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Watermarking: What it is, Why we do it, How can it be used?

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Abstract

This paper is a presentation to an EBU Transmission technology seminar: "Broadband networks: evolution and opportunities for broadcasters" (EBU, Geneva, 26-28 November 2001).

The presentation outlines different forms of watermarking, a general form of implementation, and then discusses some of the reasons for wanting to watermark a broadcast stream and the conflicting requirements these impose on the system. Finally it goes on to discuss the possible disposition of watermarking embedders and detectors in a broadcast environment, and presents the outline of the EBU generic model, as extended to include watermarking at source (e.g. in the camera).

Key words: video, watermarking

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Watermarking: What is it, Why do it, How can it be used?

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Introduction

Definition:

A watermark is an identification mark that is embedded into an audio or video signal that can be detected if required.

Example:

Visible
watermark

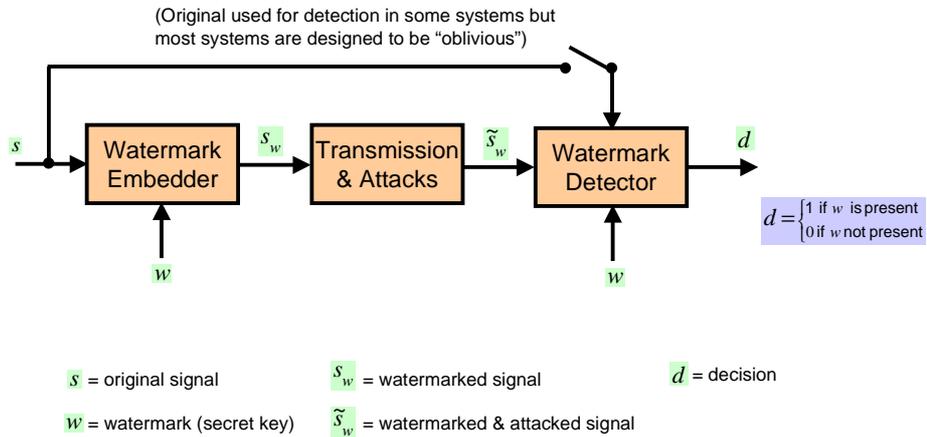


vs

Invisible
watermark



General outline of a watermarking system

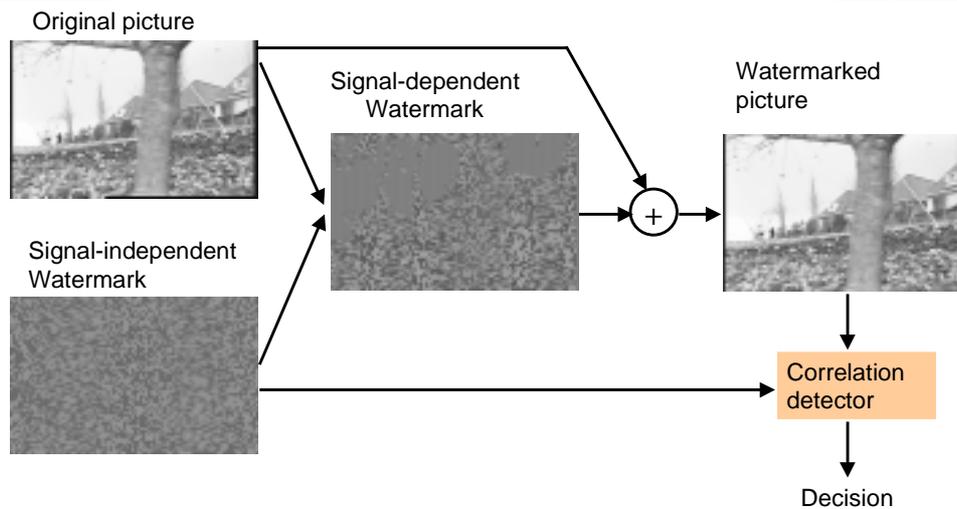


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Video Spread Spectrum Modulation



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Why Watermark?

There are many potential applications of watermarking in broadcasting

Two basic areas of application are authentication and identification

Authentication

- Authentication establishes the credibility of an audio-visual signal, that is, whether or not the signal is what it claims to be
- An authentication mark must be difficult to create and sensitive to distortions (easy to destroy)

Identification

- Identification associates an audio-visual signal with a descriptive record of information
- An identification mark should be difficult to remove and robust to distortions (hard to destroy)

The watermark properties required by authentication and identification are mutually exclusive

Uses of watermarking in broadcasting

- IPR - Copyright policing
- IPR - Metadata management
- Audience Research and Advertising
- Authentication of Web Site Content

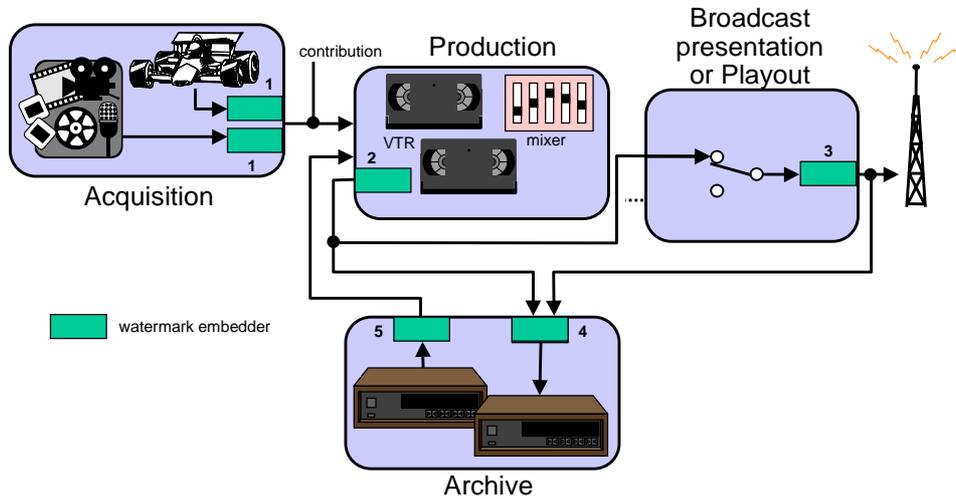
Watermark system secondary characteristics:

- Security
- Cascadability
- Orthogonality
- False positive probability
- Disclosure of algorithm
- Detector complexity

System design considerations

Embedders or detectors can be deployed at different points along the broadcast chain, depending on the purpose of the watermark

Embedding

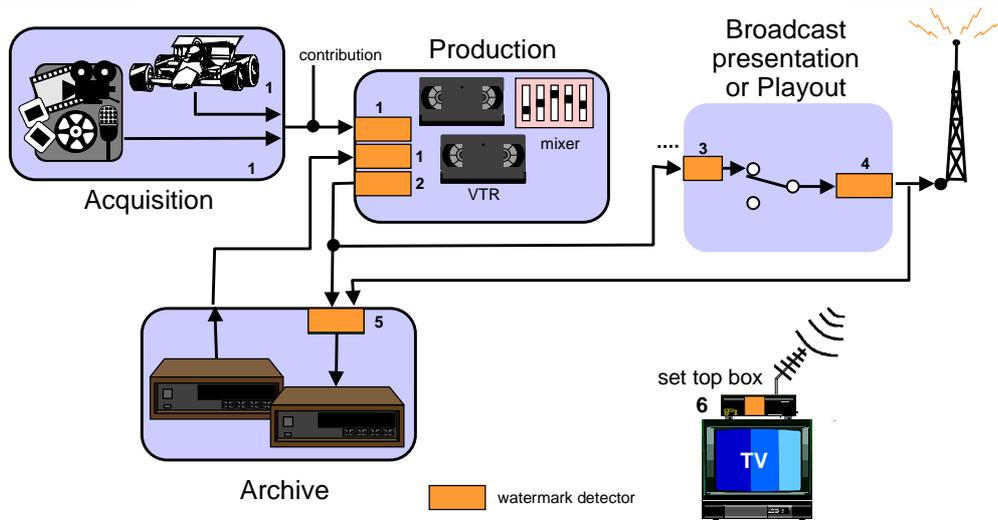


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Detection

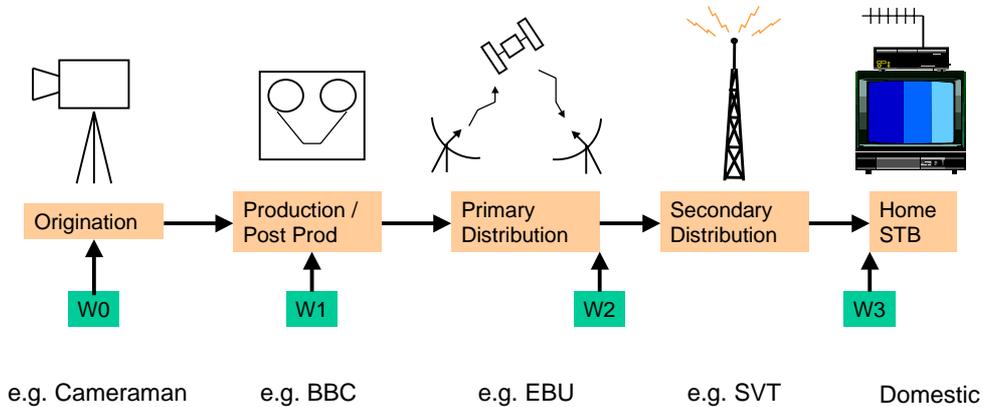


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EBU Generic Model (extended...)



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Main design parameters of a watermarking system

- **Level of perceptibility (P)**
 - watermark should be either invisible or inaudible
- **Level of reliability (R) = robustness v. false alarm**
 - high detection probability after attacks e.g. data compression and computer hacking if the signal carries the watermark
 - low false alarm probability if the signal does not carry the watermark
- **Data rate of hidden channel (D)**
 - one can open a hidden channel on top of the watermark and transmit data

Unfortunately :- $f(P,R,D) \approx \text{constant}$ (P,R,D depend on each other)

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Conclusions

- The management of programme IPR is becoming (has become ?) a significant issue for most programme originators
- Watermarking may be used to help create and record the data initially and to monitor and update the data thereafter
- The high cost of widespread monitoring may make the most obvious application of watermarking – detecting illicit copying – actually one of the less important applications