



Royal Institute of Technology

MASTER OF SCIENCE THESIS

Video Coding in H.26L

by

Kristofer Dovstam

April 2000

Work done at Ericsson Radio Systems AB, Kista, Sweden,
Ericsson Research, Department of Audio & Visual Technology.

Abstract

For the past few years, the capacity of global networks and communication channels has increased considerably. This allows for real-time applications like video conferencing and video-on-demand using compressed video. State-of-the-art video coding solutions such as H.263, MPEG-2 and MPEG-4 all have one goal in common: to achieve highest possible image quality for lowest possible bit-rate.

During 1999, the development of a new video coding standard, H.26L, started. H.26L is supposed to replace its predecessor H.263, and one of the goals is to achieve 50% greater bit-rate savings compared to H.263. The first proposal for the H.26L standard, presented in August 1999, achieves higher compression efficiency compared to H.263. However, the goal of 50% is not yet met.

This thesis proposes a method to use adaptive arithmetic coding (AAC) for entropy coding in an H.26L video codec in order to further improve the compression efficiency. It is a general solution that can be applied to any video codec. However, implementations have been made for the H.26L video codec only. AAC is based on an entirely different strategy than the variable length entropy coding technique employed in H.26L and many other video codecs.

Three experimental models for adaptation to local statistics have been designed and investigated. Results show that for high bit-rate environments significant bit-rate savings can be made using AAC, while less can be won for lower bit-rates.

Contents

1. Introduction and Background	9
1.1 Overview of Video Compression	9
1.1.1 Exploiting Spatial Redundancy – INTRA-coded Compression.....	9
1.1.2 Exploiting Temporal Redundancy – INTER-coded Compression.....	10
1.1.3 Motion Estimation.....	10
1.1.4 Entropy Coding.....	11
Run-Length Coding.....	12
Variable Length Codes.....	12
Arithmetic Coding.....	12
1.1.5 A Typical Video Codec.....	15
1.2 A Brief Overview of Existing Standards	16
1.2.1 H.261.....	17
1.2.2 MPEG-1.....	17
1.2.3 MPEG-2 / H.262.....	17
1.2.4 H.263.....	18
Unrestricted Motion Vector mode.....	18
Syntax-based Arithmetic Coding mode.....	18
Advanced Prediction mode.....	18
PB-frames mode.....	19
1.2.5 MPEG-4.....	19
1.2.6 H.26L.....	19
Only one regular VLC table used for symbol coding.....	20
One-third pixel position used for motion prediction.....	20
Seven different block sizes used for motion prediction.....	21
Integer transform applied on 4x4 blocks.....	21
Multiple reference frames may be used for motion prediction.....	21
Other features.....	22
1.3 Areas of Research and Further Aspects of Video Coding	22
1.3.1 Rate-Distortion Theory.....	23
1.3.2 Error Resilience.....	24
Reversible Variable Length Codes.....	25
Data Partitioning.....	25
Header Extension Code.....	26
1.3.3 Advanced Motion Estimation.....	26
Gradient Matching.....	27
Motion Models and Regions of Support.....	27
1.3.4 Adaptive Arithmetic Coding.....	28
1.4 Purpose and Goal	29
1.5 Outline	30
2. Video Codec Evaluation	31
2.1 H.26L versus H.263	31
2.1.1 The SNR Metric.....	31

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.