Chapter XVIII
Scalable Distribution of Watermarked Media

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ABSTRACT

Media that is distributed digitally can be copied and redistributed illegally. Embedding an individual watermark in the media object for each customer will make it possible to trace pirate copies to the redistribution source. However, digital distribution methods such as broadcast and multicast are scalable and will give all customers identical copies of the media content. Distribution of individually watermarked media is more difficult to achieve. In this chapter, methods for how media with individual watermarks can be distributed scalable are presented and discussed. These methods are categorized in four groups. One group that is based on watermark embedding in the network, another group for embedding in the client, and two groups that use fragments of the media content that are unique for each customer or shared among a subgroup of customers.

INTRODUCTION

Distribution of digital media can be done in many different ways. TV can for example be distributed through internet, cable, satellite and terrestrial transmission. The media can be transmitted using unicast, multicast or broadcast. Terrestrial and satellite distribution of TV are broadcast where all receivers are reached by the media stream (even thou they may not be able to see it if the media is encrypted**).** Unicast are used for pay-per-view and similar services over cable and internet. Finally multicast can be used for scalable distribution over networks.

A distributor has one or many customers to which the media is transmitted. In the middle of the distribution chain we have some kind of network consisting of nodes. The number of nodes can be very different between different methods of distribution. Satellite distribution will probably only have one level of nodes (the satellites), terrestrial distribution maybe at most three (relayed

signal over two extra transponders) while for large network, the media may pass through many routers before it reaches the customer.

If one of the customers retransmits the media illegally he is a pirate. One way to trace the source of such pirate copies is to use watermarks. Watermarks are embedded in the media content and every customer will get an individual watermark in the media that is distributed to him. If then a pirate copy is found by the distributor he can extract the individual watermark from the media and use it to identify the pirate. The distributor can then decide to take legal actions against the pirate or just stop the distribution to that customer. If it is known that the media contains individual watermarks it will deter customers from becoming pirates.

Pirates may try to remove the watermark by using different attacks that alter the media slightly. If two or more pirates collaborate they can try to blend their individual copies and in that way corrupt the watermarks. A good watermarking algorithm should be robust against such attacks.

Scalable distribution like multicast and broadcast are desired since they require less bandwidth. For broadcast the distributor will only transmit the media one time and all customers will get identical copies of the media. But if the distributor wants the media to contain individual watermarks, the received copies by the customers will no longer be identical. Can individually watermarked media be transmitted by broadcast? Is that not a contradiction?

How individual watermarks and scalable distribution can be combined is the topic of this chapter. Different methods will be described and discussed. These individual watermark distribution methods are categorized as being Network Based Watermarking, Unique Fragments Distribution, Shared Fragments Distribution or Client Based Watermarking. For some of these methods there exists another type of attack known as the test pattern attack. This attack is described and which methods that are robust against it.

BACKGROUND

In this section the background to watermarking is given. Compression and distribution algorithms are also discussed.

Watermarking

Watermarking is a term borrowed from the water coated stamp that can be impressed on paper, an invention first done in Fabriano, Italy in 1292 (Hartung and Kutter, 1999). During the last twenty years watermarking of digital media objects such as images, audio and video have been a research topic. The watermarks should be embedded in the media in such a way that the original media and the watermarked media should be undistinguishable from one another for human eyes and ears. This type of perceptually disguised watermarks is called invisible. Another type of watermark is visible and can for example be a logotype or copyright information that is written on an image. In this chapter only invisible watermarks are described.

The watermarks can be used for many different purposes but we will only deal with methods for finding the pirate responsible for redistributing pirate copies. For that case the media object that is distributed is embedded with watermarks in such way that the individual copy for each customer contains a unique individual watermark. Individual watermarking is sometimes known as fingerprinting but in this chapter we will refer to them as individual watermarks or simply watermarks.

Note that watermarking is not an alternative but a complement to cryptology. By encrypting a media object the distributor can control the initial distribution of the media so that only authorized customers will be able to use the data. Cryptology can also be used to try and protect the possibility to make illegal copies. If illegal copies of a media object, despite the cryptology, are re-distributed the encryption will no longer be able to control

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