

# Protection of DIP using Object Oriented Modeling of DIPRMS in E-Commerce – An Indian Perspective

Sanjay Banerjee, Sunil Karforma

**Abstract**— Copyright is used to protect the rights of the consumers and the creators of the Intellectual Property (IP). The ease of creation, modification, distribution, compatibility and above all, a large market opportunity drive the creator and the consumer to move towards digitization to create and use their IP in digital form called Digital Intellectual Property (DIP). In India the existing copyright law to protect IP is also applicable on DIP. But the same is not enough to protect the DIP in E-commerce environment and such weakness of the legal framework to accommodate the revolutionary technological changes cause a great economic loss. This discourages the creator of the DIP. The Digital Rights Management (DRM) system offers a new technological device that can be deployed in order to protect the creators from the DIP infringements caused by different kinds of attacks in the Internet during electronic transactions. Hence, this tool may also be used as a supplement to the copyright law in India particularly in E-commerce environment.

In this present article an attempt has been made to design an Object Oriented Modeling based DIP protection system in E-commerce where the creator and the consumer can perform their commercial transactions safely by managing necessary IP rights efficiently and securely. Under this system the creator of the DIP distributes the rights i.e. copying, printing, redistribution etc to the consumer of the DIP who has purchased the rights from the creator through the E-commerce system. Now, when the consumer of the digital rights downloads a DIP, DRM checks the consumer's identity, contacts a financial clearing house i.e. PayPal, Visa etc. to make arrangement of the payments, decrypts the DIP, and assigns a key or a password for future access. The assign key or the password protects the DIP from being infringed and restricts its access, which is the primary goal of the copyright law.

**Index Terms**—Intellectual Property, Digital Intellectual Property, UML, Object Oriented Technology, Digital Rights Management, DIPRMS

## 1 INTRODUCTION

THE Copyright is used to protect the rights of the consumer and the creator of the Intellectual Property (IP). In India, this is true that copyright does not prevent anyone from making the copy but make a feeling of guilty. Traditional way

that, after creation of any digital product it goes for transaction and becomes ready for consumption. The product can be modified and back to its creation state and ready for transaction again. In any of the states i.e. usage, creation or modify, the product can be destroyed [1].

### Advantage of DIP over IP

The use of DIP for efficient communication between creator and consumer has both the advantage and disadvantage. The advantages for the creator of the DIP that we figure out are as follows:

- **Ease of creation & modification:** The time required for creating DIP is comparatively less than the time required for creating traditional IP. The DIP is easily modifiable than the traditional IP.
- **Large market opportunity:** The market of any digital product is vast. The advent of Information Technology brings the era of digital age, which broaden the digital consumer market. The DIP increases the sales opportunity with comparison to the traditional IP.
- **Ease of distribution:** The distribution and the transaction of DIP are very smooth and fast.

The advantages that we studied from the side of the consumer are:

- **Wide compatibility:** The DIP is compatible with any latest digital electronics devices because of its digitalism.
- **Portability:** DIP is portable rather than any other traditional IP, as an example, an E-journal is much portable rather than traditional journal containing huge number of pages.

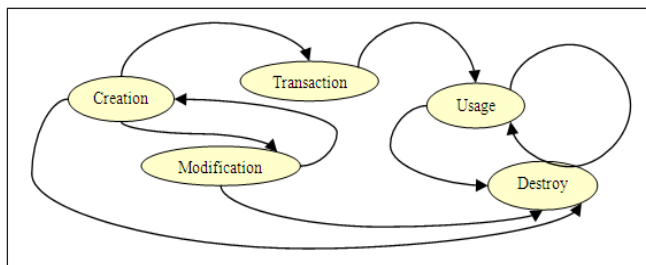


Figure-1: Life Cycle of Digital Content

of copy process takes long time, very uneconomical and exact copy of the IP cannot be possible. These discourage the consumer making copy of any IP not the copyright law.

The latest development of information and communication technology encourages the creator and the consumer of the IP to produce and consume their IP digitally during electronic transaction, known as Digital Intellectual Property (DIP). The life cycle of any digital product as shown in Figure 1 describes

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- **Ease of copy:** The DIP can be copied or make back up vary simply using latest cloning software. The digital product can be copied perfectly and cannot be distinguishable with the original one.
- **Sharing:** DIP can be shared easily among various people within the globe using Internet with very negligible amount of time.
- **Several buying options:** E-commerce can be used to create a virtual market with several buying/selling options throughout the globe, where the buyer and seller visit, buy product/services and make payment securely and efficiently.

There are also some disadvantages of the DIP in E-commerce which is highlighted in following:

The Internet makes it possible to transect the DIP electronically anywhere in the world in a very small amount of time. This is a boon to the DIP creator and the DIP consumer. Nowadays, a PC can turn to a library of DIP and can be accessed from anywhere of the world. In one side this facilitates the DIP creator to make the whole world as their new market and increase the sales opportunity. But in the other side this makes a threat to them. The ease of copy, modify, circulate etc. of the digital product becomes the nightmare to them. For instance, a creator creates a DIP and over Internet it is bought by a consumer, which means that the consumer buys the single user license. But afterward, the DIP can be copied in multiples using the latest cloning software and can be circulated throughout the world within a small amount of time. This practice undoubtedly violates the copyright act. As in the traditional mode of transaction the chance of such violation is almost absent, this mode of transaction has therefore, encouraged by the trusted system transaction. This discourages the creator of DIP to participate in E-commerce transaction system.

So, there should be a DIP protection system which is competent enough to avail the advantages of the appropriate technology to eliminate those limitations. In view of this, Digital Rights Management (DRM) is an important infrastructure for the present digital media age [2]. The purpose of DRM is to protect the copyrights and also enforces the rights of the creator of the DIP [3].

The present paper has been organized as under:

Section 2 deals with prior research relevant to the issues associated with secure DIP transaction in E-commerce. Section 3 is devoted to identify the specific objective of our study. In Section 4 we have described the methodology to design the proposed system and finally, conclusions have been drawn in Section 5.

## 2 PRIOR RESEARCH

- **Encryption:** During the initial stage of digital data protection encryption is used, based on cryptographic algorithms. It is implemented by transforming the digital information into encrypted digital information which is thereafter inaccessible for understanding. Two major categories of encryption systems are symmetric key encryption and asymmetric key encryption. Encryption can be a way of DIP protection based on cryptographic algorithms, like DES, AES and IDEA,

but this is not sufficient [4] and also not feasible because large chunks of data is being transmitted between buyer and seller in E-commerce. Encryption transforms the content of a file but does not prevent from copying a file.

For content encryption, InterTrust [5] and MediaSnap [6] employed advanced encryption standard and well known cryptographic algorithm in their DRMSolutions.

- **Digital Signature:** In DIP protection, digital signatures are used for signing licenses of the digital content and to a customer it is considered as an identity. At the client side such licenses are verified for its correctness of the usage rights [7].

Digital signature has the limitation of secure distribution through Internet i.e. once a customer purchases the usage rights he/she can distribute the rights over the Internet cause violation of copyright.

- **Digital Certificate:** Digital certificate is used to ensure the authenticity of the digital content and the valid authorization of the distributor. Digital certificates are essential mechanism to authenticate various parties involved in DIP creation and consumption in more secure manner [7].

It also has the same limitation as in digital signature. There is no prevention mechanism of secure distribution of digital certificate and its usage through Internet.

- **CD-ROM and Diskettes Protection:** CD-ROM and Diskettes protection technologies are employed for protecting digital data, software and database. It is performed by two ways, which are distinguished by applicable technologies [8].
- **Software Security Dongles:** Hardware protection facilities like security dongles are also used along with software and data protection techniques to prevent the pirate copying and illegal circulation as well. Dongle is a small microelectronic device, which is connected to one of the ports of the computer, and is a hardware system element of application protection [9].
- **Watermarking:** Watermarking is a mechanism for embedding a 'signature' of additional information into the raw digital content itself, prior to protection, in such a way as to be either undetectable or unnoticeable during normal use, but nevertheless provide the content publisher with traceability [11].

According to a recent IFPI (International Federation of the Phonographic Industry) report, it has been estimated that the Indian film industry alone loses around Rs 3 billion each year due to the infringement [10]. The music industry on the other hand has to cope with losses up to Rs 5 billion per year. Indian film industry will wipe out in the years to come, unless there is a clear-cut mechanism to control easy duplication and distribution of content over E-Commerce transaction system. Additionally, while downloading of files has gained acceptance among music lovers, it is also a fact that legally available digital content for sale on the Internet is still limited. This is because the content owners are still not convinced that their copyrighted works are safe in the Internet based electronic

transaction. This discourages them to participate in E-Commerce transaction system.

In India, very little efforts have been made to manage the Digital Intellectual Property Rights. C-DAC [11], under the guidance of Department of Information Technology, Government of India is officially working on such issues. In India they first adopted the watermarking technology to protect the DIP. Several India based Software Company and Organization already started successful use of hardware lock (dongles) such as Tally [12], SOUL [13] etc. to protect digital product.

In the light of the above discussion on the disadvantage of the current E-Commerce transaction model there is a strong justification to develop a new DRM based DIP protection model called Digital Intellectual Property Rights Management System (DIPRMS) that will comply all the discussed limitations and this can be used safely to transact DIP.

### 3. OBJECTIVE OF THE STUDY

And because law doesn't seem to have worked as a preventive measure, there is some justification that only technology based protection will ever work to protect digital works. This is referred to as Digital Rights Management or DRM.

But the current DRM based system lacks functionality, and also the interoperability among the different digital formats is one of the main bottlenecks [14]. The DRM based system should be as 'what you see as what you pay' like system [15] along with different functionality and flexible interoperability.

The Unified Modeling Language (UML) is an Object Oriented system analysis and design paradigm which offers generic prototype design technology developed by Grady Booch, James Rumbaugh, Ivar Jacobson in the Rational Software Corporation [16][17][18]. This facilitates graphically visualizing, specifying, constructing, and documenting the behavior of a system using the facilities of Object Oriented Programming Paradigm. We have shown that UML can be used very efficiently to design the secure model of E-Commerce system [19][20][21].

UML consists of a number of graphical diagrams that may be combined to define behavior of a system using the guidelines of Object Oriented Software Engineering approach which is the recent trends of high quality of software development. It includes nine diagrams namely Class diagram, Object diagram, Use Case diagram, Sequence diagram, Collaboration diagram, Statechart diagram, Activity diagram, Component diagram, and Deployment diagram which help to design the system using Object Oriented approach.

To model our proposed system we only consider the Class diagram. Class diagram is used because a class is an abstract representation of wrapping attributes and methods together to represent real life participants of DIPRMS based E-commerce system such as Creator, Content Provider, Consumer etc. in generic form. In object oriented paradigm instances of each class is called object. Objects will communicate with each other using methods through message passing.

In our proposed system we are managing different IP rights related with E-commerce transaction in a very efficient and secured manner using UML as an Object Oriented Software Engineering tool.

## 4. PROPOSED OBJECT ORIENTED MODELING OF DIPRMS

### 4.1 Identification of Objects

The objects and their methods along with their association in designing the proposed system for transacting DIP over E-commerce system are described below as depicted in Figure 2:

**Creator:** The person who is the actual owner of the copy-right work can

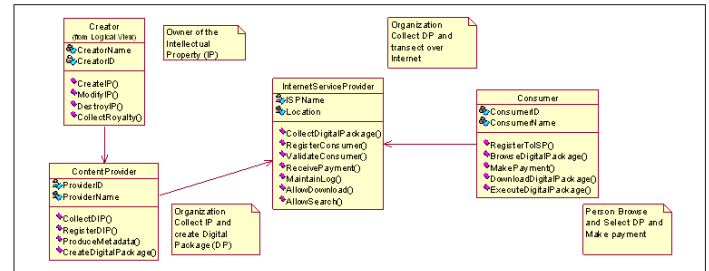


Figure-2: Class Diagram of DIPRMS

- CreateIP(): The creator of the IP creates IP digitally
- ModifyIP(): The creator of the IP, if needs, modifies the IP.
- DestroyIP(): As and when require the IP could be destroyed by the creator.
- CollectRoyalty(): The creator collects the royalty for the IP.

**Right Holder (RH):** Is the Creator or any other person or organization, performs the same task as the task performed by the Creator.

**Information/Content Provider:** Person or organization who

- CollectDIP(): The Content provider collects DIP from the Creator or the RH along with all other information about the DIP
- RegisterDIP(): The DIP is registered and Digital Object Identifier (DOI) number is collected, which can be used to recognize the DIP globally.
- Produces metadata which includes the information relating to the right along with other business information.
- CreateDigitalPackage(): Thereafter, the DIP along with other information is wrapped into a Digital Package (DP) for distribution.

**Internet Service Provider (ISP):** Is the place where actual transactions take place. It performs the role of a distributor. The ISP

- CollectDigitalPackage(): Collects DP from Content Provider and places it in a web site for sell.
- RegisterConsumer(): For any transaction the Consumers are Registered
- ValidateConsumer(): The authenticity of the Consumer is validates using digital certificates and digital signatures
- ReceivePayment(): The payment made by the consumer is collected through payment gateway.
- AllowSearch(): The DP's are displayed on the Web and Consumers are allowed to search their desired product for download along with purchase rights.
- AllowDownload(): The selected product is allowed to download after validating the Consumer authenticity.
- MaintainLog(): All the transaction made by the Con-

sumer is stored in database as transaction log for the future reference.

**Digital Object Identification Registration Agency (DOI RA):** Organization where the DIP is registered and a unique DOI is given.

**Consumer:** The intended person or any organization for which the DP is created and can

- RegisterToISP(): The Consumer Register himself/herself in ISP, where he/she can buy DP
- BrowseDigitalPackage(): The Consumer Browses/Searches DP to purchase
- MakePayment(): After selecting the desired product the payment is made through payment gateway.
- DownloadDigitalPackage(): After successfully make the payment, the DP is Downloaded
- ExecuteDigitalPackage(): The Consumer starts executing the DP and enjoys it, which is a right protected DP.

#### 4.2 Functional Architecture

The behavior of every DRM based system requires some functional architecture where Content server, License sever and Client software jointly simulating an environment suitable for DRM [11]. In order to provide a generic functional architecture for DIPRMS based system for E-commerce environment following functional architecture is proposed for transecting DIP over E-commerce in a very secured and efficient manner preserving all rights of relevant participants:

**Content Server:** It is the repository where the digital IP will be stored during transaction in E-commerce, which consisting of four logical blocks:

- **Content Storage Area:** Containing a meta-data management environment to uniquely identify the digital IP associated with E-commerce transaction.
- **Products Information Storage Area:** Containing product information along with different rights and product meta-data.
- **Packager:** That encrypts the DIP using any cryptographic algorithm to lock and unlock the DIP as and when required by end user.
- **Content Delivery Area:** Module that will responsible to delivery subsystem of digital IP associated with E-commerce transaction.

**License Server:** It is licensing repository of all digital IP which consisting of three components:

- **Key Storage Area:** Where the encryption key of a DIP is stored.
- **User Information Storage Area:** Where the user information is stored along with content usage.
- **License Generator:** That wraps the content and the encryption key to the end user's device and registers the user with the server.

#### Client Software:

A piece of software that resides locally on an end user's system that displays the encrypted content, communicating the appropriate rights i.e. print, copy, play etc and permissions to the end user and feeding back to the license server. The number of message communications required to back to the license server is determined by the contents rules at the time of pack-

aging.

A basic DRM transaction starts with the content creator, who generates an IP in different digital format. Once in digital form, the IP file is encrypted to protect it from unauthorized use, and stored on the merchant's server. A license server, possibly with the help of a payment gateway system, manages access to the encrypted file by decrypting it on demand. Decrypted IP might be delivered directly to a web browser, or an end user might download the encrypted file and decrypt it with an appropriate DRM-enabled client. Either way, the result is a fully licensed, digital-quality IP file in the hands of a consumer.

#### 4.3 Algorithm of the proposed system

The proposed system's major subtasks associated with DIPRMS based electronic transaction are outlined using following algorithm [22]. The algorithm may be used during buying/selling of any digital products/services where the rights of different participant of E-commerce like buyer, seller, payment gateway etc would be preserved efficiently and securely integrating facilities of DRM, UML and cryptography.

**Step 1:** The consumer object places an order online by selecting items from the merchant's Website. The merchant acknowledges to the customer with an order summary of the items, price, total value, order number etc.

**Step 2:** The consumer redirects the order information along with the merchant information to the transaction manager.

**Step 3:** The transaction manager object processes the order and generates a digital package (DP) based on the information submitted by the consumer. The DP is then wrapped into a DRM package along with the rights to use the same and stores the information of the DP for future reference along with the consumer account so that any party cannot deny occurrence of any previous transaction and hence, implementing strong non repudiation. The DRM package is then send to the merchant for payment

**Step 4:** The merchant object confirms the order and supplies the goods or services to the consumer.

**Step 5:** The merchant object requests payment to the payment gateway.

**Step 6:** The payment gateway object processes the request of the merchant, validate the merchant applying any strong digital signature algorithm and then the electronic fund is transferred from the consumer's bank to the merchant's bank.

#### 5. CONCLUSION

In this paper an attempt has been made to throw some light on the different security risks of the DIP transacted over E-commerce system and discussed different initiative taken by the Indian organization to offer solution. However, to fill the observed deficiency of the E-commerce transaction system no such efficient functional solution so far has been developed

In this paper an attempt is made to provide a generic functional model to fill such deficiency of DRM. In order to improve the performance of DRM we have integrated DRM,



UML and cryptography technologies for managing rights of different participants of E-commerce system in a very efficient and secured manner. To do this we have first designed those objects either internal or external and established their association with the help of Class diagram which may be used for further analysis and design of the system in more understandable and improved form using different diagramming tools present in UML.

The proposed system can have flexibility to reuse and maintain and can be used in future to design DIP in E-business system.

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