H.264/AVC SVC

An overview of the Scalable Video Coding extension

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2008-03-17

Outline

Introduction

Area
: Compression and decompression of video

Previous standards
: H.120, H.261, H.262, H.263(+,++), H.264, and

: MPEG-1 Video, MPEG-2 Video, MPEG-4 Visual, MPEG-4 AVC

Standardization institutions
: ITU-T VCEG, ISO/IEC MPEG, JVT

Timeline
: H.264 □ May 2003, SVC □ July 2007

Scalability

Definition

- Various types and degrees of a particular system property
- Removal of bit stream portions

Scope

- Temporal, spatial, quality, any combination

Motivation

- Graceful degradation in lossy transmission environments
- Bit rate, format, and CPU/power adaptation
- Inhomogenous networks and receivers

Target applications

- Satellite, cable, and terrestrial broadcasting
- Conversational services
- Gradual quality degradation storage

SVC basics

Starting point
- Loss in coding efficiency, increase in encoder and decoder complexity

Competitors
- Simulcast, transcoding

Concepts
- Substreams as valid bit streams, layers
- Maximization of substream's RD

Objectives
- Single-layer coding efficiency for each substream
- Single-layer decoding complexity
- Easy bit stream manipulation after encoding
- Backward compatibility

Standardization

- Progress in motion-compensated 3D transforms
- CfP by MPEG in Oct. 2003
- 14 Submissions (thereof 12 based on 3D wavelet transforms)
- Project start in Oct. 2004
- Consented in July 2007

Core coding tools

- Block-based hybrid video codec
- Spatial (directional) prediction
- ME/MC with unidirectional and weighted bidirectional temporal prediction, variable block sizes, and multiple reference frames, as well as so-called Direct/Skip mode
- DCT-like integer transform of variable block size
- Scalar dead-zone quantization
- Entropy encoding
- In-loop anti-blocking filter

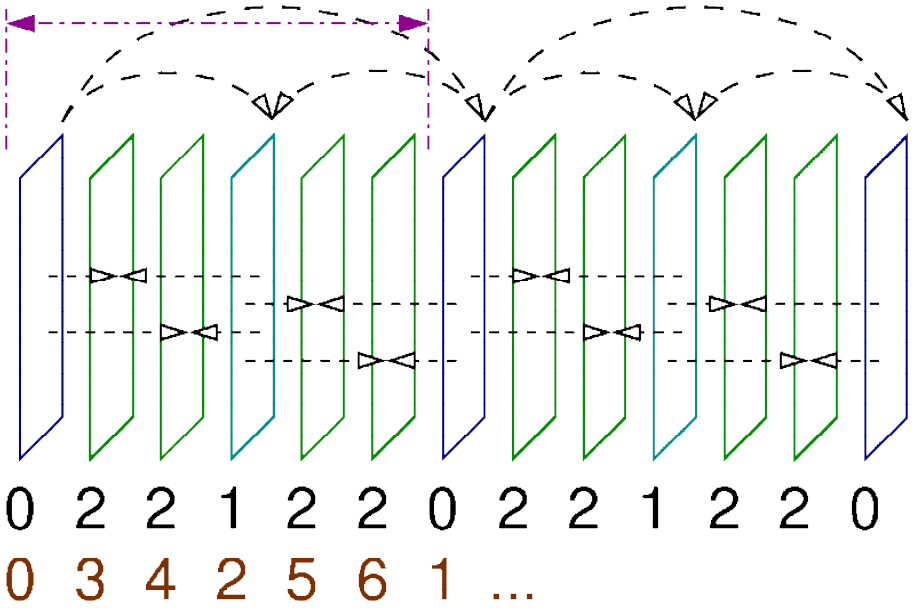
Framework

- VCL
- NAL, data units

Temporal scalability

Implied by core H.264

High-efficiency example



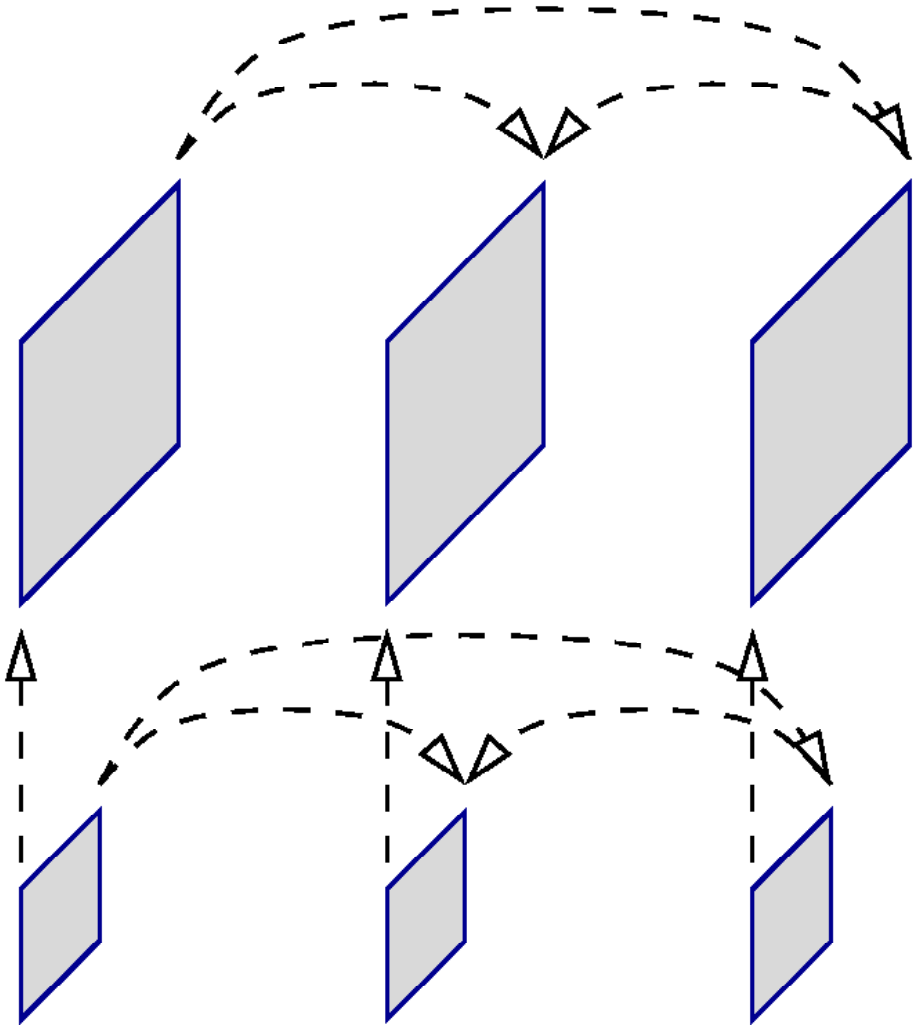
Spatial scalability

Intra- and inter-layer prediction, copy or prediction of meta data (such as macroblock and subblock mode), and residual prediction

Arbitrary resolution ratios, progressive and interlaced material

Single-loop decoding

ROI coding, additional regions

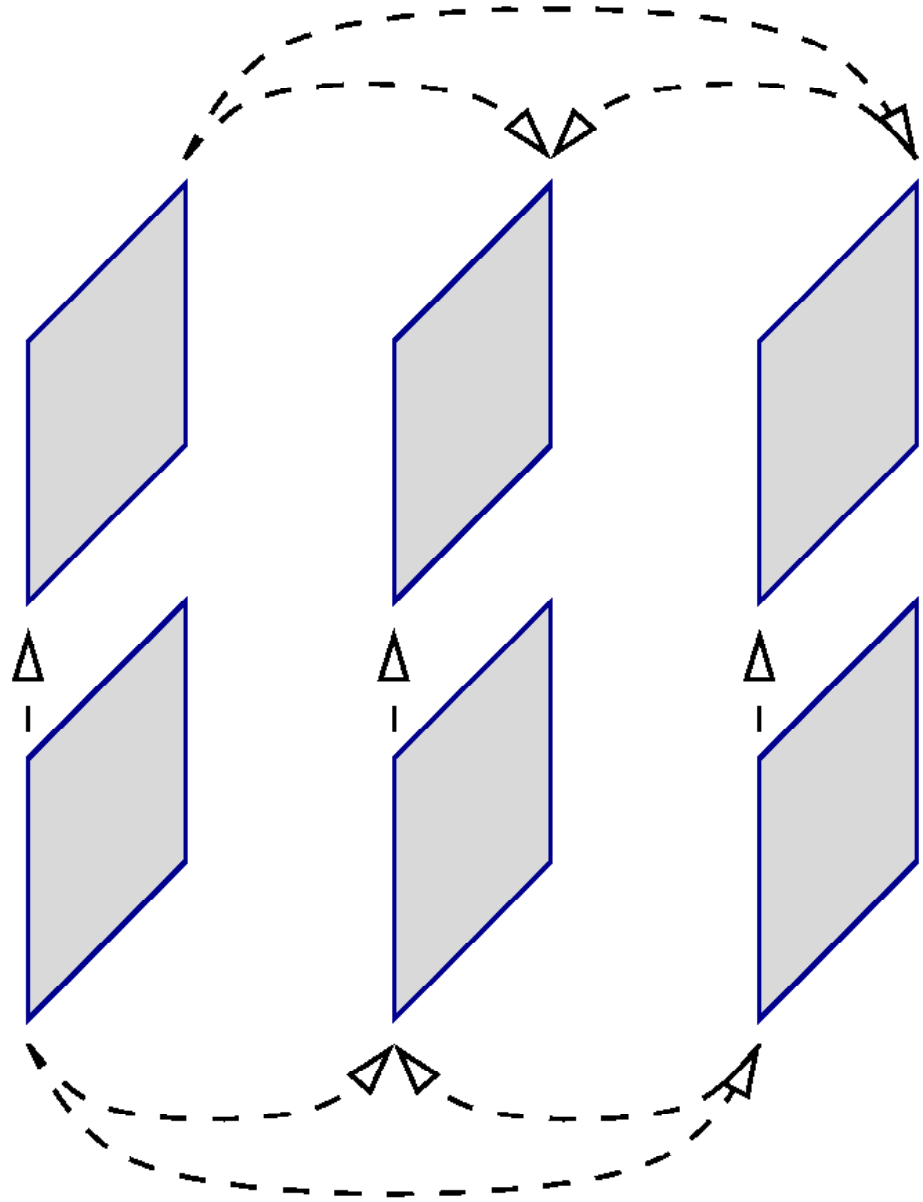


Quality scalability

Special case of spatial scalability with identical picture sizes

CGS and MGS depending on layer switching options (the latter implying drift)

Key picture concept to trade off drift and enhancement layer coding efficiency



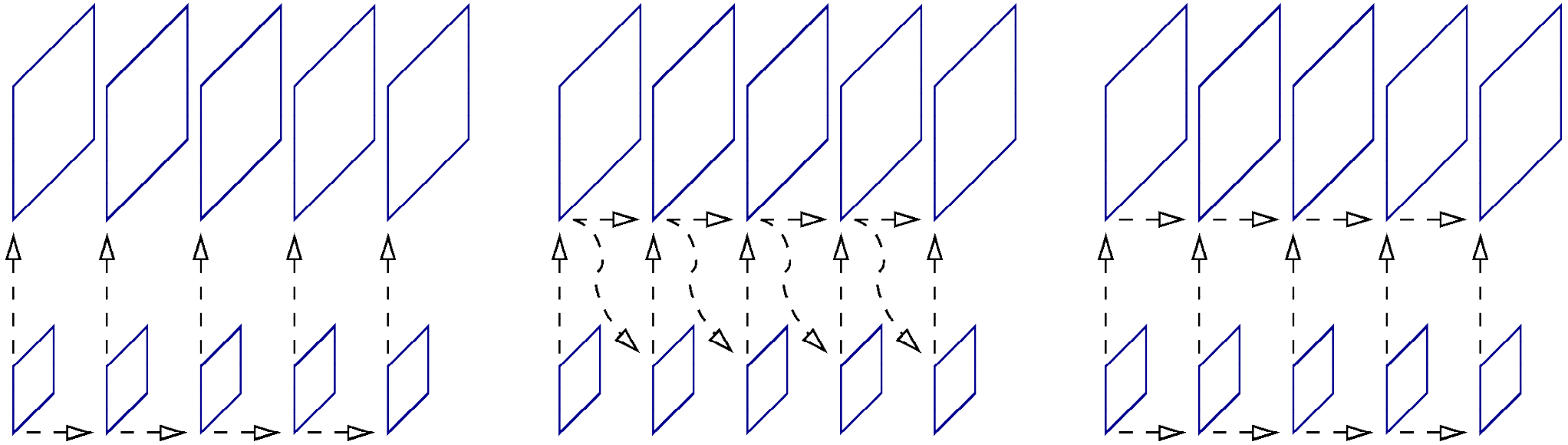
Combined scalability

Any desired combination

Trade-offs between provided degree of scalability and performance

Profiles: Scalable Baseline (conversational), Scalable High (broadcast, streaming, storage), and Scalable High Intra (professional applications)

Drift control



Summary

What's new?

- Hierachical temporal prediction structures
- Various new prediction methods
- Key pictures concept, drift control
- Single motion compensation loop in decoder
- Substream concept

Performance

- Temporal scalability without performance loss
- Scalability penalty of as low as 10% bit rate increase possible
- Scalable codec guaranteed better than simulcast

Outlook

Research involving SVC (see also references)

New profiles and levels

New extensions

H.265 from 2010 on (?)

Thank you for your attention

Questions?

References

H.264

Advanced Video Coding for Generic Audiovisual Services, ITU-T Rec. H.264 and ISO/IEC 14496-10 (MPEG-4 AVC), ITU-T and ISO/IEC JTC 1, May 2003 (Version 1)

H.264 SVC

Overview of the Scalable Video Coding Extension of the H.264/AVC) Standard, Heiko Schwarz, Detlev Marpe, and Thomas Wiegand, IEEE Transactions on Circuits and Systems for Video Technology, Vol. 17, No. 9, Sep. 2007, pp. 1103-1120

H.264 SVC spatial scalabity

Spatial Scalability Within the H.264/AVC Scalable Video Coding Extension, C. Andrew Segall and Gary J. Sullivan, IEEE Transactions on Circuits and Systems for Video Technology, Vol. 17, No. 9, Sep. 2007, pp. 1121-1135

H.264 SVC performance

Performance Analysis of SVC, Mathias Wien, Heiko Schwarz, and Tobias Oelbaum, IEEE Transactions on Circuits and Systems for Video Technology, Vol. 17, No. 9, Sep. 2007, pp. 1194-1203