



From SCORM to Common Cartridge: A step forward

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ABSTRACT

Shareable Content Object Reference Model (SCORM) was proposed as a standard for sharable learning object packaging, delivering and sequencing. Several years later, Common Cartridge (CC) is proposed as an enhancement of SCORM offering more flexibility and addressing needs not originally envisioned, namely assessment and web 2.0 standards, content authorization, collaborative forums, outcomes reporting, accessibility. Educational policy makers, specialists responsible for learning systems deployment, educational content authors and teachers committed to the learning object paradigm must opt for or coexist with two different, partially overlapping proposals for content packaging. While SCORM was conceived for self-paced computer based learning, Common Cartridge attempts at providing support for all forms of teaching and learning with a stress on interactive and collaborative environments. Variety of content, distributed content, discussion forums, assessment, student's tracking, interaction with external tools and authorization to access resources are listed as its main enhancements. This article reviews and compares SCORM and Common Cartridge from an educational perspective, seeking to provide some ground and guidelines on how to stand before these proposals. A simple process for authoring a Common Cartridge is described, as well as testing and conversion from SCORM. Suggestions are made to education practitioners on learning objects standards adoption in the most common scenarios.

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1. Introduction

The creation of eLearning material proved to be of high cost in terms of time and effort. A great many students must learn the same subjects, in much the same way. If learning material could be shared, a great saving would be possible. Sharable learning objects address a single educational objective, and contain all the learning material needed. A course can be put up as a combination of learning objects, in much the same way as a personal computer can be built from off-the-shelf parts. A common repository of learning objects, carefully identified in subject and purpose allows to select the required objects according to the learning objectives of a particular course in record time. This content core can always be supplemented by more specific material, ideally in the form of new learning objects, which besides addressing the needs of the course in question may add to the learning object repository. Besides saving time and effort, reuse and sharing of the same learning objects allow for higher quality of teaching material, avoid redundancy, and provide an ever increasing collection of teaching material ready to be used. The essential building block of this solution is the sharable learning object, a complete unit of educational material with a single, narrow educational or instructional objective. The solution required agreement on a standard for identification and packaging. A standard identification allows for the search and selection of objects according to learning objectives. A standard way of packaging allows learning platforms to import, process and deliver content in a predictable way.

SCORM, which stands for Shareable Content Object Reference Model, was such a standard (ADL, 2009b). Moodle (<http://moodle.org>), ATutor (<http://www.atutor.ca>), Claroline (<http://www.claroline.net>) and Docebo (<http://www.doceboms.org>) are some popular, free software learning platforms supporting SCORM version 1.2 objects. Concerning authoring tools, the Reload Project (<http://www.reload.ac.uk>) provides an editor (the Reload Editor) to create SCORM objects, and a player (the Reload SCORM Player) to validate and display SCORM objects on a standalone personal computer. With the help of these tools, a SCORM compliant sharable learning object can be created with moderate effort (Gonzalez-Barbone & Anido-Rifon, 2008).

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Presented as a way towards freedom for innovation, migration and interoperability, Common Cartridge was developed by product companies and publishers to meet some needs SCORM failed to address, namely assessment and web 2.0 standards, content authorization, collaborative forums, outcomes reporting, and accessibility. SCORM was designed for self-paced computer based training, while Common Cartridge aims at the online support of all forms of teaching and learning. Common Cartridge was designed to be compatible with SCORM; both standards are based on the IMS Content Packaging and LOM Metadata specifications, and migration from SCORM to Common Cartridge is straightforward if no sequencing is used (Riley, 2008).

SCORM is a suite of specifications and standards proposed by the Advanced Distributed Learning Initiative (ADL), which was formed as a developer and implementer of learning technologies across the US Department of Defense (<http://www.adlnet.gov>). Common Cartridge was proposed by the IMS Global Learning Consortium, a non-profit, member organization that strives to promote the use of learning technologies in education and corporate instruction, mainly by the creation of standards for the development and adoption of technology enabled learning (<http://www.imsglobal.org>). IMS Global Learning Consortium (IMS GLC) is a collaboration among educational technology suppliers, educational institutions and government ministries. IMS GLC Common Cartridge is proposed as an extension of SCORM, hence as a step forward in the standardization of learning content packaging.

A recent article by the authors describes learning objects, the SCORM standard, and how to go about creating a first SCORM object. The release of the Common Cartridge version 1.0 Final Specification on October 1, 2008, motivates the present article. Educational policy makers, specialists responsible for learning systems deployment, educational content authors and teachers committed to the learning object paradigm must now opt for or coexist with two different, partially overlapping proposals for content packaging. This article reviews and compares SCORM and Common Cartridge from an educational perspective, seeking to provide education practitioners with some ground and guidelines on how to stand before two different proposals for educational content standardization.

This article starts with the description of a typical present day eLearning scenario, which leads to the explanation of some commonly used eLearning terms. A description of SCORM design premises and features follows. Common Cartridge is then examined with some detail in its characteristics, origin, support, runtime model, supportive standards and file structure. A short guide describes the creation of a Common Cartridge, its validations against a testing service, conversion from SCORM to Common Cartridges; some suggestions and pitfalls to avoid are also included as lessons learned from the experience. A comparison between SCORM and Common Cartridge is then made, followed by a critical evaluation and a discussion of some controversial issues. Based on the previous analysis, some suggestions are made to educators on how to stand before learning objects and standards. Finally, some conclusions on the future of learning standards are put forward.

2. eLearning and learning objects

In a typical, present day eLearning scenario, a content author creates a learning object with the aid of an authoring tool. The author designs the learning object to serve a single learning objective, gathers all documents, images, assessment tasks or any other digitalized content, creates a metadata file describing the intended purpose of the learning object, and puts everything into a single file. This file is called a package; it is the physical implementation of a learning object, usually in the form of a zip file. The package is created according to a standard such as SCORM, or a standards profile such as Common Cartridge. Learning objects created according to these standards can be shared and reused in different courses and delivered through different platforms. Metadata allow course designers to identify and locate learning objects suitable for their educational purposes. The author selects the material, adds information and relies on the authoring tool to handle the details of package creation.

The new learning object is uploaded to a learning object repository, where it can be found by course designers, or it is used right away in a course at a learning platform. A course designer creates a new course in a learning platform, searches for and selects those learning objects which address her learning objectives, and populates the course with them. Instructions to students, dates, comments, and complementary material or references can be added to the course as needed. Discussion forums, wikis, news, tasks and other platform supported activities are created. In due time, the course is made available to students. The platform registers students, keeps records of accomplishment and does some statistics.

A student taking the course accesses the platform with a browser, logs in, and starts going through the course material and activities in the order established by the course designer, including assessment. Along the course, the student interacts with other students and with instructors. The platform records the student activities, which can be examined by an instructor. Once all requirements have been accomplished, an instructor assigns a mark, results are presented to the student and eventually uploaded to a Student Information Service where the students records are orderly kept.

The former learning process assumes that learning objects can be uniformly presented and interacted with whatever the learning platform; that they can be searched, found and downloaded from in any accessible repository, and that they can be integrated seamlessly in a course with other learning objects. To achieve this sharing, reuse and interoperability in a wide, cost effective manner, learning objects must be structured in conformance to a standard. Though educator need not be familiar with the intricacies of implementation which support learning objects, they are expected to be fully aware of their characteristics, know their possibilities and limitations, select them for a course, and interact with them as instructors in a learning platform. Many teachers like to prepare their own teaching material, hence they will rather than not prefer to create their own learning objects; they will certainly want to use an effective, user friendly authoring tool. All these tasks require some familiarity with learning objects standards. This article attempts to provide the essential information, as well as a critical view of present day proposals.

In the rest of this section a brief review of relevant eLearning terms is presented. Among the profusion of eLearning terms a minimalist approach is deliberately chosen for the purpose of this article: learning platform is used instead of Learning Content Management System, Virtual Learning Environment, their corresponding acronyms, or other terms of almost identical meaning; learning object is preferred to Reusable Learning Object or Sharable Learning Object.

More formal and detailed definitions may be found in eLearning glossaries (Cyber Media Creations LLC, 2008; JISC/QCA, 2006; Learning Circuits, 2008).

Readers familiar with the subject may safely skip the rest of this section.

2.1. eLearning

After some hesitation the term *eLearning*, which stands for electronic learning, imposed itself to designate any process of learning supported by the Information and Communications Technologies (ICTs) such as the Internet, intranets, local, wide or mobile networks, stand-alone computers and multimedia.

Computer Based Training (CBT) was one of the first terms used to designate learning done with the help of a computer, essentially off-line. In present times the term is used to designate a learning experience carried along with the help of a computer in a rather isolated way, with little or no interaction with an instructor or other learners.

Advent of the Internet enabled distribution of learning content through the web. In the eLearning context *content* refers to information captured digitally and delivered to learners in a variety of formats, such as text, hypertext, images, graphics, audio, video, animation, simulation or whatever. *Content management* comprises the technical and operational processes of managing digitalized content, such as storage, indexing, searching and retrieval. Delivery of content required a server side application. A *Content Management System* (CMS) is a software application designed for the management of content, not necessarily learning content. A *Learning Management System* (LMS) is a software application apt for the management of learning content but also providing other learning and instructional facilities such as course catalog support, launching courses, registering students, delivering instructional material, managing assessment activities, tracking students progress and doing some statistics. Several other terms are used in almost the same sense. The rather neutral term *learning platform* designates a set of learning and teaching tools based on networked computer resources. A learning platform becomes the focus of interaction and the meeting point of students and teachers.

2.2. Learning objects

Most of modern learning platforms deliver their content in the form of learning objects. A *learning object* is a small modular block of learning material serving a single learning objective, independent of other learning materials. A learning object can be used in different settings and combined as appropriate with other learning objects. Learning objects are designed to be reusable, i.e. used in several different courses, and to be sharable, i.e. used once and again among different courses, by colleagues, by other institutions or by the public in general. Hence the alternative terms Sharable Learning Object (SLO), Reusable Learning Object (RLO).

The main advantages of using learning objects are cost and quality: a learning object can stand by itself, whatever the learning platform or repository site, so it can be created with as much care as needed, revised and improved as needed, and be used in very different courses and situations. Since each learning object addresses a single learning objective, a course could be put up just by an orderly selection of available learning objects.

2.3. Metadata

Each learning object requires identification and description, so that it can be selected for a course without displaying it in full. This can be achieved through the use of accurate descriptors arranged in categories; descriptors can be assigned to learning objects to best describe their content and purpose. Information about the content of a learning object is called metadata. *Metadata* is the information attached to a learning object describing its content so as to enable it to be retrieved from a data repository according to different selection criteria. Metadata becomes most useful when it conforms to a standard, and all objects contain the same type of information. Typical fields in learning object metadata are author, title, subject, date of creation, version, content descriptors.

Metadata are typically recorded in XML. XML (Extensible Markup Language) is a markup language apt for electronic interchange. XML documents consist of text chunks enclosed within text tags. Since tagged chunks can be orderly nested, XML documents exhibit a versatile structure apt for efficient communication across different media and applications (Wikipedia, 2009).

2.4. Creation of learning objects

Packaging refers to the bundling together of the several files comprising a learning object, including files necessary for administration purposes such as metadata. Hence a learning object is implemented by a group of files bundled together in some archive format such as a zip file; the zip file is a *package*.

Learning objects are usually created with an authoring tool, a kind of editor capable of producing learning objects compliant with some packaging standard. An *authoring tool* is a software application apt for the creation of learning objects and units, modules or courses based on learning objects. Packaging a learning object according to a standard may be hard work, but authoring tools are end user applications which do not require computational expertise, though some training is desirable to profit from their offered facilities.

2.5. Specifications, standards and profiles

A *specification* is an explicit set of requirements to be satisfied for a material, product or service. A specification is a detailed, precise document describing something, or containing a plan on how to do something (Merriam Webster, 2009; Wikipedia, 2009). A standard is essentially a specification established by consensus and approved by an accrediting institution such as a IEEE or ISO. "A standard is adocument, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context!" (ISO/IEC, 2008). Both specifications and standards are used in eLearning and learning content packaging.

In standardization, a *profile* is an agreed-upon subset and interpretation of a specification. Technical specifications may be complex and may include a number of optional features; of these, only a few may be of interest for an area. In this case, it is convenient to agree upon those optional features relevant to the area and define a profile of the specification to be used in that area. Many different profiles of a certain specification are possible, but if they are well conceived all may claim compliance of the specification and do not contradict or interfere among themselves (Wikipedia, 2009).

The word standard is used rather loosely in the literature: it may refer to a standard, a specification, a profile, or a suite of standards and specifications. SCORM is defined as a collection of standards and specifications (ADL, 2009a). Common Cartridge is said to be a standard (IMS GLC, 2009a), though the last issue is entitled Version 1.0 Final Specification; in the specification document it is defined as a profile of several existing specifications (IMS GLC, 2008). This article follows practice and uses the word “standard” in the formerly mentioned loose meaning.

3. SCORM

Shareable Content Object Reference Model (SCORM) is a collection of standards and specifications that enable learning platforms to find, import and deliver learning content in a standardized way. SCORM specifies how learning objects must be created in order to ensure interoperability across different platforms and tools.

More specifically, the purpose of SCORM is to create learning objects that are (ADL, 2009a):

- *Reusable*: content must be independent of learning context.
- *Interoperable*: content will function in different hardware and software configurations.
- *Durable*: content does not require modification after software systems upgrades or changes.
- *Accessible*: content can be identified and located when needed.
- *Maintainable*: content can be changed effortlessly, without redesign, reconfiguration or recoding.
- *Adaptable*: able to satisfy different individual and organizational needs.

3.1. SCORM technical books

SCORM is organized in technical books grouped in three main categories: Content Aggregation Model, Run Time Environment, and Sequencing and Navigation (ADL, 2009b).

The Content Aggregation Model describes the types of content objects supported, the package format, the metadata tags used to describe the package, and content sequencing. *Sequencing* refers to the order in which learning material will be presented to the student. In SCORM terminology, a learning object comprises a collection of assets. An *asset* is a piece of instructional or educational material. Assets within an object may be aggregated and ordered in different *organizations*, which result in different ways of presenting the learning object material according to different learning purposes, or to the student’s progress. Metadata are used to describe the content and help search for it in repositories.

The Run Time Environment describes what learning platforms must do to correctly deliver and display content. This includes importing the package, presenting content to students, communication between platform and content, and recording the student’s interactions with content. The purpose of the Run Time Environment is to ensure interoperability between learning objects and platforms, whatever the tools used to create the objects. The SCORM Run Time API (Application Programming Interface) defines an agreed-upon set of functions to enable communication between the learning object and the learning platform. The SCORM Run Time Data Model describes a vocabulary to be used in the interchange of information when using the API functions.

The SCORM Sequencing and Navigation book describes how a learning platform will order activities when presenting them to students. The flow of learning activities may be designed to differ according to the student’s progress; SCORM allows to change the order of presentation according to the results of the student’s interaction with learning content, e.g. branching to a revision topic if the student fails in a question.

SCORM Conformance Requirements establish which tests learning objects and learning platforms must pass to claim compliance with the standard. A Conformance Test Suite comprising software and documentation is provided to help organizations test their products. A Sample Run Time Environment is also provided to test content. It works in much the same way as a learning platform, importing the packages, delivering content in the sequence established, and passing information of student’s progress.

3.2. History and support

SCORM development was started in 1999 by the US Department of Defense seeking to provide federal and private sectors with common specifications and standards for technology-based learning. The Advanced Distributed Learning Initiative was formed, and through its work several standards and specifications were incorporated into the common SCORM reference model. Trial version 1.0 was released for testing and evaluation in January 2000, followed by versions 1.1 and 1.2 in 2001. SCORM 2004 editions 1 and 2 were released in 2004. Last stable version is SCORM 2004 3rd edition, released November 2006. SCORM 2004 4th edition is in a testing phase. Some of the organizations involved in the project were: the Aviation Industry Computer-Based Training (CBT) Committee (AICC), the IMS Global Learning Consortium, Inc., the Institute of Electrical and Electronics Engineers (IEEE), the Alliance for Remote Instructional Authoring and Distribution Networks for Europe (ARIADNE). SCORM is now an international standard, and the US Department of Defense previewed at least 100,000 registered learning objects for year 2008 (Department of Defense, 2007).

To date, most popular learning platforms support SCORM objects (Gonzalez-Barbone & Anido-Rifon, 2008).

3.3. Further reading on SCORM

Readers interested in a sound yet practical introduction to SCORM are encouraged to skim through the Carnegie-Mellon *SCORM Best Practices Guide for Content Developers* (Carnegie Mellon, 2004). A very clear overview of SCORM by ADL Chief Architect Philip Dodds takes only a few minutes to read (Dodds, 2007). A step by step guide to create a SCORM object can be seen in (Gonzalez-Barbone & Anido-Rifon, 2008).

4. Common Cartridge

Common cartridge is one of three standards seeking to support upcoming learning technology (IMS GLC, 2009a, 2009b):

- Common Cartridge (CC).
- Learning Tools Interoperability (LTI).
- Learning Information Services (LIS).

CC emphasizes interaction with external applications and services; the LTI and LIS standards establish how to achieve this interaction, so IMS GLC presents all three standards together.

The Learning Tools Interoperability (LTI) standard intends to ensure correct operation across applications, systems, and web applications that combine data or functionality from multiple sources (“mash-ups”). LTI seeks to improve on the interaction of learning platforms with external tools, and provide access to learning platform facilities such as calendars, grade books and content. LTI version 2.0 will be an extension of the IMS Tools Interoperability v1.0 Guidelines allowing tool configuration, tool presentation, and accessibility. Definition of a standard way of interaction among learning platforms and external tools guarantee interoperability among different platforms in a safer way. LTI version 2.0 specifications have not yet been released (IMS GLC, 2009c).

Learning Information Services (LIS) defines how to exchange data between learning platforms and administrative systems such as Student Information Systems, to enable compilation and analysis of student information coming from multiple points. A *Student Information System* (SIS) is a software application for the use of educational institutions to manage student data such as students' progress, course attendance, assessment scores, and all information relative to students. LIS intends to improve on the Enterprise Services v1.0 specification published in July 2004. LIS specifications have not yet been released (IMS GLC, 2009d).

4.1. Purpose and expected benefits

The main purpose of the Common Cartridge standard is to organize and distribute digital learning content in the form of learning objects. CC specifies a format for the exchange of content which can be uniformly interpreted as to what the content is and how it is organized. This allows any CC enabled learning platform to correctly manage and display the cartridge (IMS GLC, 2007, 2009b). Common Cartridge is based on the Dublin Core Metadata Element Set, a simple to use 15 element metadata set widely known in learning object creation and usage.

Common Cartridge extends learning objects to include:

- Tests, test items and assessment rules expressed in a standard format, which learning platforms can read as native. This eliminates platform dependency in assessment.
- *Distributed content*: a package can include references to resources accessible in the web.
- Interaction with external tools, applications and services.
- *Authorization*: access rights can be assigned to the package as a whole or to each of its components. This allows to include proprietary content and charge for it.
- Collaborative forums.

Common Cartridge intends to expand learning objects capabilities to support more interactive and collaborative learning environments.

IMS GLC claims adoption of CC would bring a number of benefits, listed below as IMS GLC states them (IMS GLC, 2009a), with the addition of some comments. Section 7 provides a critical evaluation of CC in its present state.

- *Greater choice of content*: learning objects may contain resources of several different types and sources. Though this is expected from the learning object paradigm, CC supports a wider variety of resource types.
- *Reduce vendor/platform lock-in*: CC learning objects can be delivered through any CC compliant learning platform; development of learning material within a specific platform cannot be easily exported to another platform. CC allows native formats endorsed by educational publishers, supports many different content formats and can be used across different platforms. This is also an expected benefit of the learning object paradigm; endorsement by educational publishers is a new feature, as well as variety of content formats.
- *Greater assessment options*: CC provides support for the IMS Question & Test Interoperability (QTI) specification. IMS QTI defines an abstract data model for questions, tests and results reports allowing for exchange and tracking among different learning platforms, authoring tools, and assessment delivery systems (IMS GLC, 2009b). Though most learning platforms provide assessment facilities, they do so in their own formats and ways. Support for IMS QTI would allow assessment resources to become platform independent.
- *Increased flexibility, sharing and reuse*: course designers select resources, assemble them into a learning objects and publish them as reusable packages easy to create, share and improve. This is also an expected benefit of the learning object paradigm.
- *Support flexible packaging via URL references to web content*: including URL references within a learning object reduces the size and complexity of the package. URL references do not require update; students will be always accessing the last version.
- *Supports collaboration and web 2.0 mash-ups*: CC includes exchange standards for discussion forums. Future incorporation of LTI will enable web service launch and data exchange of distributed learning applications from within CC.
- *Support content authorization via protected resources*: the whole cartridge or items contained can be protected through a standard open authorization protocol. This feature enables educational institutions to allow access only to enrolled students, or publishers to market their resources in the form of learning objects, and eventually charge a fee for their use.
- *Allow straightforward migration from SCORM 2004*: both SCORM and CC are based on IMS Content Packaging. Conversion from SCORM to CC is straightforward if no sequencing is used in the SCORM package. SCORM content with sequencing can be played incorporating a special engine developed by Icodeon, an Alliance member (IMS GLC, 2009f).

- *Backed by the Common Cartridge Alliance, a community providing tools for implementation and conformance:* their members provide tools for testing of cartridge conformance, learning platforms, a reference implementation of the authorization model. Through the yet to come incorporation of LTI, CC is expected to become more interactive with applications and services.

4.2. History and support

Draft of version 1.0 of Common Cartridge is dated July 30th, 2008; version 1.0 Final was released October 30th, 2008 (IMS GLC, 2009a).

Common Cartridge is supported by the Common Cartridge Alliance, an online community of vendors, user institutions and practitioners promoting the use of the IMS standards Common Cartridge, Content Packaging and Question & Test Interoperability (QTI). It counts 51 institutional members at the time of writing, most of them eLearning related companies and educational institutions (IMS GLC, 2009e). Among them, BECTA is an UK government agency towards the effective and innovative use of technology in Education; the Joint Information Systems Committee (JISC) is an UK organization funded by education councils for the use of technology in support of learning, teaching, research and administration.

The Common Cartridge Alliance intends to encourage supply of products and services compatible with the supported standards, facilitate adoption of standards compliant products, and provide tools and content to enable development of products compliant with the standards and requirements established by the IMS GLC membership (IMS GLC, 2009e). A conformance program is in progress, though at the time of writing no cartridges or platforms have achieved conformance (IMS GLC, 2007).

The ATutor open source learning platform introduced CC support as experimental in version 1.6.2, on December 2008; the next release is expected to provide conformance, by May or June 2009 (ATutor, 2008). Moodle seems to be interested in CC but is presently in search of funding (Moodle, 2008). At the time of writing, no other open source platforms were found which clearly intend to support Common Cartridge.

4.3. What is Common Cartridge

A *cartridge* is a collection of complementary material produced by publishers to accompany a textbook. They are usually made available as zip files which can be downloaded from the publisher's site and uploaded in a learning platform (vuDAT, 2007). Blackboard Inc has a proprietary format for cartridges called Course Cartridge, a registered trademark. A Course Cartridge can be imported into a Blackboard course allowing instructors to add complementary content created by academic publishers (Blackboard, undated). Several publishers produce Course Cartridges or equivalent formats.

IMS GLC describes Common Cartridge as “standards for organization, publishing, distribution, delivery, search and authorization of a wide variety of collections of digital learning content, applications, and associated online discussion forums used as the basis for or in support of online learning of any type” (IMS GLC, 2009b).

Common Cartridge intends to achieve the desirable characteristics of learning objects in general, essentially reusability and interoperability, but for a wider variety of resources, located not only in the learning object proper but also in the web, and adequate for an interactive environment with instructors and other students present. CC addresses and enhances Internet supported learning (IMS GLC, 2007).

Concerning content, CC provides a standard way to represent digital learning materials. CC compliant learning objects are expected to be reusable, interoperable, durable, accessible, maintainable and adaptable as their SCORM predecessors. Further on, CC intends to support a wider variety of content formats, including audio and video, assessment content, collaborative discussion forums, and learning applications, i.e. computer programs with which data can be interchanged for a variety of purposes. A cartridge may contain a lesson plan, study or reference material, supplemental material from a publisher, test items, a complete assessment activity, a specific topic or a whole learning object comprising topics, assessment and feedback. Besides, content can be included in the CC or simply referred to by an URL as any ordinary web resource. Hence, content can be distributed, and is not limited to what the cartridge contains. Fig. 1 shows interaction of CC with the learning platform, web content, authorization services and web based learning applications (IMS GLC, 2007).

The learning environment CC developers had in mind is a collaborative one, typically a group of students with some teachers to guide them. The students interact with learning material that may be online, offline or both; the latter situation is often called *hybrid* or *blended learning*. Though CC may be used to support self-paced learning in the old CBT way, it was developed for online or blended interactive collaborative learning, with students and teachers taking part in collaborative forums, web seminars, wikis, blogs, social networks or some other yet to come form of communication and interaction (IMS GLC, 2007).

Concerning student tracking, CC previews a scenario in which students may interact with different learning platforms belonging to different campuses or departments within an institution, or even different institutions, and tracking of students' progress is carried on by a Student Information System gathering and consolidating students' data from different sources.

Proponents of CC are publishers and learning industry suppliers, so they have a vision of the market. In this view, these standards allow a more efficient market, in which publishers, learning platform developers and learning applications developers agree on a common format to save the high costs of managing a potentially endless variety of packaging formats. The ability to address web distributed content and the agreement on an authorization standard allow publishers to sell their products on the web, and institutional purchasers to grant access of selected proprietary content to their registered students (IMS GLC, 2007). Proprietary material can take many forms, from supplementary material available to buyers of an online or printed book, learning objects in a proprietary web based repository, course material developed by a company for a specific course, interactive discussion forums or seminars lead by specialists.

As standards, CC is a set of open standards; these standards are available for free and require no royalties. Any publisher can create CCs, and every platform developer can add support for CCs to her platform. CC was developed by the IMS GLC, an industry consortium of 80 voting members, with about 35 organizations contributing to its development (IMS GLC, 2007).

4.4. The Common Cartridge specifications profile

The Common Cartridge version 1.0 Final Specification comprises two documents: IMS Common Cartridge Profile v1.0, which defines an open format for the distribution of web based content (IMS GLC, 2008), and IMS Common Cartridge Authorization Web Service, which

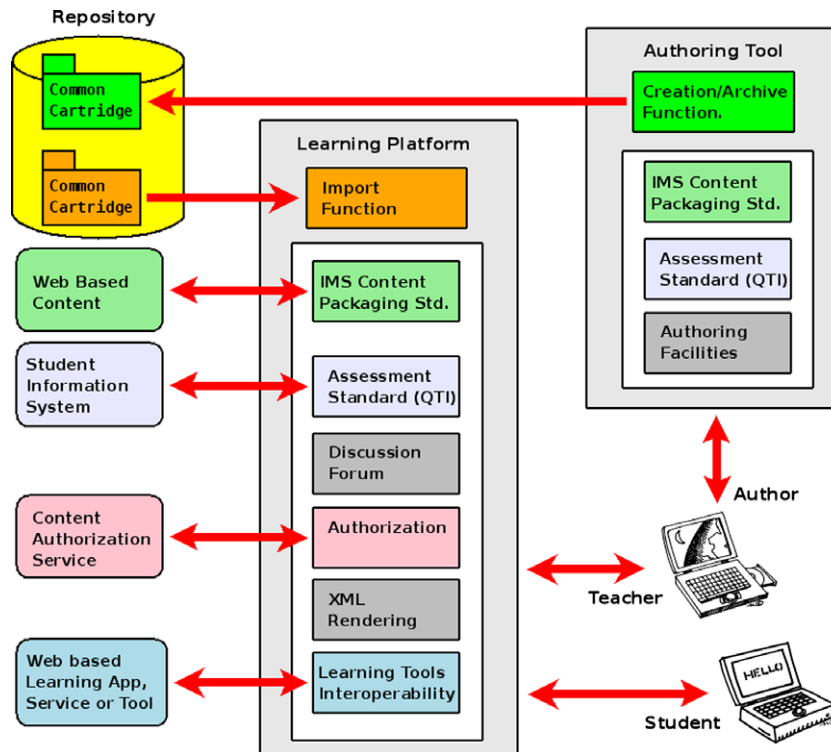


Fig. 1. Common Cartridge diagram.

defines the communication between the learning platform and the cartridge publisher to grant student access to cartridge content (IMS GLC, 2009g).

Common Cartridge defines itself as a profile of several specifications, dealing with metadata, content and authorization (IMS GLC, 2008). Common Cartridge metadata are based on IEEE Learning Object Metadata (IEEE LOM). Standards IEEE 1484.12.1-2002 and IEEE 1484.12.3-2005 define a set of attributes for interoperable learning objects, and explain how these attributes can be implemented in XML files. Common Cartridge uses a subset of IEEE LOM metadata, described in standard ISO 15836:2009 and known as Dublin Core Metadata. Dublin Core is a 15 element set of metadata considered the most useful and the most often used in learning object descriptions (Dublin Core, 2008). Dublin Core metadata are mapped to corresponding IEEE LOM metadata. To define how content should be packaged in a cartridge, Common Cartridge uses a profile of packing standard IMS Content Packaging v1.2, a standard for the distribution of digital learning content and resources, possibly coming from different sources and locations. Common Cartridge is also based on SCORM 1.2/2004, which is ADL's SCORM standard for content packaging and sequencing. Assessment may be included in a Common Cartridge, following a profile of the IMS Question and Test Interoperability standard (IMS QTI). IMS QTI defines how to create, process and exchange online assessment information. Assessment content may be tests, test items, or the results of going through these tests. Authorization to access cartridges and items within cartridges are based on the IMS Authorization Web Service v1.0, an authorization standard to grant access to proprietary content.

The CC standard intends to state clearly and unambiguously how all these specifications can be used to distribute content with a high degree of interoperability across platforms. This has been achieved by concentrating on the most commonly used features and excluding others seldom used, removing unwanted extensions, adding constraints to data in terms of type, value ranges and vocabularies, and excluding implementation options from the underlying standards. The profile is expected to be easier to implement and to test for compliance than other proposals (IMS GLC, 2008).

CC requires metadata only at the cartridge level (root folder), does not allow links to other packages, and uses only the 15 metadata elements of Dublin Core. Assessment has been restricted to the six most common QTI question types: multiple choice single and multiple answer, true/false, essay writing, simple fill in the blanks, and fill in the blanks with pattern matching (single answers can be treated using 'contains' and regular expressions). Support for authorization data has been added, as described in the Authorization Web Service specification. Discussion forum initialization can also be included in a Common Cartridge (IMS GLC, 2008).

4.5. Common Cartridge format

Fig. 2 shows the content types supported by CC (IMS GLC, 2008). The cartridge is fully contained within a Root folder. A folder is a collection of items and subfolders in a specific order; this order may be used by the learning platform to organize and present content. An IMS CC Package Metadata is an XML file describing the cartridge in terms of title, description, licensing, accessibility and the like. Items can be Files, Web Links, Discussion Topics or Assessment. A File can be HTML files or other files deliverable through the web. Web Content refer to files that can normally be delivered through the web. They may be HTML files or non HTML files such as images, audio, video, MS Office, PDF, Open Document Format, Macromedia Flash or others. HTML files may contain references to other web content files within the cartridge or external to the cartridge. A Web Link is a representation of an HTTP link, i.e. a web address, as a Learning Application Object. This representation includes a title and attributes for presentation. A Discussion Topic is a Learning Application Object used to initiate a discussion activity. It contains a title, description and file attachments. On importing a Discussion Topic, a learning platform is expected to initiate

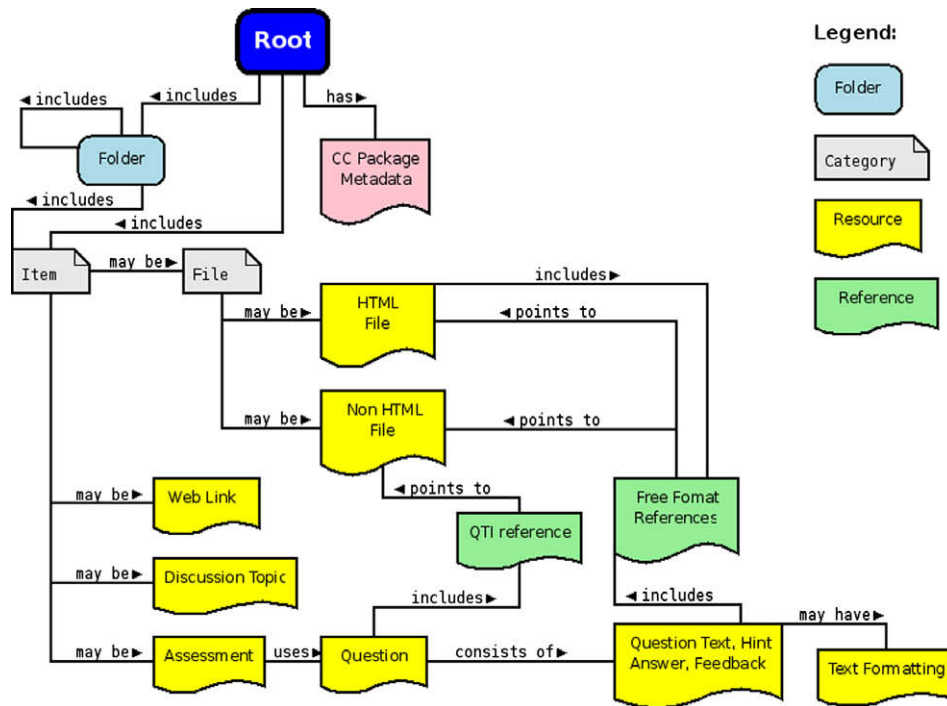


Fig. 2. Common Cartridge content types.

the new discussion topic with its own tools. An Assessment contains Questions as defined in the IMS QTI specification. A new resource type for Learning Tools Interoperability is to be incorporated when the LTI specification is finished (IMS GLC, 2008).

Fig. 3 shows the inner structure of a CC (IMS GLC, 2008). The CC Package metadata is contained in the `imsmanifest.xml` file. Cartridge metadata and roles metadata are included in this file. In version 1.0 only the roles Instructor and Learner are supported (IMS GLC, 2008). Roles allow to distinguish material visible to all from material visible only to instructors, such as instructor manuals, lesson plans or solutions files. A cartridge may contain a Web Content folder, where web content, web links and intra package references can be placed. Web content resources do not require special processing when imported into the learning platform, though their storage and rendering is defined by the platform. Resources placed in the Web Content folder can be shared by any of the Learning Application Objects contained in the cartridge. A cartridge may contain any number of Learning Application Objects, and optionally one Question Bank. A Learning Application Object is implemented as a folder structure comprising a Descriptor File and all the files and file references needed to deliver a single instance of one of these resource types: web content, web link, discussion topic, assessment or intra package reference. These files are described as Associated Content Resources. A Question Bank can embed any of the IMS QTI question types supported by the CC profile of QTI. A single Question Bank can be included in a cartridge. A Question Bank is an unordered set of questions, restricted to hold only question items. An Assessment is an ordered set of question items, and may include additional attributes which apply to the whole set, such as type of assessment, if hints or feedback or solutions can be seen by students, time limits, number of attempts allowed, if late submission is accepted. A Question Bank allows for the interchange of questions with a learning platform; once imported, usage and presentation are up to the platform (IMS GLC, 2008).

5. Creating the first Common Cartridge

This section records the steps to create a Common Cartridge with the eXe editor, shows how a SCORM package can be created with the eXe editor, how this SCORM package can be transcoded to Common Cartridge using the CETIS public transcoding service, and tests some cartridges with the IMS GLC Testing Tool.

5.1. Sample cartridges and repositories

IMS GLC provides sample cartridges to examine or use (IMS GLC, 2007), but access is restricted to Common Cartridge Alliance members, which require payment of a fee. A number of cartridges can be accessed at the IMS GLC Learning & Education Product Directory (IMS GLC 2009j). A search on the Product Directory filtered by Segment = Higher or Post Secondary, Product Type = content cartridges, Conformance mark = Common Cartridge, Standards implemented = Common Cartridge, produced 548 results, most of them from The Open University, and the rest from Elsevier. Those from Elsevier are complementary material for published books; those from The Open University can be accessed for free (OU, 2009).

5.2. The eXe editor

The eLearning XHTML editor (eXe) is an authoring tool to assist in the design, development and publishing of web based learning and teaching materials. Users can dispense with knowledge of web technologies such as HTML or XML. It is a web based authoring

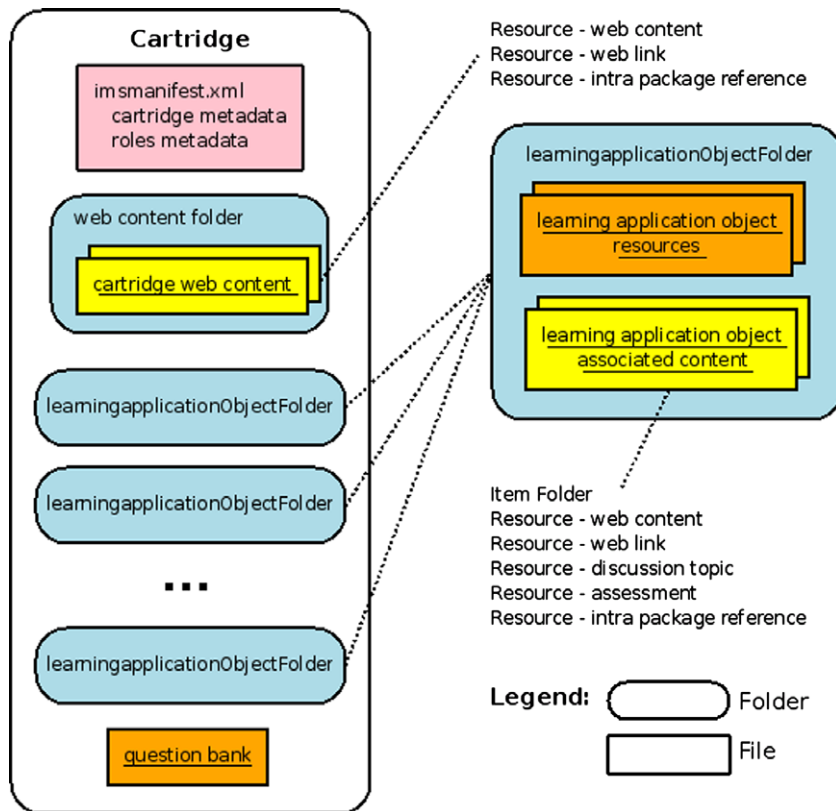


Fig. 3. Common Cartridge file structure.

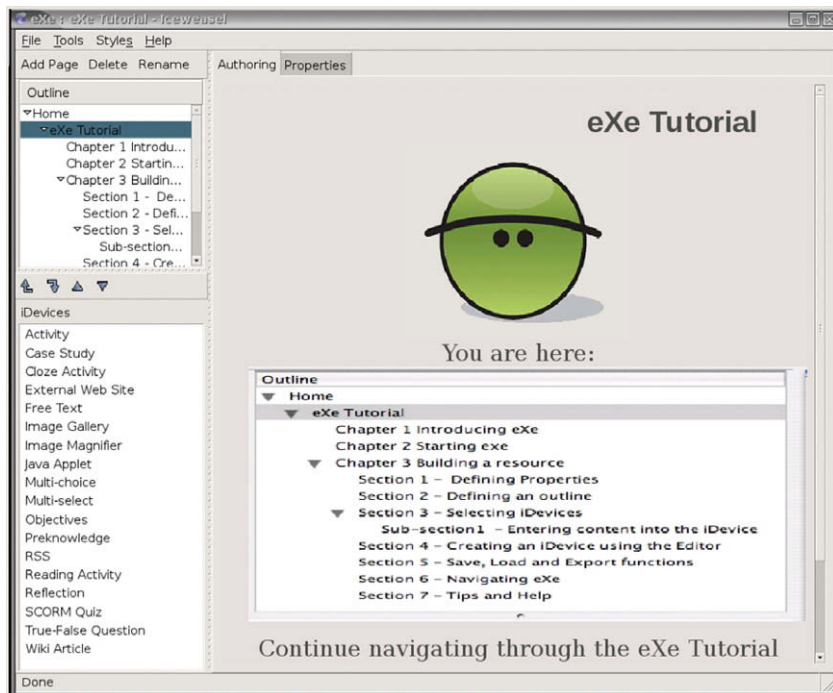


Fig. 4. The eXe interface.

environment, friendly to use, and able to export content in several formats such as IMS Content Package, SCORM 1.2, or IMS Common Cartridge. Content can also be created as a collection of self-contained web pages in a directory or in a zipped file. The eXe editor code is Open Source, published under the GNU General Public License (eXe, 2009).

Installation of eXe was quite straightforward on a GNU Linux Debian 5.00 'Lenny' box. Debian packages python-setuptools, python-zopeinterface, and python-imaging, not present in the default installation, were added using the Synaptic package management tool. After the compressed package was downloaded from the eXe site (eXe, 2009), the following commands did the job:

```
cd/export/eXe
tar xvzf exe-1.04.0.3532-source.tgz
cd exe
sudo python setup.py install
```

Installation placed eXe on the Applications, Accessories menu. eXe is a web based application, hence it runs within the default browser, in this case Iceweasel, which is based on Mozilla 5.0. Installation under the MS Windows platform should be even simpler. Fig. 4 shows a screenshot of the eXe editor.

The eXe interface comprises a central Authoring pane and two additional panes to the left, the Outline pane and the iDevice pane. iDevice stands for ‘instructional device’, which are structural elements used to describe content such as images or free text. The Outline pane allows to create and navigate a hierarchical structure of content in the form of pages or “nodes”. When selected in the Outline pane, content of a node is shown in the Authoring pane. Editing can be enabled just by double clicking within the content, or clicking on the icon with the notepad and pencil. Editing is finished by clicking a green check mark to accept changes or a blue undo arrow to discard changes. The iDevice (instructional device) pane provides a collection of iDevices: objectives, pre-knowledge, free text, case studies, several types of closed questions, external web sites and Java applets; more iDevices are available and in development. New iDevices can also be created within the eXe application.

Content is created in the Authoring pane by selecting the most appropriate iDevice and entering learning content. A course or a lesson is implemented as a collection of nodes hierarchically organized in topics, sections and units. Each node consists of one or more iDevices loaded with content. Menu option File, Export, allows content to be packaged as IMS Common Cartridge, IMS Content Package, SCORM 1.2, a self-contained web site in a self-contained folder or in a zip file, a single web page, a simple text file and even a collection of iPod Notes. Content packaged as a Common Cartridge, an IMS Content Package, or a SCORM 1.2 learning object can be imported into and delivered by any standards-based LMS.

The eXe authoring tool is easy to use. A Tutorial and Manual is provided under the Help menu. The eXe tutorial is itself learning content, and hence it could be exported both as a common cartridge and a SCORM 1.2 package, for the tests described below.

5.3. Converting from SCORM to Common Cartridge

CETIS, the JISC Centre for Educational Technology and Interoperability Standards is a United Kingdom organization funded by JISC, the Joint Information System Committee of the United Kingdom’s education funding councils. CETIS provides and contributes information about learning technologies, with a focus on technical interoperability standards. CETIS (<http://jisc.cetis.ac.uk/>) and Knowledge Integration (<http://www.k-int.com/>) provide Transcoder, an automated service for transforming between different learning content packaging or aggregation formats. The service is under development and testing; final version is expected to be available in the first half of 2009 (CETIS, 2009).

As a test, the eXe tutorial was exported as a SCORM 1.2 package. The package was created using eXe’s export facility, and named `exetutorial_scorm.zip`. The package was then uploaded to the Transcoder page (CETIS, 2009); conversion to Common Cartridge V 1.0 was selected, and the Convert button pressed. The converted package and a log file were available for download on the returned page. The conversion log reported no errors.

5.4. Testing cartridges

A Common Cartridge test tool is available at the IMS GLC site (IMS GLC, 2009k). The Tool is available to IMS GLC Alliance Community members. Community membership requires registration but no fee, and provides access to specifications, articles, best practices and the testing tool. The IMS GLC Common Cartridge site is not at all clear in its organization, and it may be difficult to find the test tool or other resources just starting at the home page. The test tool may be retrieved from (IMS GLC, 2009k); community login is required.

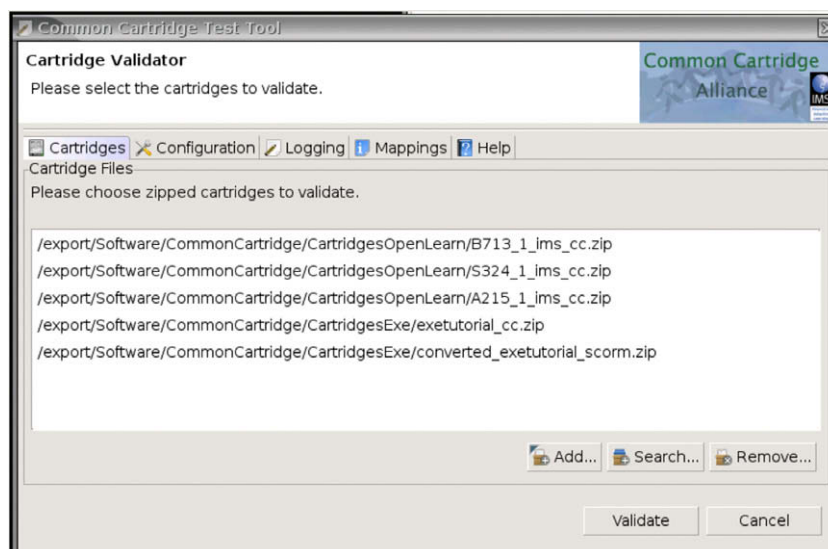


Fig. 5. IMS GLC Common Cartridge test tool interface.

Table 1
Common Cartridge compliance test results.

Cartridge	Generator	Fatal	Errors	Warns
Preparing a project (B713_1)	Open University	0	8	0
Animals at the extremes: the desert env... (S324_1)	Open University	0	2	0
Writing what you know (A215_1)	Open University	0	6	0
eXe tutorial	eXe	0	0	0
eXe tutorial from SCORM package	eXe/CETIS transcoder	0	3	0

The testing tool is a Java library. The package required some adjustment to run, and though the interface is clear enough the application may fail to work as expected or even collapse on some operations. Since this tool is aimed primarily at developers the details of installation and operation are omitted. Fig. 5 shows the Common Cartridge test tool interface.

Table 1 shows test results for three Open University cartridges, a cartridge created with eXe, and a cartridge converted from a SCORM package. The eXe Tutorial learning content in eXe was exported as a SCORM package and as a CC cartridge. The SCORM package was converted to CC by the CETIS transcoder. After running the CC test tool, no fatal errors were reported for any of the cartridges; no warnings were reported, either. Some errors were found in the cartridges, except for the cartridge directly exported from eXe. Though more thorough testing would be required, involving more varied iDevices, the eXe editor made a good job in exporting its own tutorial as a Common Cartridge.

5.5. Authoring Common Cartridge

As was shown in Section 5.2, authoring a Common Cartridge with the assistance of the eXe editor is simple, fast and straightforward. The tool is friendly and easy to use; a couple of simple content pages can be created in an hour or so by following the tutorial; a more detailed manual is also available. Both the tutorial and manual can be accessed from the eXe Help menu.

The eXe editor proved reliable in exporting both to SCORM 1.2 and to Common Cartridge. The cartridge exported from eXe passed the IMS GLC Common Cartridge Compliance Test with no errors or warnings. The tool has shown to possess merit enough to be warmly recommended.

6. CC compared to SCORM

According to IMS, CC was not designed as a replacement for SCORM but as an enhancement. SCORM was developed to support portability in the computer based training environment, with little or null interaction with a teacher or colleague students. CC was designed to allow the use of learning material in the interactive, collaborative environment of students and teachers, nowadays not necessarily gathered in the same spatial location but communicating and interacting in an equivalent way. To this purpose, CC includes support for activities not envisioned by SCORM, namely assessment, interactive content, collaboration activities, facilitation and authorization. Always according to IMS, CC was conceived to support very different learning scenarios, in the belief that web based content will be prevalent both in formal learning structures such as courses, and in informal learning such as referencing or on the job training.

CC claims to have made an effort to simplify standards applications through the use of profiles, so that implementation and testing are easier than it is with SCORM. Proponents of CC argue that prevalent learning scenarios still follow a social, collaborative model, an evolution of the classical classroom with teachers and students, printed books, students' notes, question and answering, group projects and other typical activities, which have not been suppressed, as in computer based instruction, but essentially preserved through the use of communication and information technologies. In this context, easy incorporation and integration of third party becomes of utmost importance. Agreement on a standard allows publishers to produce high value, low cost content, coming to play into an area which up to date was considered of small profit. Digital books and readers such as the Amazon kindle call for the inclusion of interactive learning experiences within the digital book context, a scenario CC is apt to enable (IMS GLC, 2007).

A feature comparison between SCORM and Common Cartridge follows (IMS GLC, 2009f).

- **Packaging:** both standards are based on IMS Content Packaging. SCORM follows version 1.1.4 (ADL, 2009a); CC builds on a profile based on version 1.2, but only features present on 1.1.4 are currently used (IMS GLC, 2008).
- **Metadata:** SCORM is based on the complete metadata set proposed by IEEE LOM (ADL, 2009a); CC is based on the Dublin Core simplified subset. However, SCORM does not enforce all LOM metadata to be used; only a few are mandatory to achieve SCORM compliance.
- **Sequencing:** SCORM requires at least one organization, CC does not enforce sequencing. SCORM allows multiple organizations, CC only one.
- **Assessment:** SCORM does not address assessment (Carnegie Mellon, 2004); CC supports IMS QTI.
- **Tracking:** SCORM only allows to pass onto the learning platform some data of the student's performance: score, passed or failed, mastery on individual objectives, and time spent on each task. These information is available only at the object level (Carnegie Mellon, 2004). CC achieves more fine grained tracking with IMS QTI, and IMS LTI is expected to enhance communication with external tools.
- **Collaborative forums:** CC provides discussion forum initiation.
- **Web 2.0, integration with other learning tools:** CC is expected to provide these facilities when the IMS LTI specification is ready.
- **Content authorization:** provided by CC through the IMS Web Authorization Service.
- **Outcomes reporting is expected to be provided by CC through several IMS specifications:** ePortfolio, Learner Information Package and Learning Information Services.
- **Accessibility:** CC is expected to provide support for learners with disabilities in the learning platforms, in content and in processes. The IMS Access for All Working Group has begun revision of its specifications in answer to ISO/IEC JTC1 SC36 requests (IMS GLC, 2009h).

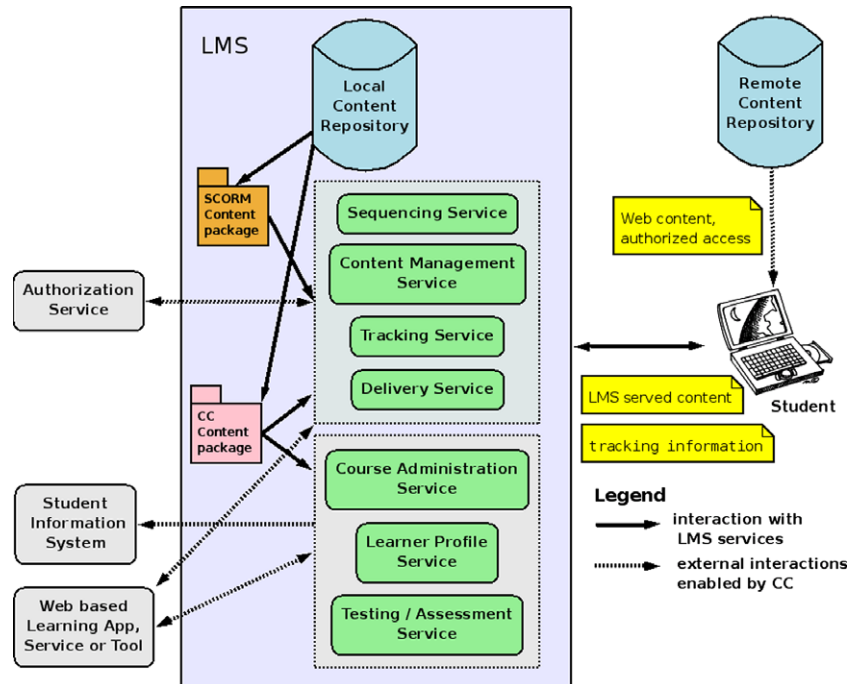


Fig. 6. LMS general model and interactions.

IMS states conversion from SCORM to CC is straightforward, since both are based on the IMS Content Packaging specification. IMS GLC is developing an automated conversion tool for certain types of SCORM content which will be available to members of the Common Cartridge Alliance. Multiple organizations possible in SCORM are not supported in CC; conversion of these objects will require special attention. A learning platform need not support SCORM to be CC compliant. If a cartridge contains SCORM content, it is up to the learning platform to provide support for playing it. SCORM content within a cartridge can be played with the Icodeon SCORM player, an application developed by Icodeon, an Alliance member (IMS GLC, 2009f).

Fig. 6 depicts a general model of an LMS application showing components and services (SCORM 2004 Overview). A SCORM content package is stored in a local content repository, and can interact with several services; sequencing, content management, tracking and delivery. A Common Cartridge content package can interact with the same services, plus course administration, learner profile and assessment. Common Cartridge also enables interaction with external services: authorization, student information and web based applications, services or tools. A student's application retrieves from the server learning content included in the content package, were it SCORM or Common Cartridge. Interaction with LMS services will be different, however, according to the type of content package. Common Cartridge packages are expected to interact more closely with LMS services, as shown in the figure. A student's application interacting with Common Cartridge content will eventually be referred to external web pages or third party remote repositories, possibly after having been granted access by an authorization service.

7. Critical evaluation

SCORM is an US DoD initiative; DoD is a customer any company would like to have in its books. Since suppliers of educational or instructional material to the DoD must conform to SCORM, a number of companies are using SCORM, not only as suppliers to the DoD but as suppliers to anyone: "the DoD recommends SCORM" is no weak argument at the moment of closing a purchase.

SCORM seems to have gained a certain foothold among educational institutions and corporate training. As has been said, the DoD alone is expecting to register at least 100,000 learning objects (Department of Defense, 2007). To gain a certain popularity in the first years of a standard should not be underestimated; not always the best standards are those that stay for long, but those that cover the essential needs and are early adopted by a critical number of users. It would be too daring and uncertain to state that SCORM has won its place for good, but it certainly has made some way.

The advantages provided by CC concerning variety of content, assessment, application interaction, collaborative learning, distributed resources, third party content incorporation and authorization services are by no means minor, and provide support for web based content, which is showing itself as a sustained tendency. However, some of these facilities require implementation of specifications which are not yet available, e.g. IMS LTI.

Common Cartridge originated in product companies and publishers. The words "industry" and "market" are frequently present in the proposal. An underneath motivation seems to be keeping up with technology in education content creation, foreseeing a decline in the market of textbooks and traditional media. These are legitimate needs, but solutions such as a content standard must equally contemplate the needs of both publishers and the education community. The following years will probably bring a loss of financial resources for education, both in the private and public sectors. This undesirable situation calls for coordinated efforts among learning material suppliers and consumers. Reducing cost of production and delivery, charging a fair fee for educational material, ensuring access to education far and wide, seem to be the way to go.

The Common Cartridge Alliance develops tools and software, such as a tool to convert from SCORM into CC. Unfortunately, most of these tools are available only to the Alliance members. Alliance membership is not free; individuals are charged a fee of USD 100 a year, higher education institutions are charged from USD 500 to USD 1500 a year, other organizations fees vary from USD 500 to USD 3000 according to revenue and to their for-profit or non-profit condition (IMS GLC, 2009i).

Documentation of Common Cartridge has a bias towards advertisement that interferes with clarity and informativeness. The Common Cartridge site at IMS GLC is somewhat confusing for the newcomer (IMS GLC, 2009a); the FAQ section seemed to be the most informative, and the Current Activities page was sometimes clearer in project descriptions than the pages of the projects themselves (IMS GLC, 2007, 2009b). A reorganization of its site and a Common Cartridge Guide with comprehensive information would be welcomed.

Very little support for CC has been gained to date within the free software community. Learning platforms like Moodle and Claroline have become major players in the education field. It is very unlikely a standard could catch on if free software learning tools do not adopt it. A great number of the students of the world interact with free software learning platforms; they are too many to be left aside. If the eLearning free software community does not feel the need to support Common Cartridge the future of the standard may be uncertain or very narrow.

Besides adopting third party content in the form of books, learning objects or applications, most teachers like to design their own courses and create their own content. Teachers prepare their own presentations, notes, difficult lessons or the whole course. This is hard work, but teachers like to teach their own way, and very doubtfully will they content themselves with picking pieces to build the puzzle. A versatile, friendly, easy to use authoring tool capable of creating CC compliant content is needed to impose the standard. Again, the free software community must be present in this area. A teacher wants his tools in his laptop or personal computer; most teachers and institutions cannot afford to pay licenses for such a widespread use. The eXe editor may come to be such a tool.

IMS claims for Web 2.0 and “free the content” have not yet had much appeal within the educational nor the open software communities. Opinion in blogs shows the new standard has arisen both hope and doubt (Adell, 2008; C6 Learning Blog, 2008; Learning Technology, 2008). CC may come to be seen as the standard to distribute educational content and support interactive learning universally, but there is a risk of its being seen merely as an agreement among publishers to improve their business. In the latter case it will probably remain only an enterprise agreement of limited application or pass away as just one more standard.

8. Controversial issues

IMS used to support SCORM, but departed from it to create Common Cartridge, on the ground that future development of SCORM is biased towards the needs of contractors with ties to the US DoD or the ADL Initiative. IMS considers LETSI, the organization developing SCORM 2.0, as being formed by the US DoD, and as such not reflecting the interests of industry in general (IMS GLC, 2007).

LETSI (Learning–Education–Training Systems Interoperability, <http://www.letsy.org>) defines itself as a coalition of eLearning vendors, adopters, associations, and policy makers committed to open software standards and supporting an open software community. It denies to be part or a spin-off of the DoD, although SCORM is recognized to have been developed by the DoD, which is transferring future development to LETSI. LETSI is an international program under the IEEE’s Industry Standards and Technology Organization (IEEE ISTO), a non-profit corporation offering an operational forum and support for standards development and post-development activities. Some of LETSI sponsor members are Adobe Systems, The Advanced Distributed Learning Initiative (ADL), the Aviation Industry Computer Based Training Committee, the Computer Society of the IEEE and the IEEE Learning Technology Standards Committee (LETSI, 2008).

SCORM 2.0 intends to extend interoperability beyond the conventional learning platform, making no assumptions about the nature of content or systems, facing the same challenges which motivated CC and which SCORM 2004 fails to cope with: collaboration, distributed content, sequencing, applications interaction, metadata, accessibility, software architecture (LETSI, 2008).

Some caution and even a touch of skepticism arise from these seemingly divergent trends. Adoption of learning objects is by no means an achieved goal, and two standards for the same needs are no standard at all.

9. Guidelines for educators

Educational content of high quality is expensive to generate, customize and maintain. Learning objects address a single learning objective, can be shared and reused, allow to put up a course in a few hours. Learning objects are here to stay.

To profit from reusing and sharing learning objects must follow a standard accepted by content creators, educators, publishers and applications developers. SCORM 2004 has proved effective, though it falls short of the interaction required by modern learning. Common Cartridge addresses the issues of interactivity, distributed content, authorization and student related services. SCORM 2.0 is an ongoing project to address practically the same needs. At the time of writing, CC is an approved standard, SCORM 2.0 is gathering requirements. Both projects are backed up by outstanding committee members and organizations.

A standard implies a sense of uniqueness. Though several standards may coexist, people go in for a standard to share and communicate on an agreed upon basis or format; the wider the acceptance, the greater the profits. From the point of view of education, a single standard would be desirable. This may not happen; SCORM 2004, CC and eventually SCORM 2.0 may have to coexist. As end users, a conservative yet attentive attitude seems the best possible. Knowledge and practice in learning object use and authoring will probably be counting among the expected abilities a teacher should have. Teachers are generally overworked, and have no time to waste, but need to know. In this context, several scenarios are possible:

- If you are familiar with learning objects as an author or a course designer, your learning platform supports CC, and your institution does not object, think of gradually switching to CC. You have nothing to lose, and probably something to win. Content creation in CC is not harder than in SCORM, and you can profit from collaborative learning, web based content, and applications interaction. Conversion of SCORM to CC can be done with specific tools, or by regenerating the original content in CC format with an authoring tool.

- If you are familiar with learning objects, your learning platform supports SCORM but not CC, and your institution does not object, go on with SCORM. You can rely on the Reload Editor and the Reload Player as friendly, effective tools to create SCORM packages. You will be switching to SCORM and converting content when the learning platform is updated and your institution defines a policy.
- If you are not familiar with learning objects but would like to try them, the eXe editor is simple to use, and an excellent tool. The tutorial is easy to follow, and a simple Common Cartridge can be created in a couple of hours, even with little previous experience.
- If you create learning content of any kind, whether following one standard or the other, or no standard at all, keep your source files ordered and identified. You can always use an authoring tool to create your learning object in one standard or the other with a modest effort. Whatever the standard, creating objects from source files always works.
- If you are not familiar with learning objects and cannot afford the time for a hands-on experience, keep current with learning objects by reading or attending to events. If possible, try some existing cartridges offered online as courses or modules.

Learning platforms are widely used nowadays, and much content is being organized within the platform itself. This may be easy and comfortable, but is done at the price of portability: content in the form of a module or course with a bunch of resources and activities is not guaranteed to be easily migrated to other learning platform. In the general case, migration should be considered as not possible, at least not without some considerable time and effort. Adopting the learning object paradigm and following a standard can be recommended as a sensible investment, both for institutions and for individuals.

The eXe editor is a friendly, easy to use authoring tool. Even if not using learning objects, designing and developing learning content with eXe may improve the quality of leaning material, or at least save time and effort. Content can be exported to SCORM or Common Cartridge immediately. The eXe editor is well worth a try.

10. Conclusions

Learning objects provide a reasonable, practicable solution to the high cost of content creation: learning content packages enable selection of topics and reuse of material to put up of a course in record time, with no sacrifice in quality, or even an improvement, since reusable learning objects may have been more fully worked on. Sharing, reuse and interoperability call for a standard. Adoption of a standard does not happen overnight, much less when this adoption is not merely technical but implies the will and taste of a large mass of people such as teachers and students.

In the last few years learning platforms have been universally adopted. Offer of products reached a level of quality, functionality and accessibility as to be seen as a practical, cost effective solution to deliver educational content. Adoption of learning objects may follow a similar trend. A significant difference exists, though: installation of a learning platform is a system administrator's task, or sometimes even a decision of her own; teachers and students point their browsers to the institutional learning platform site and after some trial and error are up and running in the most essential tasks. In most cases, the learning platform was just offered, not imposed, and adopted almost spontaneously. Use of learning objects can hardly be accomplished through a centralized decision: it depends on the will and taste of teachers, a much wider corps of different ages, technical proficiency and tastes. The advantages offered by learning objects seem neat and clear, but riping of benefits is not immediate; hard work stays in between. Though it can be argued that time and cost pressures in education will push hard towards technical solutions, and eventually win the game, a rally towards learning object adoption is certainly not to be expected. It may take years to see a high percentage of educational offer supported by learning objects. Anyway, learning objects are a good idea, provide a practicable solution for real problems, and have become a strong player in the education field.

Today educators and institutions are faced with two learning package standards proposals. Though it may fall short of some present day possibilities, SCORM 2004 is a mature standard, is well documented, major learning platforms support it, several authoring tools are available, and many prestigious institutions promote its use. CC is a recently released standard, cartridges can be created and displayed, and there are a number of cartridges to be examined. Documentation is insufficient, tone is too much of an advertisement, there are not many tools, most are not freely available, the educators community has not been adequately addressed, few open software developers have engaged in support. Though Common Cartridge extends and improves on SCORM, it is yet unclear if it will impose itself as a standard. If learning objects become more frequently used, a standard will be eventually adopted. Common Cartridge is simpler than SCORM 2004, but it has not gained momentum enough to ensure its imposition.

Following the analysis made in this article, educational institutions and educators are suggested to stick to SCORM if they are already using it and find it suitable for their needs; migration to CC is practicable and can be done in the future. Those who have not yet adopted a learning objects standard are cautiously suggested to try CC, mainly owing to its greater simplicity and flexibility. Anyway, every person or institution interested in learning objects should keep an eye on the development of both standards. Hopefully, the next few years will bring convergence to a unique model. Whatever the standard, learning objects offer real advantage, are simple to use and fun to author.

Acknowledgement

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