The CD-Lomas project: an RCP-based Collaborative Distributed Learning Object Management System

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Abstract. In this paper we describe a SCORM conformant system, named CD-LOMAS (Collaborative Distributed Learning Object MAnagement System), which is evolving towards an RCP architecture. The proposed system supports the creation of a community of users which shares and collaboratively creates contents in a highly distributed environment. Artifact management features, such as coordination of cooperative content development and versioning, and context-awareness are also provided.

Keywords: Learning Object, SCORM, Content management, reusability, community.

1 Introduction

Creating and reusing quality contents is one of the challenge of the e-society. Many organizations (business and educational) in the entire world are creating digital contents which are stored in Content Management Systems (CMSs) and spread through the servers of the various companies. Contents are represented in terms of Learning Objects and many Learning Object (LO) repositories are available on the Web (eduSource)[12] since 1997 (MERLOT)[19]. Some of them are distributed, such as (IMS Global Learning Consortium)[15], others adopt service oriented architecture, such as (ARIADNE)[2], (De Moura et al.)[10][18], but they generally lack in supporting collaboration and context awareness.

The adoption of standard formats such as SCORM [1][15][17] favors the reuse of these contents in different technologic context. Indeed, SCORM enables to classify the LOs by using LO Metadata [14]. In this way, it is possible to create repository of multimedia contents that can be searched through sophisticated indexing systems and exchanged through the web [11]. In spite of great interests towards LOs and their standards, LOs have not been reused as foreseen. Reasons could be lack of quality [5] and the static structure of learning repositories that, generally, offer only the possibility of searching and browsing. Indeed, existing e-learning systems do not provide support to meet the need of groups of user both in case of creation and sharing of contents [3].

Content creation is a complex process involving several people with different roles who have to cooperate to gain the best results. Also the sharing of contents requires a group space where contents can be accessed and manipulated. On the contrary,

Learning Management Systems support individual learning and personalized workspace and, as a consequence, collaborative group-based learning is not appropriately supported.

In this paper we present the RCP based evolution of CD-LOMAS (Collaborative Distributed Learning Object MAnagement System) [8], an on-going research project aiming at designing and developing a system for the management of LOs distributed on several sites, the asynchronous collaboration on their development and the creation of communities of users focused on the same interests. In particular, the aim is to enable the sharing of contents represented using the standard SCORM.

The system also classifies the users in terms of their interests, considering the produced materials, and enables to create user communities on the base of the interest topics. In this way, people are provided with context awareness on the contents and on the authors sharing the same interests. This solution enables a team of geographically spread content creators to cooperate in the planning and in the production of learning materials. Cooperation is supported enabling the course manager to control the activities concerning the development of materials assigning different permissions to the process actors depending on their role. Context awareness is granted by notifying the interested people when an event concerning a LO of their interest occurs, without generating an overload of messages. CD-LOMAS also supports the LO revisions for granting the quality of the produced material.

The system was born as a Java application supporting only collaborative features which now is evolving toward a collaborative and community framework, built on top of the Eclipse Rich Client Platform. Indeed, the new release of the system will support community management providing group space features.

The remainder of this paper is organized as follows. Section 2 presents an overview of CD-LOMAS, while Section 3 details its architecture. Section 4 introduces the RCP evolution of CD-LOMAS. Finally, Section 5 discusses concluding remarks and future work.

2   CD-LOMAS overview

CD-LOMAS is a distributed environment supporting the cooperative handling of LOs. It allows the distribution of LOs among different sites. In this way it is possible to create a virtual community which cooperates in the production of the learning material and interacts as all authors were in the same place. In particular, CD-LOMAS supports content authors in the creation of LOs using cooperative or collaborative authoring. The first approach enables authors to interact only during the revision process and each author produces his/her individual content. Differently, in collaborative authoring the concept of ownership becomes irrelevant and authors work together.

CD-LOMAS enables the composition of a LO, supporting the reuse of existing LOs spread among the various repositories. Authors are assisted in creating and updating LOs following the standard SCORM and in sharing information.

Users can create groupspaces where they can cooperate in the creation and in the sharing of contents. Groups are composed on the base of a classification of interests.

2.1 Learning object composition and configuration management

The proposed system has been designed starting from two open source applications, RELOAD [21] and its Web version, WELOAD [24]. In particular, CD-LOMAS reuses the features offered by these applications for composing LOs, for inserting the associated metadata and for browsing LOs. RELOAD composes LOs on the local computer of a user. This feature has been extended with the capability of performing these operations when the component objects are scattered on different Local CD-LOMAS repositories of the network. The user is able to search the repository while composing LO and the location of the objects is transparent.

Tools supporting Configuration Management for software systems, such as (ADAMS)[6] and (CD-LOMAS)[7] help to coordinate the activities of the developers. The capability to add these functionalities to a LO repository enables organizations to cooperate in the repository creation and in the sharing of LOs.

CD-LOMAS emphasizes the LO life cycle by associating the users with the different operations they can perform on each LO. This feature, together with the resource permissions definition and management, enables to reuse existing LOs and to cooperate in the creation of new materials. The owner of a LO can finely tune the permissions related to it, and can provide different kind of usage for several users or user groups.

Quality management is also supported by associating each LO with a standard template and an inspection checklist to be validated during the review process. Each template can be customized for a specific LO.

The support for cooperation is provided through typical configuration management features [7]. In fact, CD-LOMAS enables groups of people to work on the same LO, depending on their roles. Different users can access the same LO according to a lock-based policy or concurrently, if branch versions of the same LO are allowed by the LO owner.

Teachers can cooperate in the creation of learning material by using the learning project management features offered by CD-LOMAS. A user having the permission can create a learning project involving a group of LO managers, where each LO manager is responsible of the management of a LO. The LO manager can delegate his/her permissions to a user or to a group of users if the LO is decomposable in simpler LOs.

2.2 Supporting Context Awareness

The system has been enriched with features to deal with some of the most common problems faced by cooperative environments, in particular context awareness and communication among users [5] [23]. A first context-awareness level is given by the possibility to see at any time the people who are working/using a LO. In particular, context awareness is mainly supported through event notifications: i.e., messages generated in response to specific events triggered by one of the subsystems of CD-LOMAS.

Event notification in CD-LOMAS adopts a publish-subscribe paradigm: as soon as an event concerning a LO occurs, the users who subscribed such event are notified. CD-LOMAS increases the context awareness without overloading a teacher or a learner with useless event messages. To this aim, a user can selectively specify the events concerning a LO (s)he needs to be notified of.

In particular, (s)he can require to be informed about:

- events having a direct impact on the LOs on which the user has a locked reuse permission or on which (s)he is working on;
- events concerning all the LOs referring to a specific topic;
- events concerning specific LOs;
- events generated by a specific teacher on a specific topic. In this case the interested user sends a request module to the teacher that can accept or refuse the subscription.

2.3 Handling Projects and Groupspaces

The main contribution of CD-LOMAS is its functionality to manage learning projects aiming at producing contents, and learning community in general. It also manages the cycle-life of LOs and the assurance of their quality. In particular, it is possible to assign resources with specific roles to a given learning project.

- The *Administrator* manages the system itself, including human resources; he/she also defines learning projects and the corresponding learning project managers;
- The *Learning Project Manager* is the responsible of a learning project. (S)he allocates and manages the resources allocated on a project, defines the LOs to be developed and the corresponding LO managers, allocates resources to LOs, and defines artifact dependencies;
- The *LO Manager* manages the evolution of a LO and defines roles and permissions for content authors working on its components and assets;
- The *Quality Manager* manages LO templates and checklists;
- The *Content Creator* is responsible of the composition of a LO;
- The *Reviewer* verifies that the produced LO is conformant to the quality requirements.

The roles above concern the planning and the cooperative creation of learning materials inside a project. All members share the project space and can examine the material checked-in by the others. CD-LOMAS also provides the possibility of assigning permissions to teachers and students for searching and using LOs. In particular, once a LO is checked-in the repository the learning project manager decides the permissions (s)he eventually gives to other systems users. (S)he can decide to globally share a LO with all other users, or only with a specific subset of global roles (i.e., teacher or students), or (s)he can fix a group of users that can access the owned LO (i.e., students frequenting his/her course, community of database teachers). Each user or group of users can obtain different reuse capabilities, such as:

- *derivative reuse*, the LO can be downloaded in the user workspace and modified. The user obtaining this capability becomes the owner of the variant and receives a request to insert the source LO in his/her subscription list. In this way, when the original LO is changed, the variant author is notified, thus (s)he can propagate the changes in the derivate LO. Vice versa, the original LO owner can subscribe events concerning the variant aiming at knowing how his/her material has been improved.
- *locked reuse*, the LO is reused unchanged (referenced), the user course space refers to the LO which can only be played;
- *play*, the user can take a look to a LO, which can be only played but cannot be inserted inside a course;
- *entry catalogue only*, users can only receive the description of the object in a ranked list. In the last case the system provides support to an interested user in asking to the LO owner the permission to use or reference a LO. The LO owner finds the request in the Feedback section accessible from his/her workspace. The LO owner can grant or deny each permission.

It is important to point out that the system offers on one side the possibility to create learning materials in a cooperative way, with specific roles and tasks assigned to each team member, on the other side it enables to apply a unified content strategy [4][22], where the members of a group create a community of interests and should work together in collaborative way and no member owns any part of an object. The manager of the group is the user who creates the groupspace. In this environment authors freely work together aiming at ensuring that content is not written more than once. Check-in, check-out, event notification, locking and versioning are still applied, but all the users have the same permissions on the objects of the group.

Let us note that a SCORM LO is packed in zip format. To reuse and compose LOs structured as zip packet is complex. Thus, we decide to entirely apply the standard, but to store the LOs without packing them. The components of a LO are stored in the local Database and the packet is created only when the LO is exported.

3. The CD-LOMAS architecture

The CD-LOMAS architecture is composed of two kinds of systems: the Global LOR Management System (GLOR) and the Local LOR Management System (LLOR). This two level architecture allows the access to learning materials distributed among several LLORs by referring only to a GLOR. When needed, several GLORs can be connected.

Hiding to the user the structure of the network enables to easily add new nodes, obtaining scalability by distribution.

The basic functionality of a LLOR is to store LOs in SCORM format.

The GLOR assigns to each content author a workspace, an area reserved to him/her, where (s)he manages the contents to create courses in a cooperative or standalone way. The workspace is allocated on the LLOR of the LMS Machine in which the author has his/her account.

The GLOR supervises the access to the resources stored at LLOR level. In particular, the GLOR system manages the LOs lifecycles basing on events generated during the cooperative or standalone LOs creation process. It also enables users to search the distributed repository and to access, depending on the user permissions and roles, to the required LOs.

In particular, the Global LOR Management System is decomposed into six subsystems:

- The *LO Manager subsystem* which poses a great emphasis to the LO life cycle by associating to the users the different operations that can be performed on a LO. It is responsible of the critical functionalities needed to perform effective collaboration in authoring and using LOs: access to shared information, check-in and check-out, locking and version control. Moreover, the LO Manager subsystem provides support for the definition of LO types with related standard templates and for a checklist-based inspection and review phase of the LO life cycle. It also handle the user access permissions on LOs.
- The *Collaboration Manager subsystem* is responsible of managing learning projects and the groupspaces associated to user communities.
- The *Event Engine* has in charge of collecting and dispatching events concerning a LO. Users can subscribe particular events concerning LOs and courses (such as the production, updating or deletion of a LO, or the publication of a LO on a given subject), thus increasing the context-awareness level. The Event Engine notifies interesting events to the subscribed users of the CD-LOMAS system.
- The *User Management subsystem* manages users and their roles in accessing CD-LOMAS services.
- The *Administration subsystem* provides several administration features, such as adding or deleting a LLOR, security and reporting.

- Access to the database is achieved through the functionalities offered by the *Database Broker*, which accepts queries from each client, forwards these queries to the databases on the LLORs, collects the results and returns a ranked list to the user.

The *Local LOR Management System* stores LOs and courses and contains the teachers workspaces. When a LO is ready to be published it is transferred in the repository, locally handled, and is available to be deployed. It includes the Extended RELOAD component which has been obtained extending RELOAD, a largely adopted LO editor [21].

Each user can compose LOs inside a personal workspace, using the LO Editor offered by the Extended RELOAD component, enabling to compose a SCORM package using local assets, local LOs or existing LOs spread through the network.

The *Event Handler subsystem* is responsible of generating and dispatching events about LOs. Events are used to signal the GLOR about the life cycle of a LO, and to enforce the user context awareness about interesting LOs.

4. Evolving towards Eclipse Rich Client Platform

The CD-LOMAS project is evolving towards a *client application*, built upon Eclipse RCP. The RCP nature of current release of Reload let us easily embed it in the CD-LOMAS architecture. This enables our system to inherit the benefit of using native widgets, the inherent GUI organization based on and guided by views and perspectives. We are going to develop a plug-in for each needed view, namely:

- *My Workspace*, allowing each user to compose his/her LO using assets locally provided or composing LOs taken from the repository;
- *GroupSpace*, aiming at grouping LOs corresponding to a specific learning group. It is a common space where several users can collaborate in the development of the material of a course or can share information interesting for their group. Each group has at its disposal a chat, a forum and a wiki.
- *My LOs*, showing the catalogue of the LOs owned by the user. Search can be performed on the LO metadata and the owner of a LO can define the user permissions on it;
- *Request of Other Users*, showing the requests of access permissions on the LOs owned by the user;
- *Global Learning Object Catalogue*, showing the catalogue of all the LOs available in CD-LOMAS. Each objects is described by some significant metadata and a brief explanation. For any content in the repository, when allowed, users can view reports displaying every course and people in the system that is currently using the selected item;
- *User Feedbacks,* enabling the user to require feedback on events concerning specific LOs, LOs belonging to a given subject or LOs produced by a given user.

The RCP RELOAD editor has also evolved towards this technology and exposes all the features needed to standard embed itself in a plug-in architecture. Different perspectives will enable to optimize the arrangements of the UI views. In particular, we are initially creating three perspectives: one for the LO management and searching, another for the access permissions and feedbacks, the other for the management of the groupspaces. Fig. 1 and 2 shows the first two perspectives. Let us note that Fig. 2 includes the RCP version of RELOAD inside the right-hand view in the lower part of the screenshot.
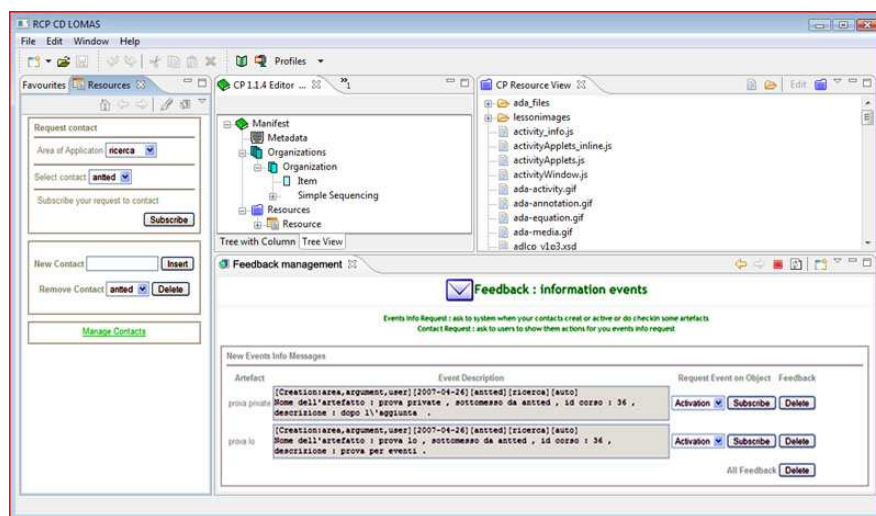

Fig. 1. Access permission and feedback perspective

5. Conclusion

In this paper we have described the functionalities offered by the CD-LOMAS system and its evolution towards an RCP based application. CD-LOMAS enhances collaboration both in the creation of LOs and in the reuse of existing LOs.

We are testing the current RCP version of CD-LOMAS which favors the creation of communities of content users/providers with the same interests. We are also going to investigate perceptions on usability and usefulness of CD-LOMAS with lecturers and students across different disciplines within the university. We believe that the proposed collaborative features provide new opportunities for the socio-constructivist scenarios needed to support collaborative learning that should be investigated.

We also plan to enhance the searching capabilities by using semantic web techniques. Ranking of LOs and expertise management should also be considered in

the next release of the system and further contributions of the user community, such as the possibility to share annotation and the other features of participatory systems.
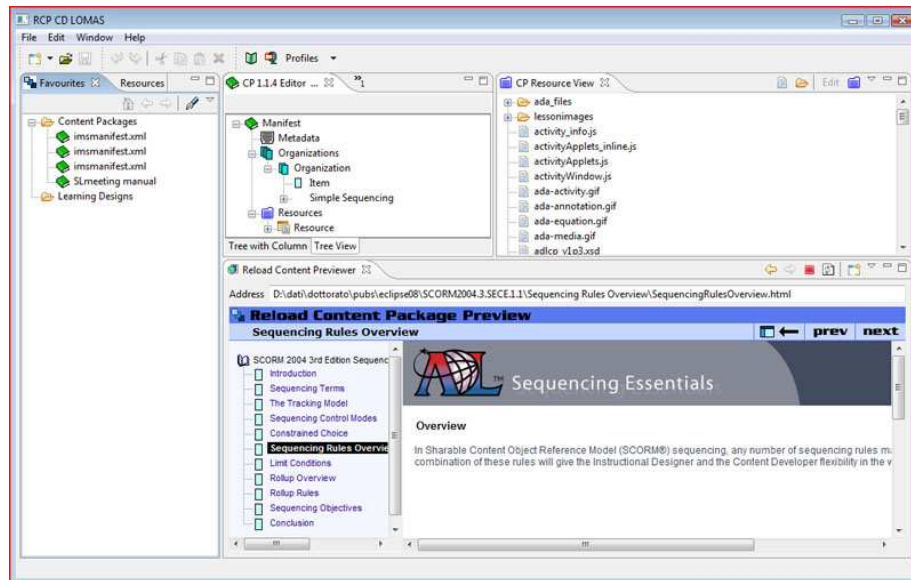

Fig. 2. Learning Object Management perspective

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