

# DVB Terrestrial Broadcasting - 1

Peter Barnett, C.Eng.

[peter.barnett@mandercom.co.uk](mailto:peter.barnett@mandercom.co.uk)

+44 1794 341053

# About the DVB

- DVB is a Standards Developing Organisation (SDO)
- Uses ETSI (& CENELEC) to ratify standards
- Originally started as a European organisation, but now world-wide: 100 of its 250 members are from outside Europe

# About the DVB

- DVB's members are drawn from:
  - Broadcasters
  - Network operators
  - Manufacturers
  - Regulators
- There are more than 100 DVB standards

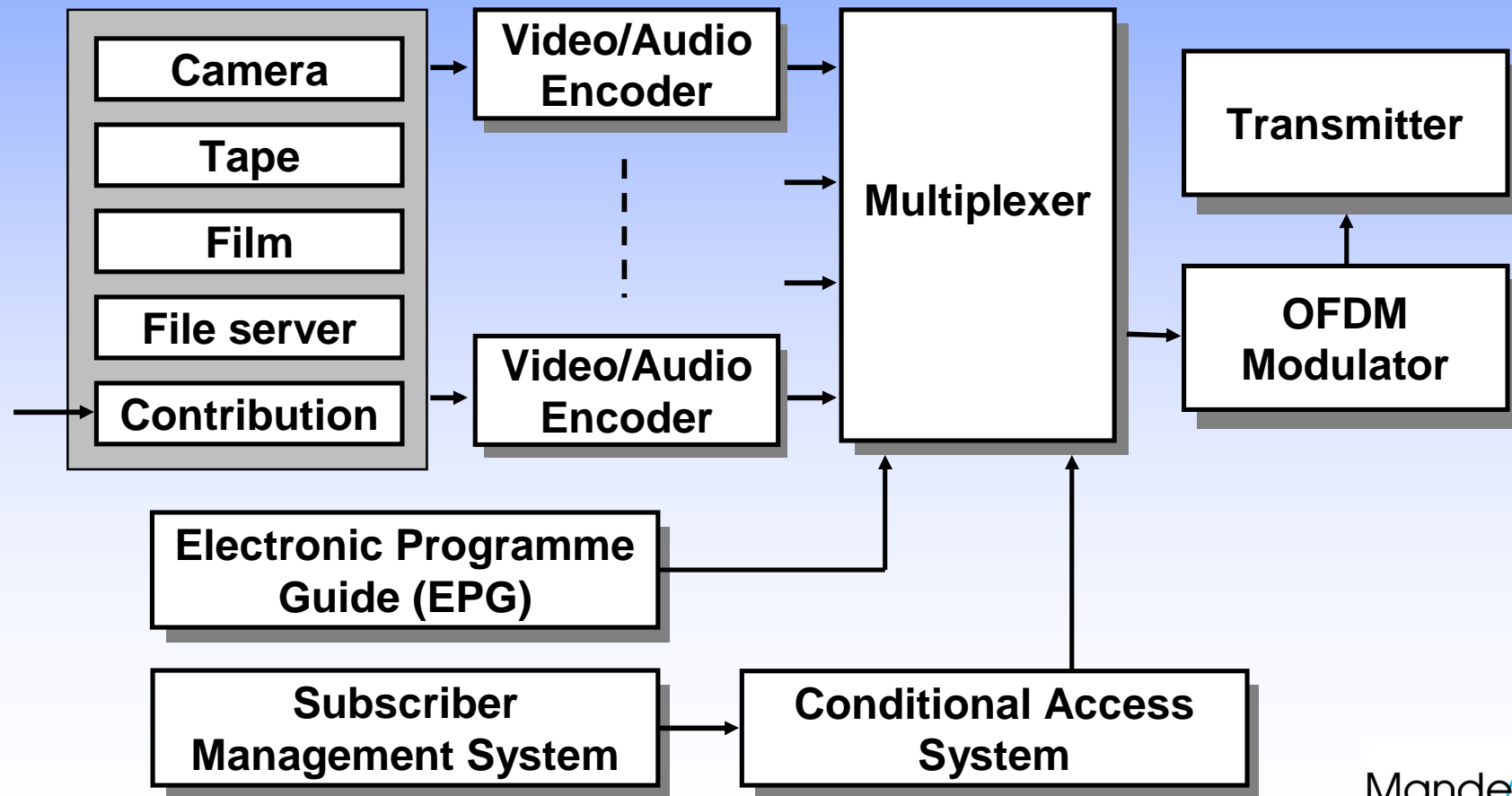
# About the DVB

- DVB services are on the air in every continent
  - Satellite (DVB-S and DVB-S2)
  - Cable (DVB-C and soon DVB-C2)
  - Terrestrial (DVB-T and DVB-T2)
- DVB-S or DVB-S2 is used by about 99% of the world's digital satellite TV services
- DVB-C is used by most of the world's digital cable TV services
- DVB-T has been adopted by more than 120 countries

# Why digital?

- With analogue, you get 1 TV channel per RF channel.
- With digital:
  - you get...lots of channels! (see later for how many)
  - lower transmitter power gives the same coverage as analogue
  - high spectrum efficiency (especially with SFN)
  - you can carry new services: part-time channels, multiple languages, multi-channel audio, subtitles, advanced programme guides (e.g. 7 day, with genres), interactivity, high definition, 3D, radio stations, etc.
  - no network degradation

# The basic building blocks



# Video encoding

- Aim is to reduce the bit-rate to the lowest possible value while maintaining acceptable picture quality
- Most common: MPEG-2
- More efficient: MPEG-4, H.264/AVC

# MPEG-2 Video Compression

Toolbox for bit-rate reduction includes:

- Removal of temporal redundancy: inter-frame compression
- Removal of spatial redundancy (DCT): intra-frame compression
- Quantisation of DCT coefficients
- Variable length coding (VLC)

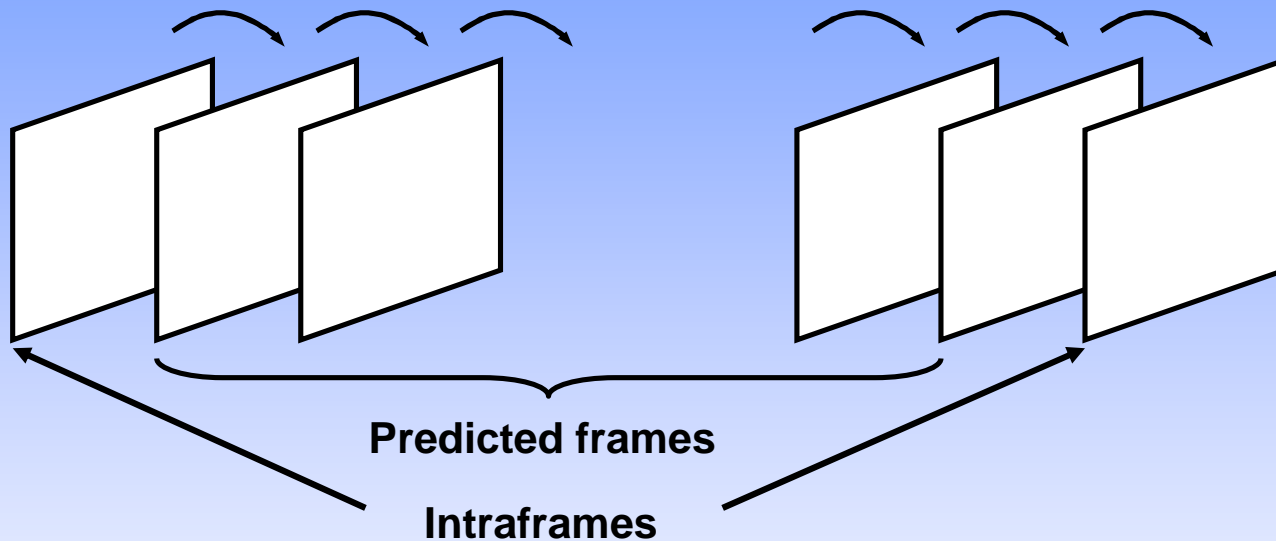
# Temporal redundancy

Three classes of video frame:

- I-frames, make no reference to other frames
- P-frames, predicted from earlier I- or P-frames
- B-frames, predicted from both past and future frames

Only P- and B-frames use temporal redundancy

# Temporal redundancy



- Use motion estimation to predict the next frame.
- Use DCT to encode the difference between predicted and actual.

# Spatial redundancy

- Operates on blocks of 8x8 pixels.
- Discrete Cosine Transform (DCT) converts spatial elements to frequency domain (lossless).
- Scaling related to human vision's perceptual sensitivity.
- Quantisation controlled by feedback from rate buffer.

# Spatial redundancy

Pixel values for  
a block taken from  
a typical picture

176	171	185	203	206	203	193	178
165	156	160	170	171	168	159	152
140	134	136	135	135	134	127	120
131	129	127	128	128	128	128	127
124	122	122	120	120	121	124	119
127	127	127	127	126	126	123	118
127	127	127	127	127	122	117	119
128	127	127	127	125	121	115	114

Increasing horizontal frequency →

Increasing  
vertical  
frequency  
↓

1106	12	-22	12	4	6	2	0
145	-15	-16	10	3	7	1	0
98	-4	-20	4	5	1	1	-1
52	-15	-8	1	-1	2	-2	0
18	-10	-1	-1	-1	1	-2	0
9	-4	-3	-2	1	-1	0	0
-4	2	-4	1	-3	2	1	0
-13	1	0	0	-1	1	1	2

← Values after  
DCT processing

# Spatial redundancy

DCT values after quantisation and scaling:

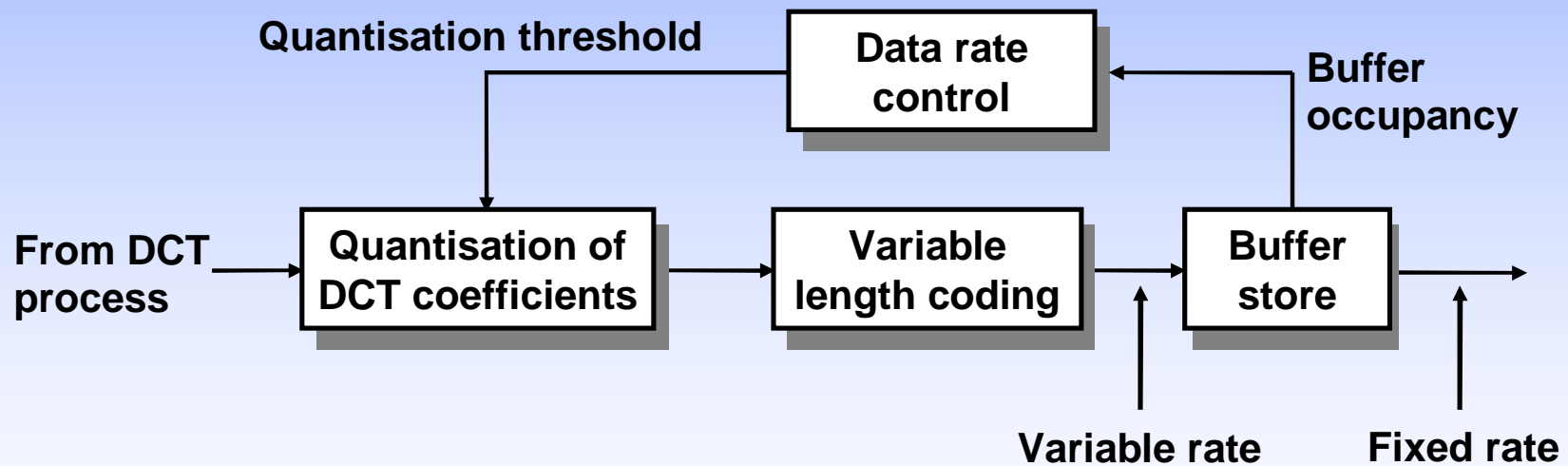
*Increasing horizontal frequency* →

*Increasing vertical frequency* ↓

138	1	-1	0	0	0	0	0
8	-1	-1	0	0	0	0	0
5	0	0	0	0	0	0	0
2	-1	0	0	0	0	0	0
1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0



# Control of quantisation



# Coding artefacts

- Impairments are:
  - different from PAL/NTSC (e.g. cross-colour)
  - dependent on bit rate
  - dependent on picture content
  - mainly due to detail being omitted, and in severe cases can lead to blocks becoming visible
- Broadcaster can trade picture quality with number of services

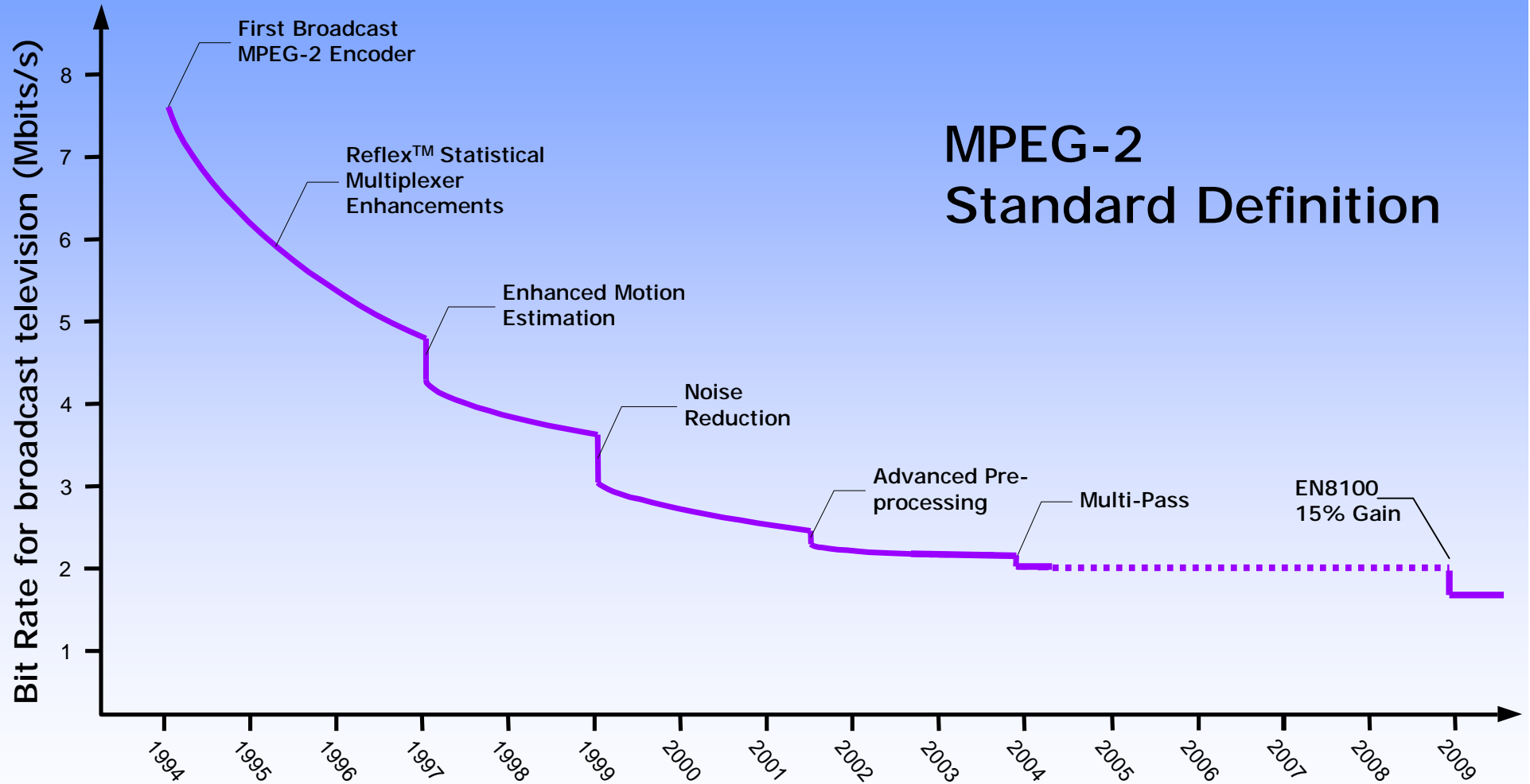
# Statistical Multiplexing

- Share bandwidth between several programmes in a group
- Peaks in demand due to picture content tend not to coincide
- Overall effect is more consistent picture quality

# MPEG audio

- Uses a psychoacoustic algorithm based on the characteristics of the human hearing system.
- Divides the audio spectrum into sub-bands.
- The model determines the just-noticeable level of noise for each sub-band, and adjusts quantisation.
- Loud sounds reduce the ability to hear quiet sounds at other frequencies, so the quiet sounds may not need to be transmitted.

# What bit rate?



Source: Ericsson

# What bit rate?

- **MPEG-2 SD: ~2Mbit/s**
  - May not get significantly better?
- **MPEG-4 SD: ~1.7Mbit/s**
  - Much younger standard, so there should be some way to go in further reducing the bit-rate

# Bit rates for HD

- Early services ran at 15-18Mbit/s
- At IBC 2009, Ericsson demonstrated six channels of video (no audio) in 30Mbit/s
- A DVB-T2 multiplex with 36MHz capacity should easily carry five HD services, maybe six...

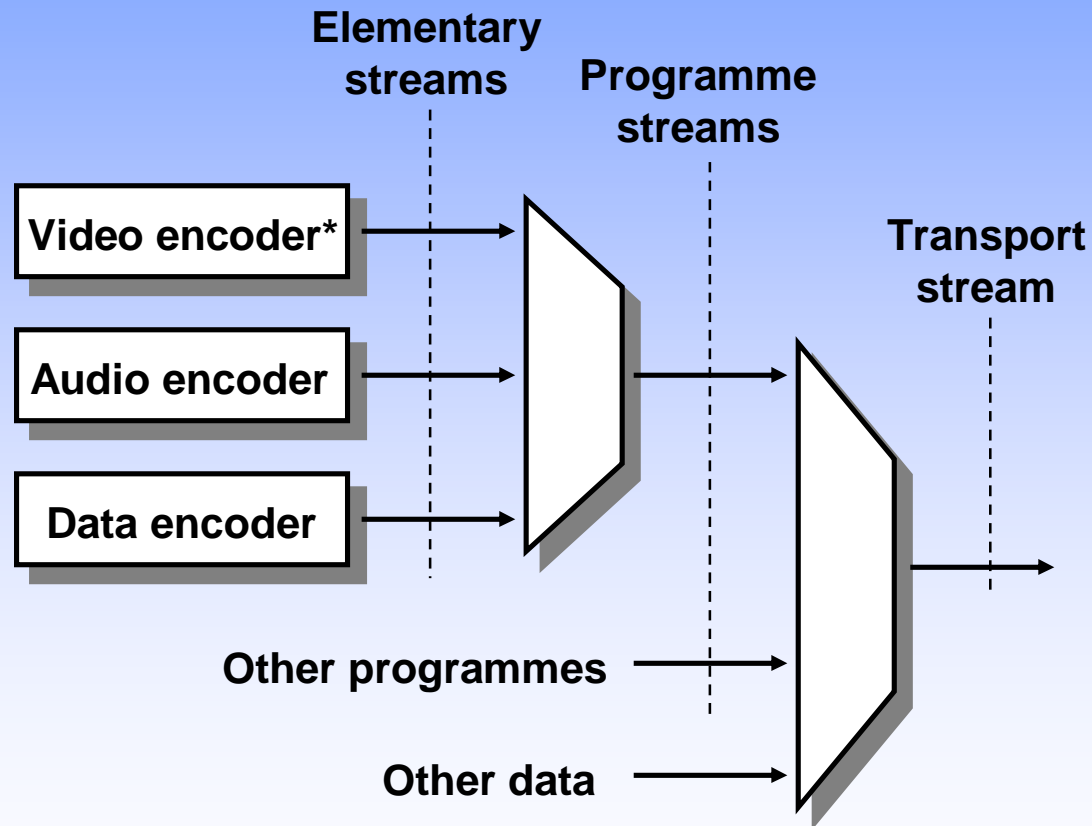
# MPEG system layer

**Elementary Stream**: a stream of information that forms part of a programme, e.g. sound.

**Programme Stream**: a set of elementary streams having a common time base, that form a programme. A programme typically comprises video, associated sound channels, and data.

**Transport Stream**: a combination of one or more programme streams with one or more independent time bases, formed into a single stream. The transport stream is formed into packets of 188 bytes.

# MPEG system layer



\* *standard definition (SD) or high definition (HD)*

*Any questions?*