

Identity Management and E-learning Standards for Promoting the Sharing of Contents and Services in Higher Education

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1. EXECUTIVE SUMMARY

In this paper, we present the status of identity management systems and e-learning standards across Europe, in order to promote the mobility and the sharing of contents and services in higher education institutions.

With new requirements for authentication, authorization and identity management for Web applications, most higher education institutions implement several solutions to address these issues. At the first level, the adoption of directory Servers like LDAP, Active Directory and others, solve some problems of having multiple logins and passwords for authentication.

The growing of Web applications like Learning management Systems, portals, Blogs, Wikis, and others, need a more effective way of identity management, providing security and accessibility. Web Single Sign-On (SSO) resolves some of these issues of identity management, because the authentication is managed centrally and the user can navigate through different Web applications using the same session. One example of a Web SSO system is the Central Authentication Systems (CAS).

SSO systems provide an effective way to manage authentication and authorization inside institutions, but are restricted to the administrative domain of each institution. With the implementation of Bologna Process more students, lecturers and staff will be on mobility programs within European higher education institutions. The creation of identity management federations is mandatory to provide the mobility of users and to permit the exchange of contents and services between institutions.

The creation of identities federations across Europe is been in discussion by TERENA (Trans-European Research and Education Networking Association) to provide a service federation like the EDUROAM WI-FI network that permits the mobility across Europe. This paper reports on some of the issues highlighted in the light of recent developments.

To share contents and services within Europe, the adoption of standards is mandatory. IEEE LTSC (Learning Technology Standards Committee), IMS (IMS Global Learning, Inc) and ADL (Advanced Distributed Learning) are standards organizations that publish a set of standards to promote the interoperability, reusability and integration of e-learning contents and services. The most important standards that promote the sharing of contents and services across Europe are Sharable Content Object Reference Model (SCORM), IMS Digital Repositories Interoperability and IMS Learning Design.

This paper presents the main features of e-learning standards and how it can be used in conjunction with identity management systems to create collaborative learning objects repositories to promote a more effective learning experience and a more competitive European space for higher education, with respect to the requirements of knowledge based societies.

2. Identity and Access Management

The rapid growth of information technologies inside higher education institutions to support learning, management, research and library services, has led to the appearance of software islands, without the possibility of communication between these pieces of software.

To face the problem of integration of information systems, several institutions adopt new approaches to share information between the systems, centralizing the information systems using a data warehouse approach.

The data integration in higher education institutions has several advantages in the optimization of resources and promotion a culture of shared access to information in order to support the institutions strategic goals. The integration of data and applications require the integration of identity management systems in order to provide a more effective way to manage access to applications.

Access management is the term used to describe the process of permitting access to protected online information. It describes the administrative process to allow access to online resources (eg. Web sites or Web applications) for any individual based on the provided identity.

In this context identity and access management are based on several key concepts, including:

- Authentication - the process of verifying the identity of any individual that is requesting access to any resource.
- Authorization - the process of determining what kind of access that should be granted to the user based on his/her credentials.
- Attributes - information about the user, like membership or role
- Trust - the agreement between different parties and systems for sharing identity information.
- Access management - the processes and technologies for controlling and monitoring access to protected resources. It includes authentication, authorization, trust, and security auditing.
- Federation - a special kind of trust relationship between distinct organizations that agree to share identity information beyond internal network boundaries.

This new requirements for authentication, authorization and identity management originated mainly from the growth of Web applications in higher education institutions. Most of Web applications are role based, which means that the authentication of the users is mandatory to provide the authorization based on the user profile. Web applications that normally require user authentication are virtual learning environments, academic and institutional portal, virtual research environments, wikis, blogs, libraries, etc.

The variety of Web applications that require authentications implies that the user needs to introduce their credentials in each application. The adoption of single sign-on for all the campus Web applications is the common solution to provide a better user experience. The main web Single Sign-on approaches are presented in the follow section.

2.1. Web Single Sign On

Web Single Sign On (SSO) gives response to some of the issues related to identity management, because the authentication is managed centrally and the user can navigate through different Web applications using the same session.

The first applications of Single Sign On applications come from enterprise Single Sign On, defined as the ability for a user to enter the same id and password to logon to multiple applications within an enterprise. This approach at enterprise level was extended to Web applications using mechanisms to use the same session in different applications.

There are in general two major ways that can be used to implement a single sign-on system. They include the use of cookies and X.509 certificates.

In the case of the use of cookies, when a user is authenticated by the single sign-on system, the system saves a cookie in the user's browser, which is essentially a tiny file of information about the user session. Because the HTTP protocol is stateless, cookies are used regularly to store information in user's computer, like username and user preferences.

When the user attempts to access a resource, the end system can request the cookie. If it is present and is valid then the user can access the resource. If the cookie is not present or not correct, for example if it is expired, then the user would be asked to re-authenticate.

The main concern of using cookies to store the user session is related to security, because the information stored in the cookie can be read back from the browser by the Web server. Cookie theft and session hijacking are the main security problems because when an attacker takes over a user session, gain unauthorized access to information or services in the computer system.

Another disadvantage of the use of cookies to support Single sign-on is the inability to use the system if the user has disabled cookies in the browser. In this case, all the functionality of the system is compromised.

The other alternative to implement single sign-on systems is based on X.509 certificates, which has the advantage of improving security, but increases the complexity of the system. The complexity and the costs of a public key infrastructure (PKI) is the main drawback of this approach. Certificates are used sometimes in conjunction with cookies to improve the security of the system and maintain the simplicity of a cookie based single sign-on.

The main technologies developed by universities that provide Web SSO are:

- Yale Central Authentication Systems (CAS)
- Washington Pubcookie
- Stanford WebAuth
- Michigan Cosign
- A-Select (Surfnet)

The Yale Central Authentication System has a good implementation and is now supported by JA-SIG, the non-profit global consortium of educational institutions and commercial affiliates supporting open source software development. CAS uses a cookie-based model. When the user initially addresses a new service on the Web, his request is redirected to CAS. CAS generates a large random number that represents the connection from this Browser to one particular service (identified by the URL of the service). This number is appended to the URL and sent back to the service. The service now opens a separate HTTPS session to CAS to validate the ID number and obtain the identity of the user browser.

SSO systems provide an effective way to manage authentication and authorization inside institutions, but are restricted to the administrative domain of each institution. With the implementation of Bologna Process more students, lecturers and staff will be on mobility programs within European higher education institutions. The creation of identity management federations is mandatory to provide the mobility of users and to permit the exchange of contents and services between institutions.

2.2. Federated Identity Management

Federated Identity Management builds a trust relationship between Identity Providers (IdP) and Service Providers (SP). It devolves the responsibility for authentication to a user's home institution, and establishes authorization through the secure exchange of information (known as attributes) between the two parties. There are a number of advantages for institutions in adopting a federated access management system. The main advantages are:

- With the growing of web applications and authentication scenarios, including access to internal and external resources, and collaborative requirements within e-learning and e-research, the use of federated access management improves the user experience, because users only need to use their institutional username and password.
- It is based on international standards and is implemented at national level in several countries like UK, USA, Australia, Switzerland, Finland, Spain, Germany, Netherlands and Denmark.
- It separates authentication from authorisation. Authentication is controlled by the user's home institution; authorization is based on user attributes and controlled by the resource provider.

The adoption of standards is mandatory to constitute federations. The most important standards to support federations are: SAML, Liberty Alliance and Shibboleth.

SAML (Security Assertion Markup Language) is an XML standard for exchanging authentication and authorization between security domains. SAML is a standard approved by Organization for the Advancement of Structured Information Standards (OASIS) and receive contributions from Liberty Alliance with the Identity Federation Framework (ID-FF) in SAML 2.0. The Liberty Alliance was formed in 2001 by approximately 30 organizations to establish open standards, guidelines and best practices for federated identity management.

By the integration of ID-FF from Liberty Alliance in SAML 2.0, SAML is now a wide adopted standard for identity management. Based on the SAML standard, Internet2 Middleware Initiative developed an architecture and open-source implementation for federated identity-based authentication and authorization named Shibboleth. Shibboleth provides Single Sign-On capabilities for in Campus and federated scenarios. SAML is a common language to federated access systems like Shibboleth (USA, Australia, Finland, Switzerland, UK), PAPI (Spain, Poland), A-Select (Netherlands, Australia) and FEIDE/Liberty Alliance (Norway).

Shibboleth Single Sign-on and Federating Software it was developed specifically to address the challenges of (Internet2, 2008):

- multiple passwords required for multiple applications
- scaling the account management of multiple applications
- security issues associated with accessing third-party services
- privacy
- interoperability within and across organizational boundaries
- enabling institutions to choose their authentication technology
- enabling service providers to control access to their resources.

The Shibboleth System includes two major software components: the Shibboleth Identity Provider (IdP) and the Shibboleth Service Provider (SP). Identity Provider is the software run by an organization with users wishing to access a restricted service and Service Provider is the software run by the provider managing the restricted service. Shibboleth leverages the organization's identity and access management system, so that the individual's relationship with the institution determines access rights to services that are hosted both on and off-campus.

Shibboleth has a wide adoption in identity federations in higher education like the UK Federation (UK), Switch AAI (Switzerland), DEMOaar (Germany) and HAKA (Finland).

The Switch AAI federation has 36 members, which are mainly universities, the UK federation has 341 Identity providers and service providers and the HAKA has 26 members. The growing of the number of members in any national or international identity federation depends on the quantity and quality of contents and services available in the federation. E-learning contents and digital libraries are the main services that take advantage of identity federations, increasing the use of subscribed services and reducing the security risks associated with user's accounts.

3. E-learning Standards

With the continuous growth in number of virtual learning environments and authoring tools, there arises a necessity to provide mechanisms of interoperability between tools and systems in order to support the portability, reusability and independence of contents and systems.

E-learning standards provide common data structures and communication protocols for e-learning objects and cross-systems workflows. The main organizations developing e-learning standards are:

- ISO (International Standards Organization)
- IEEE LTSC (Learning Technology Standards Committee);
- CEN (European Centre of Normalization)
- IMS (IMS Global Learning, Inc)
- AICC (Aviation Industry CBT Committee)
- ARIADNE (Alliance for Remote Instructional Authoring and Distribution Networks for Europe)
- ADL (Advanced Distributed Learning)

In Figure 1 is represented the process of standardization, where AICC, IMS, ADL and *Ariadne* produce the specifications that are proposed to IEEE LTSC for standardization. IEEE LTSC with ISO/IEC/JTC1/SC36 evaluates the specification to propose as a standard to ISO.

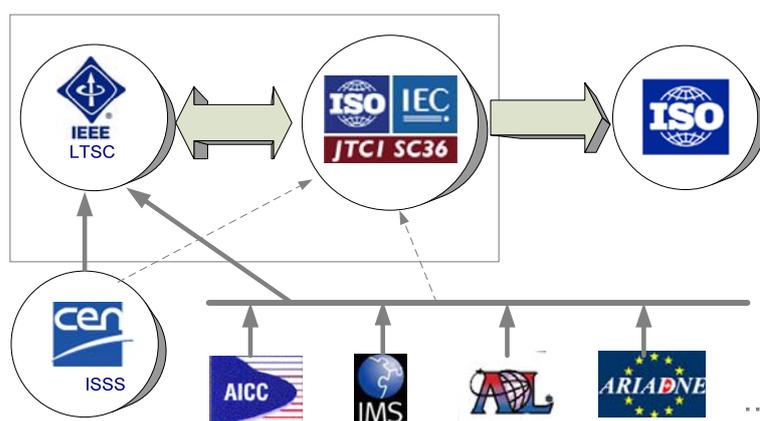


Figure 1 – E-learning standards organizations

The adoption of standards is crucial for the development of e-learning, because it permits the interoperability of systems and the reuse of contents. The standards that are more relevant at the moment are SCORM and IMS Learning Design. These standards and specification are presented in the follow sections.

3.1. SCORM

The Sharable Content Object Reference Model (SCORM) is a collection of standards and specification provided by ADL in 1999, with the aim to integrate in the same model standards for metadata, content package and communication between client side content and a host system. SCORM increases the interoperability of learning materials, and aims to foster creation of reusable learning content as instructional objects within a common technical framework for Web-based learning (E.J.-L. Lu & Y.-H. Chen, 2006). Shareable content objects (SCOs) are individual, electronic units of learning that may be combined to create a course of study. SCORM as three parts:

- Overview - Information about the model
- Content Aggregation Model - how to create learning sequences and reuse contents in different systems

- Run Time Environment: How content is launched and the learner's progress is tracked and reported back

Content Aggregation Model (CAM) describes the components used in a learning experience, how to package these components for exchange between learning systems, how to describe contents with metadata to provide search and discovery, and how to define the rules for learning sequence. It includes the Learning Object Metadata, which provides information about content to help search and discover content, and the content packaging specification, which defines how to package a collection of learning objects, their metadata, and information about how the content is to be delivered to the user (Figure 2).

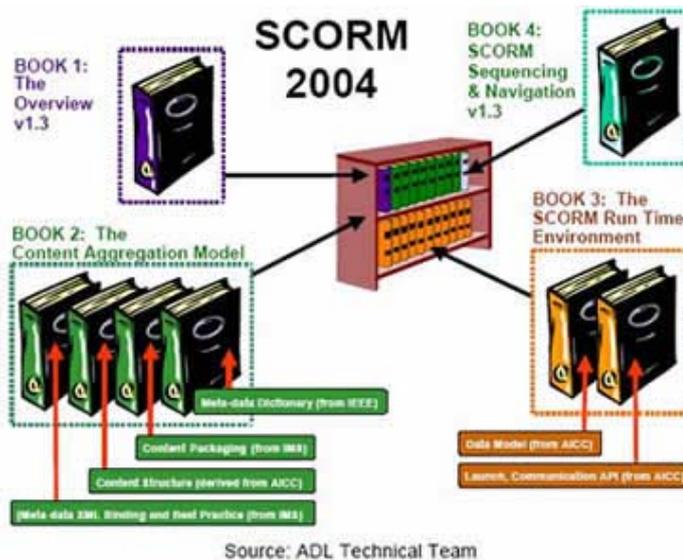


Figure 2 – SCORM reference model

The Run Time Environment is an API that sends information back and forth between the learner (content) and the LMS. The API provides a simple way to “get” and “set” information from a user’s browser to the server-side LMS. The API is based on Javascript to support the communication between the client and the server, capturing the user actions and send it back to the server.

3.2. IMS Learning Design

The learning management systems are usually used in blended-learning projects as a content repository where the students access the materials designed for campus classes. In this scenario there is little innovation in the learning process and learning materials are static.

Stacey (Stacey, 2003) refers that there is a general opinion that the contents like they are structured in e-learning, is nothing like turning the page of a book, without any type of interactivity and pedagogical strategy, which implies that the students has the feeling that the contents are static and uninteresting.

To change this opinion is necessary to transform the educational process, based on the student activities, being the learning management system and the contents only the environment to achieve these objectives. This is in agreement with the Bologna Process, which argues the necessity to center the educational process in the student, based on the learning outcomes and student competence.

To support the adoption of any learning methodology in e-learning and blended-learning environment, the IMS Global Consortium approve the Learning Design specification in 2003 (IMS, 2003), based on the Educational Markup Language (EML) developed in the Open University of Nederland.

Learning Design is a specification used to describe learning scenarios. These learning scenarios can be presented online and reused in any context, supported by any compliant learning management system. It can describe a variety of pedagogical models including group work and collaborative learning.

IMS Learning Design relies on a number of elements. These include roles that people perform (who does what); activities (what they do); and environments, which include where they do them (services) and what they do them with (learning objects). The overall scenario or design is described within the method element, which contains play, act, and role-parts elements, and is analogous to a theatrical play. A learning design may be based around the achievement of specified learning objectives by learners; it may also define prerequisites. As well as allowing an entire design to be shared or reused, IMS Learning Design allows these elements to be reused in other learning designs (Jeffery and Currier, 2003).

The implementation of Learning Design specifications has three levels:

- Level A contains the main components of Learning Design except the properties, conditions and notifications;
- Level B adds the properties and conditions of Level A, with supports the personalization of the learning process;
- Level C adds the notifications, making possible sending messages based on learning events.

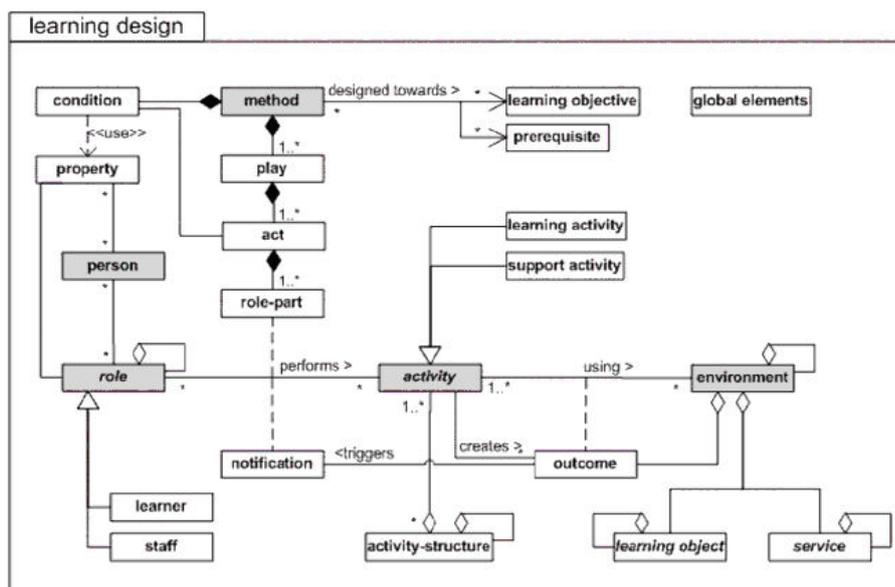


Figure 3 – IMS Learning Design specification (IMS, 2003)

The Learning Design specification can describe learning scenarios based on learning activities, making possible to reuse learning activities and resources. SCORM is an effective model to describe learning objects and can be used in conjunction with Learning Design to provide the reusability of learning objects and learning contexts. The learning activities can improve the educational process based on the student needs according to Bologna Process.

4. Promoting the Sharing of Contents and Services in Higher Education

Federations are an effective way to promote a deeper collaboration between higher education institutions in order to promote the mobility of students and faculty within Europe. This is very important to Europe in order to respond to the new challenges of the knowledge based societies where the knowledge is the base of the economy and development.

To structure content for sharing is very important to adopt standards like SCORM and IMS Learning Design. SCORM permits the sharing of learning objects between institutions and their reuse in several learning activities and Learning Design used to describe any learning scenario.

The main characteristics of Learning objects are reusability, accessibility, portability, interoperability and durability. Learning objects can be modified and versioned for different courses, can be indexed for easy retrieval using metadata standards, operate in different systems independently of the hardware and software and can remain intact through upgrades to the hardware and software.

The reusability is an important feature of learning objects permitting the construction of learning sequences based on distributed learning objects that can be produced in several institutions. To facilitate the discovery and reuse of learning objects is necessary the adoption of federated identity management systems to share contents and services within Europe.

There are several initiatives of learning objects repositories to promote free access to online resources, the most known are:

- MIT OpenCourseWare (OCW)
- Carnegie Mellon Open Learning Initiative (OLI) project
- MERLOT - Multimedia Educational Resource for Online Learning and Teaching
- Jorum - National learning object repository in UK

OpenCourseWare (OCW) is a free publication of MIT course materials that reflects almost all the undergraduate and graduate subjects taught at MIT. The project starts in 2000, and the first proof-of-concept site it was available in 2002, containing 50 courses. By November 2007, MIT completed the initial publication of virtually the entire curriculum, over 1,800 courses in 33 academic disciplines. Going forward, the OCW team is updating existing courses and adding new content and services to the site.

Based on OpenCourseWare experience, the OpenCourseWare Consortium is a collaboration of more than 100 higher education institutions and associated organizations from around the world creating a broad and deep body of open educational content using a shared model. The mission of the OpenCourseWare Consortium is to advance education and empower people worldwide through [opencourseware](http://opencourseware.org).

The OLI project, developed at Carnegie Mellon, is working on a free and widely and effective online education. OLI grew out of collaboration among cognitive scientists, experts in human computer interaction and seasoned faculty who have both a deep expertise in their respective fields and a strong commitment to excellence in higher education. The project adds to online education the crucial elements of instructional design grounded in cognitive theory, formative evaluation for students and faculty, and iterative course improvement based on empirical evidence.

MERLOT (Multimedia Educational Resource for Learning and Online Teaching) is a Web-based open resource primarily for faculty and students in higher education that aims to alleviate the problem of locating relevant materials of high quality on the WWW. MERLOT is a wide repository to improve the effectiveness of teaching and learning by expanding the quantity and quality of peer-reviewed online learning materials that can be easily incorporated into faculty designed courses. It includes links to thousands of learning materials, sample assignments, evaluations of the learning materials by other individual users and panels of faculty and links to people with common interests in a discipline and in teaching and learning. MERLOT has more than 19580 resources in several areas.

Jorum is a free online repository service for teaching and support staff in UK Further and Higher Education Institutions, helping to build a community for the sharing, reuse and repurposing of learning and teaching materials. It supports access to over 2,500 learning resources for download for direct use in the classroom and within virtual learning environments (VLEs). Recently Jorum became an open repository, named JorumOpen, where lecturers and teachers will be able to share materials under the Creative Commons license framework: this makes sharing easier, granting users greater rights for use and re-use of online content and easier to understand.

Open access repositories are at the moment the focus of e-learning, providing a more effective learning experience with high quality materials. In Europe, several higher education institutions are creating their learning objects repositories for faculty reuse of materials. The project PROMETEUS (PROMoting Multimedia Access to Education and Training in EUropean Society) it was funding by European Union to apply and integrate the IEEE LTSC and learning standards in the European contexts and cultures, with a clear underlying ideal to promote access to knowledge, education and training for all European citizens--regardless of their age, work situation, geographical location or social status. PROMETEUS has brought together hundreds of public and private sector organizations. The following issues addressed by PROMETEUS project was:

- optimal strategies for multicultural, multilingual learning solutions,
- new instructional and training approaches and new learning environments,
- affordable solutions and platforms based on open standards and best practices,
- publicly accessible and interoperable knowledge repositories.

Another European project to promote e-learning repositories is the foundation for the European Knowledge Pool (ARIADNE). ARIADNE is an European Association open to the World, for Knowledge Sharing and Reuse. The core of the ARIADNE infrastructure is a distributed network of learning repositories. It was based on results of ARIADNE European projects, which create tools and methodologies for producing, managing and reusing computer-based pedagogical elements and telematics supported training curricula.

ARIADNE and PROMETEUS projects it was the most relevant initiatives to promote the sharing of contents across Europe, but it was not the aim of these projects to create a European repository. The European Higher Education Area, in which students can choose from a wide and transparent range of high quality courses and benefit from smooth recognition procedures, is a great opportunity to implement new polices to respond to the challenge of how to improve the attractiveness of European Higher Education Area and how to implement the Lisbon strategy in order to improve the competitiveness of Union knowledge-based economy.

To address this aims the sharing of contents and services across European higher education institutions is mandatory. The creation of an European Federation and an European Learning Objects Repository are two essential steps to improve the knowledge of European citizens. The main issues related to the implementation of an European repository are:

- How to the change the educational paradigm, from a teacher centered paradigm to a distributed paradigm, where the knowledge is produced and transmitted collaboratively;
- What type of ontology should be used to describe learning objects to be effectively organized in courses;
- How to stimulate the adoption of SCORM and Learning Design standards;
- How to develop multilingual and multicultural learning objects.

The adoption of e-learning standards and the separation of presentation layer and information layer, based on XML technologies, can contribute to a more effective collaboration in the development of learning objects, based on the open source paradigm, under the Creative Commons license framework, in order to share, use and re-use online content.

The adoption of a European identity federation is important even for open access repositories, because it is possible to personalize the delivering of contents and services for lecturers and students, track the student progress and to control the quality of learning materials based on student learning experience.

5. Conclusions

SSO systems provide an effective way to manage authentication and authorization inside institutions. However, they are restricted to the administrative domain of each institution. With the implementation of Bologna Process more students, lecturers and staff will be on mobility programs within European higher education institutions. The creation of identity management federations is mandatory to provide the mobility of users and to permit the exchange of contents and services between institutions.

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