

# Chapter IV

## Masking Models and Watermarking: A Discussion on Methods and Effectiveness

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### ABSTRACT

*Many audio watermarking techniques presented in the last years make use of masking and psychological models derived from signal processing. Such a basic idea is winning because it guarantees a high level of robustness and bandwidth of the watermark as well as fidelity of the watermarked signal. This chapter first describes the relationship between digital right management, intellectual property, and use of watermarking techniques. Then, the crossing use of watermarking and masking models is detailed, providing schemes, examples, and references. Finally, the authors present two strategies that make use of a masking model, applied to a classic watermarking technique. The joint use of classic frameworks and masking models seems to be one of the trends for the future of research in watermarking. Several tests on the proposed strategies with the state of the art are also offered to give an idea of how to assess the effectiveness of a watermarking technique.*

### INTRODUCTION

Ownership is one's right to possess something and decide what is to be done with it. The concept of

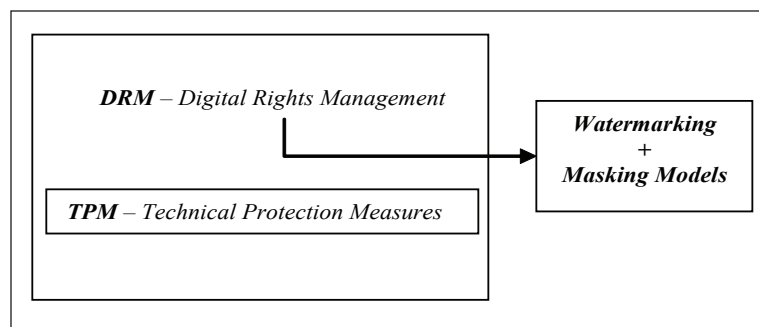
ownership is distinct from possession, intended as having something in one's custody. Such demarcation, very easy to understand and prove in case of a material good (e.g., as a house or a car),

becomes particularly ephemeral in case of digital data. First of all, the diffusion and movement of digital content cannot be practically traced: as an example a collection of songs can be published on a Web site, a CD, or a DVD, and once it is legally distributed for the first time, there is no way to control its following circulation. Then, there are many ways to reproduce digital content and obtain copies identical to the original. Starting from a copy, a malicious person can alter or manipulate the original content and present himself/herself as the owner. This can result in great damage for the rights' genuine owner since an image or a song in a digital format are esteemed on the whole respect to their origin, which is a proof of quality, source, and content integrity. From this introduction it seems, and it is definitely true, that the encountering problems in ownership for digital content is the digital nature itself of the content: an image, printed on photopaper, can be copied with more difficulty without the original matrix (e.g., the negative, in case of a photo; or the master registration in case of an audio sample) and, in every case, the copy can be easily distinguished from the original. Furthermore, a photopaper image could not be present on millions of instances at the same time as happens to an image published on the Web. For all these reasons, different ap-

proaches have been developed for proving an origin's copyright information of digital content. On the whole, digital rights management (DRM) is any of these technologies when used to control access to digital data. DRM is not a technical protection measure (TPM). Actually, such technology controls or restricts the use and access of digital media content on electronic devices with such technologies installed, acting as components of a *DRM* design (See Figure 1). The objective of this chapter is to provide a comprehensive explanation of the crossing use of masking threshold and *watermarking* as one of the most effective *DRM* strategies.

This chapter is organized as follows. The first section provides an overview of *DRM*, discusses the distinction between cryptography and *watermarking* (explaining the relevant applicative fields in a *DRM* context of both solutions), describes *watermarking* in general, and introduces the *masking models*. The second part is a description of the crossing use of the *masking models* and *watermarking*. The third presents two works from the authors of audio *watermarking* schemes based on the use of the psychological masking threshold. Finally, some conclusions on the trade-off robustness/fidelity, and more generally on the use of *masking models* in watermark schemes, are drawn.

*Figure 1. DRM and TPM*



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