Digital Rights Management: An Ecosystem Model and Scenarios for Higher Education

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Overview

In the education community, digital learning content is being created and managed in a complex and changing environment. Institutions and organizations are building digital repositories of learning objects and other content. The repositories are federating with each other and are providing widespread access to their collections in ways that make it difficult to know who is using digital content and how it is being used.

Multiple authors may be associated with any piece of content that may be distributed through multiple channels, modified several times, and used in many different ways for teaching and learning. Educators and researchers who locate digital content may modify or combine it with other content for unanticipated purposes. These developments require a careful examination of the requirements and methods for managing intellectual property rights using information and communication technology—in other words, digital rights management (DRM).

This research bulletin suggests a model of the components and processes that make up a digital rights management ecosystem in the education community. The model is an attempt to synthesize and simplify the deep and complex topic of DRM, and it is intended to provide a framework for analyzing DRM scenarios, requirements, roles, and technology options. The output from the model is a structured analysis of DRM requirements, current and potential solutions, and the identification of gaps and issues in supporting these requirements. A follow-up ECAR research bulletin will examine the issues related to the tools and applications for implementing DRM in a digital ecosystem.

Highlights of Digital Rights Management

Digital rights management is often viewed as the ability to prevent consumers from accessing or distributing digital content without authorization. For example, the book publisher South-Western defines DRM systems as those that “...help protect the copyright of materials by defining how the content can be used. These rights are determined by the publishers.” This “retail” view is based on a model where content is published by a single source and is ultimately consumed by users who do not modify it.

Although commercial licensing is an important market mechanism used by for-profit publishers in education, it is not the only model of intellectual property management. Nor is protection against unauthorized use the only capability that must be supported by a DRM ecosystem. Educational and research activities require policies, standards, and technologies that support rather than limit sharing and reuse of learning resources.

Effective rights management should enable sharing while respecting the conditions and requirements that rights holders have associated with their content. Digital rights management must act as an enabling—not just a controlling—technology.

The goal of many content authors in academia is to share their intellectual property as widely as possible while receiving appropriate attribution whenever and wherever their
works are used. In addition, many repositories and content providers want usage data for evaluation purposes as well as for determining costs associated with distribution licenses. Currently, attribution is enforced by professional norms within the academic community, and usage is typically tracked and reported by distributors (such as bookstores) that have a direct relation with their content providers (such as publishers). This model does not meet all the requirements of distributed network environments.

The IT infrastructures of colleges and universities provide access control and security within their organizational confines. These capabilities can be used to enable and control the use of documents and other files stored and used within these boundaries. Content sharing in academia, however, crosses the boundaries of technology environments and organizations to form highly distributed systems that can span the globe. Content may be distributed to any number of delivery media, platforms, or environments. Therefore, the technology used to express and enforce the terms and conditions associated with digital content must be “persistent” in the sense that it must be available whenever and wherever the content is accessed, distributed, or used.

It is not feasible to use ad hoc or proprietary methods for managing the intellectual property rights associated with so much content from so many sources. Standardized and automated methods are needed for expressing, transmitting, interpreting, and enforcing rights.

A Digital Rights Management Ecosystem Model

Figure 1 shows the DRM ecosystem model. It depicts how rights flow through the system and defines a set of actors, applications, standards, and services relevant to the education community. The model includes the following components:

**Rights Management Environment:** Rights management takes place in an environment composed of the law, policy, practice, market mechanisms, organizations, roles, and community expectations. This environment sets the context, expectations, and goals of any rights management implementation.

**Actors:** Rights apply to people and organizations, not to technology. Any implementation of rights management must identify the key actors and keep them firmly in mind. Actors can include authors, publishers, librarians, repository managers, faculty, and students.

**Content Life Cycle:** Digital rights management exists within the larger context of content management. Processes related to creation, distribution, acquisition, and use of content—the content life cycle—form the underlying structure of which DRM is a part.

**Tools and Applications:** Content is created, distributed, acquired, and used through software that includes authoring tools, content repositories, learning management environments, and personal computing environments. Rights management affects all these tools and applications.
Rights Management Processes: The model organizes rights management processes into four major categories: defining rights, distributing/acquiring rights, enforcing rights, and tracking usage. These processes must be supported in a DRM ecosystem.

Standards and Services: Rights management makes use of services provided by an enterprise infrastructure and places its own demands for new standards and services. If the rights management environment provides the human context for DRM, then standards and services provide the technological context.

Figure 1. DRM Ecosystem Model for the Education Community

The model can be used to analyze the rights management components of a given ecosystem. The steps involved are:

1. Identify environmental factors that affect rights management, including market models, the legal and policy context, important actors (organizations and people) and roles, and expectations for the management of rights.
2. Identify the content life cycle(s) in the scenario.
3. Identify where and how rights should be defined, acquired and distributed, and enforced.
4. Identify where and how usage should be tracked.
5. Identify what services are required for steps 3 and 4.
6. Identify what services are provided by existing technology.
7. Identify what functionality gaps need to be filled and what approaches are realistic.
Applying the Model

Following are three scenarios that demonstrate the application of this model to higher education.

Scenario 1: Commercial Content

In this scenario, a college bookstore acquires online "course packs" from a textbook publisher. The course packs complement and support the textbook being used for a particular course. Course packs are loaded directly into a campus course management system through which students access them.

1. Environmental factors

   ▪ Market models. The market model in this scenario is a consumer model in which a rights holder (the publisher) distributes content (course packs) to a consumer (students) in exchange for money. The college bookstore is acting as a distributor buying the content from the publisher and selling it to the consumer.

   ▪ Legal and policy context. As with all scenarios in this bulletin, copyright and other applicable laws form the legal context. Different laws may apply depending on the country or countries in which the transactions take place. In countries with laws similar to those in the United States, the publisher most likely is the rights holder and sells licenses that permit the content to be distributed and used in certain ways. This is no different from selling books, videos, or DVDs. If some of the content is copy protected or prevents printing, then the Digital Millennium Copyright Act (DMCA) may apply, making it illegal for students (or anyone else) to circumvent that protection.

   ▪ Important actors (organizations and people) and roles. Important actors in this scenario include the publisher of the course packs, the college bookstore, faculty and instructors who assign the content, and students who use the content.

   ▪ Expectations for the management of rights. The publisher expects contractual arrangements between it and the bookstore to be enforced and access to course packs to be restricted to students who have bought the text or the course pack supplement. The publisher may require that usage be tracked so it knows how many units have been sold, and the bookstore may want to track usage as part of inventory control. To protect its business model, the publisher also wants the contents of course packs to be protected from unauthorized modification, reproduction, or distribution.

2. Content life cycle. The content (course packs) enters the college ecosystem from an external but controlled source (the publisher). The course packs are distributed through a course management system and are “consumed” by students. This is a simple linear distribution chain in which no modification of content takes place.
Rights

- *Definition of rights.* Rights are defined through existing law and through a contract. This works because the publisher and the college bookstore are trusted partners who negotiate a contract directly with each other. The course packs are made available only after a relationship is established and contracts are in place.

- *Acquisition and distribution of rights.* Students acquire rights from the publisher by purchasing a textbook or by separately purchasing a license for the course pack. The college bookstore school acts as an intermediary that distributes the rights to the students and also acquires distribution rights from the publisher.

- *Enforcement of rights.* Rights might be enforced in three places in this scenario. The publisher might rescind distribution rights if the bookstore does not meet required terms and conditions. The course management system could enforce rights by denying students access to the course pack if access is not authorized. The content in the course packs may include intrinsic protection that prevents it from being copied or altered; it may also be encrypted in a way that requires a student to enter a key before the content can be displayed.

3. **Usage tracking.** If usage tracking is a requirement, then it may occur either in the course management system when the course packs are used or at the bookstore when the course pack licenses and textbooks are sold.

4. **Services required.** The services potentially required in this scenario include content protection (copy protection or encryption), authentication and authorization services, financial services (to handle fees and licenses), and usage tracking and reporting services.

5. **Services provided by existing technology.** Course management systems provide authentication and authorization services. Sometimes these are integrated into larger institutional authentication services. If access is granted by course or by section, this type of authentication and authorization is sufficient. Financial and usage tracking services associated with selling textbooks and course pack licenses are already in place and being used. Copy protection requires “rights enabled” software. Some document formats (such as PDF) can be more easily copy protected than others. Copy protection can be hacked, but the DMCA makes this a federal offense in the United States.

6. **Gaps/future technology.** The rights management required by this scenario is not significantly different from that required for traditional sales of books or media. The sticky points are:

   - Course management systems may not handle access control based on anything more than membership in a particular class or section. Mechanisms are needed to provide access based on external factors such as the possession of a license.

   - Copy protection depends on developing technologies that have not been fine-tuned. Ideally students should be able to legally and conveniently make *backup*
copies of content accessed through course management systems but be prevented from distributing them.

- There is no persistence of rights management once content is copied into the student’s personal computing environment. The rights associated with the content are not expressed in a way that can be interpreted and enforced by personal computing technology from other vendors. Standards and technology are emerging for rights expressions that can be read by humans and processed automatically by computers. Standardized rights expressions are needed to manage rights across distributed and federated networks of information sources.

Scenario 2: Sharing a Faculty-Developed Test Bank

A professor has developed a bank of interactive test questions. Funding for the project was provided by the National Science Foundation (NSF), and in return, the professor promised to (a) make the question bank available to any faculty member at any accredited university or college, and (b) report the usage of the test bank to the NSF. The test bank can be downloaded in the form of an executable file. With some technical expertise, this file can be used to make questions available on a course Web site or to load questions into a course management system. The professor makes the executable file available on her own Web site and also gives a copy to her university’s library, where it become part of a searchable institutional repository.

1. Environmental factors

- Market models. Attribution and contributions to the community translate into funding, promotion, and other personal rewards for the author. The rights holder does not expect the content to be sold. If a commercial content provider wants to sell or distribute the test bank, a new market model would come into play.

- Legal and policy context. Copyright and other applicable laws form the legal basis for rights management. Although funding for the test bank came from the NSF, the agency does not claim any intellectual property rights. Therefore, the rights holder is either the professor or her institution (or some combination thereof), depending on the terms of employment. In practice, the professor is either the rights holder or acts as the prime agent for the rights holder. Policies (or legislation) about privacy, record keeping, and so forth could affect rights management in this scenario. Despite the fact that the professor wants to collect data on the usage and results of her test questions, this data may be confidential.

- Important actors (organizations and people) and roles. Important actors in this scenario include the professor, faculty and students at other institutions, the library at the professor’s institution, and the NSF.

- Expectations for the management of rights. The professor expects that attribution will be given whenever her questions are used and that usage data will be returned to her. The professor does not expect the content to be sold or
commercially distributed and does not want the test bank questions to be modified without her permission.

2. **Content life cycle.** The question bank was created by the professor in her personal computing environment. She distributed it to her Web site and to the university library. Faculty members download the executable file from her Web site or from the university’s repository. The file allows questions to be incorporated into class Web sites or loaded into a course management system. Students interact with the quizzes through these sources. Some faculty members who use the questions want to make additions and changes. To do so, they must contact the authoring professor for permission and to obtain the source code for modification.

3. **Rights**

   - *Definition of rights.* This is an example of a distributed use model where the partners are not known to each other. Access to content (the interactive questions) is governed by roles (professor or student). Rights may be explicitly defined by statements incorporated into the content (for example, a license agreement), by a statement on the professor’s Web site, or by a statement associated with the question bank in the library’s institutional repository.

   - *Acquisition and distribution of rights.* Faculty members acquire usage and distribution rights when they download the executable file for the question bank. Students acquire rights when they use questions through a course Web site or course management system. The rights must reflect the distribution rights granted by the authoring professor: faculty members do not have the right to modify the questions without permission, and students do not have the right to access the executable file or (implicitly) to distribute and share questions.

   - *Enforcement of rights.* The ban on modification of the executable file is enforced by its format—without the source code it cannot be edited—but an authentication and authorization system is needed to prevent unauthorized students from accessing the executable file. This system must be in place on the authoring professor’s Web site and in her institution’s repository. If a faculty member downloads the executable file, it becomes that person’s responsibility to enforce distribution restrictions. Moreover, some type of copy/print protection is needed to prevent students from distributing copies of quiz questions. Those protections could be provided within the content (put there by the author) or enabled by the course management system used to deliver the quiz questions.

4. **Usage tracking.** The authoring professor wants the usage of questions reported back to her. She may have to settle for download statistics from her Web site and from her institution’s library repository, but she would prefer to receive data back from faculty members who deploy her questions. This requires tracking at the point of consumption, specifically, when students use the quiz questions.

5. **Services required.** The professor’s Web site and her library repository require authentication and authorization services to restrict access to the full question set to faculty at accredited educational institutions. Course Web sites and course
management systems require authentication and authorization to restrict access to
students enrolled in the course and possibly as part of the effort to prevent
unauthorized redistribution of the quiz questions. Copy/print protection is required
as discussed above. Regardless of how rights are enforced in this scenario, they
need to be expressed so that faculty members understand the terms of use (for
example, that reporting usage data is a condition for using the questions). If copy
protection is to be implemented by systems delivering the quiz questions, then
those systems must know that the questions are to be copy protected. The service
required is a rights expression service that expresses rights, terms, and conditions
in a standardized way.

6. Services provided by existing technology. Authentication and authorization
services are provided by library repository systems. Approaches such as
Shibboleth can provide trusted authentication across cooperating institutions.
Downloads and usage statistics can be tracked using existing logging and reporting
technology, and files in certain formats can be intrinsically copy/print protected.

7. Gaps/future technology. If the authoring professor disseminates her work through
a typical personal or departmental Web site, it is unlikely to provide the needed
authentication services. Furthermore, there is nothing to prevent a faculty member
from downloading the executable file and intentionally or unintentionally granting
access to students. If formats such as HTML are used for the quiz questions, copy
and print protection are not available. These gaps illustrate the need for a rights
management methodology that associates rights with content in a way that travels
with the content as it is distributed and redistributed. Systems that can read,
interpret, and act on standard rights expressions may fill this need, as illustrated by
the Australian COLIS project.

Scenario 3: Community College Use of Video Materials

A community college history instructor has purchased a set of videos of the PBS series
The Civil War by Ken Burns and wants to make a number of scenes available online so
students in his class can view them while working on their term papers. The community
college has a media server that can stream digitized extracts to students.

1. Environmental factors

- Market models. The initial purchase by the professor follows a consumer model
where PBS distributes content to the instructor in exchange for payment. The
market model relevant to the class, however, is one where content is provided
by an educational institution in exchange for tuition. Even though PBS has a
public service component, there is a discontinuity in the market models under
which the video was acquired and under which portions are distributed.

- Legal and policy context. The scenario described is precisely the type of
situation envisioned by the TEACH Act. Prior to enactment of the law, online
distribution of “displays and performances” (as a video is called in legal
terminology) was not allowed. The TEACH Act makes this possible, albeit with
numerous restrictions and requirements. In this scenario, the law requires that:
The community college have a copyright protection and rights management policy in place and that staff (including the history instructor) be made aware of the policy.

If *The Civil War* is available in digitized form, the community college must purchase it. Converting video to streaming media is allowed only if there is no alternative source of digitized content.

The digitized versions of scenes from *The Civil War* must be maintained in a way that reasonably prevents their use by anyone other than intended recipients and for any longer than is necessary for the students to complete their class assignment.

A copyright notice must be displayed to students.

The content must be protected in a way that technologically prevents students from obtaining local copies that could be redistributed or used past the time period needed for the class assignment.

**Important actors (organizations and people) and roles.** Important actors and roles include the content publisher (PBS), the instructor, the organization on campus that manages the server where the content will be hosted and served, and students taking the history course.

**Expectations for the management of rights.** PBS expects that its intellectual property will used in accordance with U.S. law, including the TEACH Act. The community college administration expects that faculty and staff will follow institutional policies with regard to intellectual property rights.

2. **Content life cycle.** *The Civil War* video was produced by PBS and purchased by the instructor. If a digitized version is available, it must be purchased by the community college. The video will then be loaded to the server by the community college’s technical staff and viewed by the students who are enrolled in the course.

3. **Rights**

   **Definition of rights.** Rights are defined by PBS at the time the video is published and sold. U.S. copyright law, however—in particular the TEACH Act—also grants certain usage and distribution rights with associated conditions.

   **Acquisition and distribution of rights.** The instructor acquired a license when buying the video, which likely does not permit public displays or rebroadcasting. The TEACH Act, however, permits the instructor to display portions of the video online for a class. Thus the right to use the video as envisioned may be viewed as having been acquired at the point of purchase as well. Students acquire rights to see the portions of the video when they enroll in the class, and these rights are distributed by the community college. The rights distributed to the students are severely restricted and do not include the right to redistribute content or to retain content past the end of the period during which they are authorized to see it.
Enforcement of rights. Rights must be enforced at numerous points in this scenario. The original license purchased by the instructor (as part of buying the video) undoubtedly forbids copying and redistribution. If any technological protection is used, as might be the case with some newer digital formats, the DMCA makes it illegal to defeat the protection. Even without protection, the community college will be very reluctant to put a copy on its media server in violation of copyright law: the threat of litigation sufficiently outweighs the cost of compliance, which in this case may mean buying a digitized copy. Once the video (or portions of it) are on the media server, the TEACH Act requires that access be restricted to students enrolled in a class that is using it and that it not be made available for any longer than necessary. These restrictions might be enforced by the media server or by a course management system (or class Web site) through which the video is accessed. Downloading, at least in a form that can be retained or distributed, must also be prevented. Without more sophisticated services that express and enforce licenses, the most plausible way to do that is to use a format that cannot be converted to a local copy.

4. Usage tracking. The community college is not required by law to track usage, but it presumably may be called on to demonstrate that content used under the TEACH Act is only accessible by enrolled students and cannot be downloaded. The community college may wish to track usage for other reasons, such as generating statistics for internal budgeting purposes or tracking student use of the video.

5. Services required. Authentication and authorization services are needed to restrict access to students who are legitimately enrolled in the history course. Content protection (copy protection and/or encryption) is needed to prevent unauthorized copying and use of the content. Usage tracking is desirable.

6. Services provided by existing technology. Course management systems provide most of the authorization and authentication services needed in this scenario. To fulfill TEACH Act requirements, the system must restrict access to enrolled students and limit access to the times when the content is needed for class purposes. Streaming media available today can prevent copies from being made.

7. Gaps/future technology. Basic TEACH Act requirements can be met with existing technology; however, gaps remain. For example, very little extant technology allows a document to be copied but not distributed or viewed only during a specific time period. Moreover, access to resources in course management systems is generally set up by instructors, adding another administrative duty for those whose primary job is teaching. As with the previous scenario, what is needed is a way of associating rights directly with content and relying on systems (such as course management systems) to interpret and enforce these rights, rather than programming the rights into the systems via access control.

What It Means to Higher Education

Digital rights management—the management of intellectual property rights through using digital technology—is needed for the development of the knowledge economy in
higher education. It promotes knowledge sharing as much as it protects content from unauthorized use. The ecosystem model in this research bulletin provides a structure for clarifying DRM requirements and identifying what technology is involved and what gaps still exist. Applying the model is a valuable first step in understanding the challenges and opportunities facing any institution or organization contemplating a DRM implementation.

When applying the model, several things become apparent. First, rights management can be very complex. Second, existing frameworks for digital rights management—primarily using “role-based authorization”—have limitations, particularly in a distributed network environment. These issues support a move toward “persistent” methods that associate identifiers, rights, and conditions directly with content. Third, the standards and services required to implement persistent methods and to apply DRM to market models other than retail are just starting to emerge. Implementers must decide what can be done today while managing the risks associated with a changing environment.

**Key Questions to Ask**

- What digital content ecosystems is my institution involved in?
- What are the market models, laws, and policies relevant to digital rights in these ecosystems? Who are the actors? What are the expectations for the management of rights?
- What content life cycles are part of the ecosystem? Where and how in that life cycle should rights be defined, acquired, distributed, and enforced?
- Where and how should content usage be tracked?
- What services are needed to support the ecosystem? What services are provided by existing technology? What gaps need to be filled? What approaches are realistic?
- As learning-management and content-repository technologies become more widely used, how are we making faculty, students, and administrators aware of important rights management issues and their responsibilities?

**Where to Learn More**


**Endnotes**


9. This scenario was proposed by Gerd Kortemeyer as part of an interactive presentation on DRM at the NLII 2004 Annual Meeting and was analyzed through a role-playing process during that presentation. Kortemeyer is the director of the Michigan State University Laboratory for Instructional Technology in Education (LITE), <http://www.lite.msu.edu>.


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