Codierung visueller Inhalte: Standards, Trends und Anwendungen

Detlev Marpe
Fraunhofer HHI, Berlin, Germany

Compression as enabling technology

Computer animation

Live Content

Recorded Content

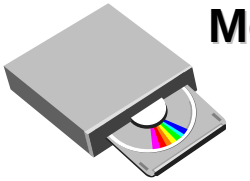
Post production

Lossless or near lossless

Media Encoder

Archive

Storage Media



Media Encoder

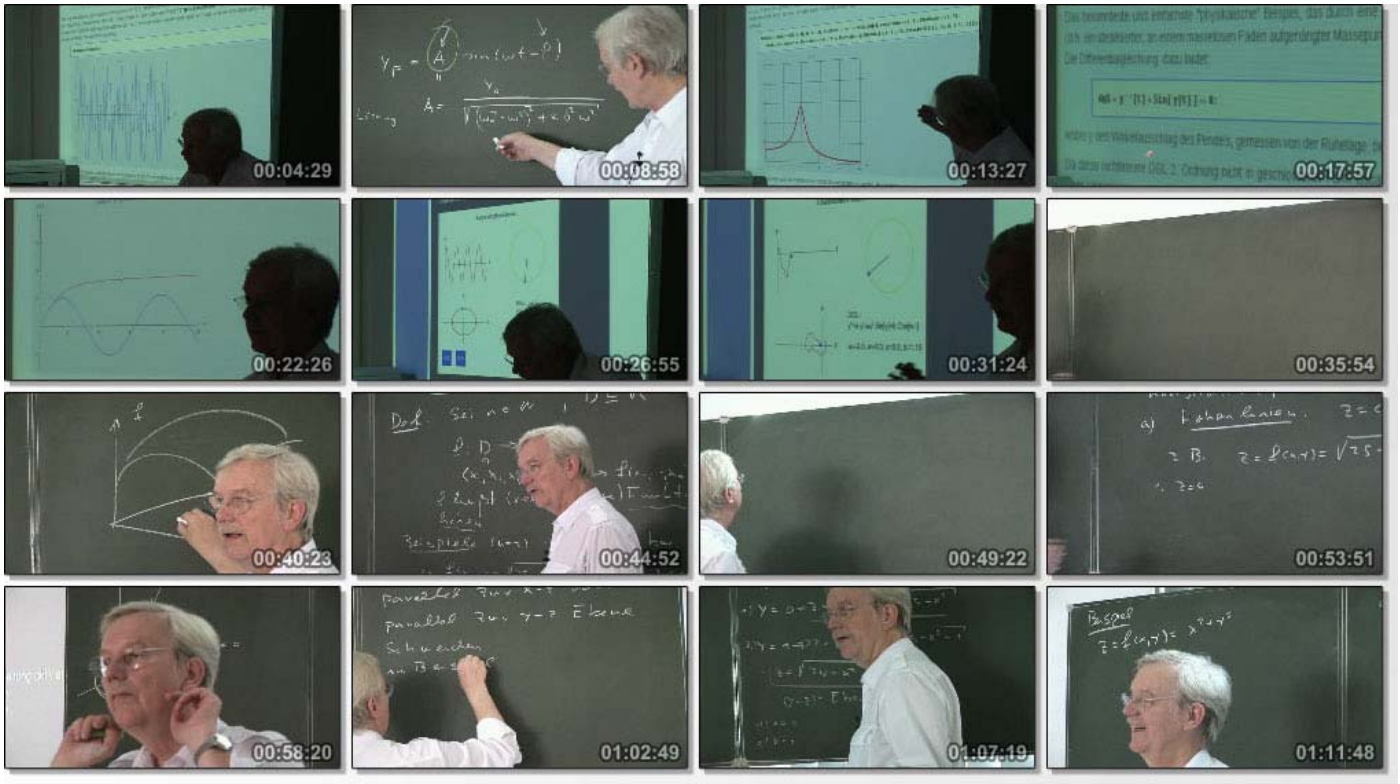
lossy

Transmission

Focus of this talk

What are desirable compression ratios ?

Let‘s take an example:



A highly esteemed „e-teacher“ in action ...

What are desirable compression ratios ?

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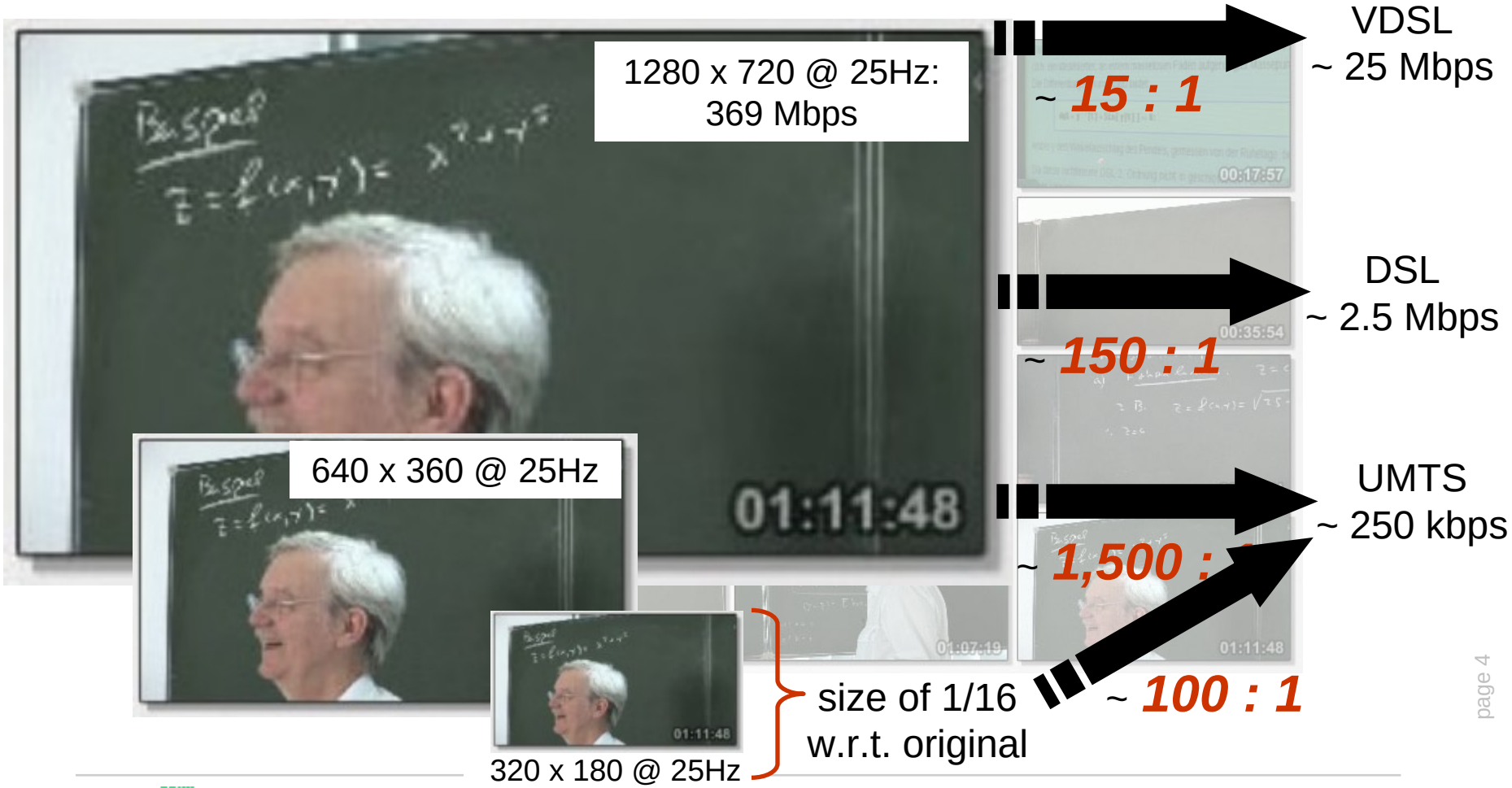
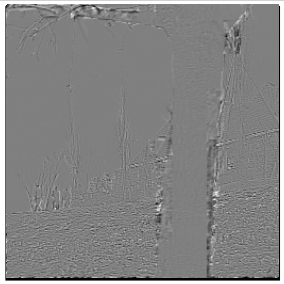


Outline

Transform coding + predictive coding



Difference image (with motion compensation)

+ -

DCT-encoder

channel

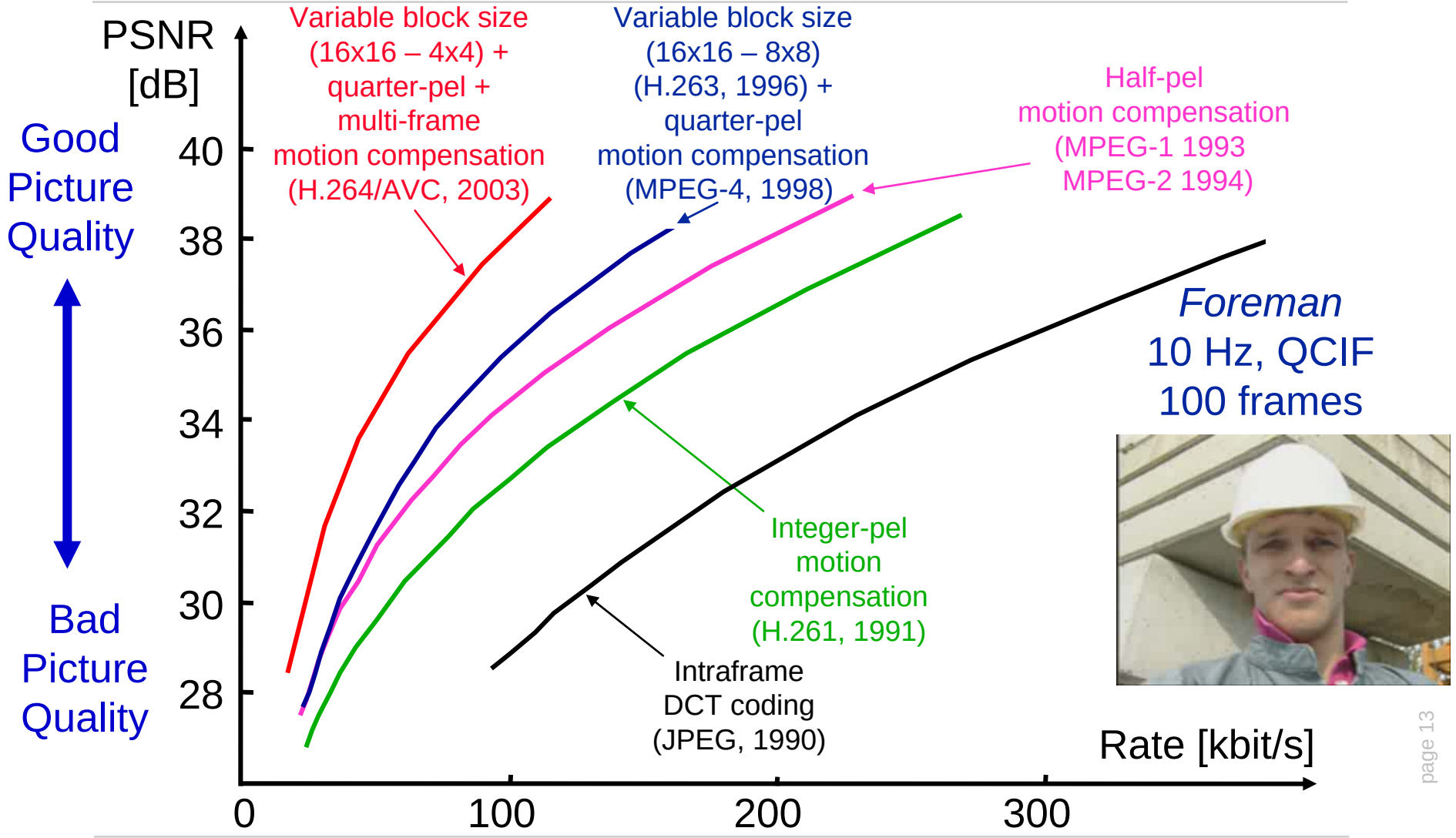
DCT-decoder

Motion compen-sation

Motion vectors

Motion estimation

Milestones in Video Coding

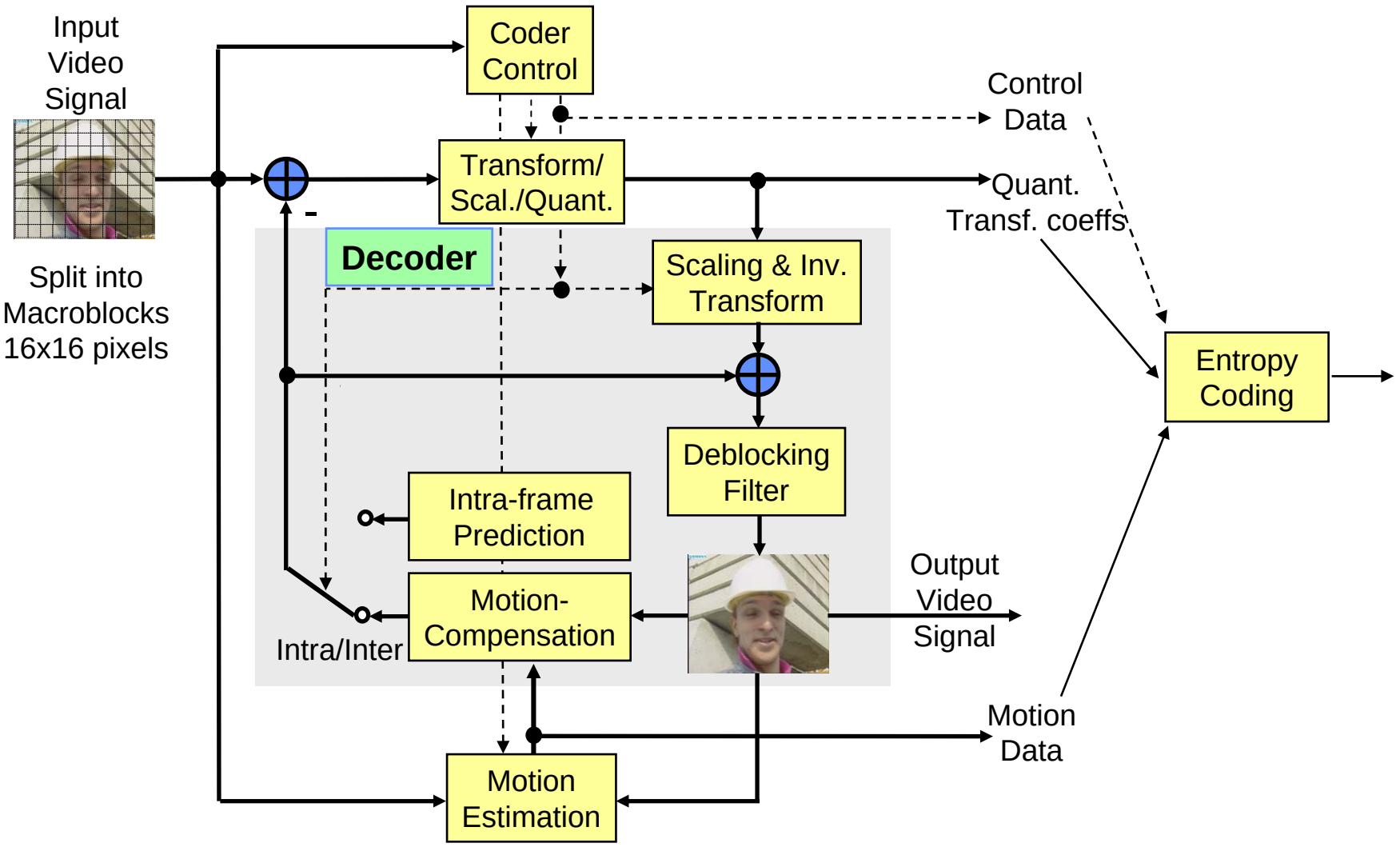


Outline

H.264 / AVC: A Brief Historical Review

- **1997**: ITU-T VCEG – Video Coding Experts Group started standardization activity H.26L ("L" = long term; H.26P ⇨ H.263)
- **August 1999**: 1st Test model (TML-1) chosen among 4 technical proposals from Telenor, Nokia, Strathclyde University, and HHI
- **December 2001**: Formation of the Joint Video Team (JVT) between VCEG and MPEG (Moving Pictures Experts Group): joint project – **H.264 / AVC (Advanced Video Coding)**
- **May/July 2003**: Approval of Version 1
- **Sept. 2004**: Approval of Fidelity Range Extensions ("FRExt")
- **July 2007**: Approval of Scalable Video Coding (SVC) Extension
- **January 2008**: Final draft of Multiview Video Coding (MVC) Ext.

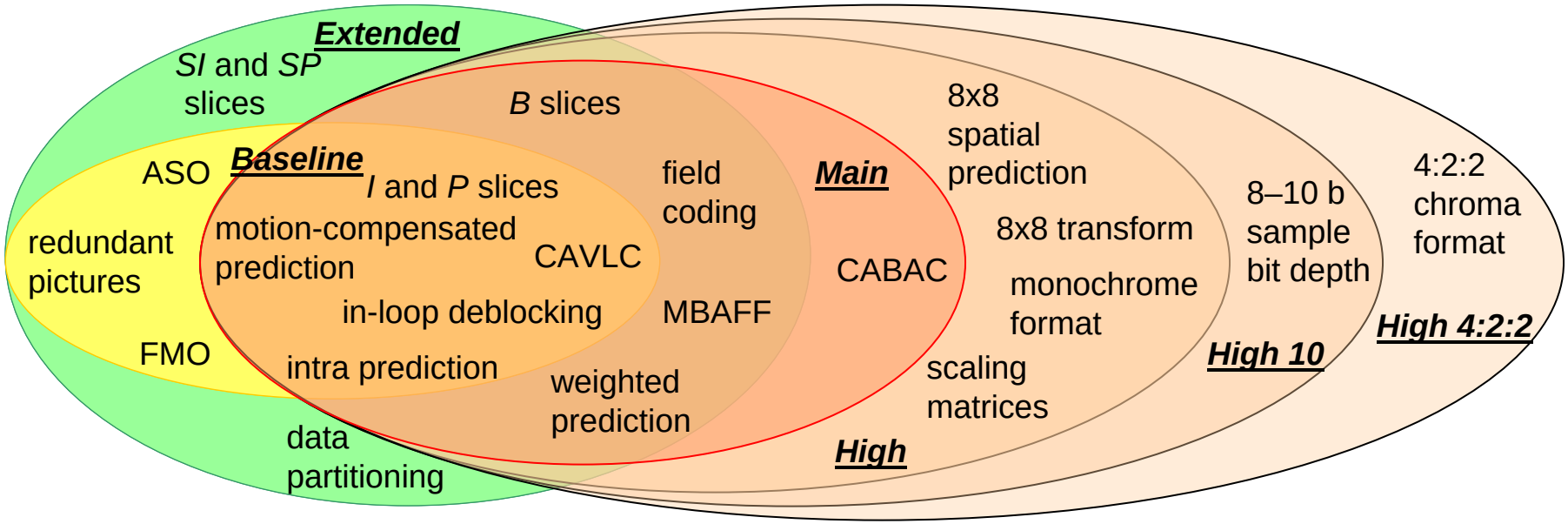
Basic Macroblock Coding Structure



Main Innovative Features

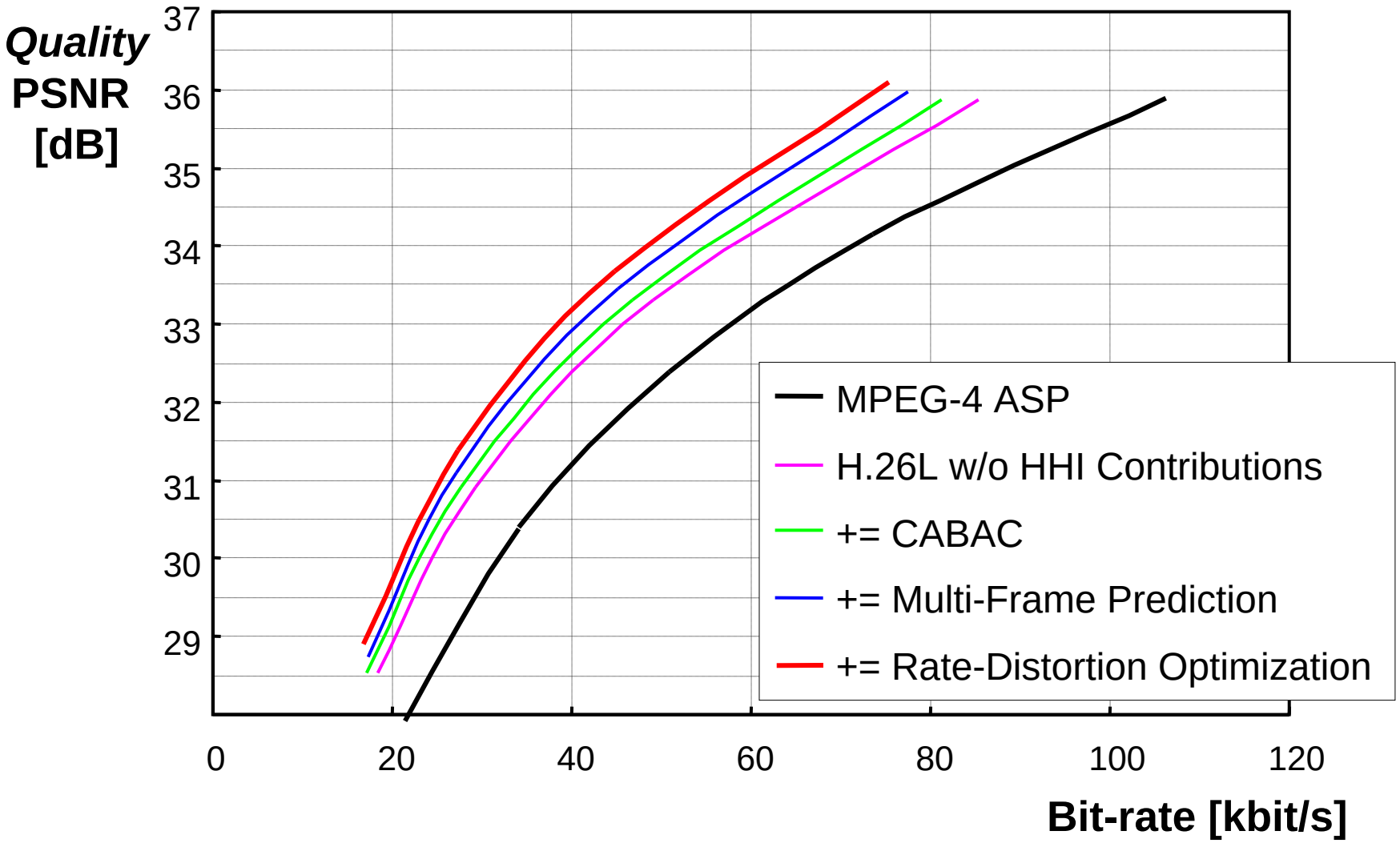
- Video coding layer **of H.264/AVC is similar in spirit to other standards but** with important differences
- New **key features** are:
  - Enhanced motion compensation
    - Better block segmentation
    - Multiple reference pictures and generalized B pictures
  - Adaptive transform block sizes
  - Enhanced entropy coding (CABAC)
- Substantial **bit rate savings (typically around 50%)** relative to any other standard for the same perceptual quality
- **But:** New design typically demands for more computing resources – rough guess: 2-3x the requirements of MPEG-2 for decoding, 3-4x for encoding (depends on profile, etc.)

H.264/AVC Profiles* and Related Tools



*not including Professional Profiles

HHI Contributions* to H.264/AVC



*plus: substantial administrative support (e.g., management, editing, SW)

H.264/AVC-Based Product Examples

- **Mobile TV** (use of Baseline profile)
  - **Digital Video Broadcasting – Handheld (DVB-H)**
  - **Digital Multimedia Broadcasting (DMB)**
  - **Multimedia Broadcast/Multicast Service (MBMS)**

- **SDTV / HDTV Broadcast / IPTV** (use of High/Main profile)
  - **DVB**: revised implementation guide TS 101 154 (DVB-C/S/T)
  - **Direct-to-home broadcast satellite**, e.g.,
    - DirecTV, Dish Network (USA)
    - Sky HD, BBC HD (UK and Ireland)
    - Premiere, ProSiebenSat.1 (Germany)
  - **Terrestrial HDTV** pay-TV services in France

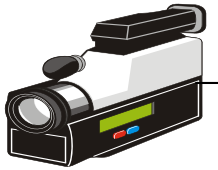
- **Media Storage** (High profile)
  - **HD-DVD** specification of the DVD Forum
  - **BD-ROM** specification of the Blu-Ray Disc

- **Mobile Phones & Players** (Baseline/Main/High)
  - **Nokia, Sony PSP, Apple iPod**

- **Internet Streaming** (Baseline/Main/High)
  - **Apple Quicktime, Adobe Flash Player, YouTube, etc.**

Outline

Scalable Video Coding (SVC) - Principle



SVC encoder

scene

128 kbit/s

H.264/AVC decoder

QCIF@ 7,5 Hz

256 kbit/s

SVC decoder

CIF@ 15 Hz

512 kbit/s

SVC decoder

CIF@ 30 Hz

1024 kbit/s

SVC decoder

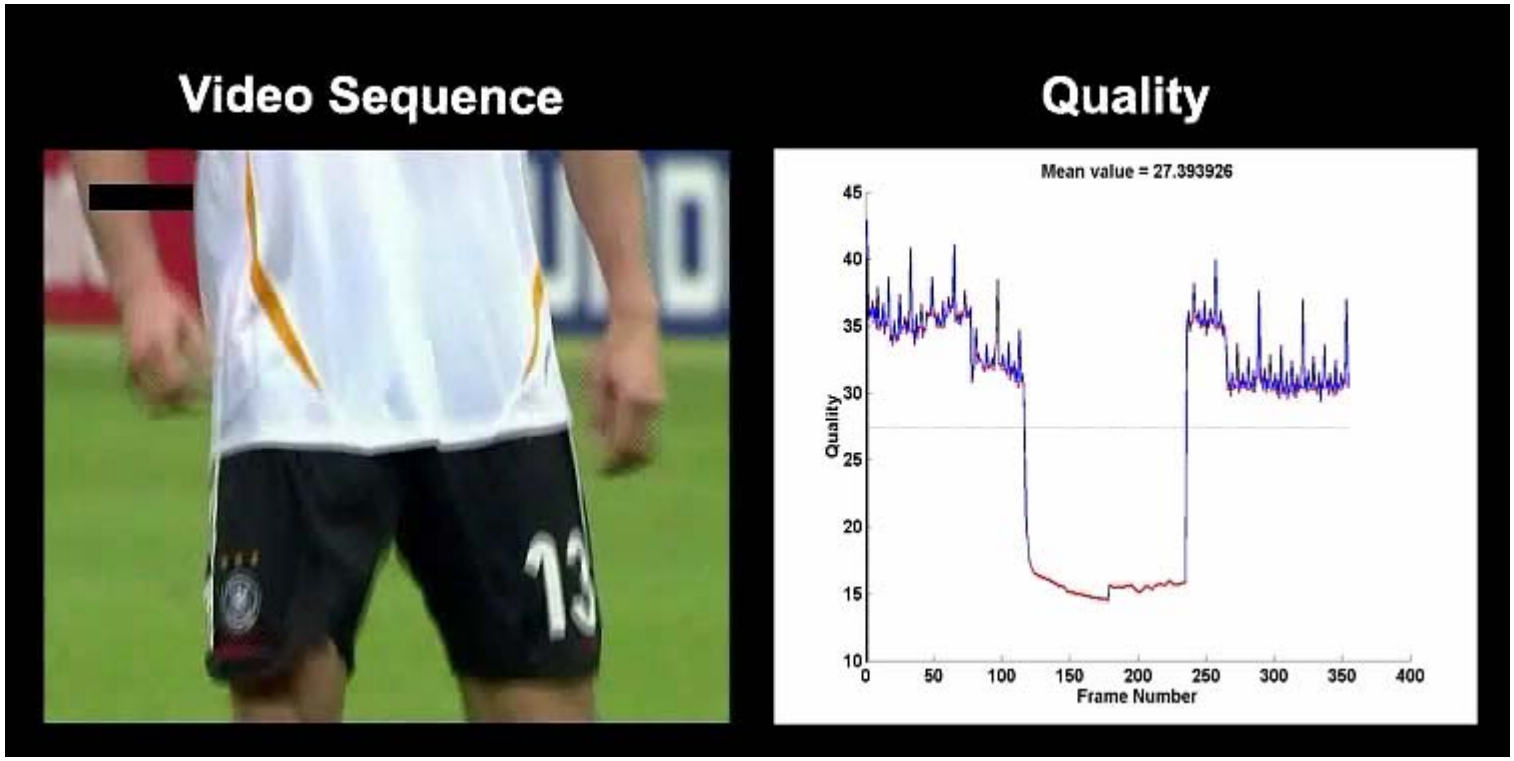
TV@ 60 Hz

Functionalities and Applications

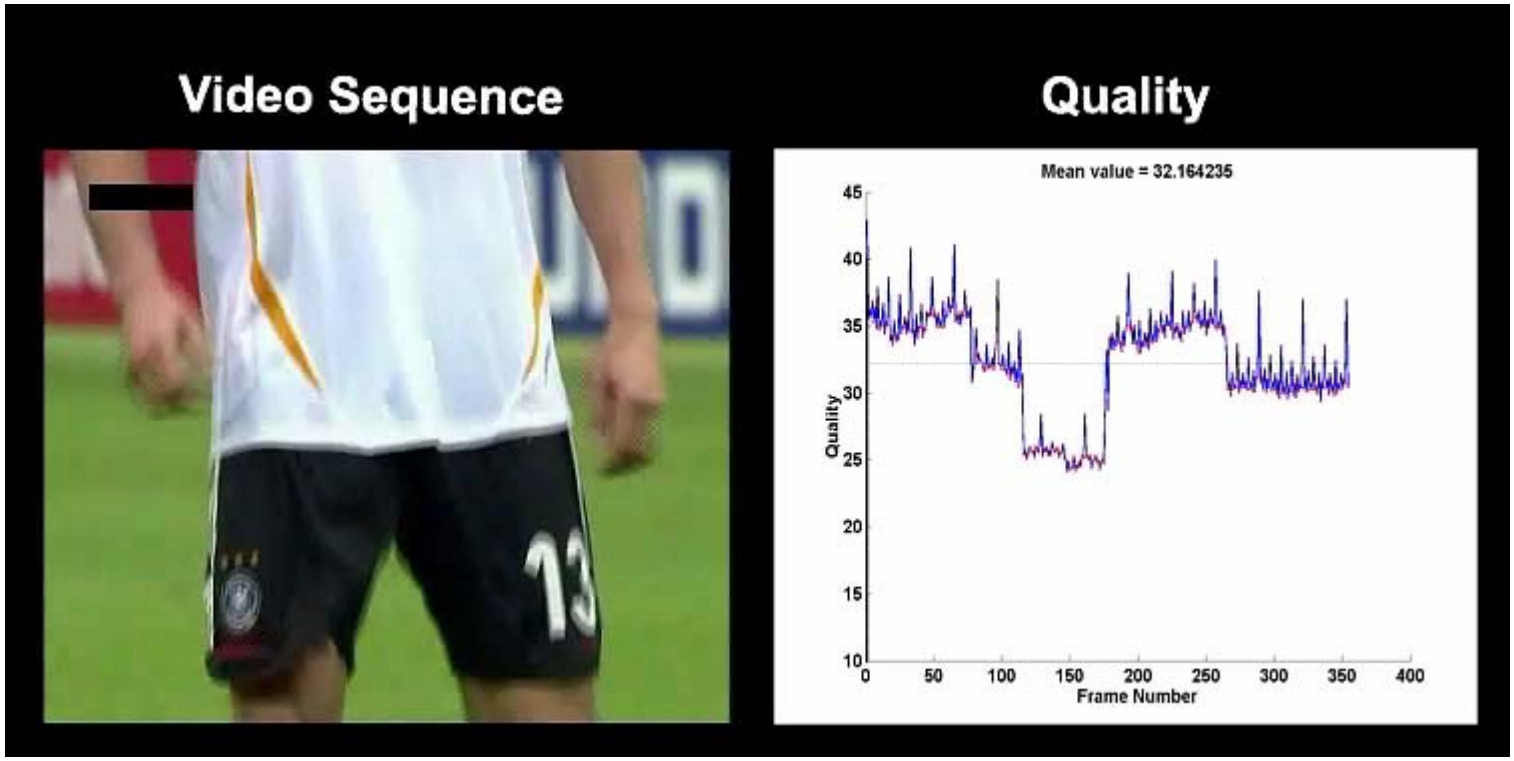
- **One single encoding process to produce the scalable bitstream**
  - **Encode once** and then customize the stream to access content
  - Cost in terms of **coding efficiency loss < 10%** typically
- **Partial decoding of the scalable bitstream allows:**
  - Graceful degradation when the “right” parts of the bitstream get lost
  - Bit rate adaptation
  - Format adaptation
  - Power adaptation

- **Potential Applications**
  - Format enhancement services: e.g., upgrade from 720p to 1080p
  - Robust video delivery in internet/mobile networks
    - combine with unequal error protection
    - guarantee base layer delivery

Mobile TV without graceful degradation



Mobile TV with graceful degradation



Outline

1 From Principle to Standards

2 H.264/AVC - Core Coding Technology and Applications

3 Scalable Video Coding Extension: More Functionality and Adaptability

4 **A New Frontier: 3D Video**

This talk is not about 3DTV with glasses

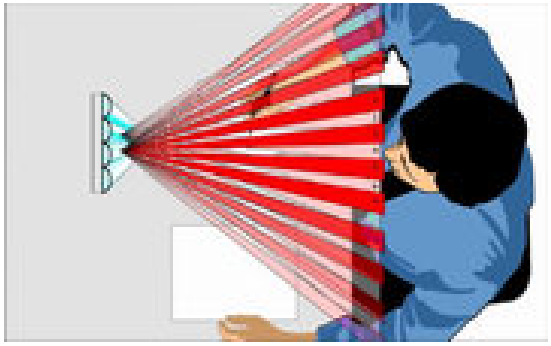
Autostereoscopic 3D Display

Prototype developed at HHI

- 3D impression without glasses
- Automatic head and gaze tracking with built-in cameras
- Automatic adjustment of 3D rendering due to user motion

Multiscopic / Multiuser 3D Display

3D flat panel displays for viewing stereoscopic or 3D images without special eye glasses



Provides up to 9 different views by using a system based in lenticular lenses

E.g., Philips 3D LCD display – shown at IFA 2006

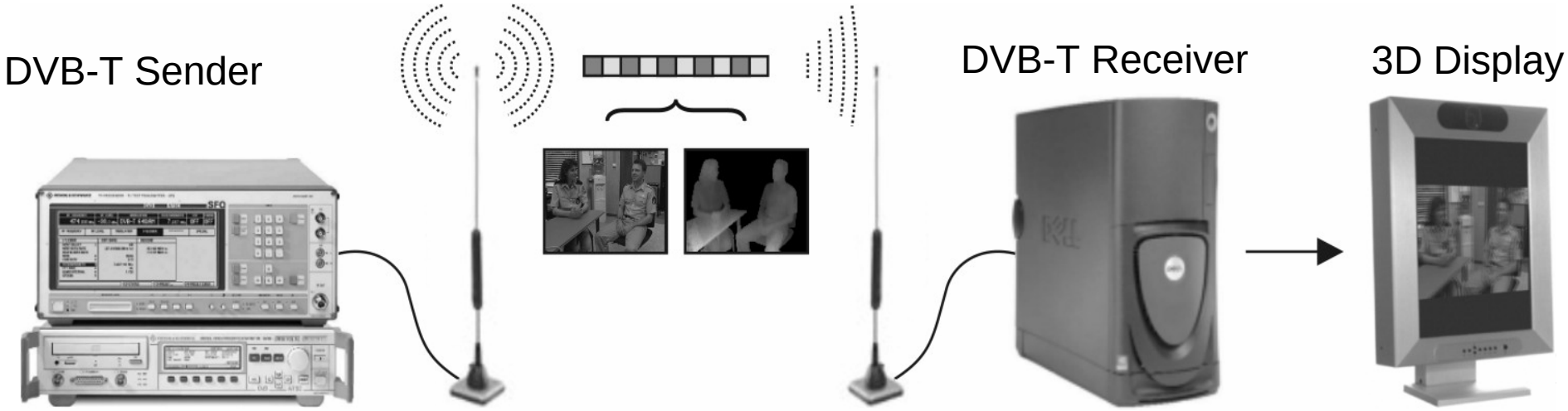
3D Video: 2D Video + Depth

- **Generation of 2 views for each eye from one 2D video plus one map with per pixel depth information**

- **Rendering of a stereo pair at the decoder and displaying on a special 3D display**

3D TV Transmission over DVB-T

- **Demonstrated first time at IBC 2004 in Amsterdam**
- **Two 3D programs (each with video + depth) in one MPEG-2 TS**
- **Video (MPEG-2 @ 3 MBit/s), depth (H.264/AVC @ 300 kbit/s)**
- **MPEG-C Part 3:** Defines a simple container format
  - Backward compatible to existing MPEG video coding standards
  - Includes 2D video + depth + auxiliary data (stereo config)



Conclusions

- **H.264/AVC Video Coding Standard**
  - Successful both in terms of technical and commercial aspects
  - Used in all video application areas (except for Digital Cinema)
- **SVC Extension**
  - Next step in Video over IP
  - Will also be used in Broadcast (e.g., 720p to 1080p)
- **3D TV**
  - Next step is extension towards 3D TV: high-quality multiscopic displays need to be available
  - Efficient video coding for 3D TV is still a topic of research
- **Videoconferencing**
  - Demo: seeing is believing

Videoconferencing heute

- **Raumsysteme für Konferenzräume**
  - Keine Adhoc-Besprechungen möglich
  - Multipoint nur mit teurer MCU
  - Keine Zusammenarbeit per Application Sharing
  - Polycom, Tandberg

- **Webconferencing**
  - Sehr schlechte Integration von Video und Audio
  - Daher meist mit paralleler Telefonkonferenz
  - WebEx, Netviewer

Wer oder was ist daViKo?

- **2001: Gründung der daViKo GmbH**
  - Spin-off der Fachhochschule für Technik und Wirtschaft Berlin
- **Kernkompetenzen**
  - Software Video-Codec Entwicklung
  - Netzwerkprotokoll
- **daViko-Videoconferencing**
  - reine IP-basierte **Software-**Lösung
  - **Multipoint** Konferenzen ohne teure MCU
  - Präsentation und Zusammenarbeit durch **Application Sharing**
  - **Aufzeichnung** und Wiedergabe von Konferenzen
  - **Hohe** Audio- und Video-**Qualität** mit Software-basierten Codecs (**H.264**)

Thank you for your attention!