

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

IPeMS
A Digital Rights Management framework for learning objects

31 July 2006

By: Margaret Hill
To: Dr Kinshuk
Paper: 157 899

**A thesis contributing to a Master
of Information Science degree
Information Systems Department
Massey University
Palmerston North
New Zealand**

Contents

List of tables	4
List of figures.....	4
Abstract.....	5
Acknowledgements.....	6
1 Introduction.....	7
1.1 Research Background	7
1.2 Importance of the research	7
1.3 Research questions arising from the research topic	7
1.3.1 Scope of research	8
1.4 Research design	8
1.4.1 Purpose	8
1.4.2 Methodology.....	9
1.4.3 Results	9
1.4.4 Limitations of the research	9
1.4.5 Thesis structure	9
2 Literature review	11
2.1 Introduction	11
2.2 Theories underpinning intellectual property	11
2.2.1 Land property and intellectual property	11
2.3 Debate about reward of effort	13
2.4 Internet and IP	14
2.5 Management of IP rights	15
2.5.1 Protection of IP by law	15
2.5.2 Protection of IP by technology	18
2.6 Digital Rights Management (DRM)	19
2.6.1 DRM technology	19
2.6.2 DRM is complex	21
2.6.3 Resolving the 'fair use' debate	22
2.7 Digital learning objects	23
2.7.1 Trading in Learning objects	24
2.8 Web Services technology.....	25
2.8.1 Web Services architecture overview	25
2.8.2 Application of Web Services in NZ	26
2.9 Summary and conclusion.....	27
3 What is required for online contracts?	29
3.1 Introduction	29
3.2 Objectives of initial data collection	29
3.3 Data collection	29
3.4 Sampling	30
3.5 Avoiding bias.....	30
3.6 The questions and results	31
3.6.1 Questions requesting background information	31
3.6.2 Questions and results of Section A	31
3.6.3 Questions and results of Section B	32
3.7 Post survey procedure	33
3.8 Seeking endorsement	33
3.9 Analysis.....	33
3.9.1 Existence of policies for DRM in NZ organisations	33

3.9.2	Observations of current management to share IP with external users ..	33
3.9.3	Components of an online contract to manage IP	34
3.9.4	Further comment on permissions	34
3.9.5	Further comment on constraints	35
3.9.6	Legislation in NZ.....	35
3.9.7	Regulation - Monitoring and compliance	35
3.9.8	Other opportunities to manage IP.....	36
3.9.9	Satisfying the IP rights of others	36
3.9.10	Need to follow standards for schemata, protocol and metadata	37
3.9.11	Philosophical debates – more research questions posed	37
3.10	Conclusion	37
4	A framework to manage Intellectual Property of digital learning objects	38
4.1	Introduction	38
4.2	The algorithm	38
4.3	Scenarios	40
4.4	Conclusion	42
5	The prototype - IPeMS	43
5.1	Introduction	43
5.2	The prototype	43
5.2.1	What's in a name?.....	43
5.3	Choice of development platform	43
5.3.1	Making the choice of development platform	44
5.4	Consideration of evaluation criteria.....	44
5.4.1	Evaluation criteria	45
5.5	Design of the prototype	45
5.5.1	Requirements of the prototype	45
5.5.2	IPeMS – the client web application.....	46
5.5.3	Database	50
5.5.4	XML Web Services	50
5.6	Development of IPeMS	52
5.7	Migration to Server.....	52
5.8	Conclusion	54
6	Evaluation of IPeMS	55
6.1	Introduction	55
6.2	Purpose of evaluation	55
6.3	Methodology	55
6.3.1	Data collection.....	55
6.3.2	Sampling	55
6.4	The evaluation survey questionnaire	56
6.4.1	Questions requesting background information	56
6.4.2	Questions and results of Sections A and B	56
6.5	Analysis.....	57
6.5.1	Attributes of Web Services	57
6.5.2	Usefulness of IPeMS to an educator	58
6.5.3	Cautious creators	58
6.5.4	Opportunities of IPeMS	59
6.5.5	Design interface preferences.....	60
6.5.6	Further comments relating to sharing of IP included:	61
6.6	Summary and conclusion of evaluation	62

7 Conclusion	63
7.1 Conclusion of Research	63
7.2 Limitations and opportunities of the research.....	63
References	65
Appendix A: Initial survey questionnaire	68
Appendix B: Results from Section A and B of Initial survey questionnaire	71
Appendix C: Expert questionnaire.....	74
Appendix D: Evaluation questionnaire.....	77
Appendix E: Results from Section A and B of Evaluation questionnaire	80
Appendix F: Web service code	87
Appendix G: Web service XML schema	89

List of tables

Table 1: Initial survey questionnaire	68
Table 2: Results from Section A of Initial survey questionnaire.....	71
Table 3: Results from Section B of Initial survey questionnaire.....	71
Table 4: Evaluation survey to assess a prototype - IPeMS	77
Table 5: Results from Section A of Evaluation questionnaire.....	80
Table 6: Results from Section B of Evaluation questionnaire.....	81

List of figures

Figure 1: A framework to manage Intellectual property of learning objects	38
Figure 2: IPeMS – Login page.....	46
Figure 3: IPeMS – Search page showing search result.....	47
Figure 4: IPeMS – Search page showing permissions and constraints of LO	48
Figure 5: IPeMS – Contract page	48
Figure 6: IPeMS – Microsoft message	49
Figure 7: IPeMS – Contract page showing confirmation of contract.....	49
Figure 8: IPeMS – Relationship diagram.....	50
Figure 9: IPeMS – Web Services page showing list of operations	51
Figure 10:IPeMS – Single test form to test the Web Method Authenticate	51
Figure 11: Dual view of files on local host machine and WinIIS server	53

Abstract

The Internet is long-acclaimed to provide a medium for easy sharing of ideas and collaboration, and has huge potential for academic and training organisations to share learning resources. However, there are no formal mechanisms for managing intellectual property (IP) and there remain today tensions between freedom to share and ownership of creativity.

Theories around land property rights have contributed to the rights of IP as we know them today. Creating digital IP, however, is not a physical labour like toiling the land. It does not preclude the owner from retaining a copy and copying the IP does not make the IP more scarce, or competitive to possess.

Management of IP rights is about finding a balance between over zealous enforcement and 'free' use of IP. Protection of IP can be achieved by law and technology, and a mechanism for managing the use of digital learning objects would require a digital rights management (DRM) framework.

Architecture of XML (eXtended Markup Language) Web Services is emerging as a standardised approach to dynamic component connectivity and interoperability that relies on self-describing components and open connectivity standards and emerging standards, including IP (Internet Protocol), SOAP (Simple Object Access Protocol), WSDL (Web Services Description Language) and UDDI (Universal Description, Discovery and Integration).

XML Web Services technologies have great potential as the underlying technology for the establishment of a DRM framework for learning objects (LOs) on the Internet.

An initial survey, with endorsement of findings by experts in Information and Communication Technologies (ICT) in education, identifies the components of an online contract that would license an educator to use LOs. A framework is proposed and a prototype of an intellectual property electronic management system (IPeMS) is designed and developed. Web Services operations authenticate teachers and enable the teachers to search for LOs. The teachers can view permissions and constraints of use of the LOs, and can create a contract, with or without payment as the conditions dictate, that, on agreeing to, will license the teachers to use one or more learning objects. Another evaluation survey completes the research study, giving feedback about IPeMS, with respect to its application to an educational environment, to license an educator to use digital LOs.

Acknowledgements

This research has been a journey of discoveries. I would especially like to thank the following people who along the way assisted me.

This research would not have happened without the participants of the initial and evaluation surveys. Thank you for prompt replies and for contributing to the knowledge around an online intellectual property management system.

There were times during the programming of the prototype that I found difficult. Special thanks to Chris Barker and Errol Thompson who kept me focused on object-orienting programming in .NET when the going got tough.

I appreciated the guidance and wisdom of Dr Kinshuk, my supervisor, of Massey University, New Zealand (NZ). Meetings with Dr Kinshuk and attendance at organised research days were great motivators to keep me going.

As a part time student I always enjoyed a conversation with other Information systems students at Massey University, NZ, about their research and to share aspects of my own. A special thank you to my buddy Carol Zhou, who on one occasion came to my rescue with a Visual Basic .NET manual.

I thank my business colleagues at Multi Serve Education Trust, NZ, for enquiring about my thesis progress and remaining confident about its completion.

And finally, I am very grateful to my husband and my family for their ongoing support and patience.

Margaret Hill
July 2006

1 Introduction

The Internet is long-acclaimed to assist similar thinking people to collaborate and share ideas, and provides huge opportunities for academic and training institutions to share their learning resources. However, there are no formal mechanisms available for academic and training organisations to manage the intellectual property (IP) rights of these resources.

This research involves the development of a digital rights management (DRM) framework that enables educators to carry out agreements over the Internet, with or without payment, to license the use of learning resources.

1.1 Research Background

This research extends previous work of the author (Hill, 2004), who was fascinated by code segments called Web Services. She claimed that the architecture of XML (eXtended Markup Language) Web Services was emerging as a standardised approach to dynamic component connectivity and interoperability that relied on self-describing components and open connectivity standards and emerging standards, including Internet Protocol, SOAP (Simple Object Access Protocol), WSDL (Web Services Description Language) and UDDI (Universal Description, Discovery and Integration).

The researcher recognised that XML Web Services technologies could have great potential as the underlying technologies for the establishment of a DRM framework for managing learning objects (LOs) on the Internet. The motivation for this research was to show this potential by designing a framework and building a DRM prototype that enabled educators to carry out agreements over the Internet, with or without payment, to license the use of LOs.

1.2 Importance of the research

A prototype of the DRM framework, using XML Web Services technology, is developed and demonstrated. Such a system could make sharing of digital learning resources on the Internet easy, without losing the IP rights of the creator. The findings of this research about the DRM prototype could initiate dialogue between developers and clients in a commercial environment to build such a system that will manage IP rights in education on the Internet.

1.3 Research questions arising from the research topic

From an initial investigation, the following research questions were identified:

- What DRM policies currently exist in organisations (educational and business) in New Zealand (NZ)?
- What are the components of a contract for DRM in organisations who share resources with external users?
- What would be the design of an appropriate Web Services-enabled DRM framework to respond to a teacher's request for license to use LOs?
- Can a prototype of a DRM framework, using XML Web Services technology, be developed?

- How will we know if the prototype can be effectively applied to an educational environment, to license a teacher to use one or more LOs?

The findings to these research questions provide the substance of content for this thesis. The journey of research endeavours to answer these questions.

1.3.1 Scope of research

The focus of this research is on developing a framework to manage the IP of learning resources in an educational environment only. As part of this research, the prototype addresses some issues of user interface design of a DRM system. The research does not provide conclusive attributes, but identifies some essential attributes of a DRM system that need to be considered in building a commercial product. This research could provide a point of dialogue between a developer and a client.

1.4 Research design

The research design follows a conventional structure where purpose, methodology, findings, discussion and conclusion are presented (Emerson, 2000; Booth, Coulomb and Williams, 1995).

1.4.1 Purpose

The purpose of any research is to find answers to research questions. The activities of research are iterative and generally can be identified as:

- A literature review to determine the extent of the field and define components of objects in the research study.
- Development of a model that creates the research questions, and considers the design of approach to the study, that is, the methodology.
- Implementation of the research design to collect and process data.
- Evaluation of research outcomes and analysis of research findings. A conclusion presents recommendations and reflections of the research process.

The objective of this research is to investigate the development of a DRM framework using XML Web Services technologies. It is intended that the Web Services will create the contract for the teacher that, on agreeing to, will license the teacher to use selected LOs.

Specifically, this research seeks to:

- Identify the DRM policies that currently exist in organisations (educational and business) in NZ.
- Determine the components of a contract for digital rights management in organisations who share resources with external users.
- Design an appropriate Web Services-enabled DRM framework to respond to a teacher's request for license to use LOs.
- Develop a prototype of the DRM framework.
- Evaluate the prototype with respect to its application in an educational environment to license a teacher to use one or more LOs.

The next section looks at the types of methodology used in this research to find the answers to the research questions.

1.4.2 Methodology

There are a number of methodology tools available to a researcher, for the purpose of finding answers to research questions. This research study used literature review, surveys, and personal communication, as follows:

- A literature review provided understanding of the theories behind IP and online trading, the concept of DRM, LOs, and the technology and application of XML Web Services. The review helped to define the sort of questions that should be asked in the initial survey.
- An initial investigation using a survey determined the components of an online contract to manage IP rights and to license educators online to use LOs.
- An evaluation survey of the prototype DRM framework gave an insight into who would use such a system, and how a full implementation might look like.

Results from different types of methods used were collected and collated as explained in the next section.

1.4.3 Results

The literature review helped to determine the questions of the initial survey. The results from the initial survey questions and the endorsements of ICT educational experts identified the components of an online contract to license educators to use LOs. A DRM framework was designed on these findings and a prototype of the DRM framework showed to a sample population what such a system could look like in terms of its services, functions and interfaces. An evaluation was carried out to test the appropriateness and usefulness of such a DRM system in an educational context.

1.4.4 Limitations of the research

This research study was limited by time (as defined by the requirements of a Master's student timeframe) and cost.

Opportunities of further research are identified by the researcher in section 7.2 "Limitations and opportunities of the research".

1.4.5 Thesis structure

The thesis structure reflects the research design. Each section of this research is summarised:

Literature review

The literature review explored and assisted the understanding of IP management of learning objects, using XML Web services technologies. The review begins by looking at the theories that underpin IP. The theories have their beginnings in property rights that were first applied to land. However, there are some obvious differences around attributes of digital IP being non-exclusionary (where the creator still retains the creative work) and non-rivalrous (where by copying you are

proliferating the creative work and not making it scarce and competitive). There still exist tensions today around 'fair use' and first sales rights of IP. The intent of the medium of Internet is discussed and a call for a balance is made between free use by the user, and protection of IP rights of the creator. Maintaining this balance requires a management system using both law and technologies of DRM.

Digital LOs are held in repositories and their attributes lend themselves to being managed digitally for trade. XML Web Services technologies have great potential as the underlying technology for the establishment of a DRM framework for trading LOs on the Internet.

What is required for online contracts?

An initial survey determined the components that are required for an online contract. The results showed that organisations had varying protection of their IP, but had a clear idea of the essential requirements of a contract that would manage digital IP rights.

A framework to manage IP of digital LOs

The findings of the initial survey contributed to the design of a framework. An algorithm describes a framework that will authenticate the user, provide a global search for LOs and a contract to manage IP rights. Scenarios are given to put the framework in a real-time context.

The prototype – IPeMS

A prototype of the framework to manage digital IP rights was designed and built, using Web Services technologies. The name DRM was dropped in favour of IPeMS (or Intellectual Property electronic Management System). The system was developed using Visual Basic .NET, and client user interfaces were designed appropriately for their purpose.

Evaluation of IPeMS

An evaluation survey acquired feedback from the participants about IPeMS, with respect to its application in an educational environment, to license an educator to use digital LOs.

Conclusion

The conclusion summarises the journey of the research that involved the development of a DRM framework, using XML Web Services technologies that enabled educators to carry out agreements over the Internet, with or without payment, to license the use of learning resources.