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Related work:

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- *Test Assertions Guidelines Version 1.0*. Latest version. http://docs.oasis-open.org/tag/guidelines/v1.0/guidelines-v1.0.html
- *Test Assertion Markup Language Version 1.0*. Latest version. http://docs.oasis-open.org/tag/taml/v1.0/testassertionmarkuplanguage-1.0.html

Abstract:

The specification defines a model for Test Assertions that are associated with a specification, and defines their use and semantics.

Status:

This document was last revised or approved by the OASIS Test Assertions Guidelines (TAG) TC on the above date. The level of approval is also listed above. Check the “Latest version” location noted above for possible later revisions of this document.

A version of this document with formatting inconsistencies was initially published at the “This version” location noted above. It has been removed and archived at the following URI: https://www.oasis-open.org/committees/download.php/47574/testassertionsmodel-1.0-os-error.zip.

Technical Committee members should send comments on this specification to the Technical Committee's email list. Others should send comments to the Technical Committee by using the "Send A Comment" button on the Technical Committee's web page at http://www.oasis-open.org/committees/tag/.

For information on whether any patents have been disclosed that may be essential to implementing this specification, and any offers of patent licensing terms, please refer to the Intellectual Property Rights section of the Technical Committee web page (http://www.oasis-open.org/committees/tag/ipr.php).

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1 Introduction

1.1 Terminology

Within this specification, the key words "shall", "shall not", "should", "should not" and "may" are to be interpreted as described in Annex H of [ISO/IEC Directives] if they appear in bold letters.

1.1.1 Data Model Formal Definition Terminology

The means of formally defining the model in this specification involves the use of terms “class”, “attribute”, “datatype” and “association”. These are terms familiar in an object oriented paradigm but should not be strictly interpreted as object oriented terms. The terms are used as a means of formally defining the data structures in the model and do not specify or imply how that data is to be accessed or used. The use of the object oriented terminology should not be taken to mean that the implementation is to be object oriented.

Class

The term “class” is used when the structure so modeled is a complex grouping of more than one entity (either “attributes” or “associations” or both).

Datatype

The term “datatype” is primarily used of a simple, primitive type such as a string or integer.

Attribute

The term “attribute” is used to specify an entity that is an instance of a primitive or simple datatype such as a string or an integer.

Association

The term “association” is used of an entity which is an instance of a class (i.e. its structure is defined by a class) and which appears as an element inside another class.

1.1.2 Domain terminology

This section provides definitions of terms that are related but not central to the notion of test assertion. These definitions represent a common understanding among practitioners but do not pretend to be here authoritative.

Conformance

The fulfillment of specified requirements by a product, document, process, or service.

Conformance Clause

A statement in a specification that lists all the criteria that must be satisfied by an implementation (data artifact or processor) in order to conform to the specification. The clause refers to a set of normative statements and other parts of the specification for details.

Implementation

A product, document, process, or service that is the realization of a specification or part of a specification.

Normative Statement, Normative Requirement

A statement made in the body of a specification that defines prescriptive requirements on a conformance target.

Test Case

A set of a test tools, software or files (data, programs, scripts, or instructions for manual operations) that verifies the adherence of a test assertion target to one or more normative statements in the specification. Typically a test case is derived from one or more test assertions. Appendix A proposes a more precise definition of the meaning of deriving a test case from a test assertion. Each test case typically includes: (1) a description of the test purpose (what is being tested - the conditions / requirements / capabilities which are to be addressed by a particular test), (2) the pass/fail criteria, (3) traceability information to the verified normative statements, either as a reference to a test assertion, or as a direct reference to the normative statement. They are normally grouped in a test suite.

Test Metadata

Metadata that is included in test cases to facilitate automation and other processing.

1.2 Normative References

[ISO/IEC Directives] ISO/IEC Directives, Part 2 Rules for the structure and drafting of International Standards, International Organization for Standardization, 2004. http://www.iso.org/iso/standards_development/processes_and_procedures/iso_iec_directives_and_iso_supplement.htm

1.3 Non-Normative References

[CONFCLAUSE] OASIS, **"**Guidelines to Writing Conformance Clauses ", September 2007

http://docs.oasis-open.org/templates/TCHandbook/ConformanceGuidelines.html

[CONF1] **OASIS, "**Conformance requirements for Specifications" , March 2002,

http://www.oasis-open.org/committees/download.php/305/conformance_requirements-v1.pdf

[CONF2] **OASIS, "**Conformance testing and Certification Framework" , Conformance TC, June 2001,

http://www.oasis-open.org/committees/download.php/309/testing_and_certification_framework.pdf

[RFC 2119] S. Bradner. *Key words for use in RFCs to Indicate Requirement Levels*. IETF RFC 2119, March 1997. http://www.ietf.org/rfc/rfc2119.txt.

[VAR] **W3C, "**Variability in Specifications", WG note,2005,

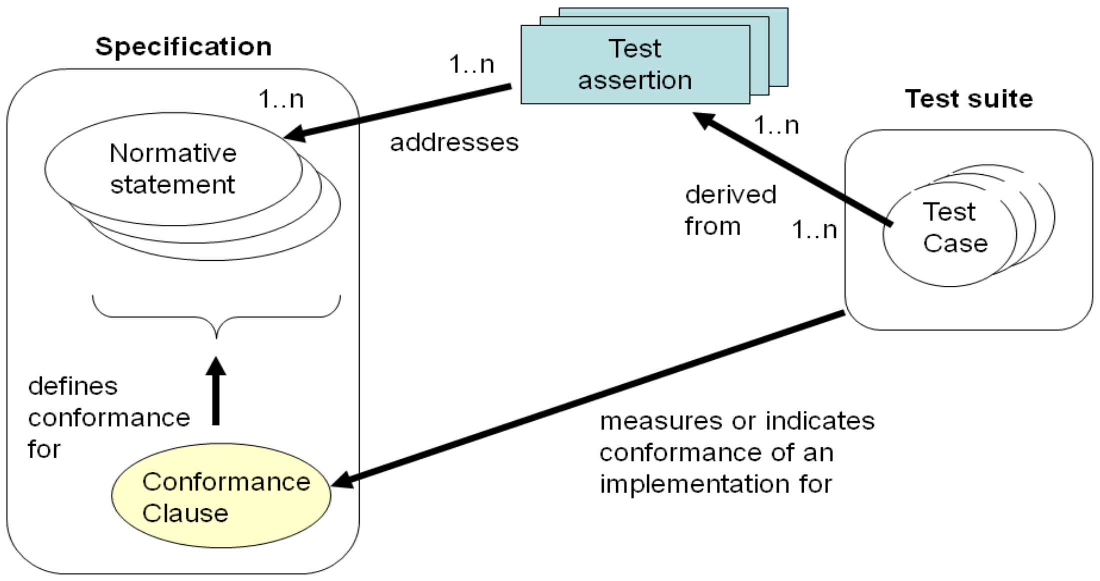
http://www.w3.org/TR/2005/NOTE-spec-variability-20050831/

2 Role and Rationale

2.1 The Role of a Test Assertion

A test assertion is a testable or measurable expression for evaluating the adherence of an implementation (or part of it) to one or more normative statements in a specification. It describes the expected output or behavior for the test assertion target within specific operation conditions, in a way that can be measured or tested.

Fig.2 How Test Assertions relate to Specifications and Testing



A Test Assertion should not be confused with a Conformance Clause, nor with a Test Case. The specification will often have one or more conformance clauses CONFCLAUSE [[CONF1]][[CONF2]] which define various ways to conform to a specification [[VAR]] . A set of test assertions may be associated with a conformance clause in order to define more precisely what conformance entails for a candidate implementation. Test assertions lie between the specification and any suite of tests to be conducted to determine conformance. Such a test suite is typically comprised of a set of test cases. These test cases are derived from test assertions that address the normative statements of the specification.

2.2 Benefits of Test Assertions

Improving the Specification

When defined at an early stage, test assertions may help provide a tighter specification. Any ambiguities, gaps, contradictions and statements which require excessive or impractical resources for testing can be noted as they become apparent during test assertion creation. If there is still an opportunity to correct or improve the specification, these notes can be the basis of comments to the specification authors. If not developed by the specification authors, test assertions should be reviewed and approved by them which will improve both the quality and time-to-deployment of the specification. Therefore, best results are achieved when assertions are developed in parallel with the specification.

Facilitating Testing

Test assertions provide a starting point for writing a conformance test suite or an interoperability test suite for a specification that can be used during implementation. They simplify the distribution of the test development effort between different organizations while maintaining consistent test quality. By tying test output to specification statements, test assertions improve confidence in the resulting test and provide a basis for coverage analysis (estimating the extent to which the specification is tested).

Aligning Implementations

Test assertions provide explicit guidance for implementers of a specification, by stating more concretely and practically the conditions to fulfill in order to conform. Unlike test suites which can only be exercised once the implementation work is done, test assertions are usable early on during the implementation work.

3 Test Assertion

3.1 Test Assertion Overview and Terminology

3.1.1 Core Test Assertion Parts

The following are defined as the "core" parts of a test assertion:

Identifier

A unique identifier for the test assertion. It is recommended that the identifier be made universally unique.[1]

Normative Sources

These refer to the precise specification requirements or normative statements that the test assertion addresses.

Target

A test assertion target is the implementation or part of an implementation that is the main object of the test assertion, and of its Normative Sources. It categorizes an implementation or a part of an implementation of the referred specification.

Predicate

A predicate asserts, in the form of an expression, the feature (a behavior or a property) described in the specification statement(s) referred by the Normative Sources. If the predicate is an expression which evaluates to “true” over a Target instance, this means that the test assertion target exhibits this feature. “False” means the target does not exhibit this feature.

3.1.2 Optional Test Assertion Parts

The following are defined as the "optional" parts of a test assertion:

Prescription Level

The prescription level is a keyword that indicates how imperative it is that the Normative Statement referred to in the Normative Source, be met. The test assertion defines a normative statement which may be **mandatory** (MUST / REQUIRED / SHALL), **permitted** (MAY / CAN) or **preferred** (SHOULD / RECOMMENDED). This property can be termed the test assertion’s prescription level.

NOTE: in the case of the normative source including keywords 'MUST NOT' or 'shall not' the prescription level '**mandatory**' is used and the 'NOT' included in the predicate. Similarly, a statement with NOT RECOMMENDED or SHOULD NOT belongs to the **'preferred'** level**.** There are differences between various conventions of normative language [ISO/IEC Directives] [RFC 2119]and the above terms **may** be extended with more specialized terms for a particular convention and its distinct shades of meaning.

Prerequisite

A test assertion Prerequisite is a logical expression (similar to a Predicate) which further qualifies the Target for undergoing the core test (expressed by the Predicate) that addresses the Normative Statement. It

1 One way to do this is to designate a universally unique name for a set of test assertions and to include this name along with the identifier when referencing the test assertion from outside of this set.

may include references to the outcome of other test assertions. If the Prerequisite evaluates to "false" then the Target instance is not qualified for evaluation by the Predicate.

Tag

Tags represent properties or 'keywords' that qualify a test assertion. Tags may be given values. Tags provide a means to categorize the test assertions. They enable the grouping of the test assertions, for example based on the type of test they assume or based on some property of their Target .

Variable

Variables are convenient for storing values, reuse and shared use, within or across test assertions. Another use of a variable is as parameter or attribute employed by the writer of a test assertion to refer to a value that is not known at the time the test assertion is written, but which will be determined at some later stage, possibly as late as the middle of running a set of tests.

Description

An informal definition of the role of the test assertion, with some optional details on some of its parts. This description **shall not** alter the general meaning of the test assertion and its parts as described in this model. This description may be used to annotate the test assertion with any information useful to its understanding. It does not need to be an exhaustive description of it.

3.1.3 Implicit Test Assertion Parts

In an actual test assertion definition, the previously mentioned parts are often explicitly represented as elements of the test assertion.

A concrete representation of a test assertion **may** omit elements (core or optional) provided they are implicit, meaning that the context in which the test assertion is defined, allows for unambiguous determination of the non-explicit element, e.g. via some rule or inference. A common case of implicit test assertion components is the implicit target: When several test assertions relate to the same target, the latter may be described just once as part of the context where the test assertions are defined, so that it does not need to be repeated. This calls for further structural components than those described so far. The more complex structure **may** include a test assertion set whose model caters for sharing of test assertion parts among a group of test assertions.

3.1.4 Informal Notation

The following notation will be used for a plain English representation of a test assertion. In bold, are the test assertion part names as defined in the above terminology section :

```
TA id: (here state the Identifier of the test assertion)

Normative Source: (here state the Normative Source reference or copy)

Target: (here state the Target identifier)

Prerequisite: (here an assertion stating the Prerequisite with possible
reference to the Target. Notational convention: the reference to the Tar-
get is within square brackets.

Predicate: (here an assertion stating the Predicate and referring to the
Target. Notational convention: the reference to the Target is within
square brackets.)
```

Prescription Level: (here state the **Prescription Level** of the test assertion, which is a keyword among {mandatory, preferred, permitted})

Tag: (here a name / value pair expressing a particular **Tag**. This test assertion part can be repeated. Notational convention: use the operator '=' between name and value.)

Variable: (here an identifier, along with its definition and/or value, representing a **Variable** that is reused in some other part of the test assertion. This test assertion part can be repeated. Notational convention: use the operator '=' between name and value, and put the definition in parenthesis just after the name, if any.)

Description: (here state the **Description** of the test assertion)

This informal notation will be used for describing examples of test assertions.

Example of informal Test Assertion:

TA id: gizmo-TA300

Normative Source: specification requirement 317

Target: electrical-gizmo

Prerequisite: [The gizmo] has a low-battery indicator.

Predicate: The low-battery indicator of [the gizmo] is a red LED that is flashing below CRITICAL-CHARGE battery voltage.

Prescription Level: mandatory

Tag: conformanceclass = "international"

Variable: CRITICAL-CHARGE (the critical voltage limit in a battery).

3.2 Test Assertion Model

3.2.1 Convention Used for Formally Defining the Model

The means of formally defining the model in this specification involves the use of terms “class”, “attribute”, “datatype” and “association” as defined in section 1.1.1.

Example Formal Definition:

```
myclass {

  content : string (0..1)
  id : string (1..1)
  Child : child (1..*)
  Sibling : sibling (0..*)
}
```

With the exception of the example above, all of the textual representations of model constructs in this specification are normative and authoritative. However, some classes in this specification **may** be extended either by adding further attributes or by adding further associations or both. This is indicated in the prose immediately following the representation of the class.

The class name, here called '`myclass`', is shown before the opening curly bracket.

The attributes combine the name of the attribute in lower camel case separated by a colon from the name of the datatype on which the type of the attribute is based.

The associations combine the name of the association in upper camel case separated by a colon from the name of the class which is associated and which represents the type of the association.

The cardinality is specified using the notation "(x..y)" where "x" represents the lower bound and "y" the upper bound of the cardinality. The symbol "*" represents a limitless upper bound. There are the following cardinalities used in the model:

(0..1) specifies an optional, singular entity (lower bound 0, upper bound 1)

(0..*) specifies an optional, multiple entity (lower bound 0, upper bound unlimited)

(1..1) specifies a mandatory, singular entity (lower bound 1, upper bound 1)

(1..*) specifies a mandatory, multiple entity (lower bound 1, upper unlimited)

(x..y) specifies an entity lower bound x, upper y where x and y are positive integers, for example (1..2)

In the example representation above the class "myclass" has a mandatory attribute, shown with "(1..1)" to signify that it is mandatory, called "id" whose content is type "string". Another attribute named "content" is shown to be optional by the notation (0..1). The "myclass" class has associations to other classes called "child" and "sibling". These are similar to attributes whose types are complex and represented in this model as classes. The (0..*) notation signifies that the entity named "sibling" has multiple cardinality and is optional. The (1..*) after the association called "child" signifies that this association is mandatory and multiple.

Any graphic images such as class diagrams included in this specification are non-normative. It is the text which shall be taken as normative. Any diagrams are to be interpreted loosely as illustrative material and in the case of any discrepancy with the text it is the text which is to be taken as authoritative.

3.2.2 Mapping Test Assertion Terminology to the Formal Notation

Table 1. Mapping Section 3.1 test assertion parts (as defined in the previous terminology section) to the formal Test Assertions Model

Test Assertion Parts	**Corresponding Entities in Test Assertions Model**
Test Assertion	Class: testAssertion
Core Parts	
Identifier	attribute: testAssertion.id ('id' attribute of testAssertion class)
Normative Source	Class: normativeSource
Target	Class: target

Predicate	Class: predicate
Optional Parts	
Prescription Level	attribute: prescription.level ('level' attribute of prescription class)
Prerequisite	Class: prerequisite
Tag	Class: tag
Variable	Class: variable
Description	Class: description

3.2.3 General Structure of a Test Assertion

A test assertion **shall** include, implicitly or explicitly the following parts:

- Identifier
- Normative Source
- Target
- Predicate

In addition, a test assertion **may** optionally include the following parts:

- Prescription Level
- Prerequisite
- Tag (possibly many)
- Variable (possibly many)
- Description

3.2.4 testAssertion

An instance of testAssertion is a testable or measurable expression for evaluating the adherence of an implementation (or part of it) to one or more normative statements in a specification.

Formal Definition of 'testAssertion':

```
testAssertion {

  id : string (1..1)
  NormativeSource : normativeSource (1..1)
  Target : target (1..1)
  Prerequisite : prerequisite (0..1)
  Predicate : predicate (1..1)
  Prescription : prescription (0..1)
  Description : description (0..1)
  Tag : tag (0..*)
  Variable : variable (0..*)

}
```

Semantics:

- The <**id**> attribute (corresponding to the *Identifier* terminology definition) is uniquely identifying the test assertion.

- The <**NormativeSource**> association (corresponding to the *Normative Source* terminology definition) is identifying the normative statement in the specification that describes the feature or behavior that needs to be verified over a <Target> instance.

- The <**Target**> association (corresponding to the *Target* terminology definition) is identifying (or categorizing) the specification implementation(s) or parts of, subject to testing.

- The <**Prerequisite**> association (corresponding to the *Prerequisite* terminology definition) expresses a pre-condition to be satisfied by the <Target> in order to qualify for the test expressed by the <Predicate>. It is a boolean expression: if evaluates to "true", the <Predicate> can be evaluated over the <Target>. If evaluates to "false", the <Target> is not qualified for this test assertion.

- The <**Predicate**> association (corresponding to the *Predicate* terminology definition) expresses the feature or behavior expected from the <Target> as stated in <NormativeSource>. It is a boolean expression: if evaluates to "true", the <Target> instance exhibits the expected feature. If "false", the <Target> does not.

- The <**Prescription**> association (corresponding to the *Prescription Level* terminology definition) expresses how imperative is the statement referred by <NormativeSource>: usually one level among {"permitted", "preferred", "mandatory" }(corresponds to optional/recommended/required)

- The <**Description**> association (corresponding to the *Description* terminology definition) gives an informal definition of this particular test assertion.

- The <**Tag**> association (s) (corresponding to the *Tag* terminology definition) add some annotation mechanism in the form of (name, value) pair(s), or just a (name) property.

- The <**Variable**> association (s) (corresponding to the *Variable* terminology definition) provide some way to parameterize the expressions used in other elements of the test assertion, or to abstract some of its values. It is in the form of a (name, value) pair or just a (name). An additional definition statement may be added to the name.

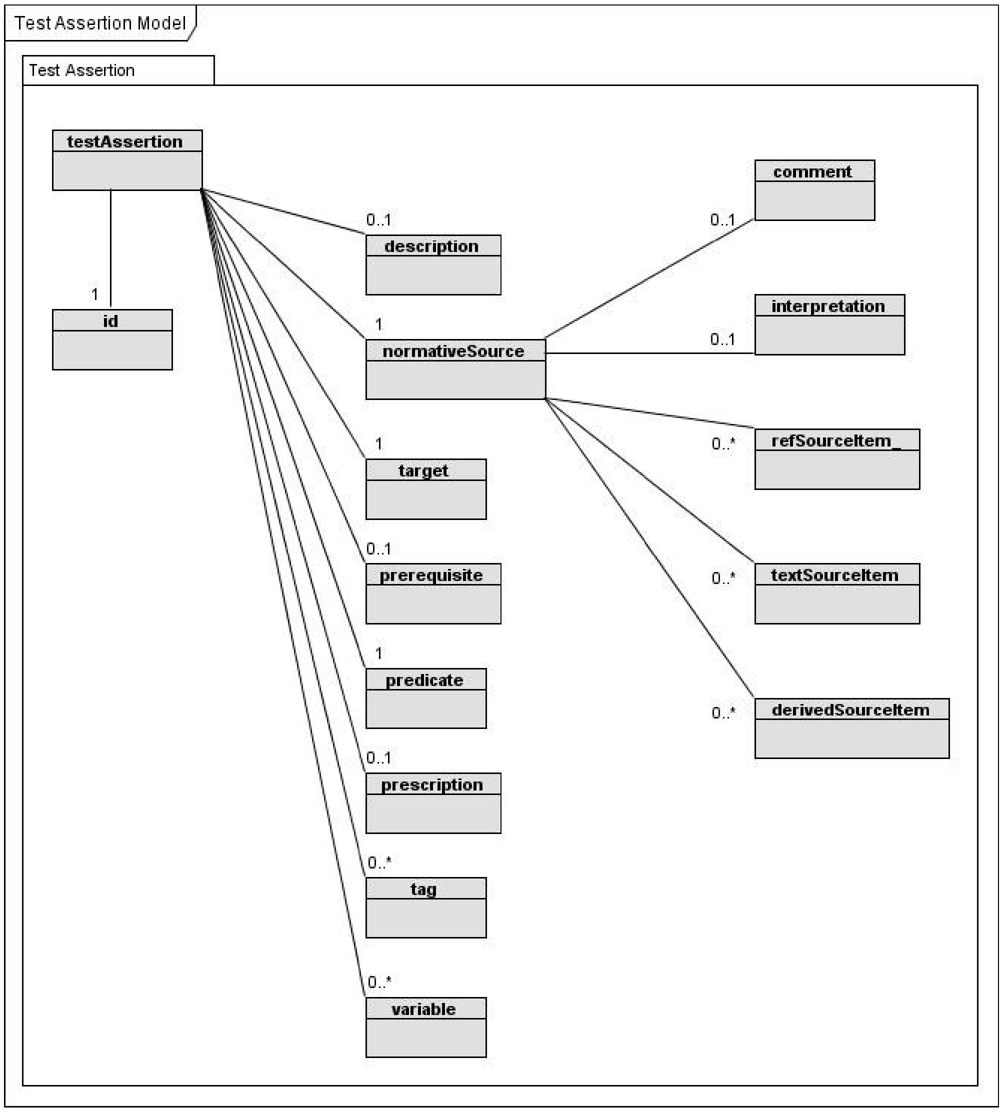
Other attributes and associations **may** be added to the `testAssertion` class.

The `NormativeSource`, `target` and `Predicate` elements, although mandatory, **may** be implicit and also **may** be declared in a test assertion set (specified later). An instance of the `testAssertion` class may have any of its parts defined implicitly, i.e. their actual representation can be inferred, either from a container structure like a “test assertion set” or from other rules.

The `Prerequisite` and `Predicate` elements are of same nature. They are logical statement evaluating to true or false, which may in turn be composed of sub-expressions or sub-statements. These sub-expressions may be captured by `Variables`.

The overall semantics of a Test Assertion with regard to its Target, may be summarized as follows:

- The "**Target” is said to be not qualified for the Test Assertion** if the Prerequisite (if any) evaluates to "false" over theTarget .
- The "**Target” is said to fulfill the Normative Statement addressed by the Test Assertion** if the Prerequisite (if any) evaluates to "true" over the Target , and the Predicate evaluates to "true".
- The "**Target” is said to not fulfill the Normative Statement addressed by the Test Assertion** if the Prerequisite (if any) evaluates to "true" over a Target , and the Predicate evaluates to "false".



Test Assertion (Non-Normative UML-Style Class Diagram)

3.2.5 id

This attribute is the identifier of the test assertion. Its string value **should** be universally unique.

3.2.6 normativeSource

An instance of 'normativeSource' identifies the normative statement in the specification that describes the feature or behavior that needs to be verified over a 'target' instance.

Formal Definition of 'normativeSource':

```
normativeSource {

  content : string (0..1)
  Comment : comment (0..1)
  Interpretation : interpretation (0..1)
  RefSourceItem : refSourceItem (0..*)
  TextSourceItem : textSourceItem (0..*)
  DerivedSourceItem : derivedSourceItem (0..*)

}
```

Semantics:

```
- The <content> attribute allows for quoting the entire normative source in-
side the test assertion (e.g. a copy of the original normative statement as
it appears in a specification), when it is a single statement.

- The <Comment> association allows to add comments about the normative
source.

- The <Interpretation> association may be used to add an alternative de-
scription in prose of any kind to a normative source e.g. to clarify its
meaning or facilitate human understanding. It may provide further informa-
tion clarifying how the predicate (or prerequisite) relates to the normative
source.

- The <RefSourceItem> association references the original normative source
statement, when externally defined.

- The <TextSourceItem> association quotes verbatim the source item.

- The <DerivedSourceItem> association  derives a form of words equivalent in
meaning to the source item. This is useful when the source consists of
tables, diagrams, graphs or text spread over several parts of the specifica-
tion.
```

Other attributes **may** be added to the `normativeSource` class.

The normative source of a test assertion may be provided as a reference using the `refSourceItem` class.

Formal Definition of 'refSourceItem':

```
refSourceItem {

  name : string (0..1)
  uri : string (0..1)
  documentId : string (0..1)
  versionId : string (0..1)
  revisionId : string (0..1)
  resourceProvenanceId : string (0..1)
}
```

Semantics:

```
- The <name> attribute is the name of the referred document containing the
normative statement.
```

```
- The <uri> attribute contains a URI that locates the resource.

- The <documentId> attribute identifies the referred document containing the
normative statement.

- The <versionId> attribute identifies the version of the referred document.

- The <revisionId> attribute identifies the revision of the referred docu-
ment.

- The <resourceProvenanceId> attribute contains additional source informa-
tion associated with the referred document (such as authorship identifiers
to certify its authenticity).
```

Other attributes **may** be added to the `refSourceItem` class.

An alternative to using a reference to point to the normative source in a specification is to actually quote verbatim the source item so the normative source includes an association with a class named `text-SourceItem` which allows a direct, verbatim quote of the specification text.

Formal Definition of 'textSourceItem':

```
textSourceItem {

  content : string (0..1)
  name : string (0..1)
}
```

Semantics:

```
- The <content> attribute is quoting the normative source item.

- The <name> attribute is an informal qualifier of the statement.
```

Other attributes **may** be added to the `textSourceItem` class.

An alternative again to quoting verbatim the source item is to derive a form of words equivalent in meaning to the source item and for this the normative source includes an association to a class named `derivedSourceItem`. This is particularly useful when the source consists of tables, diagrams, graphs or text spread over several parts of the specification.

Formal Definition of 'derivedSourceItem':

```
derivedSourceItem {

  content : string (0..1)
  name : string (0..1)
  uri : string (0..1)
  documentId : string (0..1)
  versionId : string (0..1)
  revisionId : string (0..1)
  dateString : string (0..1)
  resourceProvenanceId : string (0..1)

}
```

Semantics:

```
- The <content> attribute is expressing the normative statement as it has
been interpreted from the (possibly non-textual) referred source material.

- other elements have same semantics as in refSourceItem class.
```

Other attributes **may** be added to the `derivedSourceItem` class.

Formal Definition of 'comment':

```
comment {

  content : string (0..1)

}
```

Other attributes **may** be added to the `comment` class.

The `comment` class may be used to simply add comments of any kind (or as further specified in a conformance profile for this markup or a customization thereof) to a normative source test assertion part.

Formal Definition of 'interpretation':

```
interpretation {

  content : string (0..1)

}
```

Other attributes **may** be added to the `interpretation` class.

The `interpretation` class may be used to simply add an alternative description in prose of any kind (or as further specified in a conformance profile for this markup or a customization thereof) to a normative source test assertion part. This allows a prose expression to be added to improve human understanding of its logic. It provides further information about how the predicate (or prerequisite) relates to the normative source.

3.2.7 target

An instance of 'target' identifies (or categorizes) the specification implementation(s) or parts of, subject to testing.

Formal Definition of 'target':

```
target {

  content : string (0..1)
  type : string (0..1)
  idScheme : string (0..1)
  language : string (0..1)

}
```

Semantics:

```
- The <content> attribute is identifying the target or the set of targets
subject to the test assertion. A target can either be a specific item or a
category of items.

- The <type> attribute specifies the target category. Its values may belong
to a controlled vocabulary, ontology or other classification or taxonomy
system.

- The <idScheme> attribute specifies the identity scheme used for identify-
ing target instances, e.g. in test reports. It allows for generating the
identifier of a target instance.

- The <language> attribute identifies the expression language used in the
content attributes.
```

Other attributes **may** be added to the `target` class.

Where the scheme for listing or categorizing target types is defined in a document, the identifier, URL or URI for this document **may** be associated with the target using an additional attribute named '`schemeRef`'. A target '`schemeRef`' attribute or, for a set of test assertions, a shared target '`schemeRef`' attribute **may** be used in cases where the target type scheme is defined using an expression or prose definition within the test assertion or set of test assertions.

The target content is a string. This **may** be an expression in a specialized formal expression language which **may** be specified using the '`language`' attribute or using a complete conformance profile for that particular use of the markup.

3.2.8 prerequisite

An instance of 'prerequisite' expresses a pre-condition to be satisfied by the related 'target' instance in order to qualify for the test expressed by the 'predicate'. It is a boolean expression: if evaluates to "true", the 'predicate' can be evaluated over the 'target'. If evaluates to "false", the 'target' is not qualified for this test assertion.

Formal Definition of 'prerequisite':

```
prerequisite {

  content : string (1..1)
  language : string (0..1)

}
```

Semantics:

```
- The <content> attribute is stating the condition that must be met by the
target and/or some collateral artifact, in order for the target to qualify
for this test assertion.

- The <language> attribute identifies the expression language used for stat-
ing the prerequisite condition (content).
```

Other attributes **may** be added to the `prerequisite` class.

The prerequisite **may** be expressed using a specialized formal expression language which **should** be specified using the '`language`' attribute.

The content of the `prerequisite` class **shall** contain an expression which evaluates to `true` or `false`.

3.2.9 predicate

An instance of 'predicate' expresses the feature or behavior expected from the 'target' as stated by the 'normativeSource'. It is a boolean expression: if it evaluates to "true", the related 'target' instance exhibits the expected feature. If "false", the 'target' instance does not.

Formal Definition of 'predicate':

```
predicate {

  content : string (1..1)
  language : string (0..1)

}
```

Semantics:

```
- The <content> attribute is stating the condition that must be met by the
target and possibly some additional collateral artifact, in order for the
target to fulfill the normative statement or its interpretation addressed by
this test assertions.

- The <language> attribute identifies the expression language used for stat-
ing the predicate condition (content), if applicable.
```

Other attributes **may** be added to the `predicate` class.

The predicate **may** be expressed using a specialized formal expression language which **should** be specified using the '`language`' attribute.

A test assertion predicate **shall** be worded as an assertion, not as a requirement. Normative keywords from [ISO/IEC Directives] [RFC 2119] (e.g. 'MUST' or '**shall**' keyword) **shall** be absent from the predicate but reflected in the prescription level. The predicate has a clear Boolean value: Either the statement is true, or it is false for a particular target.

3.2.10 prescription

An instance of 'prescription' expresses how imperative is the statement referred by 'normativeSource' when applying to a 'target'. It is usually one level among {"permitted", "preferred", "mandatory"}.

Formal Definition of 'prescription':

```
prescription {

  content : string (0..1)
  level : string (0..1) (allowed values include: mandatory|preferred|permit-
ted)

}
```

Semantics:

```
- The <content> attribute is stating prescription information or annotation
associated with the normative statement or its interpretation addressed by
this test assertions.

- The <level> attribute identifies formally the prescription level, typic-
ally using a predefined keyword. The content attribute may add further in-
formation about this prescription level.
```

Other attributes **may** be added to the `prerequisite` class.

The possible values for the attribute '`level`' of the class prescription **shall** contain the set of predefined values of `mandatory`, `preferred` and `permitted`. Its values **may** be extended beyond this minimal set.

The prescription values correspond to the terms used in a specification to denote conformance requirements, or to a more nuanced expression:

- [RFC 2119] terms conveying mandatory nature of a statement such as 'MUST' and 'MUST NOT' and in Annex H of [ISO/IEC Directives] terms 'shall', etc **shall** correspond to the prescription level value '`mandatory`'.

- RFC2119 terms conveying optionality with preference such as 'SHOULD' and 'SHOULD NOT', 'RECOMMENDED', etc and ISO/IEC Directive terms 'should', etc **shall** correspond to the prescription level value '`preferred`'.
- RFC2119 terms conveying optionality without preference 'MAY' and ISO/IEC Directive terms 'may', etc **shall** correspond to the prescription level value '`permitted`'.

The RFC2119 terms for preference do not permit non-conformance without a reason and usually the same 'preferred' prescription level is acceptable but in some cases implementers **may** wish to make a distinction by making use of the extension facility and specify further enumeration values.

The prescription **shall not** affect the outcome semantics of the test assertion but **may** determine how this outcome is to be used, e.g. how the outcome affects conformance or otherwise of the implementation to a conformance profile or to the conformance clause of the specification.

Besides the use of the 'level' attribute, the content (string) **may** be used to express further information regarding the prescription level using prose or as a logical expression.

3.2.11 description

An instance of 'description' gives an informal description of a test assertion.

Formal Definition of 'description':

```
description {

  content : string (0..1)

}
```

Semantics:

```
- The <content> attribute is stating a general plain text description of
this test assertion or of its intent.
```

Other attributes **may** be added to the `description` class.

Notes:

The `description` class may be used to add a description in prose of any kind to a test assertion or set of test assertions. This is useful when a test assertion is otherwise expressed purely in a specialized, formal, logical language which might not be intended for legibility to human readers;

3.2.12 tag

An instance of 'tag' provides some annotation mechanism in the form of (name, value) pair, or just a (name) property. They may help the grouping or categorizing of test assertions - e.g. all test assertions related to a particular conformance profile "CP-1" may use a tag "conformance_profile" and be tagged with: conformance_profile = "CP-1"

Formal Definition of 'tag':

```
tag {

  content : string (0..1)
  name : string (1..1)

}
```

Semantics:

```
- The <content> attribute is the value given to this tag.

- The <name> attribute is the name of the tag.
```

Other attributes **may** be added to the `tag` class.

Notes:

A special example of tag is to indicate to which versions of a specification the test assertion or set of test assertions applies.

Another example of tag is to specify that a test assertion or set of test assertions exists to define a particular normative property or a conformance level. The `tag` class **may** be used to attach such data to a test assertion or test assertion set.

Reserved Tag Names:

`DefinesNormativeProperty` and **`NormativeProperty`**

Often, a specification uses normative statements in order to define properties of a target. For example, a “gizmo” specification may define what is an “electrical gizmo” and what is a “mechanical gizmo”, where “electrical” and “mechanical” are possible properties of a gizmo target. Test assertions associated with the verification of a property are called *property test assertions*.

A test assertion may be tagged with `DefinesNormativeProperty` to show that it is a property test assertion, and may be tagged with `NormativeProperty` to define which target property(ies) it is associated with.

`VersionAdd` and **`VersionDrop`**

`VersionAdd`: the lowest numerical version to which the test assertion applies.

`VersionDrop`: the lowest numerical version number (after VersionAdd if present) to which the test assertion does NOT apply.

Both `VersionAdd` and `VersionDrop` are optional tags. The absence of both tags **shall** mean that the test assertion is valid in all specification versions. If only a `VersionAdd` tag exists and its value is X, the test assertion will be valid in version X of the specification and all subsequent versions. If only a `VersionDrop` tag exists and its value is Y, the test assertion **shall** be valid in all versions of the specification prior to version Y. If both `VersionAdd` and `VersionDrop` tags exist, the test assertion **shall** be valid in version X and all subsequent versions up to but not including version Y.

3.2.13 variable

An instance of 'variable' allows for abstracting and naming some value used by one or more parts of a test assertion, or across several test assertions of a set.. The value of a variable may be determined at a later time, allowing the test assertion to be parameterized.

Formal Definition of 'variable':

```
variable {

  content : string (0..1)
  name : string (1..1)
  language : string (0..1)

}
```

Semantics:

```
- The <content> attribute is the value given to this variable.

- The <name> attribute is the name of the variable.

- The <language> attribute identifies the expression language used by the
value, in case it is an expression.
```

Other attributes **may** be added to the `variable` class.

Notes:

The variable value **may** be an expression, the evaluation of which may vary depending on the target instance. It may also be a sub-expression of the predicate or of the prerequisite, The notation used for these variables in the content of predicates, prerequisite, etc. is left to implementations of this model.

As for a 'tag', an instance of 'variable' may state a (name, value) pair or just a (name).

4 Conformance

Test assertion artifacts or implementations subject to conformance to this model are of two kinds:

(1) Formal Representations: Languages or notations that represent the test assertion model described in Section 3 (for example, an XML mark-up language.)

(2) Test Assertion Instances: Actual instances of test assertions, that follow the modeling principles and semantics described in Section 3. These may or may not use a formal representation.

To each one of the above implementation classes is associated a conformance clause below.

4.1 Conformance Clause for Test Assertion Formal Representation

In order to conform to this model, formal representations or implementations of class 1:

(a) **shall** represent all test assertion parts (core and optional) defined in Section 3 (3), in accordance with the normative statements and semantics of this section.

(b) **shall** use names for these parts that are identical or can be unambiguously mapped to the definitions used in Section 3.

In (a) an implementation **may** implement a datatype in the model with a more restricted datatype. (For example an attribute specified with an datatype "string" may be implemented as a URI.)

Classes in this specification **may** be extended either by adding further attributes or by adding further associations or both.

4.2 Conformance Clause for Test Assertion Instances

In order to conform to this model, test assertion instances or implementations of class 2:

(a) **shall** be represented using a notation or language, formal or informal, that maps unambiguously to the test assertion model defined in Section 3(9)

(b) **shall** include the test assertion parts mandated by the test assertion model (Core TA parts) as defined in Section 3.1 (9), in accordance with the normative statements and semantics of this section.

(c) **shall** define values for its parts in a way that is consistent with the test assertion semantics stated in the test assertion model, in Section 3.2 (11).

(d) The semantics of the test assertion over its targets **shall** conform to the semantics of the test assertion specified in Section 3.2.4 (13)

Test assertion instances **may** be extended with additional parts provided these do not semantically override or invalidate parts defined in this specification.

Mandatory statements are designated by the keyword '**shall**' and '**shall not**' in bold type, as described in Annex H of [ISO/IEC Directives] .

Appendix A. Deriving a Test Case from a Test Assertion

Although a test assertion is a testable or measurable expression for evaluating the adherence of an implementation – or a part of it – to some normative statements, the actual verification of the implementation is carried out by the test case(s) derived from this test assertion.

Because of practical constraints, it is often the case that a test case derived from a test assertion only verifies a subset of the implementations (target instances) that fall under this test assertion, or verifies these implementation only under specific conditions, or yet is only able to verify some type of outcome – either success or failure. For this reason, it may take several test cases to “cover” a single test assertion – and sometimes imperfectly. A test case is therefore only an *indicator* of fulfillment or non-fulfillment for target instances. This means that the fulfillment indication provided by a test case cannot generally be considered as a formal proof or fulfillment (or non-fulfillment) of the normative statement by a target instance.

In relation with the test assertion semantics stated in 3.2.4 the following is a set of criteria defining more precisely under which conditions a Test Case can be said to derive from a Test Assertion,:

- When a Target instance is not qualified for a Test Assertion, a Test Case derived from this Test Assertion does not indicate whether the Target instance fulfills or not the Normative Statement addressed by the Test Assertion,
- When a Target instance is qualified for a Test Assertion and satisfies the Test Assertion Predicate, a Test Case derived from this Test Assertion either indicates that the Target instance fulfills the Normative Statement addressed by the test assertion, or does not indicate anything.
- When a Target instance is qualified for a Test Assertion and does not satisfy the Test Assertion Predicate, a Test Case derived from this Test Assertion either indicates that the Target instance does not fulfill the Normative Statement addressed by the test assertion, or or does not indicate anything.

A test case is said to be derived from a test assertion if it can process [a subset of] instances of the test assertion Target, and if it can indicate either fulfillment or non-fulfillment for at least a non-empty subset of these target instances, in consistency with the semantics of this test assertion.

Appendix B. Acknowledgments

The following individuals have participated in the creation of this specification and are gratefully acknowledged

Participants:

- Dennis Hamilton, Individual
- Dmitry Kostovarov, Oracle Corporation
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Appendix C. Revision History

Rev	Date	By Whom	What
CD 1	12/15/09	Stephen Green	CD 1 candidate
CD 2	08/10/10	Jacques Durand	CD 2 draft for PR
CS1	11/30/10	Jacques Durand	CS1 approved after PR.
CSD3 can-didate	03/28/11	Jacques Durand	Removal of TA set section, addition of new Appendix A (test case derivation).
CSD3 can-didate	04/25/11	Jacques Durand	Minor edits (RFC reference moved, re-title Section 2)
CSD4 can-didate	05/10/11	Jacques Durand	Remove “language” from testAssertion and other normative source-related elements. Added an “id” subsection in 3.2. Other minor edits