

# Audio-Visual Content

Ken McCann  
ZetaCast

DVB-AVC Group Chairman



# Who are ZetaCast?

Independent technology consultancy company

- | Specialising in digital TV

ZetaCast directors have each had over 15 years experience of digital TV, including

- | Leading development of the world's first broadcast-quality MPEG-1 decoder
- | Leading design team for the world's first real-time MPEG-2 encoding system
- | Participation in the development of the DVB-T standard
- | Leading the development team for the world's first commercial DVB-T modulator



# Overview of the Presentation

Audio-Visual coding within DVB today

- | based on MPEG-2

Evolution and revolution in compression coding

- | review of history
- | future predictions

Inclusion of new a/v coding schemes in DVB

- | H.264 / AVC video
- | MPEG-4 High Efficiency AAC Profile

Possible initial applications for new a/v coding

Demonstration

# Role of DVB-AVC

## Audio-Visual Content Formats

DVB-AVC does NOT develop coding algorithms

DVB-AVC does

- | Evaluate coding algorithms against commercial requirements
- | Select parameters and define constraints
  - u trade-off between compression efficiency and implementation cost
- | Publish Implementation Guidelines



# MPEG-2

## ISO/IEC 13818 (in 9 parts)

Coding of moving pictures and associated audio

- | Targeted at standard definition TV and HDTV

3 main parts published in 1995:

1. Systems - Transport Stream, PSI etc.
2. Video - extension of MPEG-1
3. Audio - closely based on MPEG-1

Non backwards-compatible audio published 1997

7. Advanced Audio Coding (AAC)



# MPEG-2 in DVB

## TR 101 154

- | First published in 1995 as DVB Blue Book 001
- | Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in satellite, cable and terrestrial broadcasting applications
  - u Systems: MPEG-2 Transport Stream
  - u Video: MPEG-2 Main Profile (SDTV and HDTV)
  - u Audio: MPEG-1 Layer II (plus options)

## TR 102 154

- | Implementation guidelines for the use of MPEG-2 Systems, Video and Audio in contribution and primary distribution applications



# Compression Algorithm and Maturity

MPEG standards define bitstream syntax and semantics, not encoder implementation

- | more sophisticated or better tuned encoders can give significant improvements within the same algorithm
  - u same decoders

Encoder performance tends to improve over time

- | periods of evolution within a specification
- | moments of revolution caused by change of algorithm

The major enabler for improvement is that more complex processing becomes practical with time

- | driver for both evolutionary and revolutionary change

# Moore's Law

The number of transistors that can be built on an integrated circuit doubles with every generation (every 18 to 24 months)

- | Gordon Moore, Fairchild Semiconductor, 1965



# “McCann’s Law”???

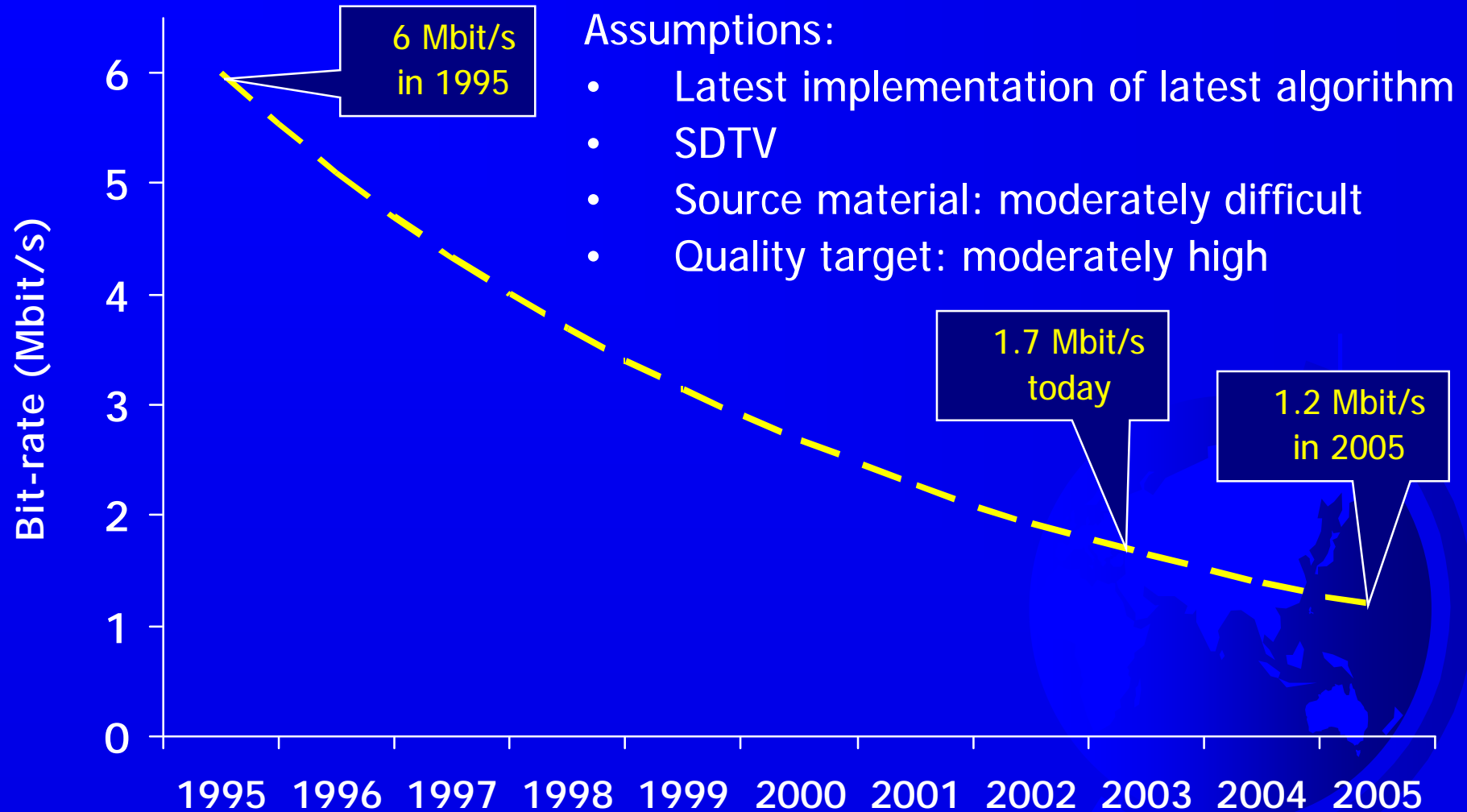
The bit-rate required to achieve a given audio or video quality reduces by an average of 15% per year

Provisos:

- | This is a long-term average
  - u will be periods of evolution and moments of revolution
- | Legacy issues may prevent change of algorithm
  - u predicted bit-rate reduction may not be achieved for existing applications
- | Encoder efficiency is difficult to measure
  - u depends on source material
  - u depends on quality expectations



# Video Coding Evolution and Revolution

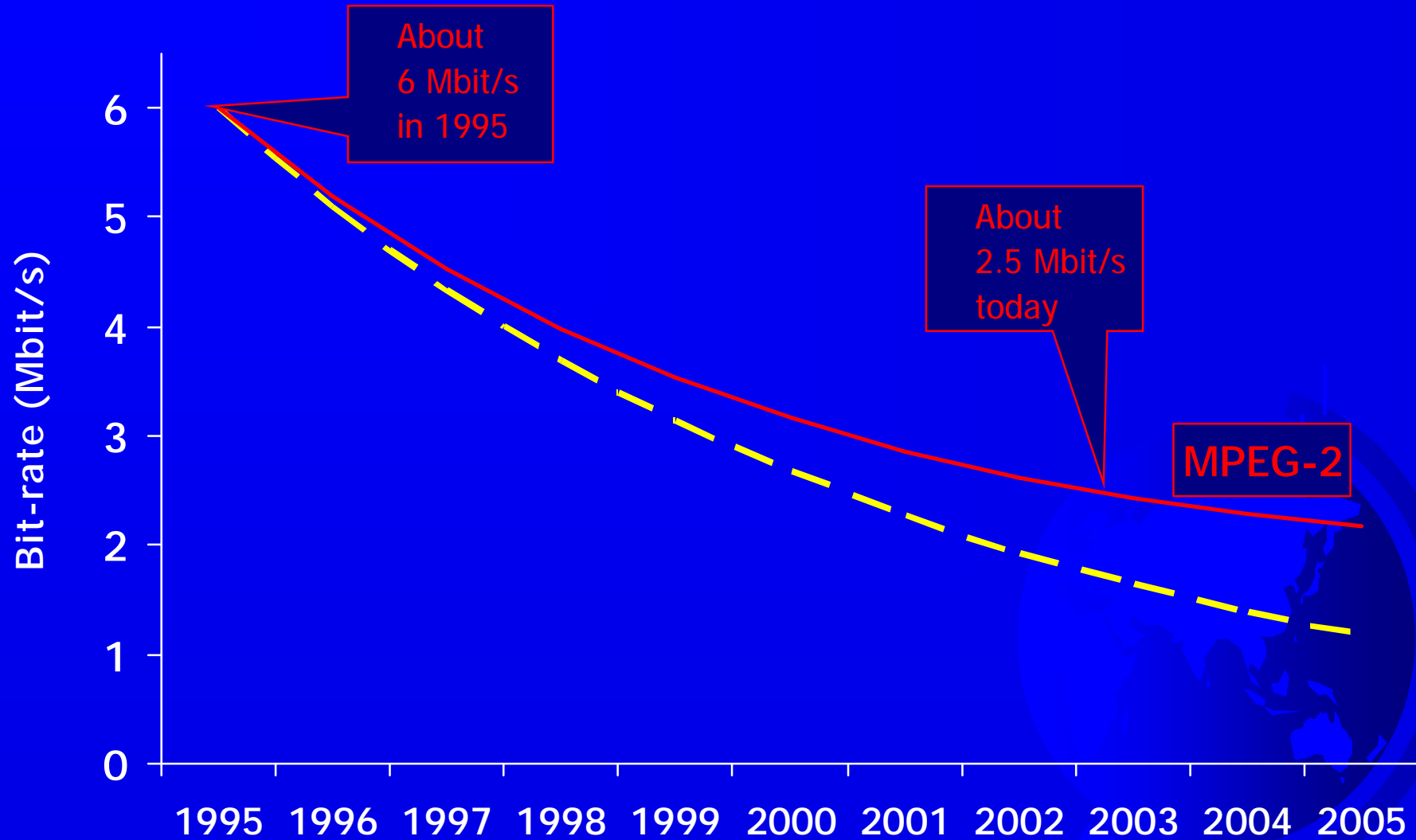


## Assumptions:

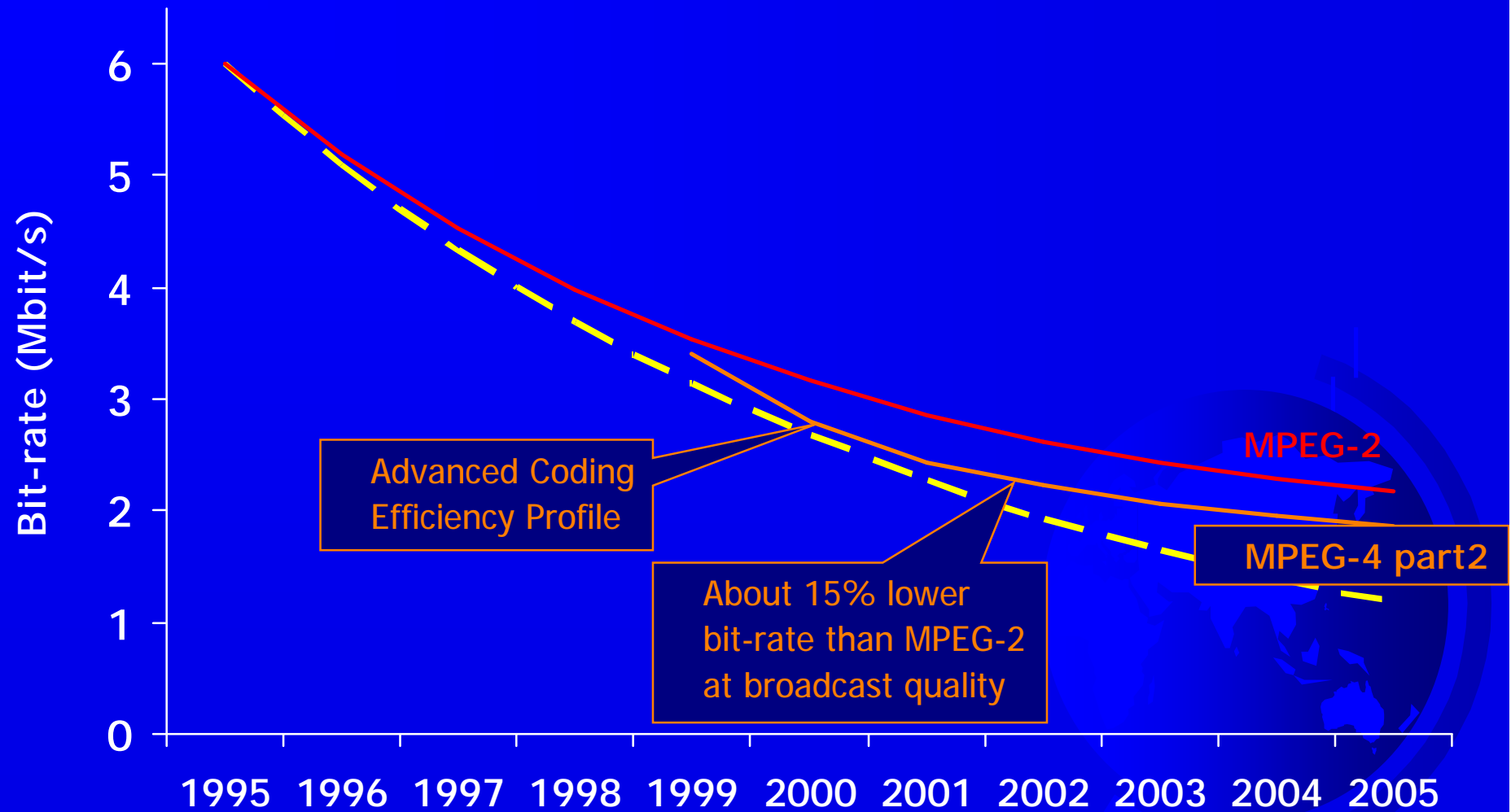
- Latest implementation of latest algorithm
- SDTV
- Source material: moderately difficult
- Quality target: moderately high



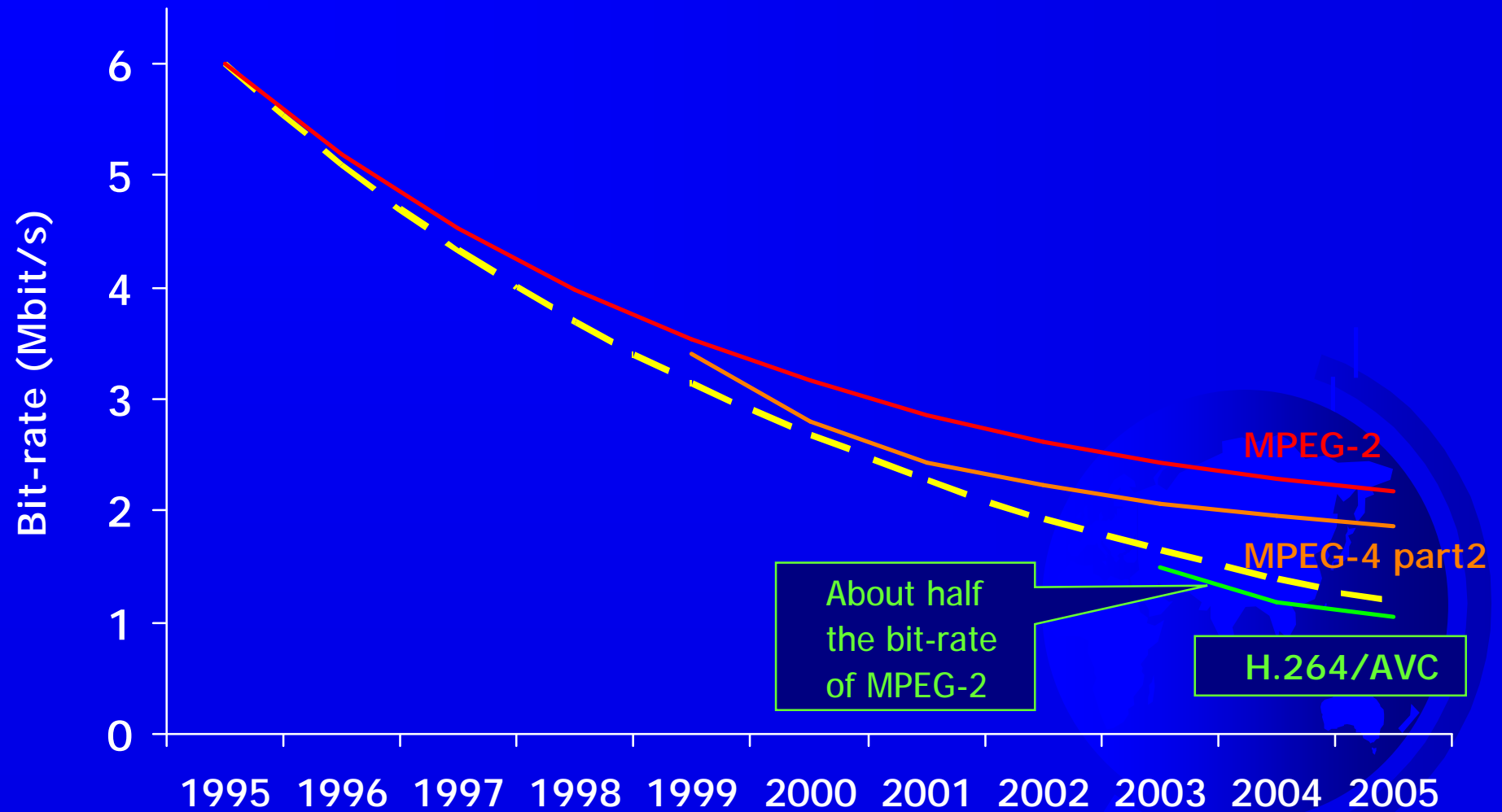
# Video Coding Evolution and Revolution



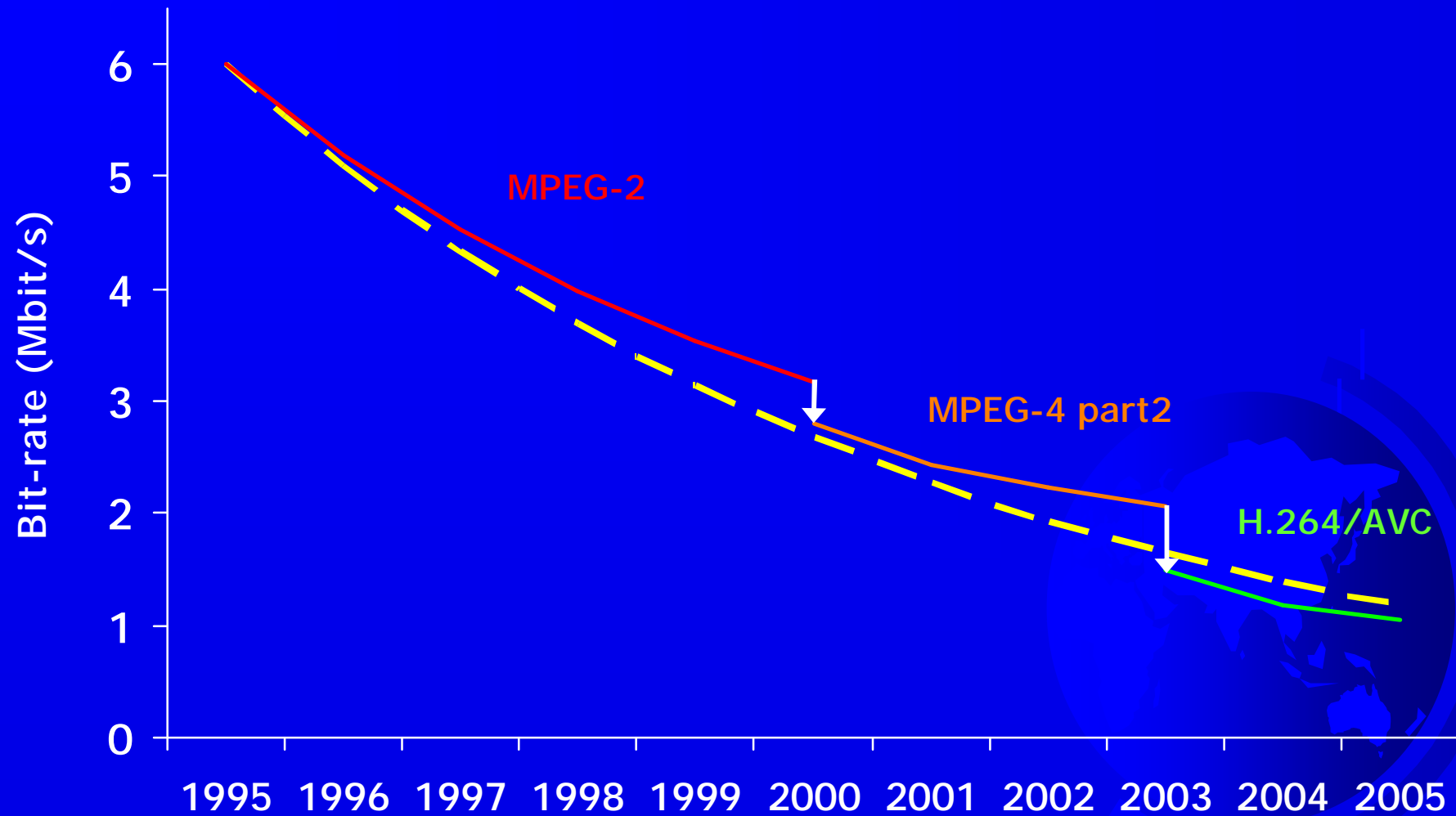
# Video Coding Evolution and Revolution



# Video Coding Evolution and Revolution



# Video Coding Evolution and Revolution



# H.264/AVC

Developed by Joint Video Team of ITU-T and MPEG

- | aka H.26L
- | aka JVT
- | aka MPEG-4 Advanced Video Coding (AVC)
- | aka MPEG-4 part 10

Schedule:

- | Frozen in December 2002
- | Final draft due March
- | Formal publication due July
  - u ITU-T Recommendation H.264
  - u ISO/IEC 14496-10



# H.264/AVC Architecture

Similar fundamental architecture to MPEG-1, MPEG-2 and MPEG-4

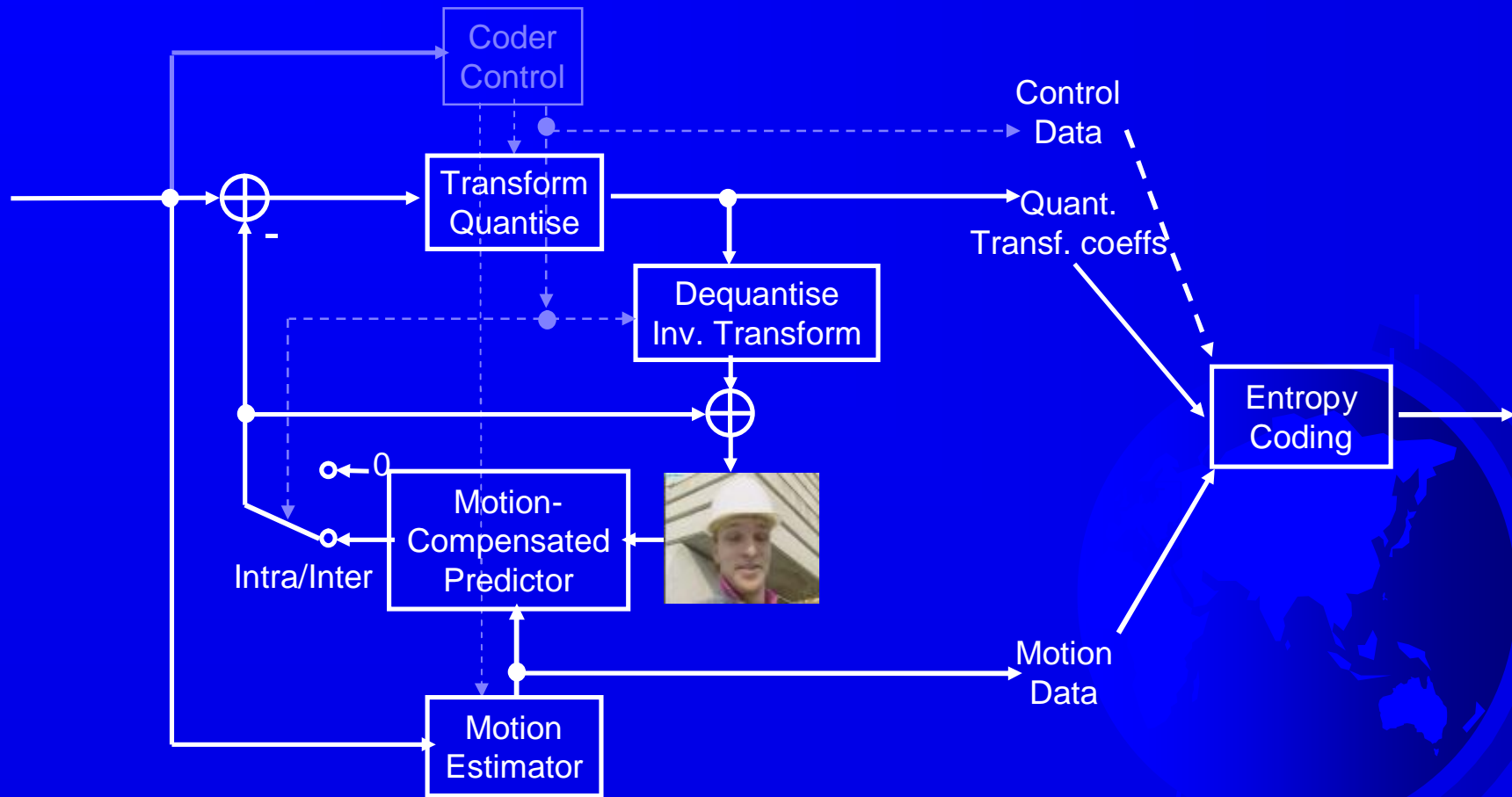
- | motion compensated block transform

## Common elements

- | I, P and B picture types
- | 4:2:0 association of luma and chroma
- | Macroblocks: 16x16 luma + two 8x8 chroma
- | Block transform
- | Block-based motion compensation

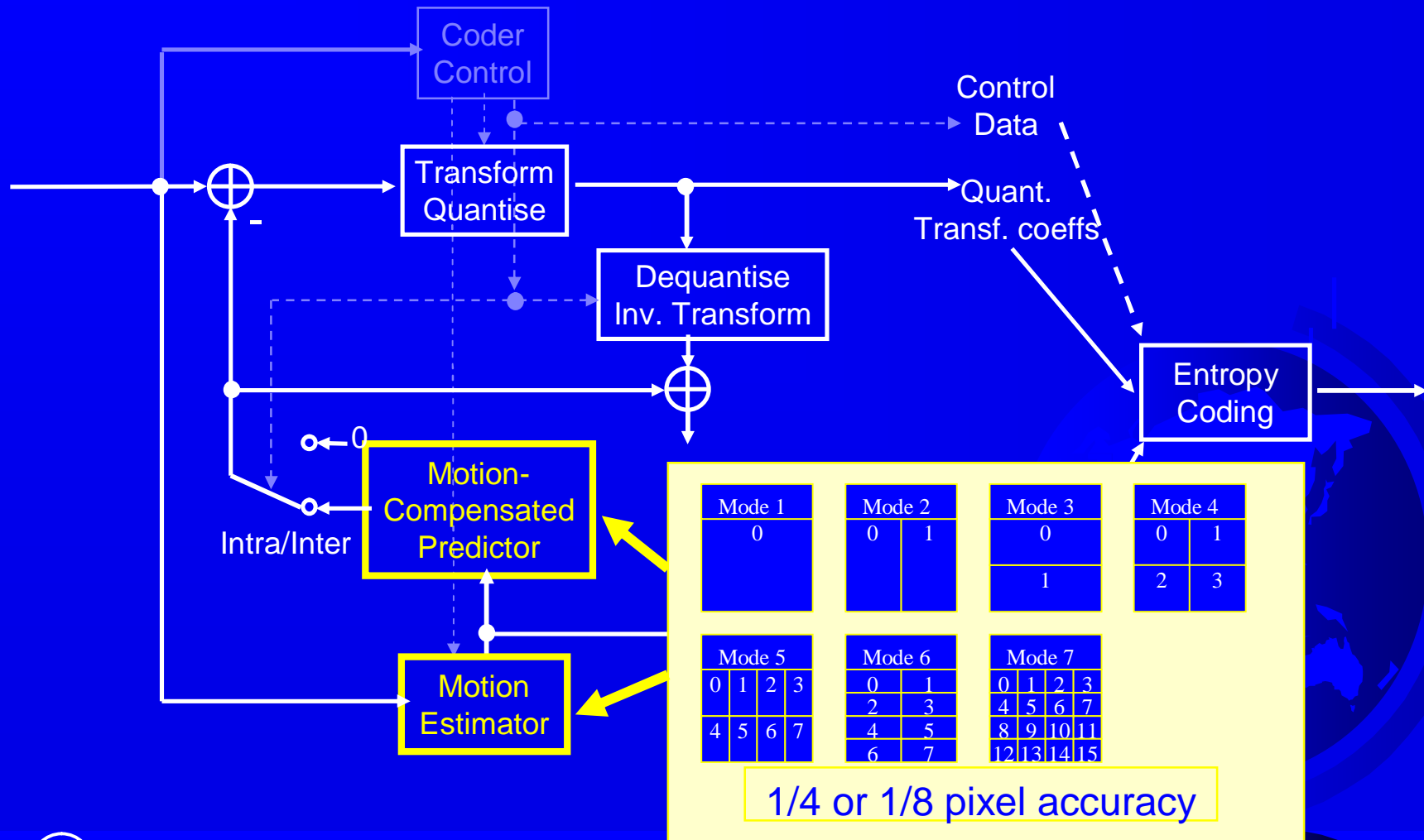


# H.264/AVC Video Coder Architecture

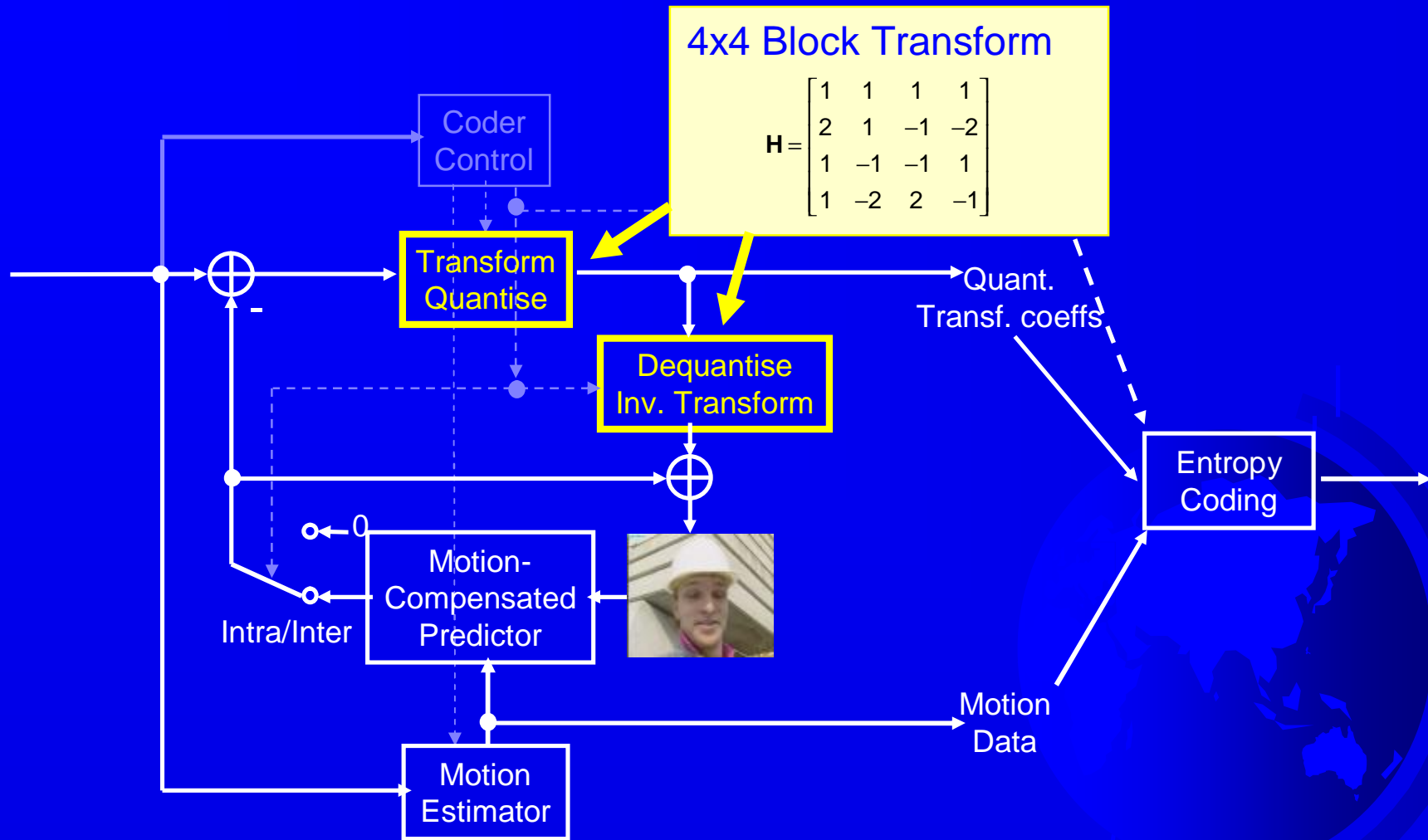




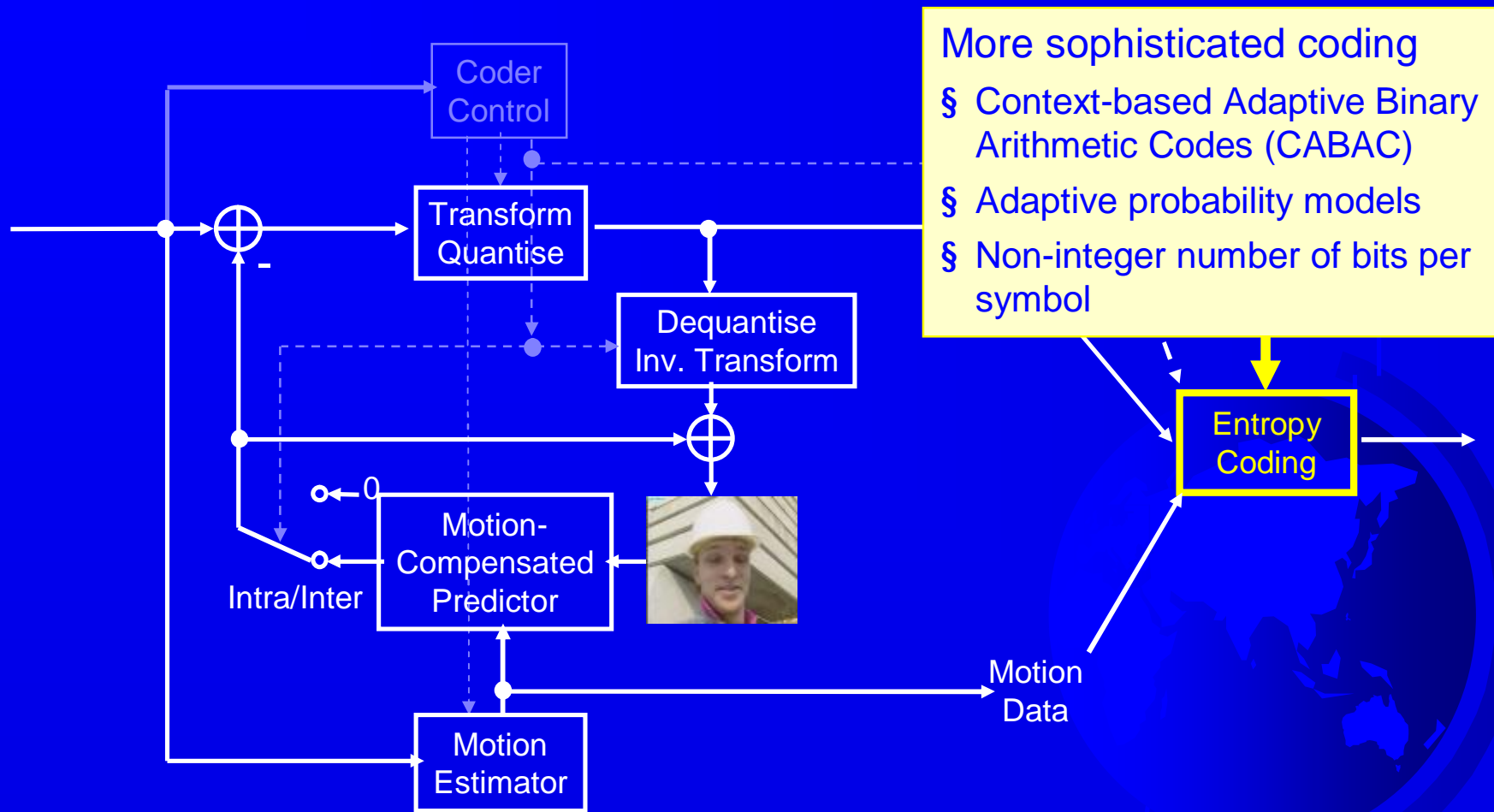
# H.264/AVC Video Coder Architecture



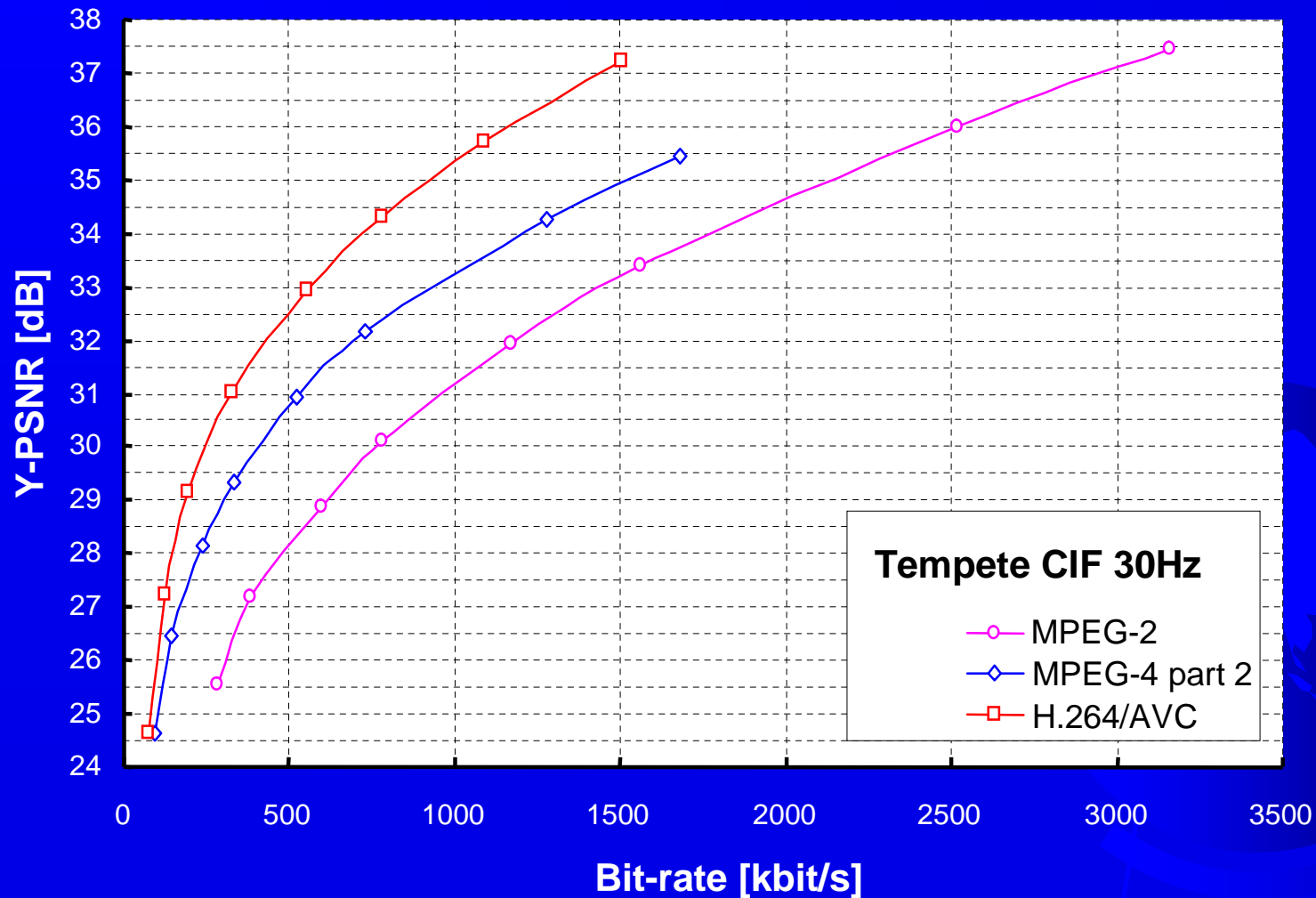
# H.264/AVC Video Coder Architecture



# H.264/AVC Video Coder Architecture



# Comparison of H.264/AVC, MPEG-4 part 2 and MPEG-2



# Advanced Audio Coding

## MPEG-4 High Efficiency AAC Profile

- | MPEG-4 AAC is a development of MPEG-2 AAC
- | MPEG-4 High Efficiency AAC Profile is a further enhancement
  - u spectral bandwidth replication
  - u lower harmonic as predictor for high-frequency information
- | Final draft of Amendment 1 to MPEG-4 part 3 due in March

## Approximate bit-rate equivalents:

- | As demonstrated at DVB World 2002 !
- | 128 kbit/s          MPEG-2 Layer II
- | 64 kbit/s          MPEG-2 AAC
- | 48 kbit/s          MPEG-4 High Efficiency AAC Profile



## Inclusion of new A/V coding schemes in DVB

First priority is new Implementation Guidelines for audio-visual representation for DVB services delivered over IP

- | TR 102 005
- | final draft due in September 2003

Second task is revision of existing implementation guidelines for DVB services based on MPEG-2 TS

- | TR 101 154 - broadcasting applications
- | TR 102 154 - contribution and primary distribution
- | Late 2003 / early 2004



# H.264 / AVC Application Categories

	Typical Display Resolution	Typical Bit-rate	Typical Application
<b>QCIF</b>	176 x 144	50 - 100 kbit/s	UMTS phone PDA
<b>CIF</b>	352 x 288	250 - 500 kbit/s	Mobile receiver PC
<b>SDTV</b>	720 x 576	1 - 2 Mbit/s	Broadcast SDTV DVD
<b>HDTV</b>	1920 x 1080 i 1280 x 720 p	5 - 10 Mbit/s	Broadcast HDTV HD DVD

# Introduction of H.264 / AVC

H.264 / AVC will NOT immediately replace MPEG-2 in existing broadcast services

- | Legacy issues will delay change-over of existing services for many years to come
- | MPEG-2 will continue to dominate SDTV digital TV
  - u MPEG-2 will continue to be the basis of DVB standards
- | H.264 / AVC may be used in emerging markets or for new types of services



# Possible Examples of Initial Applications

## HDTV

- | Not a major legacy problem in the DVB world
- | Decoder is less cost-sensitive than for SDTV
  - u main cost is in the display
- | Bit-rate saving may swing viability of business model

## Personalised DVB services over IP

- | Mobile device with CIF resolution screen
- | Multicast content via DVB-T
- | Return channel and unicast content via UMTS



# Conclusions

New A/V coding standards are being finalised

- | twice the coding efficiency of MPEG-2
  - u increased efficiency needs increased complexity
- | implementable with 2003 technology

DVB specifications will include these new compression standards in 2003

Initial applications will be in emerging markets or for new types of services

- | MPEG-2 will continue to predominate digital TV for many years to come



# Demonstration

## Broadcast Quality SDTV at about 1.5Mbit/s

1.4 Mbit/s video elementary stream

- | H.264/AVC
- | Full SDTV resolution

56 kbit/s audio elementary stream

- | MPEG-4 High Efficiency AAC Profile
- | Joint stereo

Thanks to:

