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A Prototype of System Development for Digital Rights Management in Electronic Commerce

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The Internet provides a new way of doing business, but ease of copying and of sharing valuable digital information illegally across the Internet undermine many viable business models. This paper investigates the Digital Rights Management (DRM) as a means to provide safe protection and proper delivery of digital contents through the Information highway. First, we briefly summarize the current endeavor of DRM technical development and standardization process held in key technical working groups. Then, the paper provides a generic architecture for a DRM framework and shows the implementation of a prototype of DRM system incorporating key conceptual and technical standardization development. This study emphasizes the importance of developing the DRM architecture that provides the proper protection and safe transformation of digital contents in electronic commerce.

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Ⅰ. Introduction

Digital information is now the predominant form of data, communication and network traffic. The Internet presents a unique platform for disseminating digital content such as music, video, games, software, text, business and proprietary corporate information. It promises ubiquitous access, while at the same time fundamentally challenging the traditional rules of ownership and distribution of content.

In particular, ease of copying and of sharing valuable digital information illegally undermines many viable traditional business models [Iannella, 2001; Lee and Hwang, 2002]. In such environment, safe protection and proper delivery of digital content would be a crucial requirement toward a new e-commerce model [Neylson, 2001; Lee, 2001].

Unlike the traditional transaction system where trust of business relationships can be derived from proximity, an e-commerce market, resided in the Internet, provides no such intimacy. In this e-commerce space, market participants are geographically separate so that the proximity factor does not contribute a means to build up trust among the Internet users. Provided that building trust is an essential element for any business (or transaction) model, the current version of the e-commerce models do not seem to give an appropriate gateway for building trust. Thus, there is apparently a functional gap when we are heading toward the e-commerce from the traditional trust-based market system [Rue, 1999; Park, 2000; Iannella, 2001].

Research on the Digital Rights Management (DRM) focuses on filling this functional vacancy of the market transition by providing a more viable business model based on the currently available Internet security measures and network technologies [Davis and Lafferty, 2002; Bailey, 2002]. In short, DRM refers to a set of standards, frameworks, and enabling technologies to establish trust in the electronic commerce. Currently, various technical standard groups and technical vendors are encouraged to cooperate to set up the working models of DRM infrastructure [Connaway, 2001; OEB, 2000; Blum, 1997; Martin et al., 2002]

Considering that most DRM conceptual frameworks and technologies are in the burgeoning stage, the purposes of this paper can be illustrated in two-fold. First, it gives a summary for the current window for the development of the DRM conceptual frameworks and enabling technologies, lead by many various technical working groups and commercial vendors. Second, this study applies these current technologies and frameworks to build the prototypical design of a DRM application for the electronic commerce model by providing a generic model of DRM architecture and implementing a DRM-based shopping mall that, it is hoped, leads to build a way to a trust-based e-commerce model. Note that many cases of on-line frauds, hacking, and misuse of information in the current Internet make it impulsive that this DRM technologies should be set up as early as possible to protect the electronic market user and simultaneously enhance the quality of service (QoS) in the Internet commerce [Kang and Kim, 2000; Davis and Lafferty, 2002; Mulholland, 2001]. The full-pledged Digital Rights Management should provide the complete packages of new digital commerce services that

protect, create, deliver, and enhance the intellectual property (IP) of the users in the e- commerce market.

The rest of the paper is organized as follows. Section 2. presents the overview on the development of digital rights management, focusing on the efforts of various technical working groups on the DRM standards, specifications, and technologies. Section 3. shows the generic design schema for a DRM prototype for this study. The detailed description and implementation for the DRM shopping mall prototype is illustrated in section 4. Finally, section 5. concludes the study by summarizing the results of this research and provides future research directions.

Ⅱ. Prior Research

This section begins with the definitions of DRM and its possible benefits in the electronic commerce market. Then, the efforts of the major technical working groups and organizations contributed to set up the conceptual and technical standards of DRM are summarized in regards to their specialization areas. Specifically, six non-profit consortium groups are discussed as MPEG -21, INDECS, OeB Forum, EBX, AAP, and DOI. This review also identifies a number of key commercial vendors.

2.1 What is DRM?

DRM technologies are, in essence, designed to protect intellectual property (IP) of a user by providing more control over information flow [Bolick, 2001; Torrubia et al., 2001; Ericson (a), 2001; Martin et al., 2002]. Intellectual property (IP) gives people an ownership of their own intellectual creativity and thereof by-products. DRM tries to protect IP by controlling information flow and thus building a trusted market framework using a variety of measures, e.g., encryption/decryption, watermarking, and digital signature. Thus, the definition of DRM may refer to a group of technologies and specifications to ensure that these technical development and conceptualization efforts contribute to establish a foundation of trust in the Internet market. Further, DRM does not only cope with establishing a trust-based environment but also it provides such enabling infrastructures that support the processes of the life cycles of digital content, i.e., creation, transaction, modification, usage, and consumption [Mooney, 2001; AAP, 2000; Ericson(b), 2001, Ericson et al., 2001].

Among various possible benefits that DRM provide for the establishment of the electronic commerce, three important ones are protection of digital content, protection from content authenticity, and provision for transaction & user information [AAP, 2000; Bolick, 2001].

(1) Protection of Digital Content

DRM uses encryption technologies to protect the content of digital goods. This is usually done using a special key. Once digital content is protected via DRM encryption, only the holder(s) of this key can later unlock the content and read the content.

(2) Protection from content manipulation

DRM can guard against digital manipulation, thus protecting content originality, using a one- way hash function. For example, if any

part of the original content is changed, the altered message text will become completely different message. Thus, the user of the DRM system knows whether the message has been changed during the transfer period.

(3) Provision for transaction & user information

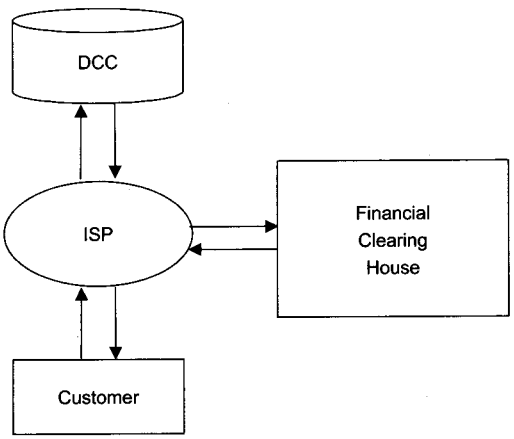
Once the business contract is made and successfully done, all information about the contract is saved in *digital forms*, and it can be used for future.

As noted earlier, trust is an essential element to any transactions (or exchange activities) to be occurred. Many DRM vendors closely guard and protect the inner workings of their proprietary trust infrastructures. On the other hand, since numerous propriety systems exist, interoperability between these propriety systems becomes a major issue in the DRM market systems [Ericson(a), 2001; Mooney, 2001]. Many technical consortium-based working groups take their initiatives onto set up DRM specifications and market structures. The next first shows a skeleton of DRM infrastructure, and then the DRM working groups and their urgent agenda are detailed.

2.2 DRM Infrastructure

<Figure 1> shows a skeleton infra-structure of the DRM-based electronic commerce. Note that there is one additional element, called Data Clearing Center (DCC) in addition to the current e-commerce system. The major role of DCC is to support for managing right-labels.

Much like the stock clearing house, this DCC is a digital content clearing organization where the transactions of right management information (RMI) are happened and recorded. In the DRM market, a digital product is a bundle of the digital content itself as well as its metadata including right information. Then, the digital product is packaged through digital packaging technologies which compress, encrypt and wrap the digital content and metadata together into a single file (or group of files) suitable for distribution. As we can see, RMI or Rights-label (information) is not managed by internet service providers. It is done in Data Clearing Center (DCC). RMI or Rights -label is stored in DBMS in DCC and this information can be used as a primary key for future usage.



<Figure 1> An overview of DRM-based e-commerce.

Besides the establishment of DCC added to the current e-commerce market, many other issues need to be addressed in the DRM-based electronic commerce. Several DRM research groups are studying on various, technical and conceptual issues and major research groups are identified below.

2.3 DRM Standardization Working Group

Many organizations and technical consortiums are involved in setting up the technological standardization for DRM market. The purpose of these organizations is to set up the standard communication medium such as establishing rights languages and terminology.

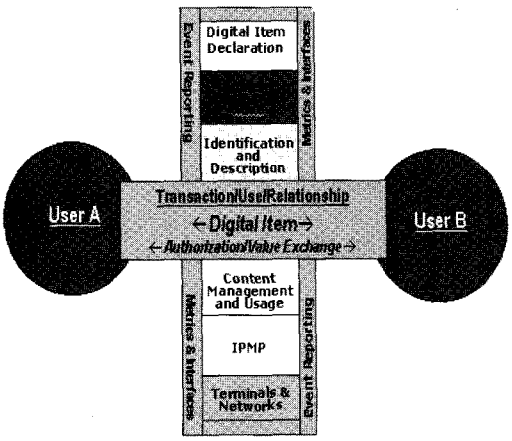
In this section, we discuss the major issues of building DRM systems by summarizing the efforts of the technical consortium-based working groups and their research focuses. Such technical working groups as MPEG, INDECS, OeB, EBX, AAP, and DOI are introduced to their primary roles in DRM-based e-commerce. Further, XML WORK tag is explained in details. Then, this paper identifies the major DRM commercial vendors and their technologies.

2.3.1 MPEG-21

Moving Pictures Experts Group (MPEG) was started in 1998 under ISO (International Standards Organization) to generate standards for digital video and audio compression. For multimedia compression and transactions, all MPEG standards (MPEG-1, 2, 4, 7) as well as such major international digital guideline for wired/wireless network environments like W3C (World Wide Web Consortium) and ITU (International Telecommu-nication Union) standards coexist today.

The aim of MPEG-21 is then to support all these existing multimedia standards (interoperability) while it sets up the e-commerce environment for transactions and usage of these digital multimedia contents (Intellectual Property Management and Protection: IPMP). To achieve these ends, new, complex solutions are required to manage the transaction process of these different content types in an integrated and harmonized way [www.self.it/mpeg].

The scope of MPEG-21 could therefore be described as the integration of the critical technologies enabling transparent and augmented use of multimedia resources. MPEG-21 supports creation, production, distribution, consumption and usage, representation, identification, and description of content, intellectual property management, financial management, user privacy, terminals & network resource abstraction, and event reporting. <Figure 2> shows the multimedia framework architecture of MPEG-21 which is consisted of seven functional elements [www. mpeg.org].



<Figure 2> Multimedia Framework of MPEG-21

2.3.2 INDECS

INDECS (INteroperability of Data in E-Commerce System) was launched in 1998 under the European Commission info 2000 project to pro-

vide a means for rights owners to create metadata standards for e-commerce [indecs. org].

In other words, the goal of INDEX is to produce generic systems to handle complex metadata for all content types. The INDECS consortium was initially made up of eleven European, US, and Australian organizations. The early specification of the INDECS mostly came from the Dublin Core, along with IFLA FRBR (Functional Requirements of Biblio -graphic Records) [www.ifla.org].

INDECS agrees to use XML/RDF format to describe digital contents. RDF is a road map to describe metadata. Five principles of the well-formed metadata of the INDECS standards are unique identification, functional granularity, source authority, technical independence, and appropriate access [indecs.org].

Unlike INDECS, which focuses on the integration (a top-down approach) of different multimedia specifications to achieve the DRM standard, several organizations in the US use a bottom-up approach in that they first build a small model and expand this model into a full-grown DRM model. Especially, ebooks have been chosen as a DRM testbed for publisher groups including OeB Forum, EBX, and AAP, which are explained below.

2.3.3 OeB Forum

The Open eBook Forum (OeB) is a loosely organized group of hardware and software companies, publishers, authors and users to set a standard for the creation and distribution of electronic books (i.e., epublication, or ejournal). In September 1999, the Open eBook (OeB) Forum released the Open eBook Publication Structure specification [www.openbook.org]. The specification is intended to give content or technology providers minimal and common building grounds over different formats of various electronic books. In September 2000, the OeB group provides the Working Report, a roadmap toward the DRM framework [www.openebook.org] The OeB report allows publishers and authors to deliver their materials in an XML-based syntax.

2.3.4 EBX

Like OeB Forum, the Electronic Book eXchange (EBX) Working Group is primary concerned with the creation, development, and transfer of digital objects, using the ebook model as a simplified version. The EBX Working Group is organizied such members as Adobe Systems Incorporated, the American Library Association, Audible, Content Guard, DigitalOwl, Glassbook, GlobalMentor, Nokia, RightsMarket, SoftLock, Thomson Consumer Electronics, Versaware, Yankee Rights Management, etc.[www.ebxwg.org]. The draft EBX specification accommodates a variety of content formats for electronic books, including Open eBook (OeB) Publication Structure and Adobe Portable Document Format (PDF). Note that OeB Forum and EBX Working Group is planned to unite near future. The unified organization will be a focal point to establish the standards activities related to electronic publishing.

2.3.5 AAP

DRM standards have also been developed

by the Association of American Publishers, Inc. (AAP) in order to promote the use of ebooks and to facilitate the development of ebook technologies[www.publishers.org]. A major focus of AAP is to solve the interoperability problems of the DRM market. AAP tries to encompass all proprietary systems currently available, and at the same time, to show a broad but standard guideline (i.e., standard vocabulary and terminology) for the current DRM market to enhance interoperability [Mooney, 2001]

2.3.6 DOI

The International DOI Foundation (IDF) was established in 1998 to support the identification needs of providers of intellectual property in the multinational, multi-community network environment. [www.doi.org]. The Digital Object Identifier (DOI) provides a distinctive identifier for an object. This DOI is also called Uniform Resource Names (URN), compared to URL used by the web. The DOI systems are characterized by

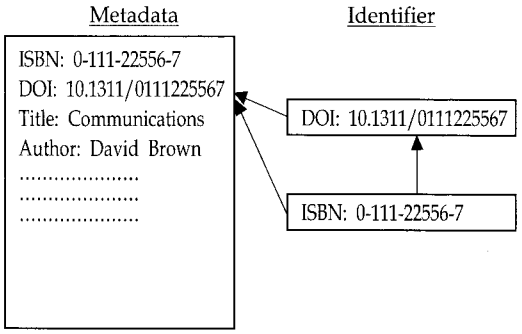
- Global identifier: the scope of DOI name is global, and thus it has the same meaning all around the world.
- Uniqueness: The same URN will never be assigned to two different resources.
- Permanent: The URN will be globally unique forever for the lifetime of the resource.

Other features of the DOI are scalability, legacy support, extensibility, and independence. The DOI has two components, the prefix and the suffix, which are separated by a forward slash, as shown in <Table 1>. There are three examples of the DOIs.

<Table 1> Examples of DOIs

Example	Prefix	Suffix
1	10.1000/123456	
2	10.100x/ISDN-900512-44-0	
3	10.ABC/456789	

In <Table 1>, all DOIs start with 10. The next element of the prefix is the number (string) that is assigned to an organization that wishes to register DOIs. There is no limitation placed on the number of DOI prefixes. DOI Registration Agencies assign DOI numbers to organizations. Currently, such simple form of DOI prefix shown above is in use. But in future, it is anticipated that the prefix may be complicated and need to be further divided into sub-prefixes. Following the prefix (separated by a forward slash) is a unique suffix (unique to a given prefix) to identify an entity. The DOI suffix can be any alphanumeric string that the registrant chooses.



<Figure 3> Illustrative example of DOI and metadata

The power of the DOI system is its function as a routing or resolution system. Because digital content may change ownership or loca-

tion over its lifetime, the DOI system uses a distributed central directory that one change is recorded in the directory and all subsequent users will be sent to the new location. The technology that is used to manage the resolution of DOI is called the Handle System (www.doi.org).

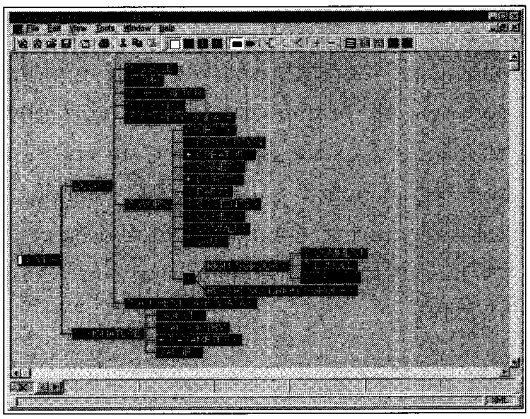
2.3.7 XrML

XrML (eXtensible rights Markup Language) provides a universal tool for specification of rights, fees, and issuing conditions (licenses) associated with the use and protection of digital content. Based on the pioneering research from Xerox' Palo Alto Research Center (PARC), ContentGuard has developed XrML to unify the Digital Rights Management (DRM) specifications and encourage interoperability [odrl.net].

XrML facilitates the creation of an open architecture for rights management of digital content and can be easily integrated with both existing and new systems. Specifically, XrML will enable users to:

- Describe rights, fees and conditions appropriate to commerce models they select.
- Provide standard terms for usage rights with useful, concise and easily understandable meanings.
- Offer vendors operational definitions of trusted systems for compliance testing and evaluation.
- Provide extensibility to new language features without compromising XrML's other goals.

The use of XrML for usage rights on digital contents is to ensure that a DRM framework provides trust and interoperability. <Figure 4> shows XrML DTDs structure.



<Figure 4> XrML DTDs (document type definitions) structure

According to <Figure 4>, there are two elements: a BODY (mandatory) and a SIGNATURE (optional) in the root element of XrML. The latter is the digital signature of the former used to ensure its integrity. The BODY element of XrML consists of the following elements as:

- TIME: a time interval in which the XrML document is valid.
- ISSUED: the time moment at which this document is issued
- DESCRIPTOR: a description of the document.
- ISSUER: an owner (or principal) of this XrML document.
- ISSUEDPRINCIPALS is a list of principals this document is issued to.
- WORK defines a digital work and its usage rights.
- AUTHENTICATEDDATA captures additional data for future usage.

XrML WORK Tags specifies a digital work and its usage rights. WORK Tags consist of OBJECT, DESCRIPTION, CREATOR, OWNER, DIGEST, PARTS, CONTENTS, COPIES, COMMENT, SKU, RIGHTSGROUP, EFERENCED-RIGHTSGROUP [www.w3.org].

To tap the possibility of this enormous e-commerce market, commercial vendors are also eager to enter this unchartered DRM market: some of the major vendors are Adobe PDF Merchant, Alchemedia, InterTrust, ContentGuard, Microsoft, Reciprocal, Wave System, Infraworks, Elisa Software Corporation, TCPA (Trusted Computing Platform Alliance), to name a few.

Ⅲ. Design of DRM Prototype

System environment sets a high-level conceptual and technical specification for the DRM prototype designed for this study. First, the DRM prototype is based upon a client/server model. It is assumed that the client/server model built for this study is a trust-based system. Encryption technologies are used to build a trust-based network system.

Encryption techniques is discussed, but the actual implementation of these encryption methods are not used. It is because in practice, this encryption function can be easily outsourcing.

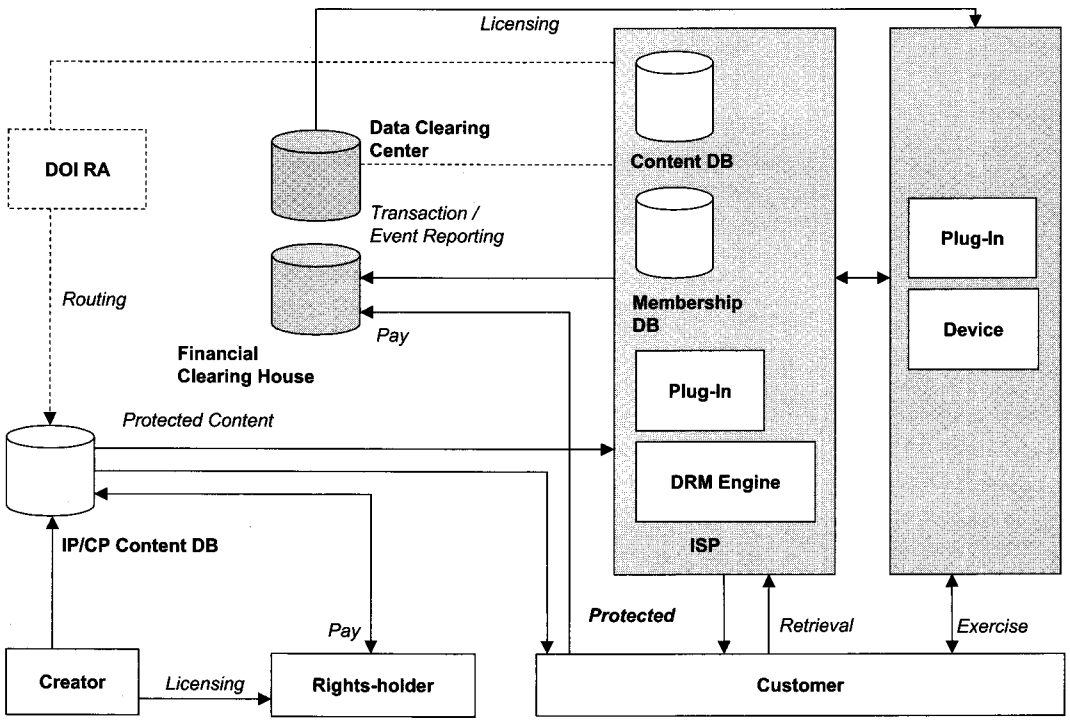
We assume that digital contents exist in a distributed environment, though the physical contents are in the local server. A simulated DOI number is given to the DRM system. The DRM prototype should implement an appropriate schema for the metadata, information for digital content itself.

The high-level architectural specifi-cations of the DRM system are as follows.

- Content description and digital item are described in more conventional ways in that the content and information about the content are declared and described using common senses and logic.
- Simulated DOI number is used for this system prototype.
- To capture IPMP (Intellectual Property Management Protection)
  information, XrML language is used.
- Event Reporting is done in the server through a local database. In other words, Digital Clearing Center (DCC) has not been fully implemented in this system. However, the essential functions of DCC are simulated in the server.
- A customer is able to verify the usage rights through a plug-in. In this study, MS Media Player is used for a viewer.
- Encryption algorithms are discussed. But, as mentioned above, the actual encryption process (i.e., key generation, digital signature, watermarking) is not implemented for this study.

3.1 System Architecture

The system is built on a digital commerce market structure where a protected digital content is exchanged through the Internet. The system architecture gives a relationship between the key elements of DRM infrastructure consisted of content suppliers (creator, rights -holder, etc.) and content users, DOI registration agency, data (and financial) clearing center, and Internet content service providers. Internet



<Figure 5> System Architectural Shaema

content service providers are consisted of four essential elements as content database, membership database, plug-in, and the DRM engine in <Figure 5>.

The system elements for the DRM market differ from the current e-commerce market in three distinctive ways. First, all digital contents (and thereof their transactions) are identified and registered in DOI mechanism. Second, digital contents and contents transactions are secured through encryption mechanism in the DRM market. Third, all the transaction records are kept for later uses, which is through data clearing center (DCC). In these transaction processes, right management information (RMI) is created for and attached to each digital element.

Detailed description for each element in the system architecture in <Figure 5> is shown as follows.

Creator is a person (i.e., author) or an organization that create a digital content. Capturing intellectual activity, known as IPMP, is very difficult and important in the DRM environment.

Rights-holder is a person or an organization that has rights over the digital content existed. In reality, rights-holders and creators for the digital item may not be the same persons.

Information (content) Provider (IP) is a person/organization that receives the digital content from a creator, collects all information about the content, and produce the metadata model for it. The metadata model contains various rights information and relevant business information.

Internet Service Provider (ISP) is a service

provider through which all transactions are occurred. The role of ISP is to sale the digital content received from IP.

Digital Object Identification Registration Agency (DOI RA) system here is denoted a unique object identifier for all digital objects as explained earlier. We use a simulated DOI number of doi: 10.1311 for this study.

Data Clearing Center (DCC) is an organization or mechanism where an actual transaction of all information is recorded and stored permanently.

3.2 Content Metadata

```
<XrML>
<BODY type = "Kent Sample Data"
version = "1.0">
    <ISSUED> 2000-4-30 </ISSUED>
      <TIME>
        <FROM> 2000-04-30T00:00 </FROM>
        <UNTIL> 2050-08-31T23:59:59
        </UNTIL>
      </TIME>
    <DESCRIPTOR>
      <OBJECT type = "Person">
        <ID type = "SSN"> 011-337-1234 </ID>
      <NAME> David Brown </NAME>
      </OBJECT>
    </DESCRIPTOR>
</BODY>
</XrML>
```

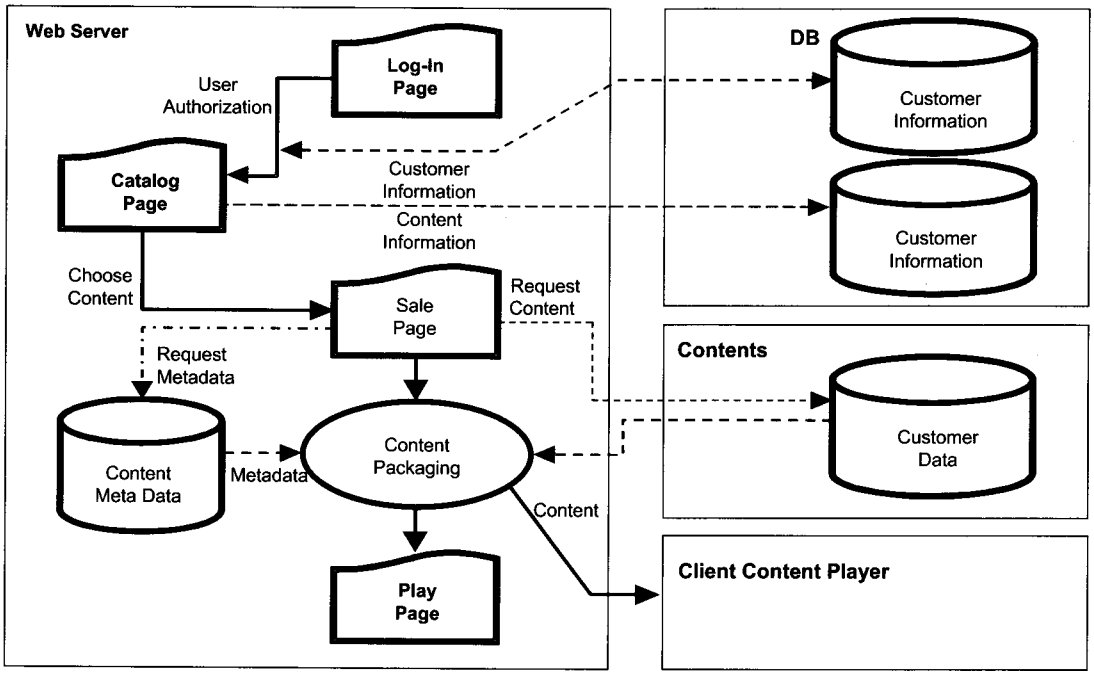
In digital environment, a digital item must be identified, described, and captured by some standard formats such as MPEG. Such standardization provides interoperability across the different platforms and technical infrastructure. Note that these content metadata are created before any transaction activity occurs. In other words, these information about the digital items itself should be kept in separate data storage places from the transactional databases. Most information in this section is being created and captured during the transactional process. As stated earlier, XrML language is used to describe the right conditions and issues. Following is an example of the XrML codes used in this study. Description of a particular transaction, along with brief content information, ownership and/or rights information, usage information, etc. would be contained in an example of XrML Tags below.

Ⅳ. Implementation of The DRM Prototype

This section illustrates the implementation of the DRM prototype built for a digital commerce market. The actual coding has been done using a judicious mix of Java, Jsp, and XrML. XrML is used as a right language that specifies rights and issuing conditions of content transactions. The high-level block diagram of the DRM prototype is as shown in <Figure 5>, whose elements consist of a client, a web server, a database server for customer information, and a content storage server for a digital item itself. A client initiates a contact and receives a service through the web server from the digital content retailer. The web server is connected to the local database server for customer information, and to the digital content servers in distributed environments.

4.1 Detailed Block Design of DRM System Prototype

<Figure 6> shows the more detailed block-



<Figure 6> Detailed block design of the DRM prototype

design of the DRM system prototype especially in the web server where it shows the flow of information in the five steps according to transaction processes: login, catalog, sales, content packaging, and play-in. Each step of the transaction processes is discussed in details next.

4.1.1 Login

A user needs login to buy digital item to the system. In this stage, the user's ID and password are compared with those in an existing customer information database. Connection to the database is done by the JDBC: ODBC driver of Sun. All information for connection to a database using JDBC is in java.sql package. Once the driver is loaded, the connection is established using the programming coding below.

```
Class.forName ("sun.jdbc.odbc.JdbcOdbcDriver");
Connection conn = null;
String url = "jdbc:odbc:shop";
conn = DriverManager.getConnection (url,"sa","");
Statement stmt = conn.createStatement ();
```

After the connection to the customer database is established, the user's identity is compared with the existing entries in the database using the SQL query statement and the rs.next () method.

```
String id = req.getParameter ("ID");
query = "select id from user_info where id
        = ' "+id+" ' ";
ResultSet rs=stmt.executeQuery (query);
```

In case of a new user, he must register first in order to use this shopping mall system. The registration process is consisted of a number

of actions that the new user needs to provide some of the user's personal information including a user ID, a password, an authorization number, customer types (as individual or organization), addresses, etc. Of course, this user information will be stored in the customer information database for further usage.

4.1.2 Catalog

After a successful login, the user is now able to select or purchase digital items, whose information is stored and provided by the local database of a retailer. SQL query statements and the rset.next() method retrieve the information about digital contents in the DB as shown below.

In the catalogue page, the user can screen merchandise items using one of the three options as keywords, conditions, and media types.

```
While (rset.next())
{
String dbTitle = rset.getString ("Title");
String dbType = rset.getString ("Type");
String dbDirector = rset.getString ("Director");
String dbArtist = rset.getString ("Artist");
String dbDescription = rset.getString
       ("Description" );
...
}
```

4.1.3 Sales

As the user chooses his sales items, the digital contents and associated metadata such information as fees, usage conditions, DOI number, effective date, etc., described in a XrML language, is transferred from the respective content meta databases for the packaging process, which will be described in the next section shortly.

Note that all these transaction information are also recorded in a Data Clearing Center (DCC). The essential roles of DCC in the DRM market environment are to provide the transaction report as well as financial processing functions for all transactions. It is this Data Clearing Center that is responsible for the registration for all exchanges taking placed and that keeps their transaction records kept for the future use.

As noted earlier, in this prototype, however, DCC is not separated from the local database server. Whenever a transaction occurs, the transaction record as well as all other information associated with a transaction will be updated in the local database. Thus, all transactions for each user are kept and can be viewed in this local database server so do the lists of all users. In this way, the key roles of DCC are simulated through the local database server.

4.1.4 Content Packaging

The content packaging process is a number of sequential steps that extract only necessary information according to the user's choice and sales' specifications, combine them with content into an appropriate bundles, and finally deliver the digital packaged bundles to the user.

First, the digital content metadata, delivered from the content metadata database, is copied as temporary file (temp.xml). Then using a

parser, we make this temp file into a parsed (in a form of tree) XML document. In this tree document, we can add the necessary information or can remove the unnecessary information by selecting or not selecting a node as shown below.

```
parse handle = new parse();
Vector v = new Vector();
String tmp_xmlurl = "";
tmp_xmlurl=request.getParameter ("XMLURL");
handle.setDoc (tmp_xmlurl);
```

Following is an example of the XrML parsing process. Note that in the previous login stage, a user either login as either individual (home usage) or organization (theater usage). Let's suppose that a user logins as an individual. The following code goes to RIGHTSGROUP Tag and extracts the attribute of the business model type (individual) as the value for the bm_type.

```
v.addElement ("WORK");
v.addElement ("RIGHTSGROUP");
bm_type = handle.getAttrNode (v,"name");
v.clear();
```

Then it removes the all bm_types except the attribute of the bm_type extracted above. In this way, all the unnecessary XrML Tags are deleted, and as a result, the remaining Tags contain the necessary information only for a transaction.

```
v.addElement ("WORK");
handle.setRemoveByExceptAttr
(v,"RIGHTSGROUP", "name", bm_type);
v.clear();
```

Likewise, if the user chooses PLAY option as the buying type, all other buying type elements in XrML Tags are eliminated, and only necessary information for this particular transaction is attached to the digital content which will be later delivered to the user. The following code shows a case where the COPY buying type is not selected so that the COPY option Tags is removed from the tree node in the parsed XrML document.

```
v.addElement ("WORK");
v.addElement ("RIGHTSGROUP");
v.addElement ("RIGHTSLIST");
handle.setRemoveNode (v,"COPY");
v.clear();
```

After all unnecessary nodes (information) have been eliminated, the remaining nodes are now reverted into a XrML document which is stored under the temp.xml file. Thus, the temp.xml file contains only the needed information as the form of XrML Tags for a particular transaction.

```
doc = handle.getDoc();
FileOutputStream FOS = new
FileOutputStream ("c:\\shop\\temp.xml");
doc.write(FOS);
```

This XML file that contains only necessary information is now attached, as the header file, to the digital content as shown in <Figure 7>.

Packaging and delivery process is described in <Figure 7> where the selected meta data is attached as the header file to the digital content. Then this packaged file containing selected meta data and the digital content is delivered to the user. Now the user can play the

digital item, which is explained next.

4.1.5 Play-in

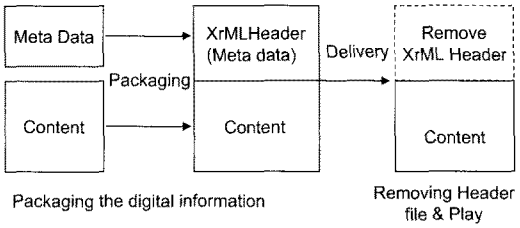
After purchasing the digital content, the user can enjoy it by exercising his option of rights such as view or play at this final stage. The cViewer() method provides a screen that displays all rights information including the title and description of the digital goods, as well as the usage rights of the user.

As shown <Figure 7> the header file of the protected content file is now removed, and then the content file (i.e., video file) can be played by the MS Windows Media player.

Note that MS Media Player can be down loaded in the first screen of the program. There are five usage rights (or choices) as play, copy, delete, view, or prints at the screen but this program we use two options, play and copy, exclusively for the program.

```
Vector v = new Vector();
String rights = new String();
v.addElement ("WORK");
v.addElement ("RIGHTSLIST");
v.addElement ("PLAY");
if (parse.getIsNode (v) == true)
{
        BoolV = true;
        rights = rights + "< li > It can play." ;
}
else rights = rights + "< li > It cannot play." ;
 v.clear();
```

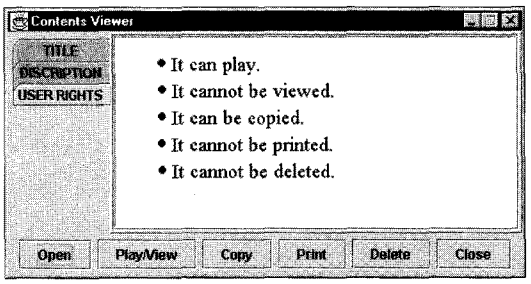
The above code is used to check the usage right options the user selects contained in the temp.xml file, and it shows the user rights information to the screen as shown in <Figure 8>.



<Figure 7> Packaging and delivery process of transaction

4.2 Major Classes in the Prototype

Following is a description of the important classes used to build this DRM prototype.



<Figure 8> Display of User Rights Information

4.2.1 CheckID

The CheckID class compares a user's ID with the IDs in the existing database. It uses get-Parameter() to get a user's ID, and connects the customer database through the driver of jdbc: odbc:shop. It uses a SQL statement to extract ID from the user information table in the database. Then it uses the method rs.next() to perform a comparison, and reports action based on the comparison.

4.2.2 InputServlet

The InputServlet class helps a registration

process of a user. A new user must register first. The registration process includes receiving all information from the user, and writing that information to the database server. The class has a getParameter() method through which it receives all information of the user's ID, name, key, password, ssn, address, etc., from the previous name.jsp file. The class utilizes Calender.getInstance() to calculate the exact date of the new user. Then the class writes all information for the user and the date of this registration to the database server.

4.2.3 LoginServlet

LoginServlet class compares the ID and password of a customer with those stored in the database. If ID and password are valid, a customer can continue its shopping process. Otherwise, it shows an error message and forces the customer to re-log-in. With use of the getParameter() method, the class gets the user's ID and password. The method pw.compareTo() compares the ID & password with the existing database. The method rd.forword() transfers a request from this class to another resource.

4.2.4 docServ

The docServ class receives the location of merchandise and the meta data about the merchandise. Then it packages these into a temporary media contents file and delivers to the user.

It has method saveTempfile() which receives the merchandise content information resided in a distributed environment and makes a temporary file.

4.2.5 UserInfoBean

The UserInfoBean class is used for coding conventions which provides getter and setter methods for accessing user information. It has methods setId(), getId(), setUser_type() and getUser_type() which perform the functions implied by their names.

4.2.6 Domhandle

The Domhandle.class is used for handle XML document. It implements the method getDocument(), findNode(), and getAttr(). The getDocument() parses XML documents into a form of tree. The findNode () method returns a node specified by a name. Then the getAttr() gets the attributes of the node given by the name specified.

4.2.7 Parse

The parse class also is used for parsing and handling XML document. A number of functions is used in the parse class. It has a number of methods as follows.

setDoc() parse XML document into document in form of tree using Domhandle class.

getDoc() transform document in form of tree into XML document.

getValueNode() return value of the first child of given node. If there is no such node, this returns null.

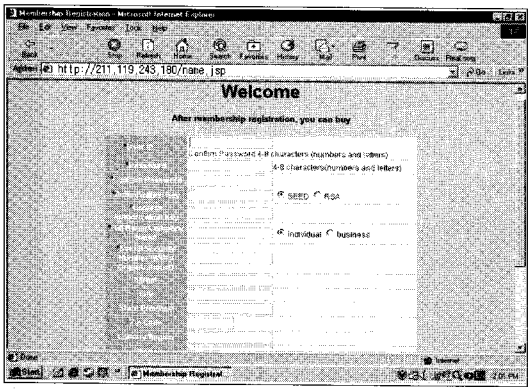
getIsNode() return true if given specific node exist, or false otherwise.

setRemoveByAttr() remove a node specified by given specific attribute name and attribute value.

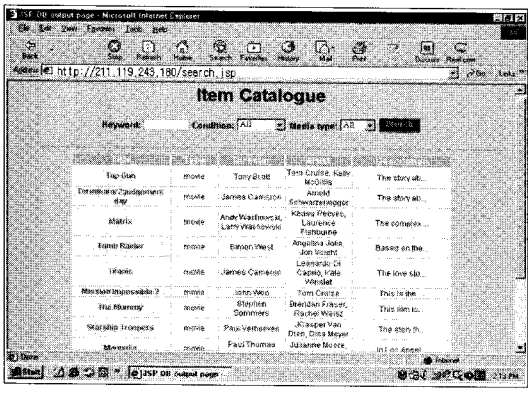
setRemoveByExceptAttr() remove nodes except node having given specific attribute name and attribute values.

4.3 Implementation using the Shopping Mall Prototype

A new user needs to register it first. It is shown in <Figure 9> where the client needs to decide registration type as either individual or organization. Depending on the registration type, individual or organization, there might be some differences in sales conditions such as sales fees, buying options.

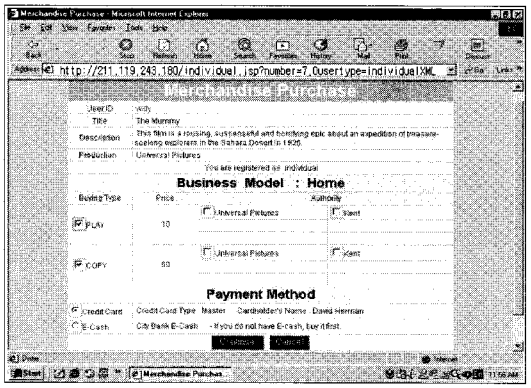


<Figure 9> Registration Form for a new user

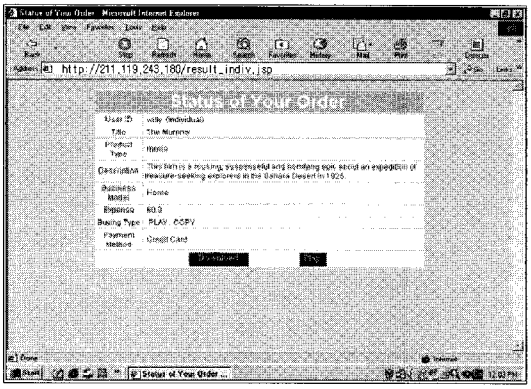


<Figure 10> Item Catalogue Page

<Figure 10> shows the page of Item Catalogue where the user, individual or organization, may select his shopping items. Once the user select the items in <Figure 10>, it will bring <Figure 11> where the user may specify the purchase method & buying type.



<Figure 11> A Screen for Merchandise Purchase

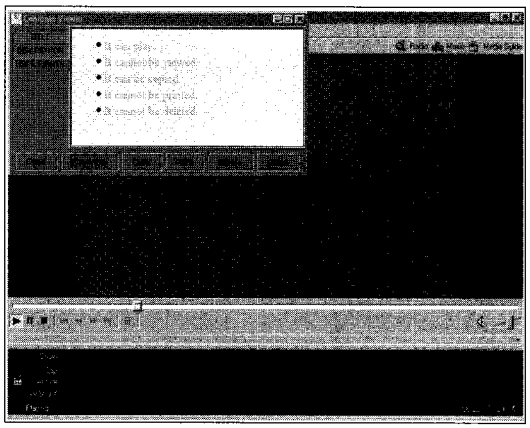


<Figure 12> The Result Screen for a Transaction

As shown in <Figure 12> where the user selected Play & Copy options, it will bring the option where the data is being down load. In <Figure 13> where the user using the Plug-in can open the file being downloaded, it displays the options of the buying type as user rights.

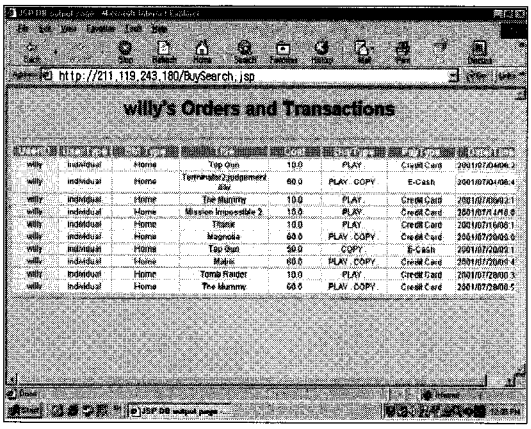
In <Figure 13>, if the Play option is chosen,

MS Media Player will show the movie in the bottom part of <Figure 13>.



<Figure 13> Buying types of transaction

In this prototype, a user (i.e., Willy) can also check all lists of purchasing items. The DRM prototype also provides all transaction lists in <Figure 14>.



<Figure 14> Example of all transaction lists

In sum, this section gives the implementation of the DRM prototype designed for a shopping mall. The detailed block design and major classes and modules are presented The experimental results are shown in <Figure 8> to <Figure 14>. This prototype sets up a DRM standard system that can be used by different types of e-commerce applications.

V. Conclusions

In this paper, the current endeavors of the digital rights management (DRM) are discussed, and the design and implementation of a DRM prototype has been carefully expeimented. First, the important developments, conceptual and technical aspects, of the DRM environment are detailed through a survey of international standardization DRM working groups and commercial vendors.

Second, this DRM prototype provides a top -level architectural design for a system in the DRM environment. Key elements of the DRM system architecture include digital object identification (DOI) and its registration agency (RA), metadata and right management languages (i.e., XrML), IPMP, encryption algorithm and protection procedures, data clearing center, etc.

Finally, the Shopping Mall DRM prototype has been built by incorporating all key objects described above. Especially, a simulated DOI number, XrML to capture IPMP, the metadata for the video are used for the experiment of this paper. Also, event reporting is done in the server. The essential functions of a data clearing center are tested. In this study, we show a detailed architectural design that is an integrated approach for securing and protecting intellectual property (IP) in this emerging digital-content commerce.

Digital information is now predominant forms of data traffic in this digital information

age. The Internet presents a unique platform for disseminating digital content while at the same time, it is fundamentally challenging the traditional rules of ownership. Especially, ease of copying and of sharing valuable digital information undermines many viable traditional business models. In such environment, safe protection and proper delivery of digital content would be a crucial requirement toward a new e-business model.

There are many frontiers that can be explored in this new digital environment. First of all, we should understand that until now, all DRM specifications discussed are not settled yet, but a suggestion by engaging working groups. In other words, the DRM specifications and standards are slowly emerging through the incessant interactions among numerous scholars and organizations.

A digital format can also be used to describe non-digital items such as physical goods. In so doing, this Digital Rights Management (DRM) system will be used as a universal market mechanism for any goods, digital or non-digital, that can be traded any place at any time.

Thus, as a business manager, it is important to recognize the new market infrastructures the components and purpose of DRM based market system.

Throughout this paper, the importance of the integrated DRM system and intellectual property has been emphasized. The essential challenge of the DRM system would be building a sound trusted market system that has accountability and keeps a record for all exchange activities on earth. To do that, the conceptual followed by technical schemas for all IPMP are, first, established for all existing goods, physical or non-physical. It is also necessary that these schemas be flexible enough for adjusting for foreseeable future change.

〈참 고 문 헌〉

[1] Bailey, D.V., "Inside eBook Security," http://www.ddj.com/, Dr. Dobb's Jounral, Nov. 2001.

[2] Blum O., "The new WIPO Treaties on Copy Right and Performer's and Phonogram Producer's Rights," CMS von Erlach Klainguti Stettler Wille, 1997.

[3] Connaway, L.S., "A Web-based electronic book (e-book) library: the netLibrary model," Library Hi Tech, Vol. 19, No. 4, pp. 340-349, 2001.

[4] Davis, T.M. and Lafferty, Tim., "Digital Rights Management: Implications for Libraries," The Bottom Line: Managing Library Finances, Vol. 15, No. 1, 2002, pp. 18-21.

[5] Erickson(a), J.S. "A Digital Object Approach to Interoperable Rights Management," D-Lib Magazine, http://www.dlib.org/dlib/june01/erickson/06erickson.html, Vol. 7, No. 6., June 2001, ISSN 1082-9873.

[6] Erickson(b), J.S. "Information Objects and Rights Management," D-Lib Magazine, http://www.dlib.org/dlib/april01/erickson/04erickson.html, Vol. 7, No. 4., April 2001, ISSN 1082-9873.

[7] Erickson, J.S., Williamson, M., Reynolds, D., Vora, P., Rodgers, P., "Principles for

Standardization and Interoperability In Web-based Digital Rights Management," A Position Paper for the W3C Workshop on Digital Rights Management, January, www.w3.org/2000/12/drm-ws/pp/hp-erickson.html, 2001.

[8] Iannella, R., "Digital Rights Management (DRM) Architectures," D-Lib Magazine, www.dlib.org/dlib/june01/iannella/06iannella.html, June 2001, Vol. 7, No. 6.

[9] Kang, W.J. and Kim, E.M., "Digital Rights Management Technology used in MP3 music in on-line transfer," *Journal of Korean Information Processing Association*, Vol. 7, No. 11, 2000, pp. 3694-3701, (in Korean).

[10] Koenen, R., "Intellectual property management and protection in MPEG," http://www.mpeg.org.

[11] Lee, S.J, "Conflicts on Rights Management in Digital Rights Management" Journal of Knowledge Property Law, Vol. 4, 2001, pp. 141-159, (in Korean).

[12] Lee, Y.H. and Hwang, D.J., "Design and Implementation of Agent based Dynamic Digital Rights Management," *Journal of Information Processing Association*, D. Vol. 8-D, No. 5, October 2001, pp. 613-622, (in Korean).

[13] Martin, M., Agnew, G., Kuhlman, D.L., McNair, J.H., Rhodes, W.A. and Tipton, R., "Fedrated Digital Rights Management," D-Lib Magazine, www.dlib.org/dlib/july02/martin/07martin.html, July/August 2002, Vol. 8, No. 7/8.

[14] Mooney, S., "Interoperability: digital rights management and the emer-ging ebook environment," D-Lib Magazine, http://www.dlib.org/dlib/january01/mooney/01mooney.html, Vol. 7, No. 1, January 2001, ISSN 1082-9873, 1-6.

[15] Mooney, S., "Digital Rights Management and the Emerging eBook Environment," D-Lib Magazine, www.dlib.org/dlib/january01/mooney/01mooney.html, January 2001. Vol.7, No.1.

[16] Mulholland, J., "Digital Rights (mis)Management," Proceeding for the W3C DRM Workshop, Sophia Antipolis, 2001, (France).

[17] Neylon, E., "First Steps In An Information Commerce Economy: Digital Rights Management In The Emerging Ebook Environment," D-Lib magazine, Vol. 7, No. 1, January 2001, ISSN 1081-9873.

[18] Park, P., Sandhu, R. and Schifalacqua, J., "Security Architecture for Controlled Digital Information Dissemination," The Proc. of Annual Computer Security Applications Conference (ACSAC), New Orleans, Louisiana, dilb.computer.org/conference/acsac/0859/pdf/08590224.pdf, Dec. 2000.

[19] Paskin, N. "The digital object identifier system: digital technology meets content management," Interlending & Document Supply, 27, November 1, 1999, pp. 13-16.

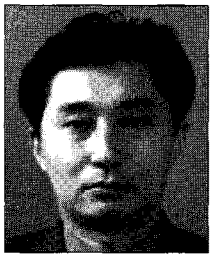
[20] Rolick, R., "Publisher's Require-ments for Digital Rights Manage-ment," DRM-Workshop, 2001.

[21] Rue, D., "Digital Watermarking for rights protection for movies," *Journal of multimedia association*, Vol. 2, No. 4, December 1999. pp. 438-450 (in Korean).

[22] Torrubia, A., J. Mora, F. and Marti, L., "Cryptography Regulations for E-commerce and Digital Rights Management, Computer & Security, Vol. 20, No. 8, 2001, pp. 724-738.

[23] Walter, M, "E-book Project Highlights Role of DOI in Selling Digital Content," The Seybold Report, www.seyboldreports.com/TSR/free/0106/ebooks.html, Vol. 1, No. 6, June 2001.
[24] AAP; Association of American Publisher, http://www.publishers.org.
[25] Digital Object Identifier, http://www.doi.org.
[26] Digital right management Workshop, http://www.w3.org/2000/12/drm-ws/.
[27] Electronic Book Exchange Working Group, http://www.ebxwg.org.
[28] IFLA FRBR (Functional Requirements of Bib lio-graphic Records), http://www.ifla.org.
[29] IETF Internet DRM Working Group, http://www.idrm.org.
[30] Interoperability of data in e-commerce system, http://indecs.org.
[31] ISO/IEC Moving Picture Experts Group, http://www.selt.it/mpeg/.
[32] OEB (OpenEBook Forum), A Framework for the Epublishing Ecology, Public Draft, http://www.openbook.org/, Sept. 2000.
[33] Open Digital Rights Language, http://odrl.net.
[34] World intellectual property organi-zation, http://www.wipo.org.

◆ 저자소개 ◆



이기동 (Lee, Ki-Dong)
서강대학교 경영학과를 졸업하고 University of Maine에서 MBA, Kent State University에서 경영정보학 박사를 취득한 후, 현재 인천대학교 경영학부에 전임강사로 재직중이다. 주요 관심분야로는 Data Mining, Digital Rights Management, Financial Applications with Neural Network 등이다.

김준우 (Kim, Jun-Woo)
서강대학교에서 경제학 석사와 미국 버지니아 주립대학교에서 경영학 박사를 취득하고 한국통신기술㈜에서 선임연구원을 거쳐 현재 인천대학교 경영학과 교수로 재직하고 있다. 주요 관심분야는 ERP를 기반으로 한 SI, 기업의 인터넷비즈니스 전략개발 등 전자상거래분야로 경영정보학, CIO 연구지 등에 논문을 싣고 있고 저서로는 경영전산개론, 전자상거래와 e-business 등이 있다.

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