

MPEG-1 Compression

- MPEG (Moving Pictures Expert Group)
- ISO/IEC standard (ISO CD 11172) in 1993
- Compression: ~26-1 (not 100-1!)
- Maximum data-rate of 1.86Mbps (inc. audio & system streams)
- 1.15Mbps for video is common (VHS quality)
- MPEG-1 syntax allows: 4095x4095x60fps
- Constrained Parameters Bitstream (CPB): 352x240 x30fps or 352x288 x25fps, YUV4:2:0
- Source must be progressive (ie non-interlaced)

Frame types

- I-frames:
 - Similar to JPEG except:
 - Luminance and chrominance share quantisation tables
 - Quantisation is adaptive (table can change) for each macroblock
- P-frames
 - Motion vectors may include half-pixel values, in which case pixels are averaged

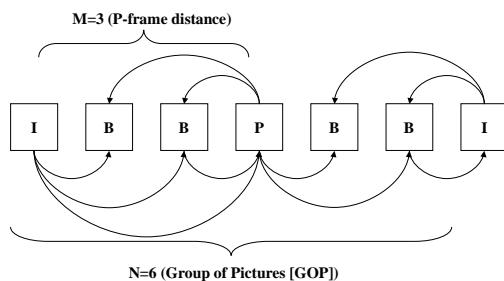
B-frames

- Bi-directional predicted frames (motion vector may point to a macroblock in a future frame, or a past frame, or both!)
- Vector search: try using the past block, the future block, and the average of the two blocks from the past and future frames, and subtracting that from the block being coded. The best result is used.
- B-frames are often reordered for transmission (eg IBBPBBP transmitted as IPBBPBB)

B-frame problems

- Computational complexity (some macroblock modes require averaging between two macroblocks)
- Increase in memory bandwidth (required to get the data between CPU and memory)
- Delay (frame used for backwards prediction needs to be transmitted to the decoder before the intermediate B-pictures can be decoded and displayed)
- Extra picture buffer needed (to store the future prediction reference)

Frame ordering



Typical frame sizes

- I-frame: 150,000 bits
- P-frame: 50,000 bits
- B-frame: 20,000 bits

MPEG-2

- ISO/IEC standard (13818) in 1995
- Aimed at higher quality video
- Supports interlaced formats
- Has extensible profiles (eg main, simple, hierarchical, next...) which constrain algorithms and levels (which constrain parameters)
- Main profile (MP): 2-15Mbps over broadcast channels or digital storage media
- PAL quality: 4-6, NTSC quality: 3-5Mbps
- Main level (ML): 720x480x30fps
- Abbreviated as: MP@ML

MPEG-2 vs MPEG-1

- Sequence layer (progressive vs interlaced)
 - More aspect ratios (eg 16:9)
 - Horizontal and vertical dimensions are now required to be a multiple of 16 in frame coded pictures
 - Syntax can now signal frame sizes as large as 16383 x 16383

MPEG-2 vs MPEG-1

- Picture layer:
 - All MPEG-2 motion vectors are half-pel accuracy.
 - DC precision can be user-selected as 8, 9, 10, or 11 bits.
 - A non-linear macroblock quantization factor that results in a more dynamic step size range, from 0.5 to 56, than in MPEG-1 (1 to 32)

Typical frame sizes

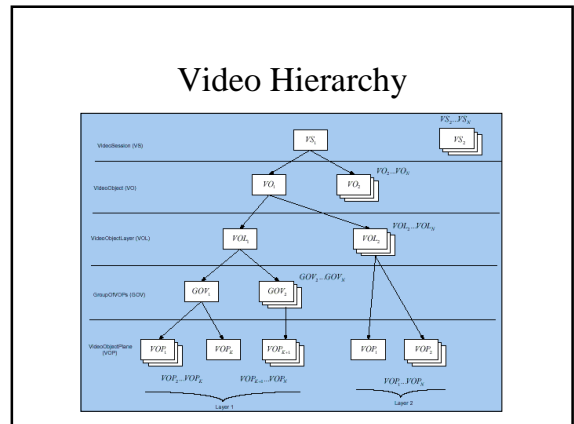
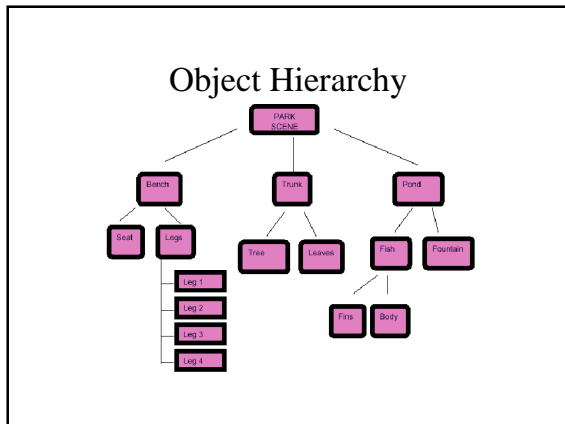
- I-frame: 400,000 bits
- P-frame: 200,000 bits
- B-frame: 80,000 bits

MPEG-3?

- Targeted HDTV applications with sampling dimensions up to 1920 x 1080 x 30 Hz and coded bitrates between 20 and 40 Mbit/sec
- MPEG-2 was found to scale to these dimensions, so MPEG-3 was dropped

MPEG-4 (H.264)

- ISO/IEC 14496 / ITU-T H.264 “Advanced Video Coding” Sept. 2002
- Aimed at low bit-rate, but can go very high (10kbps-1Gbps)
- Functional Elements remain the same, the details change
- Based on objects
- Interaction is possible



- ### DivX
- MPEG-4 compatible compression
 - original DivX 3 codec is based on (reverse engineered from) Microsoft's MPEG-4 V3 codec
 - DivX 4 codec is based on a similar codec developed by "project mayo" (still under development)
 - Good compression at 512kbps-1Mbps