Supporting Interoperability in an Existing e-Learning Platform Using SCORM

Polyxeni Arapi Nektarios Moumoutzis Stavros Christodoulakis
Technical Univ. of Crete / Laboratory of Distr. Multimedia Information Systems and Applications (TUC/MUSIC), Greece
e-mail: [xenia,nektar,stavros]@ced.tuc.gr

Abstract

The proliferation of interoperability e-learning specifications raises the need of extending existing e-learning platforms so that they can be used efficiently in a distributed environment where material producers, service providers and users (either learners or teachers) exchange information using standard models. This extension is essential to preserve digital learning material and retain the user groups and learning communities already set up. In this paper we present a generic architecture and its prototype implementation for addressing this need. This architecture is based on the two assumptions that (1) the preexistent e-learning platform is implemented on top of a relational database management system, and (2) the interoperability model to be supported is SCORM. The prototype implementation uses a web-based e-learning platform based on a solid pedagogical framework.

1. Introduction

The advances in information and communication technologies the last years, made it possible to develop new kinds of educational and training services overcoming the constraints of traditional learning processes. A lot of resources have already been invested in developing digital educational material as well as establishing learning networks that bring together teachers and learners, trainers and trainees. Until recently no significant efforts were taken to integrate all these systems and learning networks so that the learning material could be reused thus saving valuable resources. The proliferation of the Internet, the World Wide Web and interoperability specifications for digital learning resources create bright new application opportunities for the future.

ADL's SCORM model [1] is probably the most important step towards the development of interoperable e-learning systems by providing the means to overcome the incompatibility issues posed by proprietary implementations through proper standard descriptions of learning content objects and related material and functionalities. It provides reusability and interoperability of learning resources by leveraging the advances in all fields related to e-learning through proper integration and extension of various existing models.

In general, describing a course through SCORM needs reconstruction of the course almost from the beginning. This process can be performed either at low-level, by finding a mapping of existing resources to SCORM content model components, writing appropriate XML documents and adding physical files to construct SCORM Content Packages, or at a higher level, using existing tools to design SCORM conformant courseware. In [7], a SCORM conformant courseware has been implemented, by re-designing all learning resources contained in an existing Java course according to the SCORM Content Model and also reconstructing the course structure according to the SCORM Content Packaging. Considering a big collection of pre-existing courses, this manual redesigning process would be time- and cost-ineffective.

The proposed architecture overcomes the above limitation by extending the platform's functionality in order to perform the conversion process automatically. The architecture assumes that all learning material resides in a relational DBMS and implements a translation process between the relational DBMS structures and SCORM XML schema.

2. A generic architecture

The proposed architecture supports exporting and importing the educational content along with the metadata describing it from/into the relational database of the preexistent e-learning platform. The output of the export process and the input to the import process are SCORM 1.2 Content Packages [2]. These packages are called Package Interchange Files (PIF). A PIF is a zip file containing the physical files of the educational content along with an XML document (manifest file) describing the course contents and content sequencing.

The architecture (figure 1) follows a multi-tier approach with three distinct tiers:

1. The existing e-learning platform.
2. The database tier, which is a relational database management system along with the relational database.
3. The middleware tier, which realizes the transformation from one format to the other. The middleware consists of two parts:
   a. The *XML-DB middleware*, whose role is the mapping between the relational database schema

and the two SCORM XML Schemas, one for the content packaging [2] and the other for the description of learning resources with metadata [3].

b. The *Package Management middleware*, which is responsible for the transformation process. It can support the processing of both static and dynamic HTML pages.

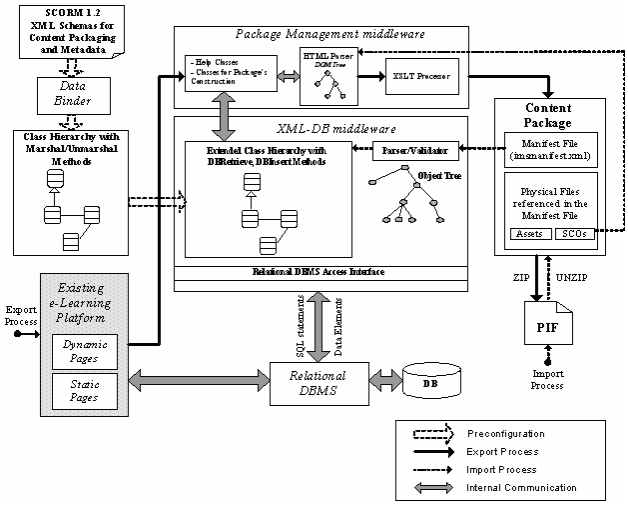

Figure 1. A generic architecture

The XML-DB middleware is a set of software components responsible for the manipulation of SCORM XML documents. It is based on the so called data binding [6] approach that supports effective separation between document structure and data modeling in terms of an object-oriented model. The objects use a schema (classes) designed especially for the data in those documents.

There are numerous XML data binding products [6] capable of transferring data between XML documents and objects. This architecture assumes a design-time binder [5]. Thus, a configuration process (illustrated with wide dashed arrows) is needed to create the classes corresponding to XML elements present in the document class to be handled. These classes are extended with DBInsert and DBRetrieve methods, which use the object tree to create INSERT/UPDATE statements to give persistence to data of the object tree, and, inversely, retrieve data from the database with the objective to build object trees that could be used thereafter to create XML documents.

The *Package Management middleware* manages the export and import processes. In the *export* process, it is responsible for finding all learning resources that compose an educational experience, and store them as SCO's and Assets inside the Content Package along with the manifest file that describe them. In the *import* process, the Package Management middleware is responsible for the decomposition of the package and the management of the whole process of storing all the appropriate information contained in the Content Package to the relational database.

3. Prototype implementation

The proposed architecture has been successfully implemented on top of an existing e-learning web-based system, the Distant Learning Center (DLC) [4]. DLC has been developed in Laboratory of Distributed Multimedia Information Systems and Applications of the Technical University of Crete (TUC/MUSIC) for the needs of the European ARCHIMED project.

DLC, empowered with SCORM export/import functionalities constitutes the building block of a distributed learning environment currently used to establish two European vocational training networks:

- The first network addresses the needs of workers in the tourism and cultural sector (ADONIS).
- The second focuses on the mass media industry (KNOSOS).

4. Future Work

One major direction of future research is the integration of SCORM and digital TV to provide effective specifications and system architectures that will transform digital TV into a learning medium thus opening new opportunities to the broad public.

At this time, our system does not support the export or import of questions or exams. SCORM 1.2 does not contain yet a schema for the description of assessments. IMS Global Learning Consortium has developed the Question and Test Interoperability specification, which defines an XML format for the coding of questions and exams and it is very possible in the future to be a part of SCORM.

5. References

[1] ADL Technical Team, SCORM Specification v1.2, http://www.adlnet.org/index.cfm?fuseaction=scormabt

[2] IMS Global Learning Consortium Inc., IMS Content Packaging Specification v1.1.2, http://www.imsproject.org/content/packaging/index.html

[3] IMS Global Learning Consortium Inc., IMS Learning Resource Metadata Specification v1.2.1, http://www.imsproject.org/metadata/index.html

[4] Stellakis D., "Design and implementation of a distant learning environment on the web", Diploma thesis (in greek), Electronic and Computer Engineering Department, Technical University of Crete, Chania, 2000.

[5] Breeze Factor, "XML/Java Data Binding And Breeze XML Binder", white paper, January 2002, http://www.breezefactor.com

[6] Bourret Ronald, "XML Data Binding Resources", 2001, http://www.rpbourret.com/xml/XMLDataBinding.htm

[7] Qu Ch., Nejdl W., "Towards Interoperability and Reusability of Learning Resource: a SCORM-conformant Course-

ware for Computer Science Education", Proc. of IEEE ICALT 2002, Kazan, Tatarstan, Russia, September 2002