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Digital Rights Management White Paper

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Digital Rights Management

1 INTRODUCTION

Digital Rights Management (DRM) is a technology that was developed and is being developed as a protection against the illegal distribution of copyrighted online material such as music or documents. In 1999, with the launch of Napster, the situation became very alarming for rights holders. Although Napster's service was ruled against in court in the beginning of 2001, alternative *peer-to-peer (P2P)* services (digital distribution services in which clients distribute files between themselves, and not using a central server) have appeared on the Internet. On January 15, 2002 two of the three most downloaded programs at CNET's [Download.com](#) are P2P applications, namely MusicCity Morpheus and KaZaA Media Desktop.

DRM is a technology that lets rights holders safely distribute and sell their content online in a digital form. This white paper focuses on audio and video content, such as music and movies, but we also briefly discuss DRM for publications, games, and software.

2 DRM APPLICATIONS

With DRM content owners can configure usage rules for their own content. This allows for new business models such as "try before you buy", promotional previews, rentals based on play counts or expiration dates, subscriptions, and purchases of streaming or downloadable media. For online content, owners can also quickly change usage rules without having to redistribute the content. Considering the applications, the most promising content for distribution with DRM are

- audio: music and audio books
- video: movies, music videos
- publishing: books, documents, news articles etc.
- computer games, and
- software

Today, the way content is packed on a physical delivery media is based on the physical characteristics of the media. On a CD, there are usually 10-20 songs and you have to buy the whole CD even if you only would like to listen to two songs. With DRM content can be rented or sold in pieces. It is possible to buy or rent those two songs without the need to purchase the other songs on the album and they can be delivered to you within a minute if you have cable, DSL, or satellite Internet access.

With DRM, books, market research, professional journals, etc. can all be securely published and distributed on the Internet. The publishers can gain access to new consumers, lower the costs of distribution, and greatly increase their knowledge of consumers' interests and needs. In addition, a provider can permit the re-use of all or portions of its information by others in the value chain, increasing collateral sales. For example, a news piece might be permitted to be re-used in a newsletter, provided that the usage rules for the news piece continue to apply.

Distributing computer games on the Internet is difficult since they tend to be very large. Downloading several hundreds of megabytes off the Internet is not yet feasible for most of us, although more and more game players have broadband Internet access. With DRM the need for a separate demo version of a game becomes unnecessary. Games can be distributed in full versions with license rules for demonstration, that is, "try before you buy".

Software can be securely downloaded or physically distributed to users, demonstrated, purchased or rented with payments and usage information going back to the participants (including the publisher, distributor and retailer) as determined by their agreements. Value-added bundles, volume discounts and other channel dynamics can be supported and enhanced.

As stated earlier, our main focus is on DRM for music and videos. They seem likely to become the first widely used commercial application. On July 23, 2001 Jupiter Media Metrix reports that U.S. consumer online music spending will grow from \$1.0 billion in 2001 to 6.2 billion in 2006, a 43 percent annual growth rate over the next five years. According to the July 2001 Jupiter Internet Music Model, online music sales will represent seven percent of total U.S. music sales in 2001 and 32 percent in 2006.

Some websites already offer DRM protected music with different licensing rules. In December 2001 two subscription services for consumers in the USA were launched [1,2]. MusicNet combines the music catalogs of record labels such as Warner Music Group, BMG Entertainment, and EMI Recorded Music. Initially, on-demand music will be distributed through the RealONE service. The other subscription service, Pressplay, offers access to a vast catalog of digital music from companies such as Sony Music Entertainment, Universal Music Group, and EMI Recorded Music through an array of affiliates, including Yahoo!, MSN and Roxio. Some smaller sites, for example EmmaFM in Finland, offer music protected by DRM and without a subscription scheme. Music tracks can be downloaded and paid for directly, for example by sending an SMS message from a mobile phone to the service provider.

3 DRM PROCESS

A DRM system usually has four software components: content protection software, a content distribution server, a license server and a content viewer/plug-in. Usually the DRM system is integrated with an e-commerce system that takes care of payments and triggers the functions of the license server. We shall not focus on the e-commerce systems in this paper. Figure 3-1 shows the basic DRM process flow.

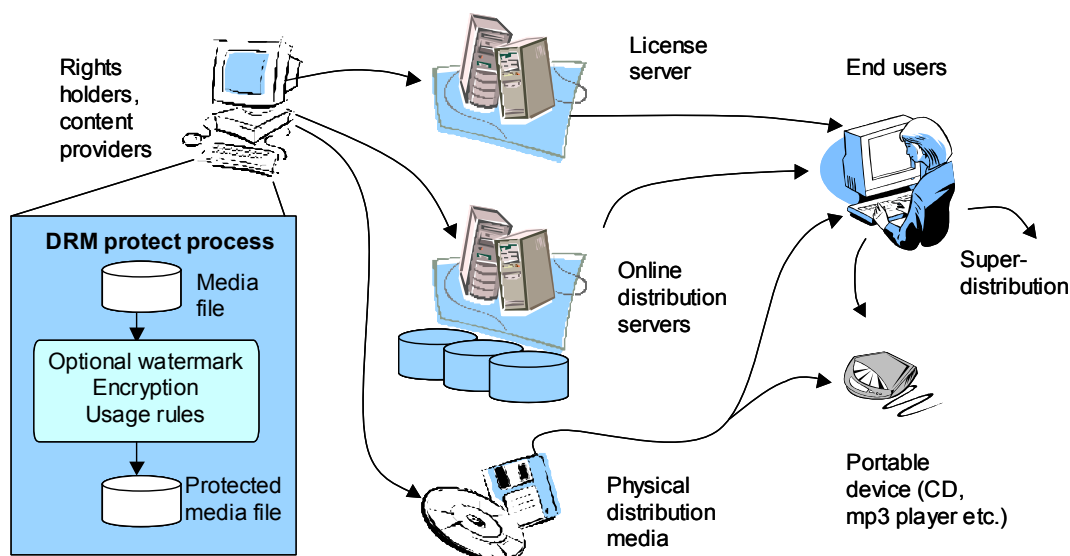


Figure 3-1. DRM process flow.

The DRM process starts with the content provider encoding the content into the format supported by the DRM software. The format depends on the software vendor, e.g. software from Microsoft only supports Windows Media files.

Next the content is encrypted and packaged using special usage rules or a license key that is saved on the license server or on the physical distribution medium such as a CD or a DVD. A typical usage rule can be a subscription model, a 24-hour rental, pay-per-view, or a license that is valid forever but the usage is limited to a single PC. The usage rules can allow the license to be moved from a PC to a single portable media such as a memory card of a mp3 player or a CD-R disc.

Audio *watermarking* technology embeds inaudible yet identifiable digital codes into an audio waveform. As with image watermarks used for currency validation, audio watermarks can verify details of the audio and video content in which they are embedded. Watermarks can carry and convey detailed information associated with the content for such purposes as monitoring and tracking its distribution and use. Watermarks can travel with the audio and video content and are resistant to attempts to remove them.

Superdistribution is a special usage rule that accelerates the distribution of content and lowers the marketing costs substantially. Figure 3-2 describes the superdistribution process.

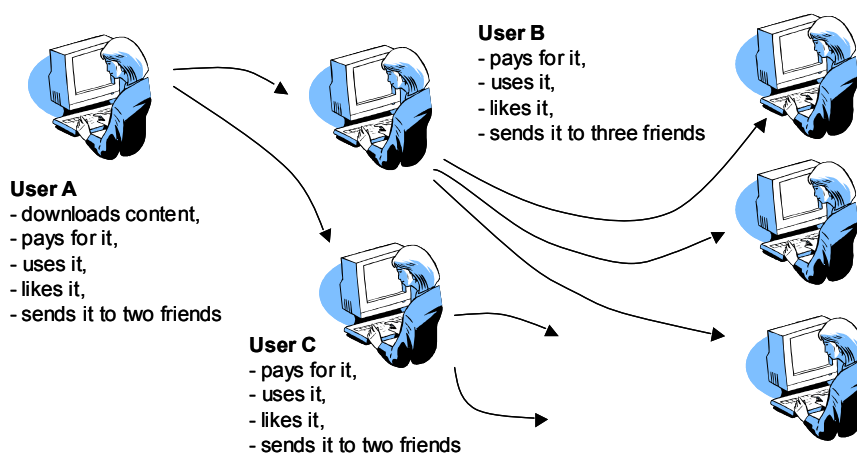


Figure 3-2. Superdistribution.

The protected content is transferred to the appropriate distribution server or saved on physical distribution media. In the case of audio and video the online distribution can be done using downloading or streaming.

At the other end of the process is an online customer who downloads the protected content or wants to receive the content stream. Before being able to play it on a PC, the customer needs a license key from the license server. The URL of the license server is included in the header of the protected media file. The license can be downloaded after the customer has paid for it using an e-commerce system.

In the case of music, the usage rules usually allow the transfer of songs to a portable music player. Special copyright technologies must be used in order to prevent illegal copying of the content from the memory card of the music player to another card. In most cases when the content is transferred from the PC to the portable device, the content license key is encrypted with the unique key of the player's (portable) memory card. The content can then only be played only from this unique card.

In this section we have described how the DRM process works in general. Software providers have different solutions, names and ways to specify the usage rules but the basic idea is the same overall.

4 DRM TECHNOLOGIES AND PROVIDERS

In this chapter, four different solutions for DRM are introduced: EMMS by IBM Corp., Rights|System by InterTrust Corp., Windows Media Rights Manager by Microsoft Corp., and RealSystem Media Commerce Suite by RealNetworks, Inc. It must be noted that although there are solutions available from other companies also, we have selected these four technologies because we consider them, at the time of writing, the most promising ones for the distribution of music and videos. Other companies delivering DRM solutions include Reciprocal, Xerox, Liquid Audio, Verance and Preview Systems.

4.1 EMMS by IBM Corp.

IBM's product for DRM is called the Electronic Media Management System (EMMS). It has an open architecture that allows for future advances and changes in the various media properties, such as encryption, compression, and watermarking.

The EMMS Content Mastering Program is used for protecting content. Currently only the AAC, ATRAC3, and MP3 audio formats are supported. On the server side, the EMMS Clearinghouse Program controls the licensing and logs all licensing transactions to facilitate royalty payments. The Web Commerce Enabler helps retailers and distributors showcase the material. The EMMS Content Hosting System takes care of online distribution and supports multiple servers with automatic content replication.

A limitation of EMMS is that it does not support streamable content. To download, play and manage content libraries, IBM's own EMMS player or EMMS software development kit (SDK) for business partners developing their own players can be used. The kit allows control over CD-R burning and SDMI (see section 6.1) compliant devices; these features are used in Sony's OpenMG Jukebox player. RealJukebox and MusicMatch players can play EMMS protected music, but do not allow CD-R burning or the transfer of music to SDMI compliant portable players.

EMMS was successfully tested already in 1998, in the first broadband music distribution trial conducted with the five leading record companies (BMG Entertainment, EMI Music, Sony, Universal Music Group, and Warner Music Group). Today, EMMS is supported by Sony's and Toshiba's audio players and by Sony Music Japan and music.co.jp Inc. content providers. NTT DoCoMo uses EMMS in its *M-stage music* mobile music service, the world's first mobile music service, launched in 2001¹.

4.2 Rights|System by InterTrust Technologies Corp.

The early market leader in content protection, at least from a visibility standpoint, was InterTrust. Founded in 1990, InterTrust spent its first eight years developing its DRM technology and establishing relationships within the industry. It succeeded in making a name for

¹ Downloading a song takes about eight minutes (when a 64 kbps PHS network is used) and the transmission cost is about 1 EUR (exchange rate 100 JPY = 0.9 EUR, October 18, 2001). The song itself costs 0.9-3.1 EUR. The monthly subscription charge for M-stage music is 2.7 EUR and you have to pay a monthly 18 EUR fee also for the mobile data (includes 9 EUR transmission charges).

itself and its DigiBox secure containers, and it has lined up an array of investors and partners in the process. Deployments of its e-commerce/DigiBox products began in 1999, though revenues were primarily from major stakeholders, including Mitsubishi, Reciprocal, Bertelsmann, NatWest and Computacenter. Some of the newer customers and partners include Nokia, Reuters and Universal Music Group. A DigiBox is a customizable cryptographic structure that supports files of any format, for example. text, HTML, EXE, MPEG etc.

InterTrust's encryption technology is general purpose and works with most media and content types, including music, publications, business information, video, games, software and images. The service secures the content and automates the e-commerce transaction that precipitates the delivery of the content to the consumer.

Earlier, InterTrust offered DigiBoxes and DRM as a service through its partners called MetaTrust Utility agents. There was no standard toolkit – publishers worked with MetaTrust agents to create secure packages. In 2001, InterTrust introduced toolkits that enable content owners to create the packages themselves. Using InterTrust's newest platform, Rights|System, the content owner first encrypts pieces of content using the Standard Packager or Streams Packager. Next, the usage rules are set and stored in secure files called RightsPacks. The encrypted content is stored on the retailer's distribution server and the RightsPacks are stored on the RightsServer. The RightsClient family consist of five products: RightsDesktop for PCs, RightsTV for set-top boxes, RightsPhone for mobile phones, RightsPD for portable music players and PDAs, and Rights|PDF plug-in.

InterTrust's DRM solution can not be used for streaming, which is a disadvantage considering the distribution of music and videos. For downloadable content, MusicMatch Jukebox is the most popular player that supports InterTrust's DRM system.

4.3 Windows Media Rights Manager by Microsoft Corp.

Microsoft's Windows Media Rights Manager (WMM) is Microsoft's end-to-end rights management platform. The first advantage compared to other DRM solutions is that there are more than 200 million DRM enabled media players for Windows and Mac already in the marketplace. The second advantage is that the WMM software is currently distributed freely, although you have to apply for a license and you have to renew the license annually. For hardware manufacturers and for non-PC portable playback Microsoft offers the Windows Media Embedded Product Adaptation Kit (WMEPAK).

On October 8, 2001 Microsoft announced Pocket PC 2002, a new version of its Windows CE operating system for handheld computers [3]. An interesting piece of news was the announcement of the new Windows Media Player which now supports both downloadable and streaming audio/video and Microsoft's DRM. This opens up new opportunities for distributing DRM protected content to mobile devices.

The DRM platform uses COM objects and therefore it can be integrated with e-commerce and distribution systems supporting also COM objects. Licenses can be distributed in "silent" mode, that is, at the same time when the user downloads the content. The consumer's PC does not have to access the URL on the license server if a valid license is found on the PC. This is very useful if the PC is not connected to the Internet all the time. A limitation of WMM is that it currently supports only Microsoft's proprietary WMA audio and WMV video formats.

Microsoft has earlier announced to develop its rights management system based on the eXtensible rights Markup Language (XrML, see chapter 5.5). The company uses it already for

eBook transactions and Microsoft Reader was the first product to incorporate XrML. The company has also announced that future releases of Windows Media Player and Windows Media Rights Manager will be XrML enhanced, but so far proprietary technology is being used to protect the content streamed between media servers and players.

WMRM is also the DRM technology used in the Pressplay music subscription service that was opened in December 2001 for users in the US.

4.4 RealSystem Media Commerce Suite by RealNetworks, Inc.

On June 20, 2001 RealNetworks announced the RealSystem Media Commerce Suite (RMCS), a platform for the secure licensing and delivery of digital media [4]. The company should start delivering it to customers in the beginning of 2002. It includes typical DRM software components: content protection software (product name RealSystem Packager), a license server (RealSystem License Server), an enhanced distribution server (plug-in for RealSystem Server 8.0) and an upgraded RealPlayer (Media Commerce Upgrade for RealPlayer). While RealSystem 8 can deliver 50 media types, the Media Commerce Suite only protects RealAudio and RealVideo in the initial release. The server components are available on Windows, Linux and Solaris. Pricing and licensing terms for the Media Commerce Suite has not yet been announced.

On the player side, RealPlayer, currently at version 8, is the most popular media player with over 200 million users worldwide. The RealPlayers installed on PCs worldwide are currently not DRM enabled, but the built-in auto-update function allows for an easy upgrade to DRM enabled playback. RealPlayer can only play the content, not transfer it to portable devices or burn to CD-Rs. RealJukebox, introduced in 1999, can perform these functions. In September 2001 RealNetworks introduced the RealOne player that combines the functions of RealPlayer and RealJukebox. The new player also has an integrated web browser that makes it an attractive choice for listening to and viewing online music and videos.

With regard to the mobile and wireless distribution of music, a mobile RealPlayer for EPOC was introduced in June 2001 [10] but it does not support streaming or DRM, and there is no player available for Pocket PC, yet.

RealNetworks is the driving force behind the XMCL initiative (see section 6.4). XMCL is not part of the Media Commerce Suite yet, but according to RealNetworks it will be as it moves closer to becoming a standard.

In December 2000, MusicNet – a company jointly owned by RealNetworks, Warner Music, BMG and EMI – opened its music subscription service for users in the US. The service is supposed to be launched later on in Europe also. RMCS is the underlying DRM component of the MusicNet platform.

In Table 4-1 we have compared some of the features of the four proprietary DRM technologies.

Table 4-1. Comparison of IBM, InterTrust, Microsoft and RealNetworks DRM features (as of January 2002).

DRM Technology	IBM EMMS	INTERTRUST RIGHTS SYSTEM	MICROSOFT WMRM	REALNETWORKS RMCS
Formats supported - Video - Music - Images - Documents - Software (games) - Streaming	No MP3, AAC, ATRAC3 No No No No	Any Any Any Any Yes No	WMV WMA No No No WMV, WMA	RA RV No No No RA, RV
Platform for content - protecting - license clearing - distribution - viewing/playing - PC - PDA	Windows Windows 2000 Windows 2000 Windows No	Windows Windows 2000, Solaris Windows 2000, Solaris Windows No	Windows Windows 2000 Windows 2000 Windows, Mac Pocket PC 2002	Windows Windows 2000 Windows 2000, Linux, Solaris Windows, Mac Q1/02 No
DRM-enabled audio/video players	MusicMatch, IBM EMMS player, Sony OMG, RealJukebox	MusicMatch, some MPEG4 players	Windows Media Player, MusicMatch, RealONE	RealONE
Supports - SDMI - XML - XMCL	Yes No Yes	Yes No Yes	Yes Yes No	Yes No Yes
DRM experience	4 years	11 years	2 years	0 years
References	bit.sonymusic.co.jp	www.midem.com	www.pressplay.com www.emma.fm	www.musicnet.com
Misc	Pioneer in fixed and mobile music distribution, no streaming support	No streaming support	Free, license has to be renewed yearly	Available Q1/2002

5 INITIATIVES, FORUMS, AND ASSOCIATIONS

In this section, we describe some of the initiatives, forums, and working groups developing standard solutions for DRM for audio and video content. This section can be considered as background information for DRM.

5.1 SDMI

Secure Digital Music Initiative (SDMI), founded in February 1999, is a forum of worldwide record industry, consumer electronics and information technology to discuss and develop specifications for DRM solutions. It was not founded to produce a single format or solution for the secure distribution of digital content, but as a forum for discussing and developing voluntary, open specifications for secure music and other secured online content. For example, the SDMI forum has specified the following criteria for secure online content:

- must be encrypted
- must be authorized for distribution by the content owner or usage rules
- must have rules embedded, associated or attached
- may be watermarked and traceable back to a unique distributor
- may be accompanied by a non-encrypted header

SDMI published a specification for portable devices [5] and in SDMI's roadmap screening technologies were divided in two phases in order to expedite the time to market of SDMI compliant components. Phase 1 compatible portable devices and PC software to transfer files to these devices began to enter the market at the end of 1999. Once Phase 1 compatible software was installed on a user's PC, it would be capable to auto-update to new Phase 2 technology, when available. In September 2000, SDMI initiated a public challenge that tested technologies proposed in Phase 2 screenings. A little later SDMI informed that some of the protection systems were successfully cracked in the challenge. SDMI continued to work on the selection of Phase 2 technologies, but in May 2001 it informed that there was no consensus found between the members for the adoption of any combination of the proposed technologies.

There were over 200 companies involved in the forum in 2000, but during 2001 there has been a significant decrease in the number of member companies and it is unclear how important SDMI will be in the future. There are terms of participation in the forum and a \$20,000 annual fee. The DRM technology providers presented in this white paper (IBM, Microsoft, InterTrust and Real Networks) are all members of the SDMI forum and support its specifications.

5.2 Associations for Secure Memory Cards

There are several types of memory cards available with different security features. Currently, there are five major technologies in the market: CompactFlash, SmartMedia, MultiMediaCard, MemoryStick, and SecureDigital.

Usually the usage rules allow the transfer of songs to the memory card of a portable music player. Special copyright technologies must be used in order to prevent illegal copying of the content from a memory card to another. When content is transferred from a PC with an SDMI compliant (see section 6.1) player such as RealJukebox, Windows Media Player or MusicMatch, the content license key is encrypted with the unique key of the media card. The content can only be played with that unique card. More sophisticated encryption schemes compared to a simple unique key have also been introduced.

SmartMedia and CompactFlash have established a large market share for themselves as early starters. SmartMedia was the first memory card with unique ID support. In May 2001 the CompactFlash Association (the consortium that controls the technology) announced the adoption of 4C Entity's Content Protection for Recordable Media (CPRM) encryption method [6]. The 4C entity consists of Intel, Toshiba, IBM and Matsushita and it has established standards for Content Protection for Prerecorded Media (CPPM) like the encryption used in DVD's. The new standard, called Secure CompactFlash, is entirely backward compatible and transparent to the user. A drawback for CompactFlash is that it is considered to be too large in size for mobile phones and portable music players.

Sony was first to market their solution called MagicGate. It is an enhancement to the MemoryStick format and makes no changes to the external design, save for the words "MagicGate" printed on the outside. However, each MagicGate MemoryStick has a unique ID and encrypted recognition technology to determine if the host device is MagicGate compliant.

MagicGate also relies on Sony's OpenMG copy protection software platform to prevent unlicensed file duplication. OpenMG is free to developers, but MagicGate technology is not. In November 1999, Sony announced that its future audio products, featuring the OpenMG and MagicGate copyright management technologies play music content secured with IBM EMMS [7].

As with SmartMedia, MultiMediaCard has a rudimentary ID function, but no advanced security features, which is a setback at a time when security is becoming paramount. Therefore SanDisk, the company behind it, teamed up with Matsushita and Toshiba and created the SecureDigital card. SD is compliant with both SDMI and CPRM and is license-free. The complete specification is available to any developer who pays entrance fee to join the SD Card Association. The CPRM format creates encryption using a series of keys spread over three categories: device, media, and content. Device keys are issued by the 4C Entity to a specific manufacturer for inclusion in each of the vendor's devices, which is a similar technique to the MagicGate approach.

5.3 MPEG

In April 2001 activities by the ISO MPEG (Moving Picture Experts Group) addressed a markup-based machine-readable rights expression language to govern intellectual property and digital rights. MPEG has produced three important standards (MPEG-1, MPEG-2 and MPEG-4) and is working on MPEG-7 and MPEG-21. Extension work is ongoing on the Intellectual Property Management and Protection (IPMP) specification for MPEG-4, with the goal to enhance interoperability in the consumption of protected content. The content description standard MPEG-7 is to be completed by the end of 2001. The multimedia framework MPEG-21 standard is in the initial development phase. MPEG has identified the need for a rights expression language and a rights data dictionary in the context of three of its standards:

- MPEG-4, for the IPMP extension
- MPEG-7, to describe, as a part of content descriptions, the conditions to access content, and
- MPEG-21, to achieve the goal of expressing rights for all creators, producers, distributors, and rights holders of MPEG-21's so-called digital items.

5.4 eXtensive Media Commerce Language (XMCL) initiative

eXtensible Media Commerce Language (XMCL) is an open XML-based language designed to establish industry-wide standards for Internet media commerce. XMCL aims to establish interoperability between proprietary DRM systems by standardizing the rules for how content can be played in a way that is independent of codecs, digital DRM systems, and e-commerce systems.

The XMCL Initiative was announced in June 2001 and it is supported by 27 companies including RealNetworks, America Online, InterTrust, IBM, EMI, and Napster [8]. MusicNet will also take steps to enable XMCL in their future server platform.

The example in Table 5-1 describes an XMCL document of a 24-hour rental license for the movie "First Blood" [9]. The rental period begins when the movie is first viewed and must occur within a week of purchase. For this example, the XMCL document always follows a template with information regarding only the specific customer and date/time information modified.

Table 5-1. An example of an XMCL document.

```

<xmcl>
  <license>
    <contentInfo>
      <contentId type="GUID">
        13AC7DE5-8028-42fe-95CE-0DC2221891C7
      </contentID>
      <ds:KeyInfo>
        xmlns:ds="http://www.w3.org/2000/09/xmldsig#">
          <ds:KeyName>ContentKey</ds:KeyName>
          <ds:KeyValue>
            <key algorithm="urn:nist-gov:tripledes-edc-cbc">
              3812A419C63BE771 AD9F61FEFA20CE63 3812A419C63BE771
            </key>
            <ds:KeyValue>
          </ds:KeyValue>
        </ds:KeyInfo>
        <rdf:RDF xmlns:rdf=
          "http://www.w3.org/1999/02/22-rdf-syntax-ns#"
          xmlns:dc="http://purl.org/dc/elements/1.1/">
          <rdf:Description>
            <dc:title>First Blood</dc:title>
            <dc:subject>
              movie, action, adventure
            </dc:subject>
          </rdf:Description>
        </rdf:RDF>
      </contentInfo>
      <validPeriod start="2001614T184300" end="2001621T184300"/>
      <usageRights>
        <useDuration length="24h" begin="firstUse"/>
      </usageRights>
    </license>
  </body>
</xmcl>

```

This XMCL document contains a single <license> element. The <contentID> element on line 4 defines the unique identifier for the content. The type attribute specifies that the id used is a GUID. The <ds:KeyInfo> element on line 7 specifies the symmetric key for decryption of the content. The <rdf:Description> section describes meta information that further defines the content. The <validPeriod> element describes that the license is valid from June 14, 2001 at 18:43 to June 21, 2001 at 18:43. The useDuration element states that the content is licensed for 24 hours from the first use.

5.5 eXtensive rights Markup Language (XrML)

XrML (eXtensible rights Markup Language) is an XML based language that assigns usage rights terms and conditions to content. ContentGuard, Inc., a Xerox spin-off company formed in April 2000 by Xerox and Microsoft, licenses the XrML specifications to the industry royalty-free in order to drive the adoption of electronic content and DRM standards by ensuring interoperability of digital rights management solutions.

XrML is intended to support the commerce of digital content, such as the publishing and selling of e-books, movies, music, games, and computer software. In addition, XrML is intended to support the specification of access and usage control for secure digital objects and services. Some of the companies supporting XrML include Adobe, HP, Xerox, and Microsoft.

6 SUMMARY

In this white paper we have described how the DRM process works and explained the basic principles behind it. There are four distinctive stages involved: content protection, distribution, license clearing, and viewing. The content protection phase consists of optional watermarking, encryption, and setting up the usage rules. We focused only on audio and video content since they are likely to become the first big commercial DRM application. We also discussed the standardization work, initiatives, forums, and associations related to DRM.

We introduced four DRM platforms that can be used for protecting audio and/or video content: IBM EMMS, InterTrust Rights|System, Microsoft WMRM, and RealNetworks RMCS. In conclusion, we summarize some points that differentiate these four technology providers and their DRM solutions.

Although we have not compared costs, probably the cheapest way to start distributing DRM protected music is to use Microsoft WMRM: the license server software is currently free as well as the Windows Media Server needed for streaming. The Windows Media format is widely used on the Internet, and most of the current online music shops use it as their choice for DRM. An advantage is also that DRM support is already integrated in the Windows Media Player that many users have. Furthermore, the announcement in October 2001 of a DRM enabled Windows Media Player for Pocket PC 2002 also makes it an attractive candidate considering mobile music distribution. WMRM currently supports only its own proprietary Windows audio and video formats.

InterTrust's Rights|System can be used for the distribution of any downloadable audio/video formats. However, the lack of streaming support is a drawback and we did not find but few references on distributing music or videos on this platform. As for mobile content distribution, Nokia has licensed Rights|System and acquired a 5% ownership of the company.

IBM EMMS has been used for four years as a DRM solution for music distribution and can be considered as the pioneer technology in distributing downloadable DRM enabled music. EMSS currently supports the MP3, AAC, and ATRAC3 audio formats, but no video formats. The lack of streaming support is also a disadvantage. IBM has strong ties with Sony in Japan that can have an effect considering future Sony-Ericsson mobile phones and mobile content distribution. Furthermore, IBM EMMS is already used in the world's first mobile music distribution service, DoCoMo's M-stage music service in Japan.

RealNetworks is the newest player in the DRM field and the first service based on RMCS was just opened in the US. The company has strong ties with the music industry via their streaming technology and the MusicNet service. There are many RealPlayer and RealJukebox users and the company has just introduced their successor: the RealONE player (beta version) which can be regarded not just as a typical player but also a web browser. With regard to the mobile and wireless distribution of music, Real is working together with Nokia, but although a mobile RealPlayer for EPOC was introduced in June 2001 [10] there is no support for streaming or DRM. Neither is there a player available for Pocket PC, yet.

In conclusion, DRM technology for audio/video content is currently in an early development stage. Considering distribution to PCs via streaming or downloading and transferring the content from PCs to portable players, there are already now a variety of choices available. For direct wireless distribution to mobile devices, the technology is still immature and only within the next couple of years can we expect to find good solutions for that.

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ADDITIONAL RESOURCES

DRM technologies:

IBM	www.ibm.com
- IBM EMMS	www.ibm.com/software/emms
GontentGuard	www.contentguard.com
Intertrust	www.intertrust.com
- InterTrust RightsSystem	www.intertrust.com/main/products/rightssystem.html
Liquid Audio	www.liquidaudio.com
Microsoft	www.microsoft.com
- Microsoft WMRM	www.microsoft.com/windows/windowsmedia/en/wm7/drm.asp
Preview Systems	www.previewsystems.com
RealNetworks	www.realnetworks.com
- RealSystem Media Comm. Suite	www.realnetworks.com/products/commerce/index.html
Reciprocal	www.resiprocal.com

Vedalabs	www.vedalabs.com
Verance	www.verance.com
MusicMatch	www.musicmatch.com

Initiatives, forums, associations:

4C Entity	www.4centity.com
Compact Flash Association	www.compactflash.org
MPEG	mpeg.telecomitalia.com
SD Card Association	www.sdcard.org
SDMI	www.sdmi.org
XMCL	www.xmcl.org
XML Cover Pages - DRM	xml.coverpages.org/drm.html
XRML	www.xrml.org

Music industry:

BMG	www.bmg.com
EmmaFM	www.emma.fm
EMI	www.emigroup.com
MusicNet	www.musicnet.com
Napster	www.napster.com
Pressplay	www.pressplay.com
Sony Music	www.sonymusic.com
UMG	www.umusic.com
Warner Music Group	www.wmg.com

DEFINITIONS, ACRONYMS AND ABBREVIATIONS

AAC	Advanced Audio Coding, standard MPEG-2 and MPEG-4 specification.
ATRAC3	Adaptive Transform Acoustic Coding 3, an enhanced version of ATRAC audio format for MiniDisk players developed by Sony
CDR	Compact Disc Recordable
COM	Component Object Model
DRM	Digital Rights Management
DSL	Digital Subscriber Line
DVD	Digital Versatile Disc
EMMS	Electronic Media Management System
GIF	Graphic Interchange Format, compressed file format for images
JPEG	Joint Photographic Experts Group, compressed file format for images
MPEG	Moving Picture Experts Group, a set of audio/video standards

MP3	MPEG-1 layer-3 audio, a popular "CD-quality" Internet audio format
NAPSTER	P2P pioneer service for distributing files over Internet
P2P	Peer-to-Peer, in digital distribution a service in which clients distribute files among themselves, not from a central server
RA, RV, RM	RealAudio, Video, Media; proprietary RealNetworks file formats
SDK	Software Development Kit
SDMI	Secure Digital Music Initiative
SMS	Short Message Service, a text message service for GSM mobile networks
URL	Universal Resource Locator
WMA, WMV	Windows Media Audio, Video; proprietary Microsoft file formats
XML	eXtensible Markup Language
XMCL	eXtensible Media Commerce Language
XrML	eXtensible rights Markup Language