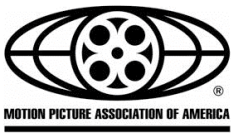
DIGITAL WATERMARK TECHNOLOGIES
Applications in P2P Networks

P2P Digital Watermark Working Group



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INTRODUCTION

This informational paper is intended to provide a high-level overview of how digital watermarks can be used in peer-to-peer (P2P) networks to enable new legitimate channels for content distribution, provide infrastructure capabilities that enable enhanced consumer experiences, and support content management activities. For this potential to be realized, all constituents in the content creation, distribution, and usage chain must be willing to agree to and implement certain obligations. Content packaging specifications would have to be defined in a collaborative process. Digital watermark technology vendors would have to upgrade their technologies to carry and detect this specified packaged content if they are not already capable of doing so. Content rightsholders would need to mark content with standardized payloads (i.e., the data carried by the digital watermark). P2P clients would have to securely include the mechanisms to detect and respond to standardized payloads. The bulk of this paper is a description of how the embedding of, detection of, and response to digital watermarks can work to enable monitoring (e.g., usage ratings), triggers (e.g., usage authorizations, enhanced consumer experiences), and other content management activities.

PDWG MISSION

The mission of the P2P Digital Watermark Working Group (PDWG) is to work jointly and cooperatively with leading content and technology companies to describe appropriate and voluntary best practices for the use of digital watermarking to 1) establish such practices for the deployment of watermarking technology implementations as a step to facilitate the legitimate consumption of licensed content through the P2P distribution channel; 2) provide P2P systems with the ability to effectively identify infringing copyrighted content; and 3) ensure that the watermark methods and solutions favored by content rightsholders and watermark technology providers can be scaled effectively by P2P network operators.

ABOUT THE AUTHORS

Participants include DCIA Member organizations and the DCIA; digital watermarking technology and solution providers and the Digital Watermarking Alliance (DWA); and copyright owners, including representatives from motion picture studios and the Motion Picture Association of America (MPAA).

DIGITAL WATERMARKING OVERVIEW

BACKGROUND

Digital watermarks are digital data elements that are embedded into actual content—not carried in the header—so the elements survive analog conversion and standard processing, such as conversion to MP3s or changes in file/media formats. Digital watermarks may be embedded into, and read from, video, audio and still images to enhance the user experience, facilitate business rules, and enrich the media ecosystem as a whole by allowing all content to be self-identifying or carry information that may trigger a defined behavior. Digital watermarking differs from pattern matching (fingerprinting) in that it is not based on statistical matches against databases of known content. Rather, digital watermarks are the equivalent of placing information within the content itself, enabling detection in stand-alone or connected applications throughout the distribution channel and at play-out. In its most common form, the digital watermark data is not perceptible to the human ear or eye, but can be read by computers. One metric for determining whether a digital watermark is acceptably robust is that, when it is embedded at an imperceptible level, it cannot be stripped out without noticeably degrading the host content.

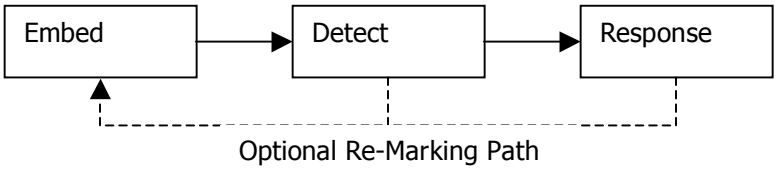
The digital data carried by a watermark can consist of any information deemed relevant for a specific application or usage model, but typically falls into two categories: 1) triggers that indicate some action should be taken (e.g., copy control information (CCI), 'flags' or trigger bits); and 2) identifiers that provide information, usually about the content, the distribution service, and/or the player/client (e.g., media serial numbers, service identifier, player or client identifier). Standards for both the structure and the semantics for conveying both categories of information must be agreed upon for a useful P2P watermark detection ecosystem and business regime to develop. Some of this work has already been tackled by other bodies and could be used as a starting point here (e.g., CCI within ATSC and CEA, Media IDs within ISAN).

Digital watermarks are in extensive use around the world, with billions of digitally watermarked objects and hundreds of millions of detectors in use for broadcast monitoring, copy protection, copyright notification, and forensic tracking applications. Major record labels and movie studios currently use digital watermarks to track content in production and prior to release to the public. This effort has led to a significant reduction in illegitimate use of pre-release music and movies, and has resulted in arrests by the FBI of individuals trafficking in screener copies of movies.

In addition, a number of digital watermarking providers are helping major content rightsholders in the media and entertainment industry today to mark currently distributed movies and music with media serial numbers. As will be discussed later, this effort is establishing an ecosystem of content that could be leveraged to facilitate the creation of legitimate, new P2P content distribution offerings. Other examples of the use of digital watermarks can be found in the Appendix.

WORKFLOW

At the highest level, the digital watermarking workflow consists of three activities that all build on each other and the contextual information provided at each stage to enable increasingly rich and interactive applications.



Embed: At one or more locations in the distribution channel, a digital watermark may be embedded to trigger an action or identify the content, distribution service, and/or player/client at varying levels of granularity. Identifiers can range from, for example, the general title of a work and/or service provider name to the specific, uniquely identifiable copy, service endpoint, or player/client. The mark can be embedded in the source during content creation and preparation, at any point in the distribution chain, and/or in the player/client following some activity, such as completion of an authorizing transaction or further reproduction or distribution of the content.

Detect: The counterpoint to Embed is the Detect step, which forms the foundation for subsequent actions. The watermark may be detected at one or more locations in the content creation and distribution workflow including in conjunction with other operations (caching, routing, etc.).

Response: Once detected, a wide variety of responses are enabled based on the data carried in the watermark, or referenced in response to the presence of the watermark. These are the identification and trigger responses discussed earlier.

Note that the P2P client (application) can incorporate other applications or plug-ins in addition to watermark detection and response application, such as data hash evaluators, acoustic fingerprint analyzers, and metadata readers. When used in conjunction with watermark detection and response, they empower a more robust detection and response environment.

The following Usage Cases are examples of the benefits that watermark embedding, detection, and response can deliver to the artist/rightsholder, distributor, service provider, end-user, and media ecosystem as a whole.

USAGE CASES

1. Respond by substituting one watermarked file for a different version of the file or related information
2. Respond by enabling a transaction, authorizing the use of, or otherwise monetizing the particular use of a watermarked file (through advertising, subscription, paid download, or other means)
3. Enhance consumer experience by enabling access to related materials
4. Respond by allowing or blocking retransmission of a file with a particular watermark
5. Enhance P2P infrastructure by reporting measurements to measurement services

USAGE CASE 1 – RESPOND BY SUBSTITUTING ONE WATERMARKED FILE FOR A DIFFERENT VERSION OF THE FILE OR RELATED INFORMATION

The P2P system (all elements making up a P2P network, including the peers, trackers, and other components) recognizes that the content being searched for as represented by a given file is permitted to be redistributed via this particular P2P application to or from this specific user, but that this particular file is not authorized, and therefore substitutes an authorized version of this content file to be downloaded, opened, or uploaded for redistribution by the user, as the case may be. An example of this implementation is a situation in which the watermark identifies the file, the system checks with a registry or determines via some other analysis that the particular instance of the content in the P2P system is problematic (e.g., the elements have somehow become corrupted), and the system redirects the download to another instance of the content.

USAGE CASE 2 – RESPOND BY ENABLING A TRANSACTION, AUTHORIZING THE USE OF, OR OTHERWISE MONETIZING THE PARTICULAR USE OF A WATERMARKED FILE (THROUGH ADVERTISING, SUBSCRIPTION, PAID DOWNLOAD, OR OTHER MEANS)

The P2P system recognizes through detection of the digital watermark that the content being searched for as represented by a given file is permitted to be redistributed via this particular P2P application to or from this specific user following a transaction in accordance with the agreement between the consumer and artist/rights holder. For example, the user agrees to either not interfere with ads delivered with the content if the content is played back at no charge, or pay a fee to receive and view the content without ads (e.g., paid download or subscription). Two specific examples are:

User downloads a video content file of a copyrighted work that has been watermarked (and may contain other identifiers) indicating that the file is for authorized P2P redistribution pursuant to requiring that a pre-roll ad be viewed and at least one interactive choice must be made by the user related to such commercial message (e.g., choosing the color of a car for an animated test drive).

User downloads a video content file of a copyrighted work that has been watermarked (and may contain other identifiers) indicating that the file is for P2P redistribution pursuant to agreeing to make a payment for viewing, which the user may charge to a credit card or PayPal account. The P2P application would then initiate a transaction to enable the download in accordance with these terms.

USAGE CASE 3 - ENHANCE CONSUMER EXPERIENCE BY ENABLING ACCESS TO RELATED MATERIALS

The P2P system recognizes that the content being searched for as represented by a given file is permitted to access related material and features such as:

1. Interactivity with an online site containing bonus material, games, and other benefits (e.g., online credits, discount coupons);
2. Downloadable bonus content, software, and other benefits;
3. Access to on-screen prompts and interactivity, such as hot spots that provide information about the content; and/or
4. Connection to a related online community or store.

In this scenario, the content rightsholder creates an enhanced experience that motivates the consumer to seek out the legitimate files being distributed via the legitimate infrastructure.

USAGE CASE 4 – RESPOND BY ALLOWING OR BLOCKING RETRANSMISSION OF A FILE WITH A PARTICULAR WATERMARK

The P2P system recognizes through detection of the digital watermark that a given file is authorized to be redistributed via this particular P2P application to or from this specific user, and therefore allows or prevents the file from being downloaded, opened, or uploaded for redistribution by the user. In the case where the digital watermark is used to signal authorization, the detecting application or element enables the processing of that file in accordance with the terms of the authorization. When the watermark is used to signal that a particular use is not authorized, the detecting application or element would limit further downloading, uploading, or playback accordingly. A P2P application might treat unmarked files differently depending on best practices for the given model. For example, in a security-focused environment, a watermark might serve as an indication of a trusted source, and an application might allow uploading of only those files that are securely marked. This case directly facilitates the development of a legitimate P2P content distribution and e-commerce environment by providing greater certainty for consumers with respect to the source and integrity of the content acquired through legitimate P2P services and by giving the artist/rightsholder comfort that the terms under which they are distributing the content will be respected.

Examples

- When a user attempts to download a video content file of a copyrighted work that has been watermarked (and may contain other identifiers), the P2P system detects and responds appropriately to data that indicates whether or not the file is for use in a P2P environment.
- When a user downloads a video content file of a copyrighted work that has been watermarked (and may contain other identifiers), the P2P system detects and responds appropriately to data that indicates whether or not the file has been authorized for this user to view by either playing/storing or not playing/storing the file.
- Similar to the first example, when a user places in a shared folder a video content file of a copyrighted work that has been watermarked (and may contain other identifiers), the P2P system detects and responds appropriately to data that indicates whether or not the file is authorized for use in a P2P environment, and determines whether to allow uploading or playback of the file.

USAGE CASE 5 – ENHANCE P2P INFRASTRUCTURE BY REPORTING MEASUREMENTS TO MEASUREMENT SERVICES

Once a digital watermark is detected, the P2P system gathers and sends anonymous data about the file and its use to a data aggregation and processing system in accordance with user agreements and appropriate privacy safeguards. The monitoring information can then be used to more accurately determine usage patterns and related information in a more precise manner than the statistical methods used in traditional broadcasting. Potential uses of this anonymous monitoring information include as a resource for determining ad rates and artists'/rightsholders' compensation and/or identifying emerging popular trends in content-type and on-line activity. (See Appendix for additional information).

CONCLUSION

This informational paper has articulated a high-level overview of how digital watermarks can be used in P2P networks to enable new legitimate channels for content distribution, provide infrastructure capabilities that enable enhanced consumer experiences, and support content management activities. The Usage Cases illustrate how consumers, artists/rightsholders, P2P system operators, and other players in this ecosystem can benefit from the adoption of watermark technology. The collection of Usage Cases is by no means complete. Readers of this report are encouraged to submit additional Usage Cases to the DCIA.

For this potential to be realized, all constituents in the content creation, distribution, and usage chain must be willing to agree to and implement certain obligations. Content packaging specifications would have to be defined in a collaborative process. Digital watermark technology vendors would have to upgrade their technologies to carry and detect this specified packaged content if they are not already capable of doing so. Content rightsholders would need to mark content with standardized payloads (i.e., the data carried by the watermark). P2P clients would have to securely include the mechanisms to detect and respond to standardized payloads.

This white paper outlines how digital watermarks can be effectively used in P2P networks to provide benefits to all constituents: users, P2P network operators, content service providers and content rightsholders. There are several technological approaches (such as content fingerprinting) that provide complementary alternatives to watermarks to support the identified Usage Cases. It is the intent of the DCIA to investigate all such categories of technologies and enable P2P infrastructures that support all viable technology approaches that can enhance the P2P ecosystem.

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APPENDIX

Monitoring makes use of digital watermarks to facilitate higher-level business processes at a business-to-business level. When projecting how embedded marks could be used in the P2P environment for monitoring and measurement purposes, it is useful to discuss how they are used today in other situations.

Broadcast monitoring enables content rightsholders and distributors to track the dissemination of content. Broadcast content can be embedded with a unique, persistent identifier (e.g., a payload indicating distributor, date and time information). Detectors are placed in major markets, where the broadcasts are received and processed. The digital watermark is decoded and used to reference complementary metadata in a database, resulting in reports sent to the appropriate parties. Broadcast verification reports can include the specific media outlet, the market, the detection time, the program within which the content aired, and whether it played in its entirety (for audio and video). Millions of broadcast advertisements, promotions, programs, sporting events, news events, etc. currently carry some form of digital watermark.

An example of broadcast monitoring involves using digital watermarks embedded in news stories, ads, and promotions. A detector infrastructure, monitoring radio and TV stations, reports which news stories, ads, and promotions are used, and when, where, and for how long they are aired. The report is accessible to the client within minutes to hours of the broadcast.

The same watermark embedded in broadcast content could be detected online, used to uniquely identify the material, and then enable the Usage Cases discussed in this document.

Similarly, still images can be digitally watermarked and enabled. An example of Internet monitoring of still images involves embedding a content ID in a digital photograph presented on the owner's website. When inappropriate use of the photograph is detected a report can be sent to the content owner. This can lead to the photograph being removed, or, more beneficially, properly licensed. Both of these actions potentially provide more choices to consumers, and increase revenues for distribution services, technology providers and rightsholders.