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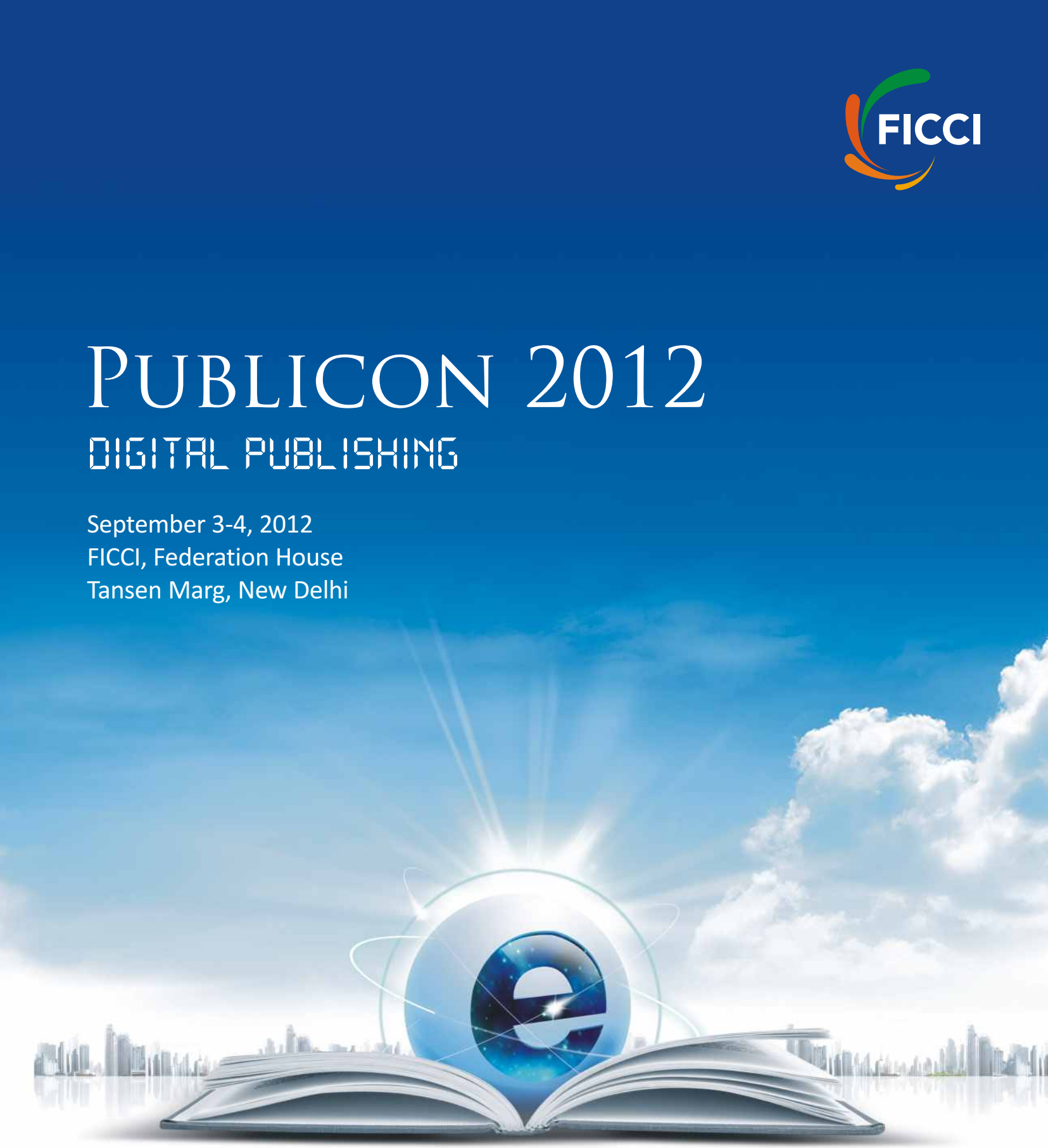

Selected Papers

Digital Rights Management

Rishu Srivastava and Bhawna Sharma

The advent of Information and Communication Technology (ICT) as well as the rapid development of worldwide web has radically changed the Internet from a mere technological infrastructure into a network linking people across the world and ultimately into the leading purveyor of information in the digital age, and also a major role player in the global economy. What initially started as a scientific and academic network has unleashed an era of electronic commerce and digital economy based on easy access and multifunctionality. The progress of ICT has engendered an era of digitized information which can be copied, shared and exchanged innumerable times by millions of people throughout the world who are connected by means of computer networks.

While in the case of analog media the quality of copied material deteriorates every time a copy is generated, digital media files can easily be replicated without affecting quality of subsequent copies. Powerful computers, improvements in compression technology and expansion of bandwidth have even made sharing of larger files very easy. Linking, framing, peer-to-peer file sharing have all led to rampant digital piracy and a difficult situation for intellectual property rights holders. The rapid digitization and unauthorized copying, reproduction and distribution of their work has meant that rights owners have had to bear significant losses. It is reported that the total number of users logged onto major P2P networks at any one time is approximately 10 million, sharing over 10,000,000 GB (10 Petabytes) worth of data.[1] It is difficult to regulate those P2P systems that are not using centralized servers but enable the user's computer to act as a search engine for processing each request and downloads. Digital Rights Management (DRM) has therefore assumed significant importance as the development and the advancement of technology needs to be complemented with intellectual property so that the social, political and financial needs of the rights holder are secured.

What is DRM?

Under Digital Rights Management, IT tools are employed to facilitate the rights holder to exploit their proprietary rights. DRM aims to enforce certain usage rules in respect of content protected by

[1] *Source: CacheLogic.com*

intellectual property such as the terms and price under which a person is entitled to use the work. The rights holders are enabled by DRM technologies to enforce accession policies in respect of copying or viewing of the content created by them. Restrictive Licensing Agreements, Encryption, Scrambling of expressive material, and embedding of a tag are some of the common DRM techniques.

From a functional perspective the DRM can be bifurcated into two broad areas:

- **Digital Rights Management-** Includes identifying and describing IPR in respect of work and parties involved in its creation and administration; and
- **Digital Management of Rights-** Includes the (technical) enforcement of usage restrictions

Drivers of DRM

World Wide Web, Internet and E-Commerce: Internet emerged as a key to successful commercial ventures all the while enabling easy distribution of copyrighted material and subsequently posing problems for rights holders to manage their IP assets in the dynamic environment.

Ripping Technology: Extraction of digital content from Compact or Digital Video Disc into other media such as the hard drive of the user coupled with web based applications (such as Napster and kazza) has made ripping a rampant problem and a threat to copyright holders.

Peer-to-peer file sharing: Peer-to-Peer networks incorporating technologies that do not require a central server, has not only made all the content vulnerable to copying and distribution but has also posed severe enforcement issues and has made legal pursuit even more difficult.

DRM: An Indispensible Tool in Protecting IP and Creating New Business Models

As the transmission technology coupled with internet based application has progressed over the years, so has the ease with which a work can be copied and distributed. The rights holders are challenged with the daunting task of protecting their copyrighted work from unauthorized use. Though perceived as the means of protecting digital media copyrights, DRM not only thus plays a crucial role in restricting the unauthorized distribution of digital content but also covers a much larger landscape by addressing issues like providing new avenues for packaging, pricing, distributing and selling the protected contents. In the coming years the traditional business models for content exploitation will undoubtedly be supplemented by new models, enabled by DRM technologies.

DRM Services for Texts, E-books and Documents

The text industry is not aloof from the DRM initiatives and technologies. Microsoft has developed a DRM system for customized electronic publications called the Digital Asset Server. Adobe, Microsoft's main competitor, is selling the Adobe Content Server. Palm's software division, Palm Digital Media, has also developed a customized DRM system for distributing its eBooks. DRM aggregators such as Overdrive, are using technologies from several DRM vendors to build custom systems for the online publishing industry.[2]

POPULAR DRM SCHEMES USED IN PUBLISHING INDUSTRY

- There are three main ebook DRM schemes in common use today, one each from Adobe, Apple, and the Marlin Trust Management Organization (MTMO).
- Adobe's Adept DRM is applied to ePubs and PDFs, and can be read by several third-party ebook readers, as well as Adobe Digital Editions software.
- Apple's Fairplay DRM is applied to ePubs, and can currently only be read by Apple's iBooks app on iOS devices.
- The Marlin DRM was developed and is maintained in an open industry group known as the Marlin Developer Community (MDC) and is licensed by an organization known as the Marlin Trust Management Organization (MTMO).
- Barnes & Noble uses a DRM technology provided by Adobe, and is applied to ePubs and the older Palm format ebooks.
- Amazon uses a DRM which is an adaption of the original Mobipocket encryption, and is applied to Amazon's Mobipocket and Topaz format ebooks.
- Adobe Reader and Microsoft Reader are the PC and Macintosh software programmes to view e-books. Each programme uses a slightly different approach to DRM.
- The first version of Adobe Acrobat e-book Reader to have encryption technologies was version 5.05. In the later version 6.0, the technologies of the PDF reader and the e-book reader were combined, allowing it to read both DRM-restricted and unrestricted files. After opening the file, the user is able to view the rights statement, which outlines actions available for the specific document. However, when viewing a more highly restricted e-book, the user is unable to print the book, copy or paste selections. The level of restriction is specified by the publisher or distribution agency.

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[2] *Digital Rights Management, Retrieved on August 13, 2012 from Wikipedia http://en.wikipedia.org/wiki/Digital_rights_management*

- Microsoft Reader, which exclusively reads e-books in a .lit format, contains its own DRM software. In Microsoft Reader, there are three different levels of access control depending on the e-book: sealed e-books, inscribed e-books and owner exclusive e-books.
- Sealed e-books have the least amount of restriction and only prevent the document from being modified.
- Inscribed e-books are the next level of restriction. After purchasing and downloading the e-book, Microsoft Reader puts a digital ID tag to identify the owner of the e-book. Therefore, this discourages distribution of the e-book because it is inscribed with the owner's name making it possible to trace it back to the original copy that was distributed.
- The most stringent form of security that Microsoft Reader offers is called owner exclusive e-books, which uses traditional DRM technologies. To buy the e-book the consumer must first open Microsoft Reader, which ensures that when the book is downloaded it becomes linked to the computer's Microsoft Passport account. Thus the e-book can only be opened on the computer with which it was downloaded, preventing copying and distribution of the text.

Source: Digital Rights Management, Retrieved on August 13, 2012 from Wikipedia http://en.wikipedia.org/wiki/Digital_rights_management

DRM Application

As stated above, DRM enables the rights holders to safely distribute their protected work online in digital format. The access rules thus devised by the content owners addresses several parameters including price of the content, frequency with which the data can be accessed, duration of accession and the authority provided to users to save, print, modify, transfer or share the data.

Several business models have also emerged on the basis of above parameters including trial before purchase, promotional previews, subscription and purchase of downloadable media.

The contents which come within the purview of DRM are:

- Audio and Video: -audio CDs, internet music, films, television content;
- Publishing: - books, e-books, documents, magazines, journals, articles;
- Software and computer games etc.

The DRM Technology Used by the Industry

The DRM is an amalgamation of disparate technologies, expertise and services which, when installed either on user's device or network server, enables the protection of the digital content. The WIPO standing committee on copyright and related rights (in its Tenth Session) has identified these technologies as follows:

Encryption

The process of encryption is employed to protect accession to owner's IP without proper authentication and authorization. It involves mathematical algorithms that scramble the digital information in such a way that it could not be accessed without the right holder's authorization.

For effective DRM the encryption system must have sufficient security depending on the type of content for which it is designed, it must be user friendly, and should be renewable and revocable in case the security of the same has been vitiated.

The management of keys used to unlock the encrypted content is the most important aspect of DRM encryption technology. Generally the Single Key encryption and Private Key/Public Key encryption are the two kinds of digital encryption employed in DRM. While the former is a much simpler, it is the latter process that involves complex Modular Arithmetic and the creation as well as processing of content secured with public/private key encryption requires a great deal of computing power.

Fingerprinting

Fingerprinting is a content-based identification technology that works by extracting the characteristics of a file and storing them in a database. When an unknown file is presented, the said technology calculates its characteristics and attempt to find its match with those that are stored in the database. The metadata is returned from the fingerprint database if an appropriate match is found. The fingerprinting systems are generally used to monitor peer-to-peer content distribution systems for copyright infringements. In comparison to computer graphics, these systems are more suitable for audio, video and audio-visual content.

Watermarking

A watermark is embedded information that is used as a part of system for Digital Rights Management. The watermarks are utilized for disparate purposes including recording of the copyright owner, distributor and distribution chain and identifying the purchaser of the work.

Contrary to encryption technology that aids in transmission of data but not in the examination of the work in protected form, the watermark remains in the content of the protected work.

Watermarking however has certain shortcomings. For instance small graphic elements cannot effectively carry watermarks due to general limitations on the amount of data that can be embedded into the content. Secondly as embedding a watermark usually involves change in the original content, the quality of the material is susceptible to alteration if watermarks are repeatedly embedded in the same content.

DRM TECHNOLOGIES USED BY MAJOR ORGANIZATIONS

- The DRM system of Microsoft's Windows Vista called the Protected Media Path contains the Protected Video Path (PVP) that tries to stop DRM-restricted content from playing while unsigned software is running in order to prevent the unsigned software from accessing the content. PVP can encrypt information during transmission to the monitor or the graphics card, which makes it more difficult to make unauthorized recordings
- Napster music store offers a subscription-based approach to DRM alongside permanent purchases. Users of the subscription service can download and stream an unlimited amount of music transcoded to Windows Media Audio (WMA) while subscribed to the service. But when the subscription period lapses, all of the downloaded music is unplayable until the user renews his or her subscription.
- Sony operated an online music download service called "Connect" which used Sony's proprietary OpenMG DRM technology. Music downloaded from this store (usually via Sony's SonicStage software) was only playable on computers running Microsoft Windows and Sony hardware (including the PSP and some Sony Ericsson phones).

Source: Digital Rights Management, Retrieved on August 13, 2012 from Wikipedia
http://en.wikipedia.org/wiki/Digital_rights_management

Overview of the DRM Technology

DRM involves two broad components: identification of intellectual property and its enforcement. While watermarking and fingerprinting are efficient tools that enable identification of the IP, encryption plays a prominent role in enforcing the same by ensuring that the content is only used for the purpose that was agreed to by the owner of the copyright.[3]

[3] *Ghatak, P., Triphati, R.C. , Chakarvarti, A .K. (July 2004), Digital Rights Management: An Integrated Secure Digital Content Distribution Technology , Vol 9, 313-331*

The steps involved in providing and implementing DRM strategies are delineated below:

- Metatagging of the appropriate contents which are created and stored within databases
- Encryption of the information to ensure that the content is secured
- Once the user is authorized to access the content, a decrypted key is used to unblock the encrypted contents and the information is made available to the client.
- The technology that a client uses to view the decrypted information may include Acrobat Reader, Internet browser, Media Player etc. The aforementioned steps are explained in details in the following segment.

DRM FAUX PAS

- In 2005, **Sony BMG** introduced new DRM technology which installed DRM software on users' computers without clearly notifying the user or requiring confirmation. Among other things, the installed software included a rootkit, which created a severe security vulnerability others could exploit. When the nature of the DRM involved was made public much later, Sony BMG initially minimized the significance of the vulnerabilities its software had created, but was eventually compelled to recall millions of CDs, and released several attempts to patch the surreptitiously included software to at least remove the rootkit. Several class action lawsuits were filed, which were ultimately settled by agreements to provide affected consumers with a cash payout or album downloads free of DRM.
- The use of the DRM scheme in 2008's **Spore** backfired and there were protests, resulting in a considerable number of users seeking a pirated version instead. This backlash against 3 activation limit was a significant factor in Spore becoming the most pirated game in 2008, with TorrentFreak compiling a "top 10" list with Spore topping the list.

Source: Digital Rights Management, Retrieved on August 13, 2012 from Wikipedia http://en.wikipedia.org/wiki/Digital_rights_management

Components of DRM System

Primarily a DRM system has four important software components:

- Content Protection Software
- Content Distribution Server

- License Server
- Content Viewer Plug

The system is usually incorporated with an e-commerce system that manages payments and initiates the function of license server.

As stated above, the DRM process commences with encoding and metatagging of the content in the format supported by DRM software which in turn depends on the software vendor.

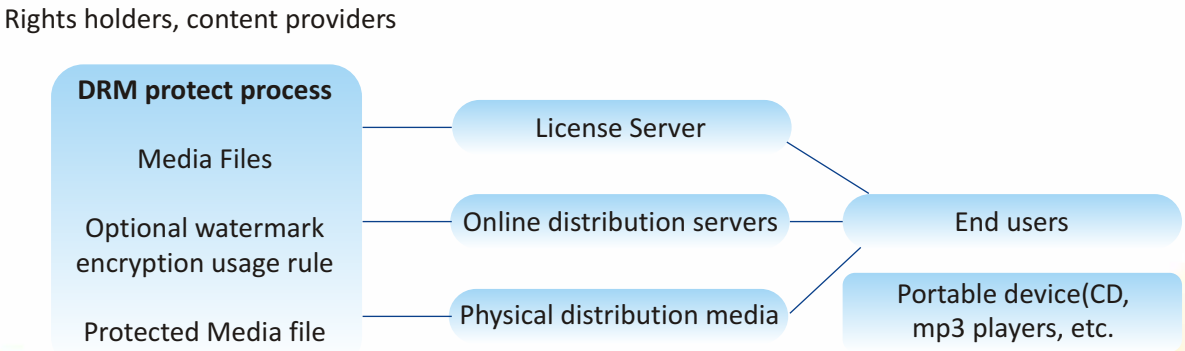
This is followed by encryption and packaging of the data. This is usually done by using special access, usage rules or a license key. The license key is saved either on a license server or on physical distribution medium like CDs/ DVDs etc.

The encrypted and protected content is then transmitted to the distribution server or may be saved on physical distribution medium. The distribution can be done by using downloading or streaming.

When the online customer downloads the protected content and wishes to receive same appropriate rights and permission for the same is communicated by the software on the end user's device to the to the end user and ultimately back to the license server.

As soon as the end user completes the formalities of registration and meets the requirements of clearing methodologies and/or payment, the DRM license handler collects the relevant information and generates the license to decrypt the information on the user's device.[4]

DRM Process flow[5]



[4]*Ghatak, P., Triphati, R.C., Chakarvarti, and A .K. (July 2004), Digital Rights Management: An Integrated Secure Digital Content Distribution Technology, Vol 9, 313-331*

[5]*Ghatak, P., Triphati, R.C. , Chakarvarti, and A .K. (July 2004), Digital Rights Management: An Integrated Secure Digital Content Distribution Technology, Vol 9, 313-331*

INTERNATIONAL TREATY OBLIGATIONS

- WIPO Copyright Treaty (WCT) and the WIPO Performances and Phonograms Treaty (WPPT) (commonly referred to as the "Internet Treaties") was adopted in 1996, by consensus by more than 100 countries at WIPO.
- The WIPO Internet Treaties are designed to update and supplement the existing international treaties on copyright and related rights, namely, the Berne Convention and the Rome Convention.
- WIPO Internet Treaties have established the new international legal norms to respond to the challenges posed by the digital technologies and dissemination of protected material over the global network.
- The WCT and the WPPT clarify the extent of rights holders' control when works, performances and phonograms are made available to the public for downloading or access on the Internet.
- Issues related to moral rights are also given new importance in the digital environment, as the new technologies offer unprecedented means for users to manipulate or "morph" copyright works, creating rights in derivative works, and possibly infringing the original authors' moral rights of integrity.
- The WCT and the WPPT provided two types of technological adjuncts to the protection of copyright and related rights, in order to ensure that the Internet can become a safe place to disseminate and license protected material

"Anti-circumvention" provision

Such provisions relate to the need of rights holders to rely on technological measures to protect their works against infringement on the Internet. No matter how ingenious the technology used to protect works against unauthorized use, equally ingenious ways may be developed to circumvent it.

"Rights management information,"

Rights management systems operate on the basis of electronic data that is attached to the works and objects of related rights. The data may identify the author or performer, the rights holder, and the work or object itself, and may further describe the terms and conditions for its use.

- These WIPO internet Treaties require nations party to the treaties to enact laws against DRM circumvention

- Treaties have been implemented in a number of important legislative instruments, including E.U. Copyright Directive, and the United States Digital Millennium Copyright Act (DMCA)
- The E.U. Copyright Directive requires Member States to provide legal protection against the "manufacture, import, distribution, sale, rental, advertisement for sale for rental, or possession for commercial purposes of devices, products or components of the provision of services" for the purposes of circumventing technological measures, including encryption, scrambling or other copy control mechanisms.
- The DMCA, Title I, creates civil and criminal liability for circumvention of copyright protection technologies and for the knowing provision of false copyright management information or intentional removal of the same, providing a technical adjunct to the rights established by copyright law

Source: WIPO, The Impact of the Internet on Intellectual Property Law, http://www.wipo.int/copyright/en/ecommerce/ip_survey/chap3.html

Opposition to DRM

- John walker in his article *"The digital Imprimatur: How Big Brother and Big Media can put the Internet Genie Back in the Bottle"* and Richard Stallman in *"The Right to Read"* have critically criticized the prevailing technology of DRM.
- FSF (Free Software Foundation) sponsored a campaign against digital rights management and re-termed DRM "digital restrictions management", as part of their effort to highlight that such technologies are "designed to take away and limit consumer's rights, and user interface copyright.
- FSF released GNU General Public License (GNU GPL or simply GPL- a free software license. The GPL is the first copyleft license for general use, which means that derived works can only be distributed under the same license terms. The GPL grants the recipients of a computer programme the rights of the free software definition and uses copyleft to ensure the freedoms are preserved, even when the work is changed.
- Steve Jobs and Bill Gates have publicly derided DRM as an impossible mission to secure digital music files with "crippling" DRM.
- The Association for Computing Machinery and the Institute of Electrical and Electronics Engineers have historically opposed DRM, even going so far as to name AACS as a technology "most likely to fail" in an issue of IEEE Spectrum

Source: Digital Rights Management, Retrieved on August 13, 2012 from Wikipedia
http://en.wikipedia.org/wiki/Digital_rights_management

DRM free Works

- Apple Inc. has sold DRM-free music through its iTunes store since April 2007 and has been labeling all music as "DRM-Free" since January 2009. The music still carries a digital watermark to identify the purchaser. Other works sold on iTunes such as e-books, movies, TV shows, audio books and apps continue to be protected by DRM.
- Tor Books, a major publisher of science fiction and fantasy books, intends to sell only DRM-free e-books by July 2012. Smaller e-book publishers such as O'Reilly Media, Carina Press and Baen Books had already forgone DRM previously.
- Webcomic Diesel Sweeties released a DRM-free PDF ebook on author R Stevens' 35th birthday, leading to more than 140,000 downloads in the first month, according to Stevens. He followed this with a DRM-free iBook specifically for the iPad, using Apple's new software, which generated more than 10,000 downloads in three days. That led Stevens to launch a Kickstarter project - "ebook stravaganza 3000" - to fund the conversion of 3,000 comics, written over 12 years, into a single "humongous" ebook to be released both for free and through the iBookstore; launched February 8, 2012, with the goal of raising $3,000 in 30 days, the project met its goal in 45 minutes, and went on to be funded at more than 10 times its original goal. The "payment optional" DRM-free model in this case was adopted on Stevens' view that "there is a class of webcomics reader who would prefer to read in large chunks and, even better, would be willing to spend a little money on it."

Discussion and Conclusion

DRM covers disparate facets including technology, legal aspects, standardization and policy making. As the classical models of publishing have moved into the digital world, the need of technological solutions for efficient and acceptable management of intellectual property rights has assumed

significance. An efficient DRM system should enable the rights holder to have flexibility of rights in adopting usage rules and policy within the legal framework, and to enjoy the liberty of deploying these technological measures for legitimate access to copyrighted works. At the same time the effect of widespread adoption of DRM technologies in the global digital economy should also be considered.

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The authors work at S. S. Rana & Company, and can be contacted at rishu@ssrana.in and bhawna.sharma@ssrana.in.