

A Conformance Test Suite of Localized LOM Model

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Abstract

Since the approval of IEEE LOM Draft Standard and the advance of network-driven learning technology, a large number of resource database constructors, content developers and learning management system vendors are likely to describe their relevant learning resources using LOM model. To ensure the process of carrying out correct implementation of LOM, there is need for a conformance test suite of LOM model. In this paper, some design and implementation issues related to LOM XML binding, parsing of metadata instance as well as carrying out conformance testing procedure are to be discussed. We hope that the initiative in this paper could elicit some opinions with respect to conformance testing of learning technology standards.

1. Localized LOM Model in CELTS-3.1¹

As of June 12, 2002 the 1484.12.1 Learning Object Metadata (LOM) draft standard [1] has been approved as an IEEE-SA standard. Taking into account presumable adoption of LOM model in educational software as well as learning resource databases, a national standard organization named Chinese E-Learning Technology Standard Committee (CELTSC), which is founded under the sponsorship of the Ministry of Education in China, had developed Chinese E-Learning Technology Standard (CELTS)-3.1 [2] shortly after the approval of IEEE 1484.12.1.

CELTS-3.1 is a localized version of up-to-date LOM model in IEEE 1484.12.1 draft standard. Among others, the foremost revision to the LOM model in CETLS-3.1 is the introduction of the core elements set.

All the elements in the core elements set are: 1. General, 1.1 Identifier, 1.1.1 Catalog, 1.1.2 Entry, 1.2 Title, 1.3 Language, 1.4 Description, 1.5 Keyword, 2. Lifecycle, 2.3 Contribute, 2.3.1 Role, 2.3.2 Entity, 2.3.3 Date, 3. Meta-Metadata, 3.2 Contribute, 3.2.1 Role, 3.2.2 Entity, 3.2.3 Date, 3.3 Metadata Schema, 3.4 Language, 4. Technical, 4.1 Format, 5. Education, 5.2 Learning Resource Type, 9. Classification, 9.1 Purpose, 9.2 Taxon Path, 9.2.1 Source, 9.2.2, Taxon, 9.2.2.2 Entry.

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This localized LOM model is the object upon which our conformance testing is conducted.

2. XML Binding

The LOM conceptual model for metadata definitions is hierarchical, which is convenient for representing data consisting of many elements and sub-elements. XML is perfectly suited for representing hierarchical models.

Since IEEE LTSC has not published its XML binding specification for LOM model, we resort to IMS Learning Resource Meta-data XML Binding Specification [3], which is adopted in SCORM Content Aggregation Model.

As stated in test specification of CELTS-3.1, the purpose of conformance testing is to verify and to validate:

- 1) The XML binding file is a well-formed XML document, and is validated against the IMS Learning Resource Metadata Version 1.2.1 XML Schema Definition (XSD);
- 2) The XML binding file contains all mandatory document elements as per CELTS-3.1;
- 3) The XML binding file contains some or all optional elements as per CELTS-3.1;
- 4) Localized LOM vocabulary is used in the XML binding file for those vocabulary-type elements in LOM model.

3. Conformance Clauses of E-Learning Standards

To make conformance testing practical and operable, conformance clauses are needed in addition to the standard itself. Generally, they are stated in a standalone test specification which accompanies the standard at the time of carrying out conformance testing procedure.

Roughly speaking, conformance clauses in LOM conformance testing is the detailed narratives of test subjects listed at the end of Section 2.

4. Conformance Testing Model

From a test suite developer's point of view, whether a metadata instance is conformant with LOM model is solely determined by the result of executing conformance test

suite. The test suite reads a metadata instance (XML document), parses it, and validates the content against the conformance clauses one by one as per test specification. At last, the conformance testing verdict, that is, whether the metadata instance is conformant with the localized LOM model, is presented, in conjunction with detailed test log describing the testing result of each conformance clause.

The work flow of conformance test suite is depicted as a UML activity diagram in Figure 1.

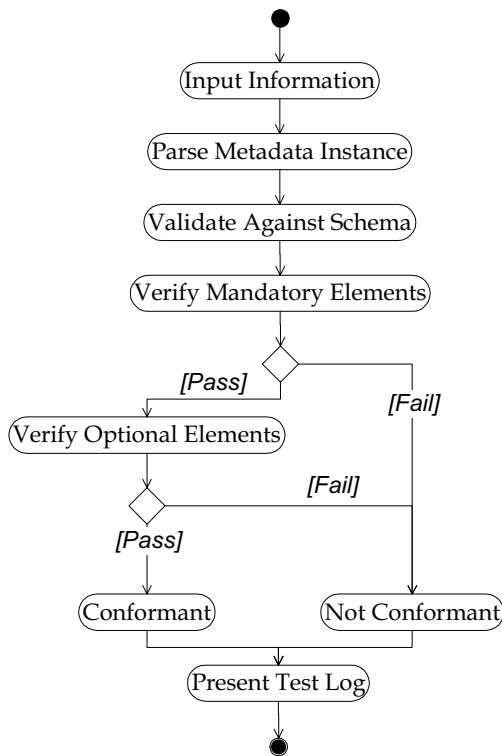


Figure 1. Conformance Testing Work Flow

As can be seen from the diagram, the essence of LOM conformance testing is semantic analysis of a metadata instance. The application implements LOM (semantic information model) with some kind of binding technique, for instance XML, while the relevant conformance test suite parses the binding file, turns it back to semantic representation, and validates it against the conformance requirements derived from the LOM specification. To some extent, the conformance testing is a reverse process of binding, as shown in Figure 2.

Henceforth, the transformation of an XML binding file to some kind of semantic representation dominates the testing procedure, which will be covered in the following section.

5. Implementation Issues

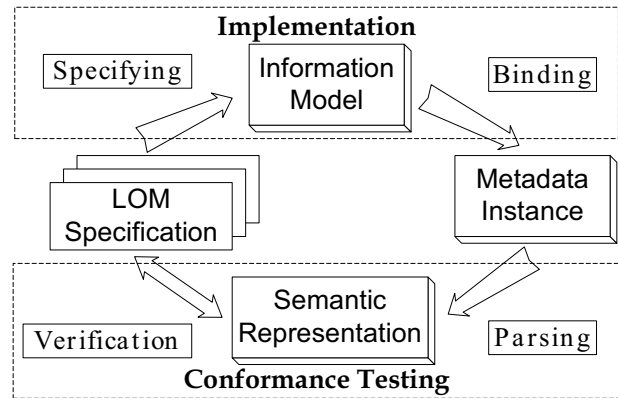


Figure 2. Conformance Testing Model

The main obstacle in translating the conformance testing model into a practicable conformance test suite is to find a semantic representation which is tailored to XML document.

Several mainstream XML processing techniques are considered and it is determined that Xerces2 Java parser, a mature open-source XML DOM parser is used to parse a metadata XML instance. The main reasons for adopting DOM parser are that DOM is suitable for processing hierarchy structure such as LOM model and DOM provides an easy-to-use and clean interface to data in a desirable format.

The purpose of choosing Java is obvious: Java and XML collaborate very well while performance is not a main focus of conformance test suite, not to mention that metadata XML instance is too small to reflect the performance deficiency of Java UI.

A metadata instance is transformed into a DOM tree in memory, thereby enabling the test suite to validate it against LOM specification with clean and easy-to-use DOM interfaces.

The conformance test suite is designed and implemented as a wizard-like Java application program to simplify its usage.

We are primarily seeking opinions about conformance testing of LOM, which may be helpful in the development of this test suite as well as the testing practice.

6. References

- [1] IEEE Learning Technology Standard Committee Working Group 12, "Final 1484.12.1 LOM draft standard", http://ltsc.ieee.org/doc/wg12/LOM_1484_12_1_v1_Final_Draft.pdf, September 2002.
- [2] Chinese E-Learning Technology Standard Committee, "CELTS-3.1, Learning Object Metadata: Information Model", http://www.celtsc.edu.cn/DOCS/CD/CD1_6/1/CELTS-3-1.zip, August 2002.
- [3] IMS Global Learning Consortium, "IMS Learning Resource Meta-data XML Binding Version 1.2.1 Final Specification", <http://www.imsglobal.org/metadata/imsmdv1p2p1/imsmdv1p2p1.html>, September 2001.