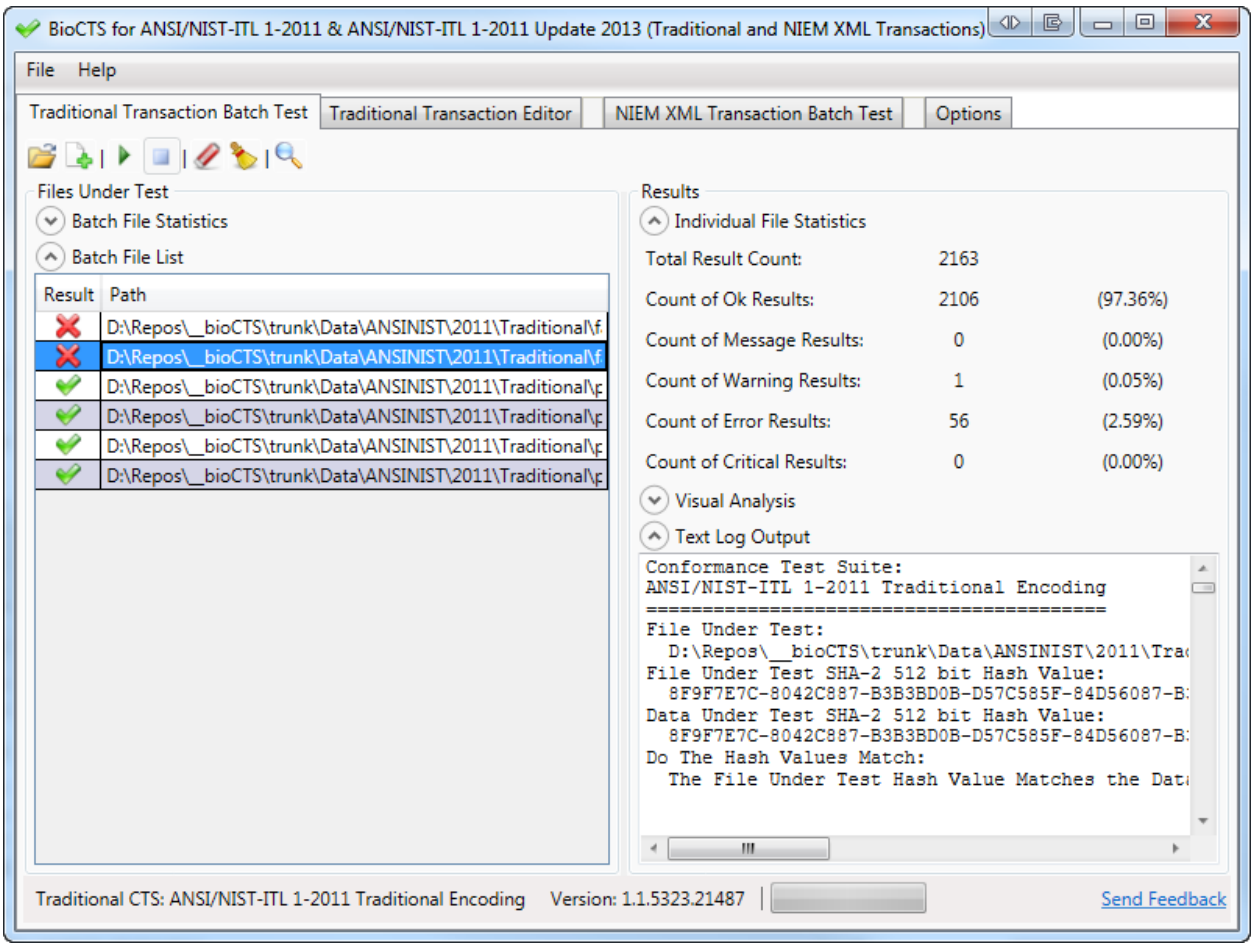

Figure 5 - Batch Test Tab with a Transaction Selected and Statistics Displayed in Right Pane

There is also a high level graphical view of the errors per Record within a Transaction. These graphs can be viewed within BioCTS itself, or saved as an image.

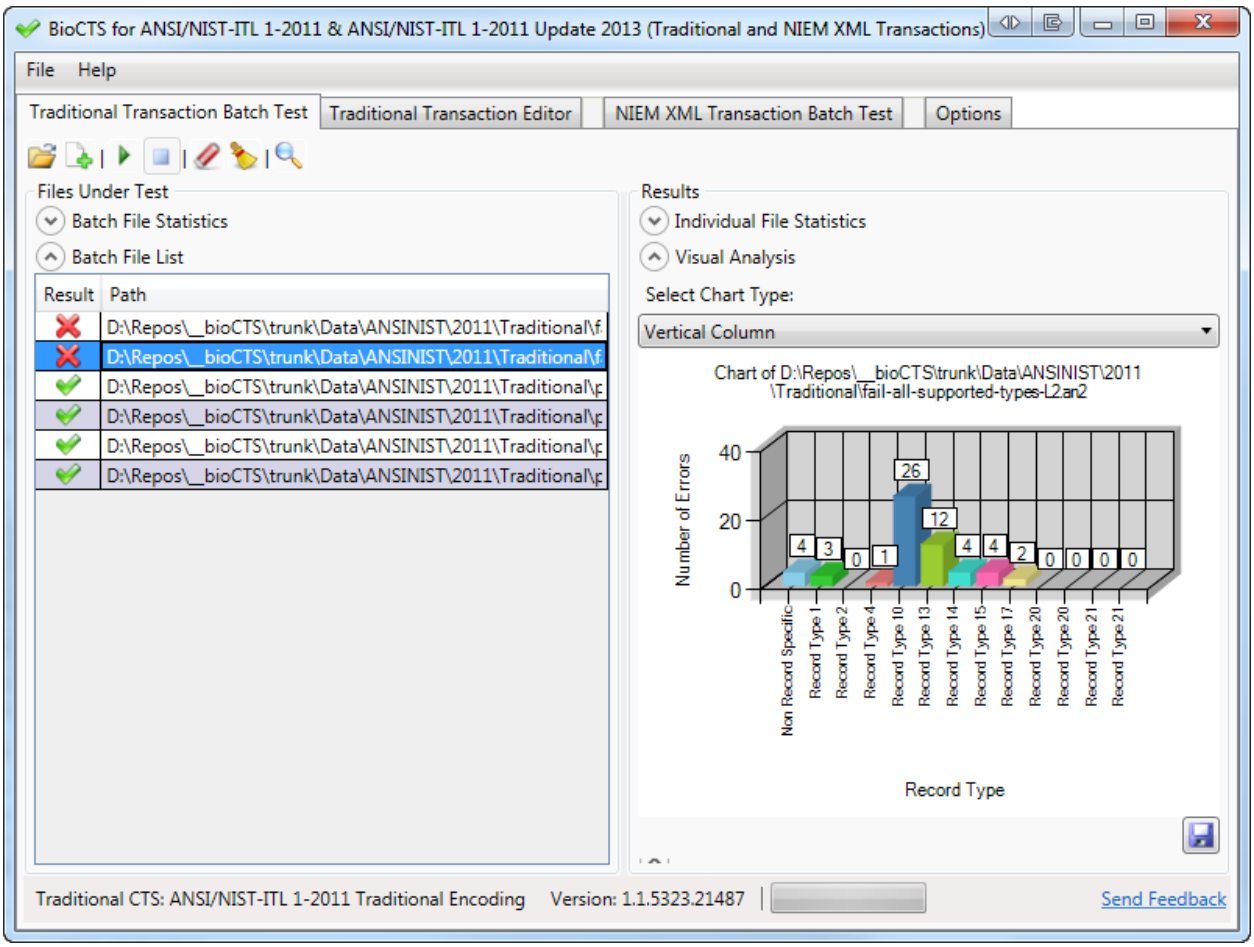

Figure 6 - Batch Test Tab with a Transaction Selected and Chart Displayed in Right Pane (Note: The Colors chosen for the chart are Random, and not indicative of any specific measurement result)

4.3.2. Traditional Transaction Editor

The Traditional Transaction Editor is designed to display every portion of a traditionally encoded transaction, allowing a user to edit, add and remove fields.

The editor is designed to display as much information as possible upon demand; the editor makes use of expander sections, which can be expanded to display more information by pressing the  button within sections.

Powerful New Editor features have been added to the latest version of the editor:

- *Add New Field – Will add a new Field to a Record. Utilizing a new Visual "Add New Field" User Interface to preview the new field. This will attempt to automatically fix the Record Length field to accommodate the new Field.*
- *Remove Field – Will remove a Field from a Record. This will attempt to automatically fix the Record Length field to accommodate the removal of the Field.*

Now users can edit existing fields within a Transaction, and add or remove fields to build Transactions from within BioCTS.

The editor displays the data and associated results in an expandable, hierarchical format, and allows editing of existing data using text fields.

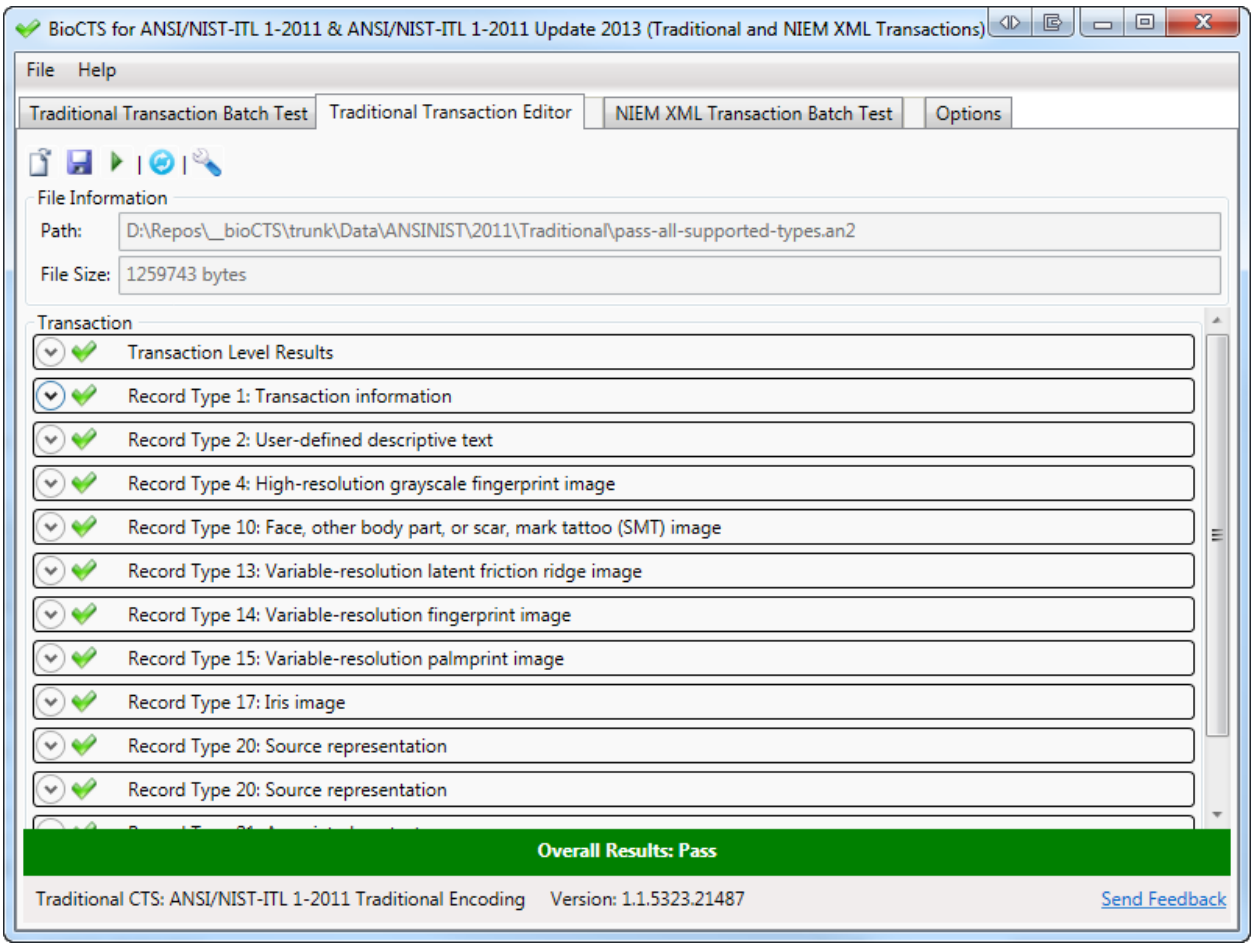

Figure 7 - The Editor with a Passing Transaction Loaded

The Editor displays results in expander sections where appropriate.

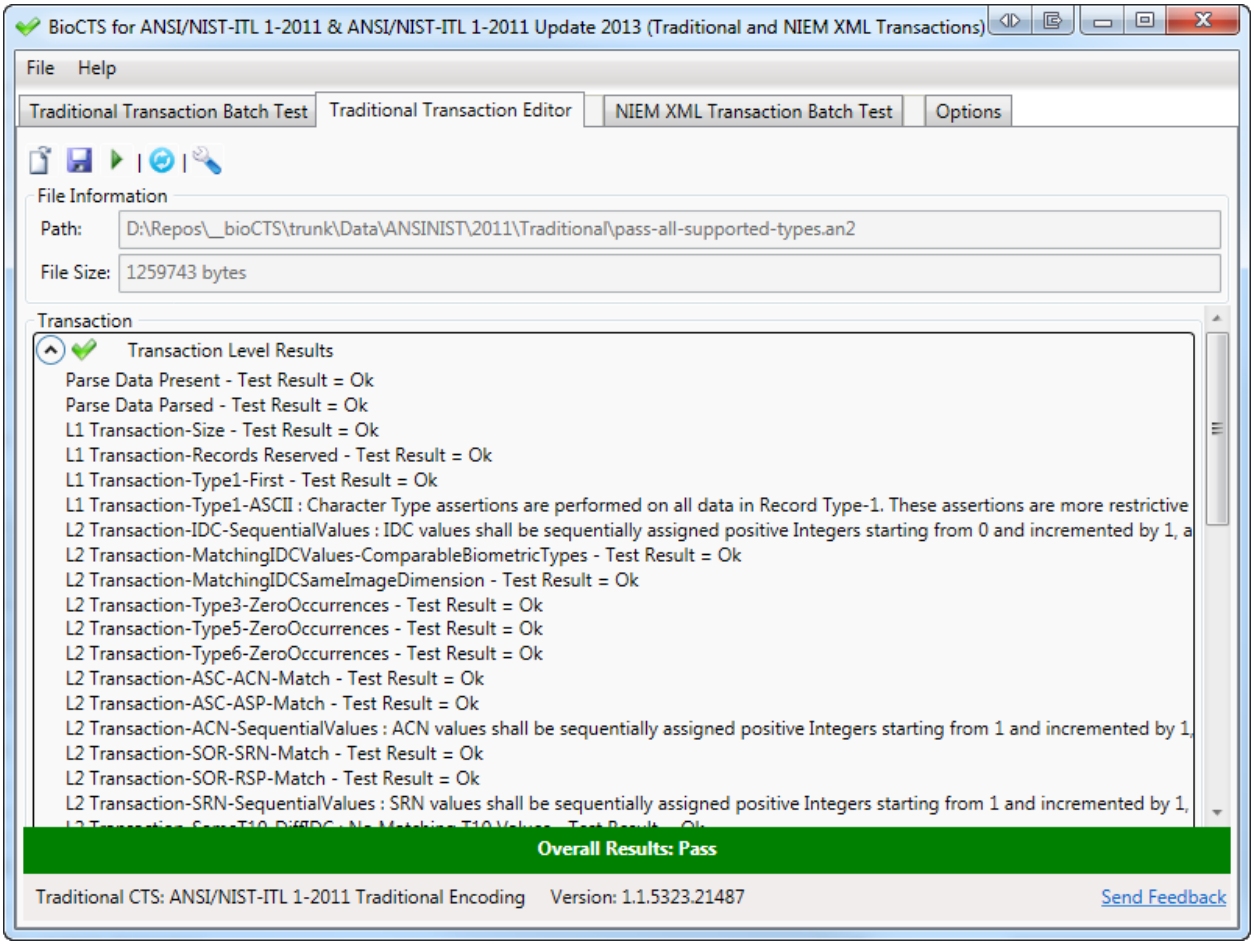

Figure 8 - The Editor Tab with a Passing Transaction Loaded - Displaying Transaction Level Results

When a record is expanded, the Editor displays a list of the fields contained in the record. Each field may also be expanded to reveal the data contained within and the associated results. At this level new Fields can be added to a Record.

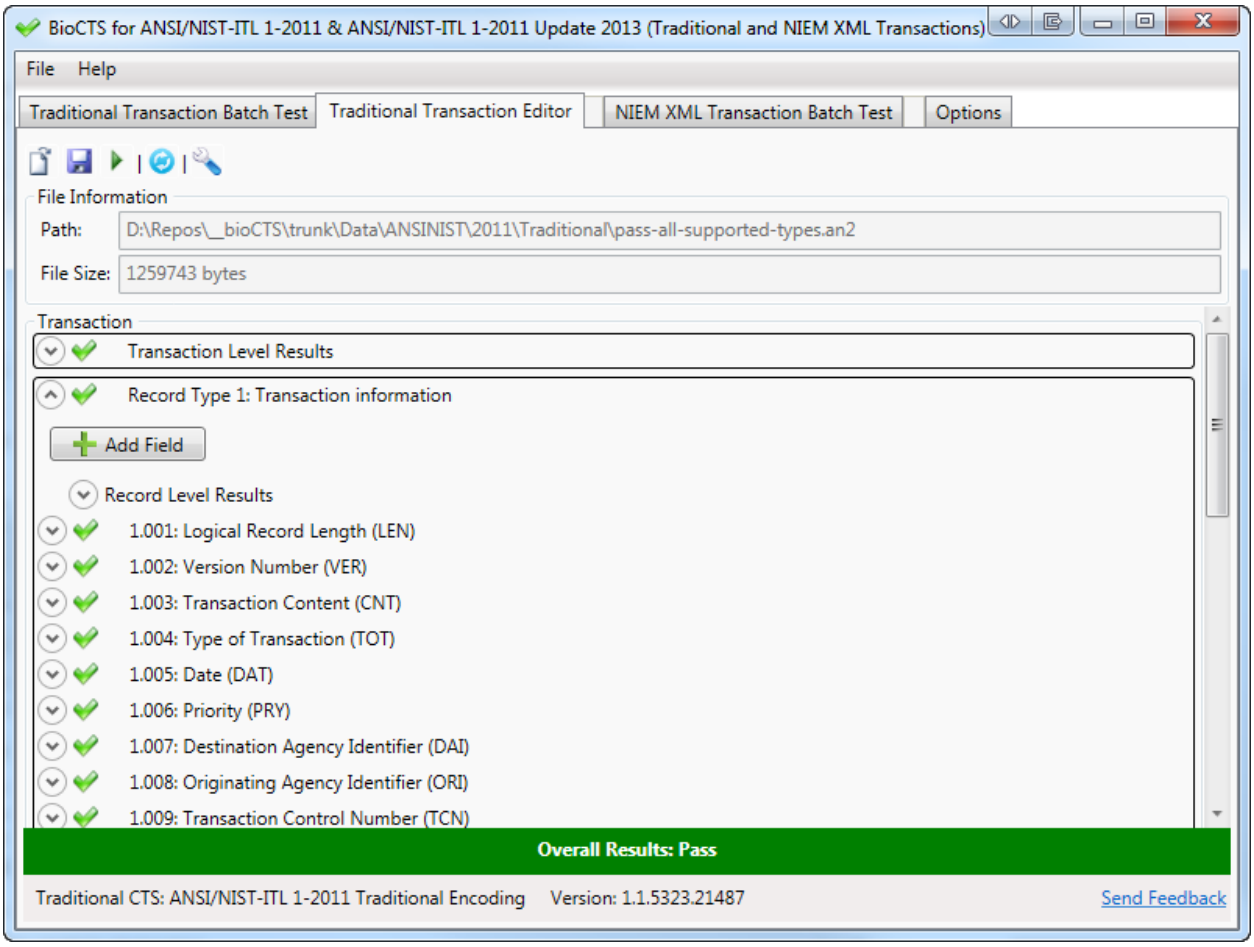

Figure 9 - Editor Tab with Record Type 1 Expanded; revealing collapsed Fields within the Record

The Add New Field prompt will give visual feedback of what the Field will look like. As the information is modified, the Visual Display will show the breakdown, so that the correct number of subfields and information items can be created.

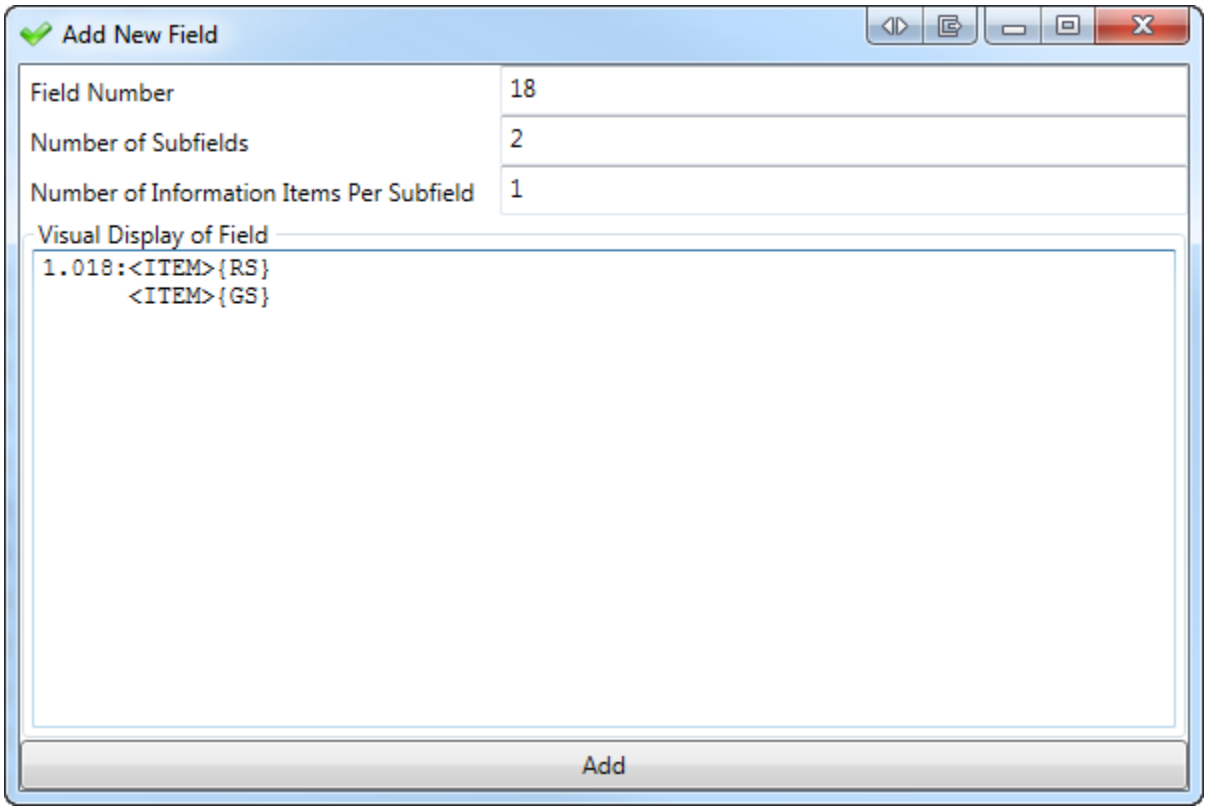

Figure 10 - The Add New Field Dialog

When expanded, a field displays expanders for the field-level results and the data that is held within the field. At this level, a Field can be deleted from a record.

The values in the data text fields can be edited. Two buttons are provided to assist when a large amount of data is being manipulated (such as in an image field):

- Loads data into the contents of a field/subfield/information item
- Saves the contents of a field/subfield/information item

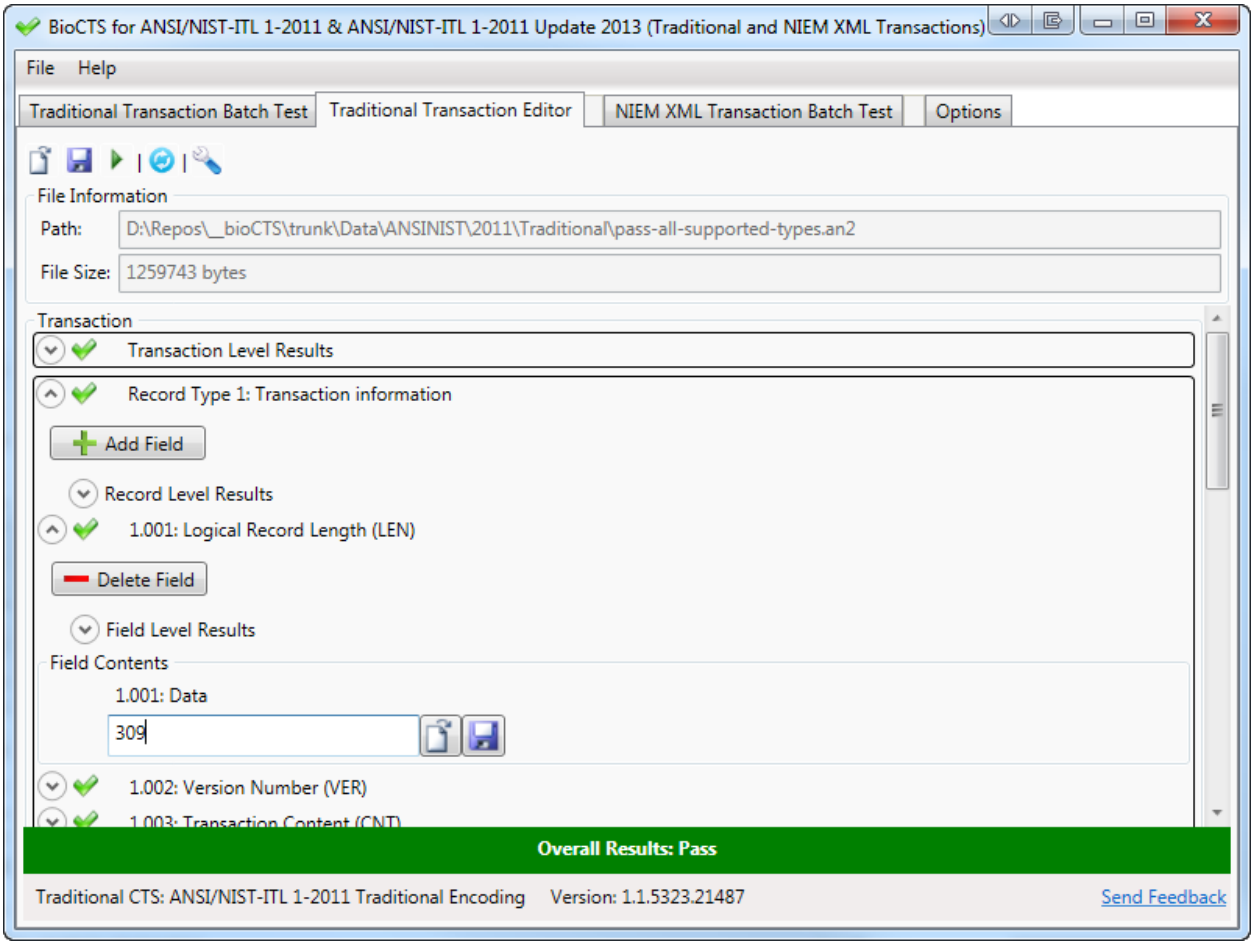

Figure 11 - The Editor Tab with Record Type 1 expanded with Field 1.001 expanded

4.3.3. NIEM XML Transaction Batch Testing

The NIEM XML Transaction Batch Testing tab contains the majority of features found within the Traditional Transaction Batch Testing Tab. Graphical Display of Statistics (currently implemented for Traditional Transaction Batch Test) is under development.

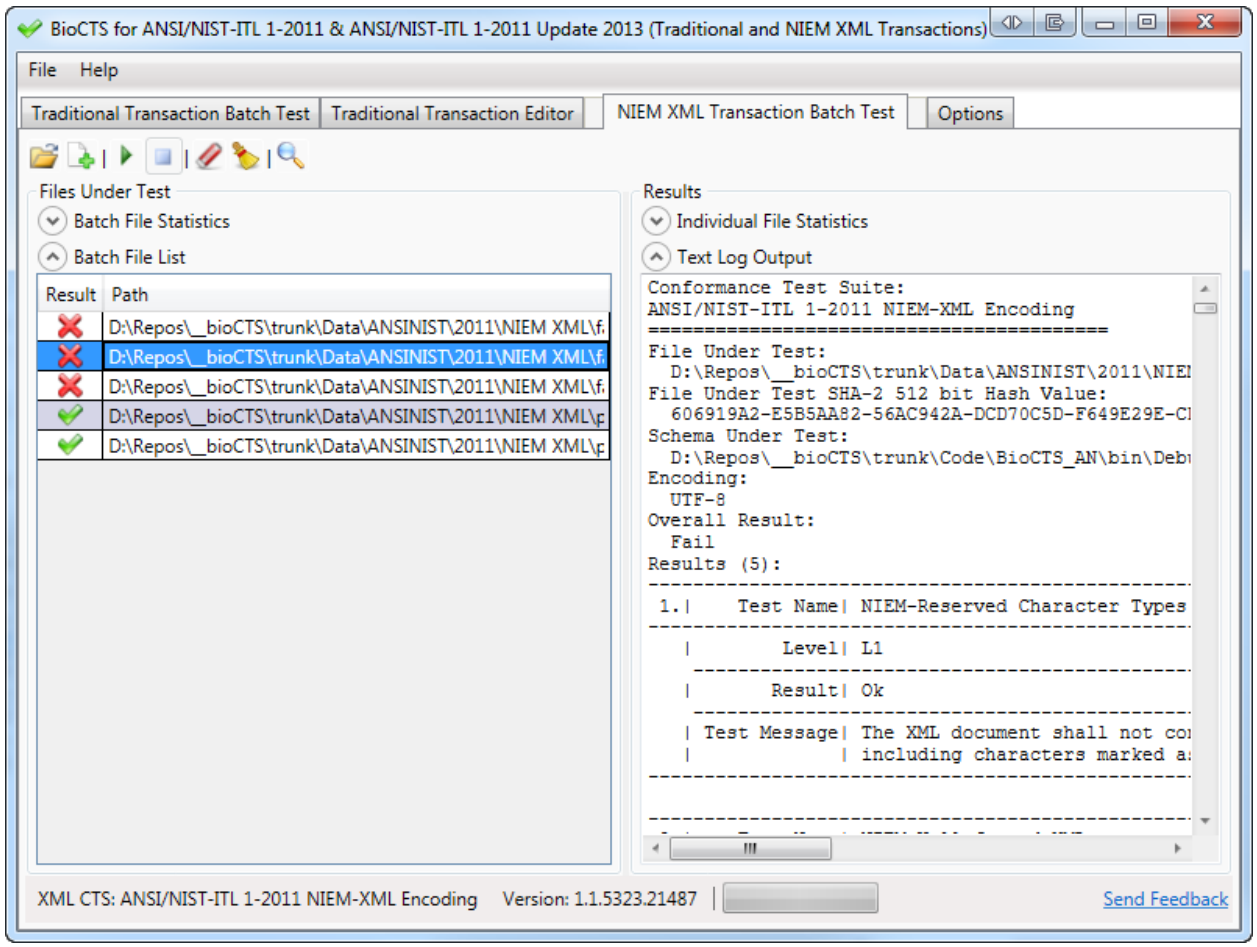

Figure 12 - The NIEM XML Transaction Batch Testing Tab showing the Text Output of a Failing File

4.3.4. Options

The "Options" tab provides several options for BioCTS, and they are described below:

- **ANSI/NIST-ITL Conformance Test Suite Selection:** The Options tab is where the Conformance Test Suites are selected. There are drop-down menus that allow for selection of a Traditional Conformance Test Suite, and a NIEM XML Conformance Test Suite.
- **Output Directory:** The Options tab also includes a directory selection of where BioCTS saves log files. Within this directory, time-stamped folders are generated for each batch test performed.
    - The time-stamped folder has the following format:
        - yyyy – 4 digit year (e.g. 2012)
        - MM – 2 digit month (e.g. 10)
        - dd – 2 digit day (e.g. 31)
        - HH – 2 digit hour in 24-hour scale (e.g. 13)
        - mm – 2 digit minutes (e.g. 59)
        - ss – 2 digit seconds (e.g. 22)
    - In the example provided below:
        - Text Output will be generated in the directory:
            - `C:\Users\dyaga\Desktop\BioCTS for ANSI NIST ITL Output\2012.10.31.13.59.22\Text Output`
        - XML Output will be generated in the directory:
            - `C:\Users\dyaga\Desktop\BioCTS for ANSI NIST ITL Output\2012.10.31.13.59.22\XML Output`
- **ANSI/NIST-ITL 1-2011 XML Schema Extension or Constraint Location / ANSI/NIST-ITL 1-2011 Update: 2013 XML Schema Extension or Constraint Location:** The Options tab is also where the Schema file location is specified. BioCTS provides a set of default Schema Files, which have been modified to allow BioCTS to perform the tests. NISTIR 7957, *Conformance Test Architecture and Test Suite for ANSI/NIST-ITL 1-2011 NIEM XML Encoded Transactions* section 2.4 contains detailed explanations for the reasons the XML Schema files provided had to be modified to perform comprehensive conformance tests of ANSI/NIST-ITL NIEM XML encoded transactions [7]. However, a Constraint or Extension Schema may be used. The features provided (and test outcome for each usage are detailed below):
    - **Extension Schemas**: Support for Extension Schemas is provided to allow substitution elements to be specified for user-defined information in the standard such as the user-defined abstract elements found in Record Type-2.
    - **Constraint Schemas**: Support for Constraint Schemas is provided to allow constraints and restrictions to be defined for use in particular applications such as standard profiles like the FBI EBTS.

    - **User Defined Fields Tested Against Default Schemas:** When XML files with User-Defined fields are tested with the Default Schema Files, the XML files will fail the schema validation test.
    - **Tests against User-Defined Schemas**: When a user-defined schema is used BioCTS is no longer working with a known set of constraints, both XML files with User-Defined fields and without can be affected.
        - If the user-defined schema is not syntactically correct, BioCTS will warn the user.
        - If the XML files tested contain User-Defined Fields that the user-defined schema does not contain, the XML files will fail the schema validation test.
- **User-Defined Field Override File Location:** A New feature to this release is the specification of a User-Defined Field Override File. There are many "User Defined" Fields specified in the ANSI/NIST-ITL standards (e.g., Type 02 Fields), and by default they are shown as "User Defined Field" within the Editor and Test Output Logs. This feature allows a user to override the names of these fields so that they are more descriptive than the default "User Defined Field".
- **Output Options:** Lastly there are options to display the Log folder after a test, the collection of enhanced statistics of the Tests performed within the software, and the option to generate XML logs or not.

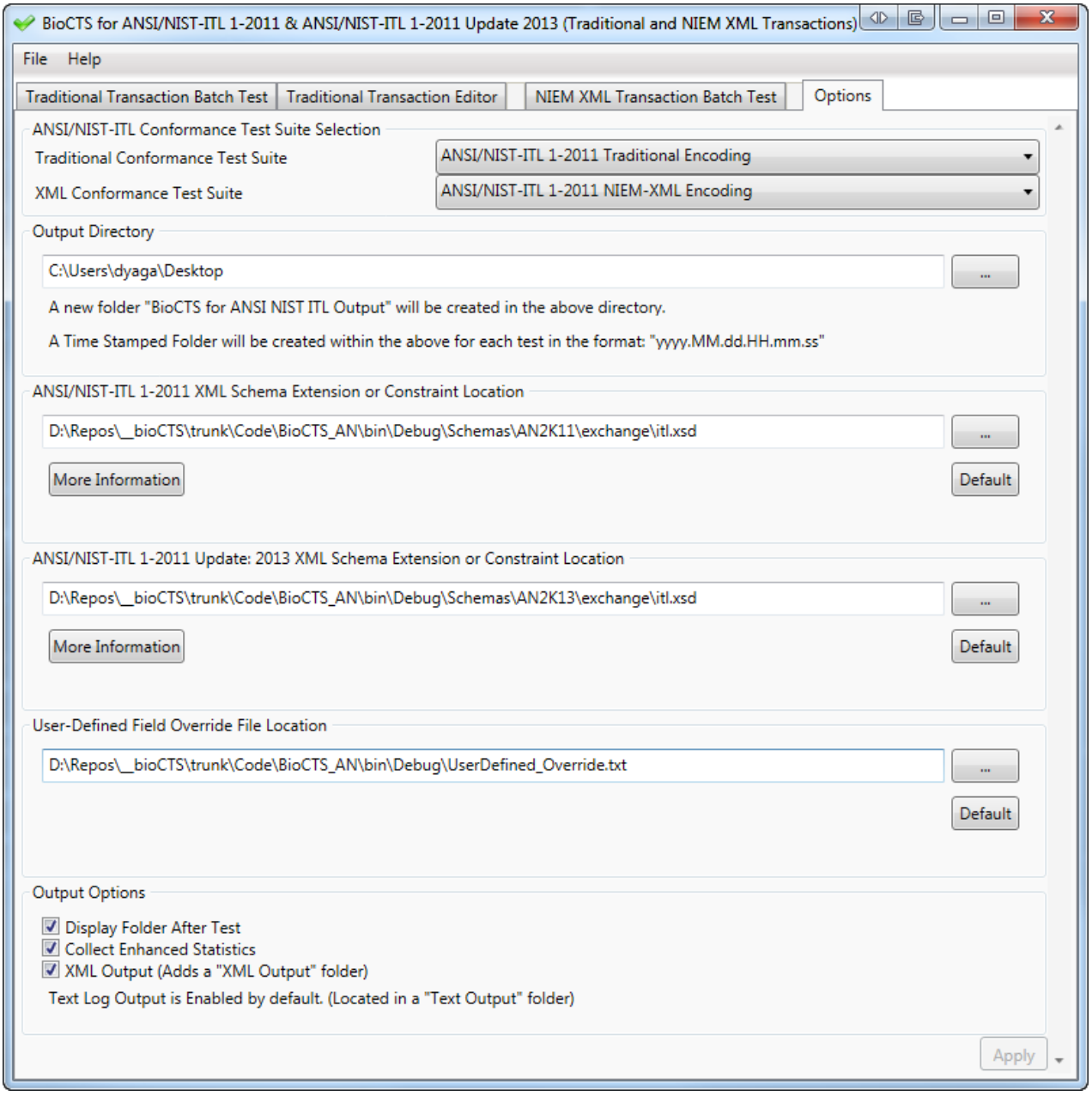

Figure 13 - The Options Tab

4.4. Elements of a Result

The result of any test is comprised of 4 elements:

- Test Name – A string to define what test took place
- Test Level – Testing can take place at multiple levels
    - Parse – A parsing error occurred with this element
    - L1 – A level 1 test
    - L2 – A level 2 test
    - L3 – A level 3 test

- Test Result
  - Ok – The test passed
  - Warning – The test passed, but warranted a warning statement (i.e. used a “Unspecified” value, etc.)
  - Error – The test failed
  - Critical Error – The test failed and is preventing other tests from being performed
- Test Message – A description of what went on during the test, and possible error message

The Text Output Log’s format has been altered since the initial release of BioCTS for ANSI/NIST-ITL. The information presented in a Test Result has been significantly expanded in this version; the test message is now generated with as much robust information as possible, including various operators and operands used within the test. The following is an example of the current Test Results, where each element of the Result is clearly labelled within the Text Output Log:

```
-------------------------------------------------------------------------------------------------------
 6.|    Test Name| 1.001-LEN-CharCount
-------------------------------------------------------------------------------------------------------
   |        Level| L1
    -----------------------------------------------------------------------------------------------
   |       Result| Ok
    -----------------------------------------------------------------------------------------------
   | Test Message| Greater Than or Equal Test: Is the character count present (3) greater than or
   |             | equal to the minimum non-negative Integer value (1)?
-------------------------------------------------------------------------------------------------------
```

Figure 14 - Text Output Result Example

The same exact Result is encoded in the XML Log as follows:

```
<Result>
  <Level>L1</Level>
  <Message>
    Greater Than or Equal Test: Is the character count present (3) greater than or equal
    to the minimum non-negative Integer value (1)?
  </Message>
  <Results>Ok</Results>
  <Test>1.001-LEN-CharCount</Test>
</Result>
```

Figure 15 - XML Output Result Example

5. References

1. NIST Special Publication 500-290 Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information
   http://biometrics.nist.gov/cs_links/standard/AN_ANSI_1-2011_standard.pdf
2. NIST Special Publication 500-290 Rev1 (2013) Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information
   http://biometrics.nist.gov/cs_links/standard/ansi_2012/Update-Final_Approved_Version.pdf
3. ANSI/NIST-ITL Standard Homepage
   http://www.nist.gov/itl/iad/ig/ansi_standard.cfm
4. DRAFT NIST SP 500-295 Revision 1 – Conformance Testing Methodology for ANSI/NIST-ITL 1-2011, Data Format for the Interchange of Fingerprint, Facial & Other Biometric Information
   http://csrc.nist.gov/groups/ST/BiomResCenter/CTA_BETA/DRAFT_NIST_SP_500_295_Revision1_October2013.pdf
5. Federal Information Processing Standards Publication 180-4, Secure Hash Standard (SHS)
   http://csrc.nist.gov/publications/fips/fips180-4/fips-180-4.pdf
6. SHA-2 Wikipedia Summary
   https://en.wikipedia.org/wiki/SHA-2
7. NISTIR 7957 Conformance Test Architecture and Test Suite for ANSI/NIST-ITL 1-2011 NIEM XML Encoded Transactions
   http://csrc.nist.gov/groups/ST/BiomResCenter/CTA_BETA/NISTIR_7957_August_2013.pdf