SPATIO-TEMPORAL REGISTRATION FOR DIGITAL ROBUST WATERMARKING IN VIDEOS

Abstract

Digital Robust Watermarking is a technique to irreversibly embed information into media such as digital video. For extraction, most schemes require the unmarked original video. As the marked copy can be significantly distorted, a precise spatio-temporal registration is required. Thus, feature analysis and registration is a very important task.

We present some of our current work, e.g., a temporal registration with sub-frame precision, and a watermarking approach based on geometric modifications.

Robust Digital Watermarks

Schematic of typical lifecycle:
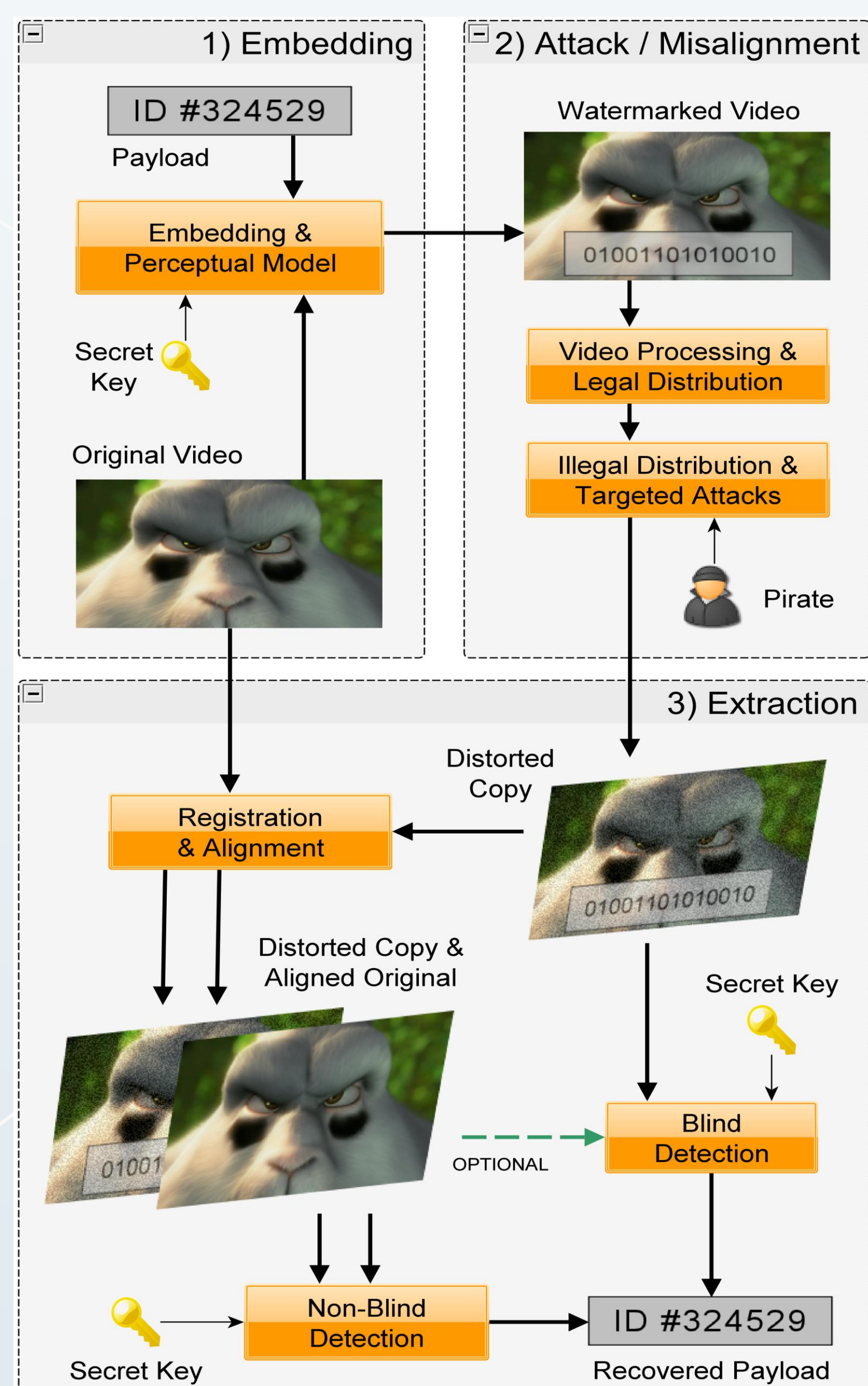
Spatial Registration

Challenge: Reverse spatial transformations, even from camcorder recording (perspective, lens distortions) or targeted attacks (such as geometric warping in the *StirMark* [3] attack).

Current approach: SIFT features + RANSAC
→ Homography matrix (no warping detectable)

Required for many non-blind watermarks, but also improves blind techniques (see below).

Improvement to the SNR

By subtracting a well aligned original video from its marked copy, the SNR is improved.

Very Robust Features

Challenge: Find features that survive extreme spatial, temporal, histogram, and image modifications, as well as very bad compression artifacts.

What is *very robust*?
The features have to survive…
➢ Blur, noise, affine transformations
➢ Shaky camcorder recording
➢ Compression down to 200kbps
➢ Resizing down to 320x240
➢ Frame rate reduction down to 25%

Use cases:
➢ Spatial & temporal synchronization
➢ Parameters of a watermark that are not transmitted but extracted from the content
➢ Seed for a Pseudo-RND (Idea: Combine watermarking with fountain codes)

Temporal Registration with Sub-frame Precision [1]

Frame-blending occurs when source and capture are not synchronized, e.g., with most analog captures.

Challenge: Find corresponding *frames and blending ratios* for each frame.

Our algorithm is used in a commercial watermarking product (patent pending).
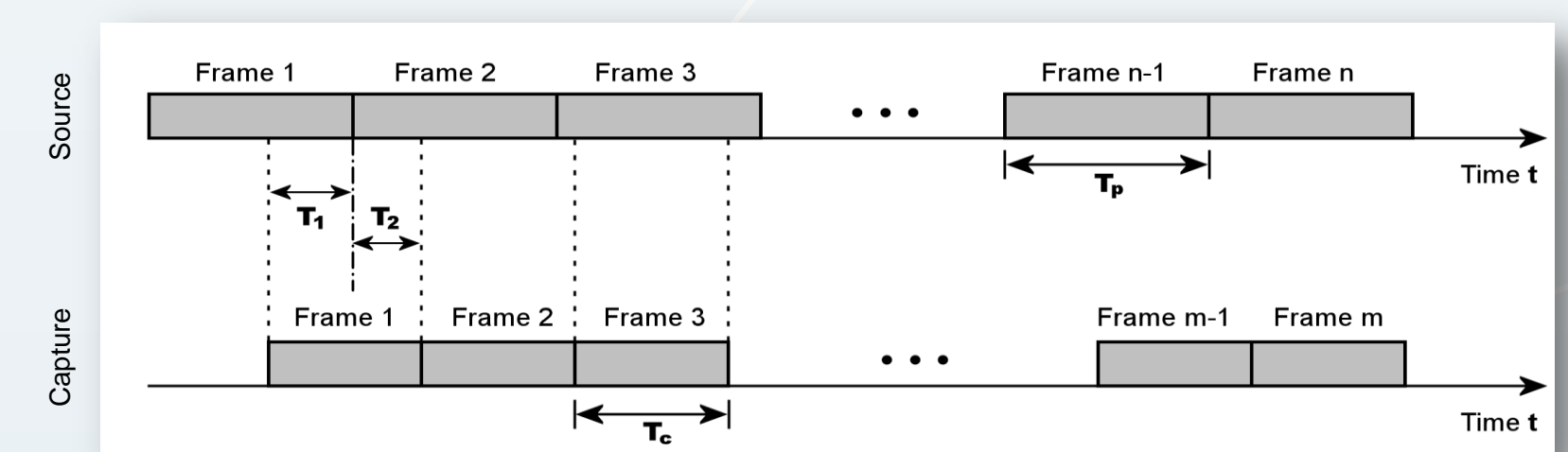
Watermarking based on Geometric Modifications [2]

A watermark is embedded by geometrically modifying frames. Currently, all frames of a shot are slightly, but globally transformed. Through registration, this can be read out later again.
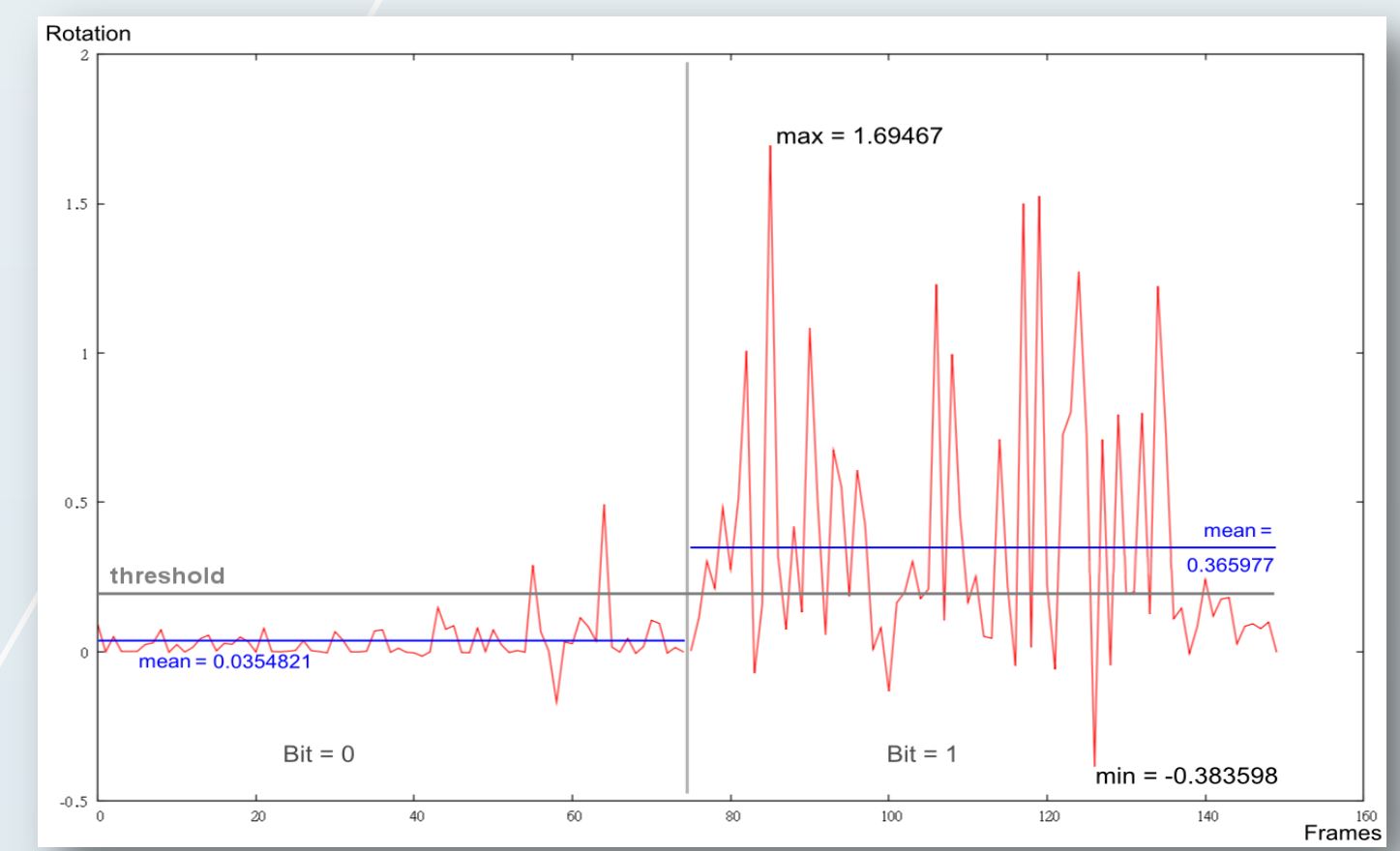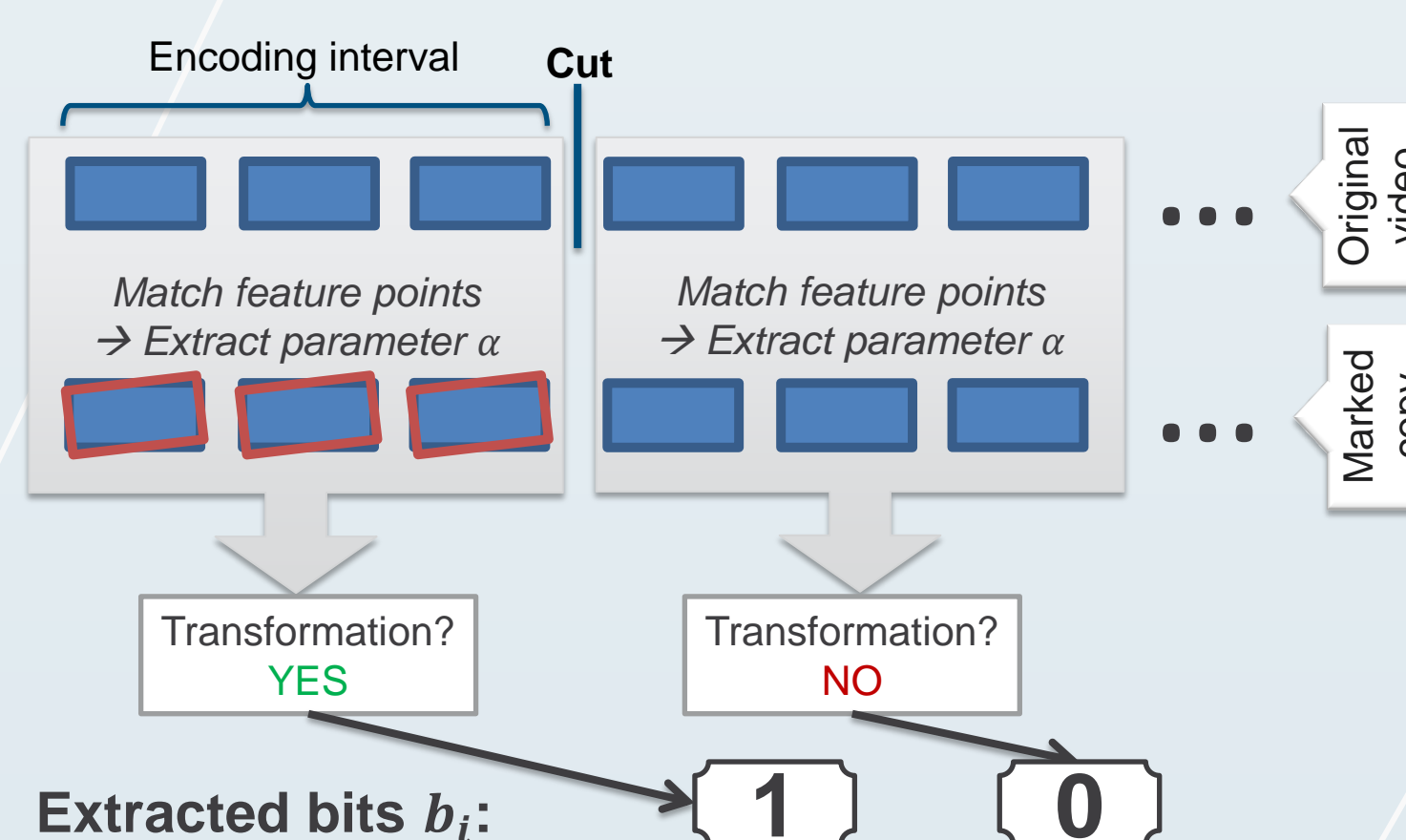
References

[1] P. Schaber, S. Kopf, W. Effelsberg, and N. Thorwirth. 2010. Semi-automatic registration of videos for improved watermark detection. In *Proceedings ACM* MMSys '10. ACM, New York, NY, USA, 23-34.

[2] P. Schaber, S. Kopf, F. Bauer, and W. Effelsberg. 2010. Robust digital watermarking in videos based on geometric transformations. In *Proceedings ACM* MM '10. ACM, New York, NY, USA, 1219-1222.

[3] F. Petitcolas, R. Anderson, M. Kuhn: Attacks on copyright marking systems. IH'98, Portland, Oregon, USA, April 15–17, 1998

Video Registration Toolkit Application

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