

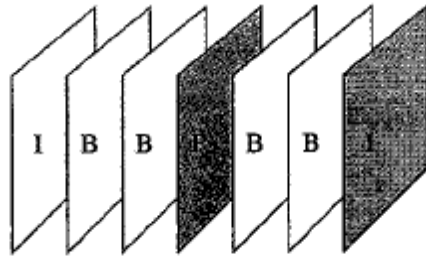
Video Compression: MPEG

The Moving Picture Experts Group method is used to compress video. In principle, a motion picture is a rapid flow of a set of frames, where each frame is an image. In other words, a frame is a spatial combination of pixels, and a video is a temporal combination of frames that are sent one after another. Compressing video, then, means spatially compressing each frame and temporally compressing a set of frames.

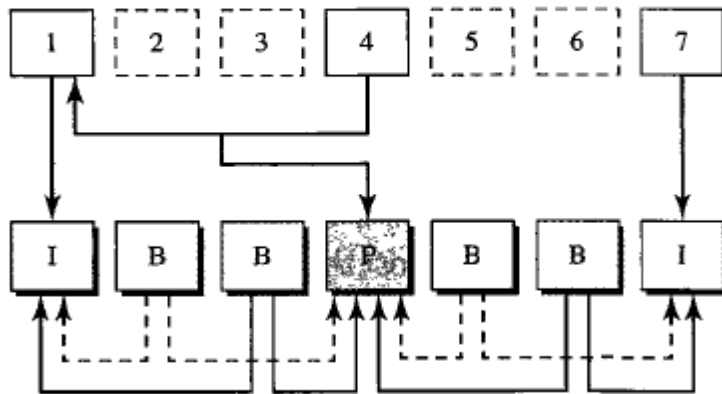
Spatial Compression The spatial compression of each frame is done with JPEG (or a modification of it). Each frame is a picture that can be independently compressed.

Temporal Compression In temporal compression, redundant frames are removed. When we watch television, we receive 50 frames per second. However, most of the consecutive frames are almost the same. For example, when someone is talking, most of the frame is the same as the previous one except for the segment of the frame around the lips, which changes from one frame to another. To temporally compress data, the MPEG method first divides frames into three categories: I-frames, P-frames, and B-frames.

- **I-frames.** An intracoded frame (I-frame) is an independent frame that is not related to any other frame (not to the frame sent before or to the frame sent after). They are present at regular intervals (e.g., every ninth frame is an I-frame). An I-frame must appear periodically to handle some sudden change in the frame that the previous and following frames cannot show. Also, when a video is broadcast, a viewer may tune in at any time. If there is only one I-frame at the beginning of the broadcast, the viewer who tunes in late will not receive a complete picture. I-frames are independent of other frames and cannot be constructed from other frames.
- **P-frames.** A predicted frame (P-frame) is related to the preceding I-frame or P-frame. In other words, each P-frame contains only the changes from the preceding frame. The changes, however, cannot cover a big segment. For example, for a fastmoving object, the new changes may not be recorded in a P-frame. P-frames can be constructed only from previous I- or P-frames. P-frames carry much less information than other frame types and carry even fewer bits after compression.
- **B-frames.** A bidirectional frame (B.frame) is related to the preceding and following I-frame or P-frame. In other words, each B-frame is relative to the past and the future. Note that a B-frame is never related to another B-frame.



MPEG frame construction



MPEG has gone through two versions. MPEG1 was designed for a CD-ROM with a data rate of 1.5 Mbps. MPEG2 was designed for high-quality DVD with a data rate of 3 to 6 Mbps.