Digital Watermarking and Its Impact on Intellectual Property Limitation for the Digital Age

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EXECUTIVE SUMMARY

Digital media like audio, video, images and other multimedia documents can be protected against copyright infringements with invisible, integrated patterns. Such methods are based on steganography and digital watermarking techniques. Most watermarks are inserted as a plain-bit or adjusted digital signal using a key-based embedding algorithm. The embedded information is hidden (in low-value bits or least-significant bits of picture pixels, frequency or other value domains) and linked inseparably with the source data structure. For the optimal watermarking application, a trade-off between competing criteria like robustness, non-perceptibility, non-detectability and security have to be made. Most watermarking algorithms are not resistant against all attacks, and even friendly attacks like file and data modifications can destroy the watermark very easily. This paper gives an overview about the basic ideas of watermarking, application for e-business, problems and limitations.

Keywords: attack; digital rights management; digital watermark; multimedia; steganography

COMMERCIAL RELEVANCE OF PROTECTION SYSTEMS FOR DIGITAL MEDIA TYPES

The digital representation of multimedia documents has become very popular in the last decade. This is particularly due to the economical integration of technologies developed in the context of the Internet and the capabilities of efficient transmission, storage and almost loss-free copying of digital media. Computer games, software, video, audio and other digital products represent an economically significant and expanding market. E-commerce giants like Amazon or eBay demonstrate the significance of the Internet for advanced business activities and making profits. Besides the increasing popularity and acceptance of Internet distribution channels like online shops and auctions, streaming video and
audio stores will promote the Internet to become the most relevant invention ever. Since more people are using broadband access methods like DSL, satellite and T1, the demand for various streaming media products have increased. Streaming media services are set up by most broadband Internet providers. Internet Giants like Yahoo, Apple and Microsoft are enabling the digital distribution of entertainment products like audio and video, steadily establishing new Internet services and offering DVD-video for one to five Euros. In addition, Apple has been successfully selling audio tracks via the Internet since 2003, and other companies are going to establish similar business model soon. But, as audio, video and any other digital media can easily be copied and redistributed over networks, a lot of business models (see above) and devices like DVD-recorders were detained on purpose (Cox, Miller, & Bloom, 2002). Particularly, the music and entertainment industry struggles against the illegal distribution over networks, especially peer-to-peer, in recent years. In 2002, the International Intellectual Property Alliance (IIPA) estimated the annual worldwide trade loss due to copyright piracy as up to $10.2 billion, excluding Europe and the United States (U.S.) (IIPA, 2004). In 2003, the IIPA (special 301 report) estimated $20-22 billion in annual losses to the copyright industry. As the copyright industry generates the highest foreign sales for the U.S. economy, the annual loss in 2002 can be estimated up to 15% worldwide, by $88 billion in foreign sales (Siwek, 2002).

As digital media can be straightforwardly copied and illegally redistributed over various channels, risk and capital loss will prevent further activities and investments online until a juristic and technical protection mechanism becomes available. These concerns are supported by the facts that digital mass recording devices like MD, CD and MP3 recorders, digital photo devices and camcorders have impressively entered the market (Anderson & Petitcolas, 1999; Cox, Miller, & Bloom, 2000; Hanjalic et al., 2000; Hartung & Kutter, 1999; Mintzer, Braudaway & Yeung, 1997; Petitcolas, Anderson, & Kuhn, 1999; Swanson, Kobayashi, & Tewfik, 1998; Wu & Liu, 2002). The importance and the supposed economical threat for copyright holders can be clarified by initiatives of the entertainment industry, like the Visual Identity Verification Auditor (VIVA), a project of the European Communities (VIVA, 2003; European Communities, 2003), and Secure Digital Music Initiative (SDMI) (SDMI, 2003). Distributors like Time Warner, Disney, Lucas Film and various professional companies like T-Systems, SCO, Yahoo and other Internet service providers have already recognized the advantages of upcoming digital areas and are establishing on-demand services. Additionally, major technical steps have been made by designing consistent distribution methods as well as developing equipment like HDTV cinema projectors, digital radio and television (e.g., Rogers, 2000).

Consolidated, we like to refer that the features of the digital world lead to economical chances like cheap distribution but also to serious risks in simplifying unauthorized copying and distribution (Rosenblatt, Trippe, & Mooney, 2002).

MEDIA PROTECTION AND CONTROL MECHANISMS

In order to provide protected material from illegal duplication, two typical technologies are being developed. One approach uses key-based cryptographic methods and procedures to control the process of copy-
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