Legimi Sp. z o.o.

Legimi Sp. z o.o.

Legimi Daisy Watermark

Technical Documentation

January 29, 2015

Contents

1 Introduction

1.1 Purpose of this document

This document describes *Legimi Daisy Watermark* technology. It explains the features, requirements and usage of this technology for watermarking audio files.

1.2 Product overview

Legimi Daisy Watermark described in this document addresses the problem of protecting intellectual property of books containing mixed audio and text files, stored in Daisy standard. It achieves this goal by adding a special *watermark message* to content files, thus allowing to uniquely identify each file's owner. Unlike DRM protection model, which encrypts the whole file and needs specific software to decrypt it, watermarking has no restrictions for the player or devices used to open the file.

The watermark is applied to the input file using *Legimi Daisy Watermark* console application. Supported file formats are Daisy ZIP archives. The same application can be used to read back the watermark message.

2 Product description

Legimi Daisy Watermark is a console tool designed to be deployed on servers, which handles downloading of purchased files. It works in two modes:

- *encode* mode: given an input archive file (a ZIP file with content adhering to Daisy specification) and information identifying the user, who bought the file, it generates an output file with this information encoded as a watermark message.
- *decode* mode: given an input audio file, it reads back the watermark message or states that there is no watermark message in the file.

2.1 Application of watermark technology

Watermark technology should be applied between the purchase of a digital audio file, and its download. The purpose of adding watermark message is to identify the original buyer in case of an illegal file leak.

Assuming that orignal audio files and user identification data do not change over time, result watermarked files can be cached on the server to speed up the download process. The cache mechanism is not a part of *Legimi Daisy Watermark*.

2.2 Watermark mechanism

Legimi Daisy Watermark encodes the Daisy archive in two ways: it adds watermark message to audio (MP3) files using *Legimi Audio Watermark* technology and to text files using *Legimi Watermark*. This documentation focuses on the audio part and general usage. For text files watermarking reference, see *Legimi Watermark* documentation.

Legimi Audio Watermark encodes the watermark message inside the audio file, using a number of different available channels. This makes it harder for the attackers to remove the protection. The watermark itself is inaudible.

2.3 Watermark Robustness

The key property of a watermark technology is its robustness against modifications of protected files. This means that the watermark message should be still readable after such operations on the audio file as recompression or pitch and tempo changes.

Legimi Audio Watermark was tested using *sox* audio editor (`http://sox.sourceforge.net/`). After watermarking, the files were modified using *pitch* and *tempo* effects. The tests showed that the watermark is robust against 1-5% modifications. This means that the file owner can still be identified after modifying audio speed by this percentage.

Aggressive modifications make it harder or even impossible to properly read the watermarked message, but also make the audio content less useful and more noisy.

Reading of watermark messages is not strictly a binary process. If a file was modified, the result may contain errors and may differ from original message. *Legimi Audio Watermark* tries to account for this kind of errors using error correction methods, but these errors may still occur. This does not mean that the decoded information is useless. It may still prove valuable when read by a human. For example, if the message contained the user name, even if some letters are incorrect due to read errors, there is still a large chance that the user can be properly identified. Therefore, it is advised to use a meaningful, human-readable information when applying watermark – e.g. a user name and surname, a special GUID that is also stored in some database, etc. An example of bad information is a numerical user id, as even a slight change in the number may result in a completely different user, with no way to recover the original id.

2.4 Installation

2.4.1 Prerequisites

To run, *Legimi Daisy Watermark* requires .Net Framework Runtime, version ≥ 3.5 (on Windows) or Mono Runtime, version ≥ 2.5 (on Linux and MacOS). On Windows, .Net Framework is installed by default, on other operating systems Mono has to be installed separately. It can be obtained from `http://www.go-mono.com/mono-downloads/download.html` or installed using APT (on Debian-based systems): `apt-get install mono-complete`.

Additionally, *Legimi Daisy Watermark* uses the following external applications and libraries:

- *Lame* – an open-source mp3 compression library. It is required for watermarking MP3 files. Binary files can be downloaded from `http://lame.sourceforge.net/links.php#Binaries`. Using APT: `apt-get install lame`. *License: LGPL.*
- *sox* (optional) – an open-source, commandline audio editor. Homepage: `http://sourceforge.net/projects/sox/files/sox/`. Using APT: `apt-get install sox`. *License: LGPLv2.*

2.5 Usage

2.5.1 Name

watermark-daisy – Legimi Daisy Watermark

2.5.2 Synopsis

`watermark-daisy.exe [options]` – using .Net Framework on Windows
`mono watermark-daisy.exe [options]` – using Mono on other platforms

2.5.3 Options

`--mode -m`: set program mode: `encode` for watermark encoding (applying), `decode` for decoding (reading) watermark message

`--input -i`: path to input ZIP file

`--output -o`: path to output ZIP file (in `encode` mode)

`--message`: message to encode, up to 32 ASCII characters (in `encode` mode)

`--verbose`: show verbose output

For additional options concerning watermarking text files, see *Legimi Watermark* documentation.

2.5.4 Output

In `encode` mode, the program saves the watermarked file to the provided output path. In `decode` mode, the program prints the decoded message (if found) to the standard output.

2.5.5 Error Codes

0	Success
1	Bad command-line arguments
2	General Error
3	Critical Error
10	Failed to verify watermark message
11	Failed to apply watermark message
12	The input file is to short to apply watermark message
13	Input file error (bad file format, file not found, etc)
14	External tool error (e.g. LAME not found)
15	General I/O error
16	Temporary file error

2.6 Restrictions and Recommendations

- short files: the watermark message needs enough audio samples to be properly encoded. The minimum audio length is approximately 2 minutes. Depending on the message length and source bitrate, watermarking shorter files may not be possible.
- as mentioned in section 2.3, it is recommended to use a meaningful, human-readable message when applying the watermark – e.g. a user name and surname, a special GUID that is also stored in some database, etc. This gives better chance of identifying the original file owner in case of a partially destroyed watermark message.

A Appendices

A.1 Sample usage

Encoding watermark message:

```
watermark-daisy.exe -m encode --input "daisy-audiobook.zip" --output
    "daisy-audiobook-watermarked.zip" --message "my watermark message"
```

Decoding watermark message:

```
watermark-daisy.exe -m decode --input
    "daisy-audiobook-watermarked.zip"
```