MPEG Video Standards

ISO MPEG Standards

- **MPEG-1**
  - standard for storage and retrieval of moving pictures and audio on storage media
- **MPEG-2**
  - a standard for digital television
- **MPEG-4**
  - a standard for multimedia applications
- **MPEG-7**
  - content representation standard for information search
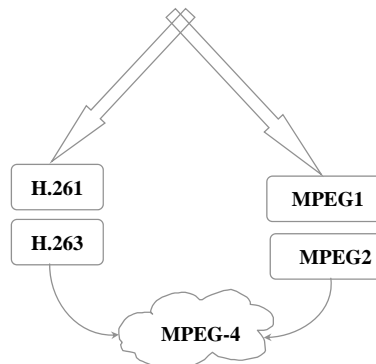

Video Compression Standards Roadmap

Communications
- Real-time encode and decode
- Low delay
- Low bit-rate

Information/Entertainment
- Real-time decode
- Delay not critical

H.261
H.263
MPEG1
MPEG2
MPEG-4

MPEG Standards

- **Are generic.**
  - Application independent
- **Specify the syntax of the coded bit stream and the decoding process**
  - enough flexibility for creativity in encoding process

- **Consist of multiple major parts**
  - Systems
  - Video
  - Audio
  - Compliance Testing

MPEG-1 Requirements

- **Primary application**
  - **Video on Digital Storage Media - CD-ROMs, video CDs**

- **Requirements: High compression & Random access**
  - **Coding of SIF noninterlaced video at about 1.5 Mbits/s with good quality**
  - **Random access to a frame in limited time**
  - **Trick modes such as fast forward/fast reverse**
  - **Tradeoff of video quality with coding/decoding delay**
    - » **important for conversational applications**
 - **Bitstream editability**
  - **A practical decoder**

Picture Types in MPEG-1

- **Intra-coded pictures (I pictures)**
  - **Intraframe coding**
  - **fast random access but moderate compression**
- **Predictive-coded pictures (P pictures)**
  - **motion compensated prediction from a past I-picture or P-picture**
- **Bidirectionally predictive-coded pictures (B pictures)**
  - **motion compensated prediction from a past and/or future I-picture or P-picture**
  - **not used for reference pictures**
  - **higher compression ratio**
- **DC-coded pictures (D pictures)**
  - **similar to I pictures**
    - » **only DC coefficients are present**
  - **not used with other picture types**

MPEG-1 Picture Types
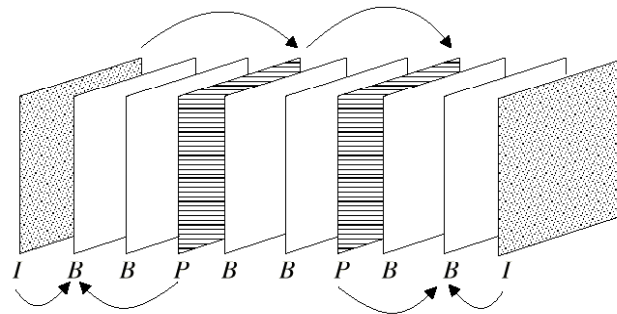
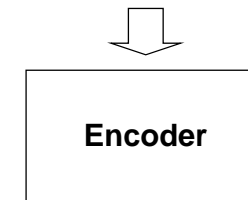**Different types of frames**
- I - intracoded frame
- P - forward/predicated frame
- B - bi-directional/interpolated frame

Picture Order in the Coded Bitstream

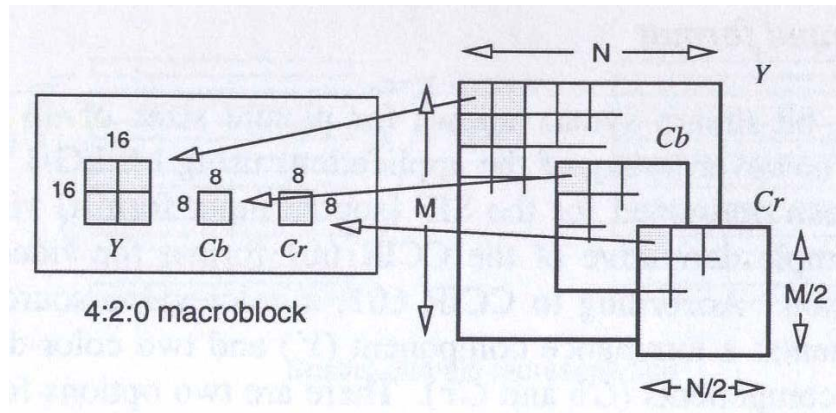$_1$**I** $_2$**B** $_3$**B** $_4$**P** $_5$**B** $_6$**B** $_7$**P**

Encoder

$_1$**I** $_4$**P** $_2$**B** $_3$**B** $_7$**P** $_5$**B** $_6$**B**

Macroblock

Overview of an MPEG Encoder
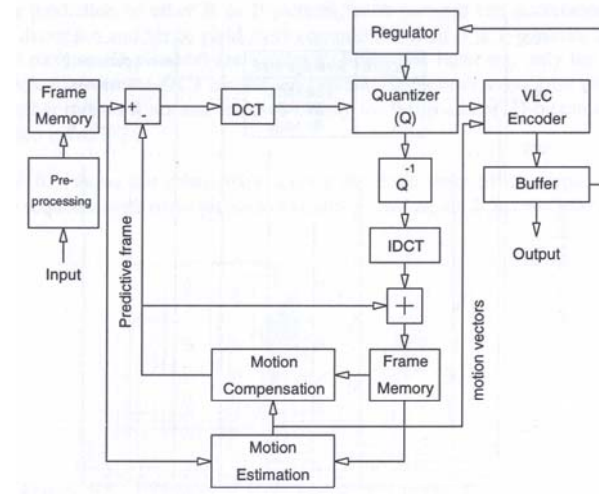
Forward Motion Compensation
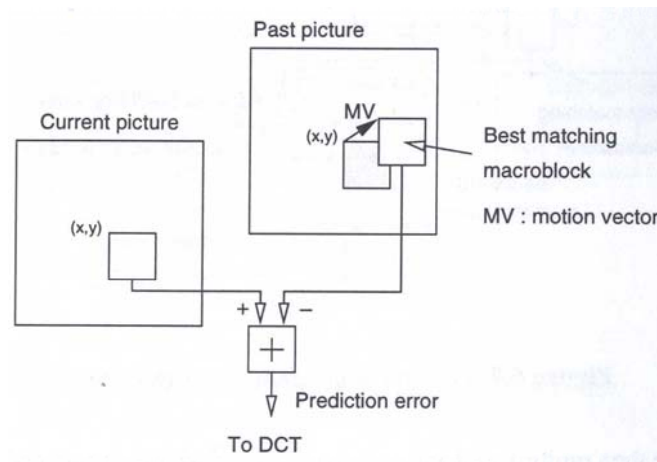
Bidirectional Motion Compensation
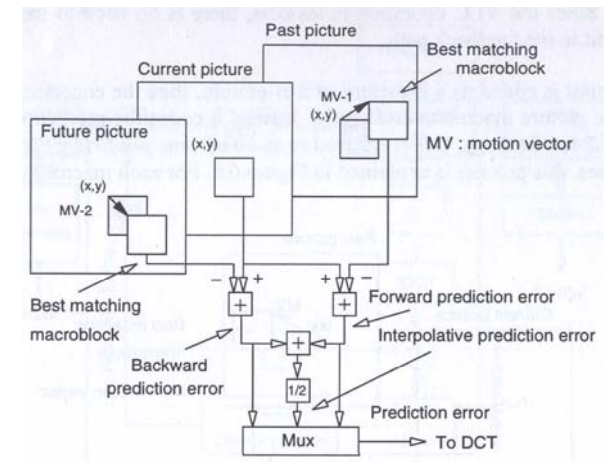
Overview of an MPEG Decoder
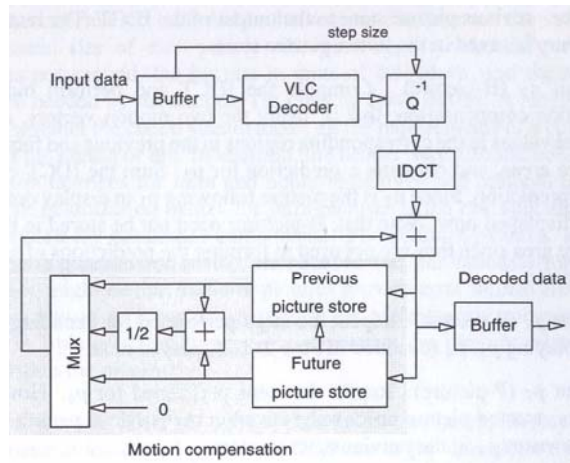
Motion compensation

Structure of Coded Video Bit Stream
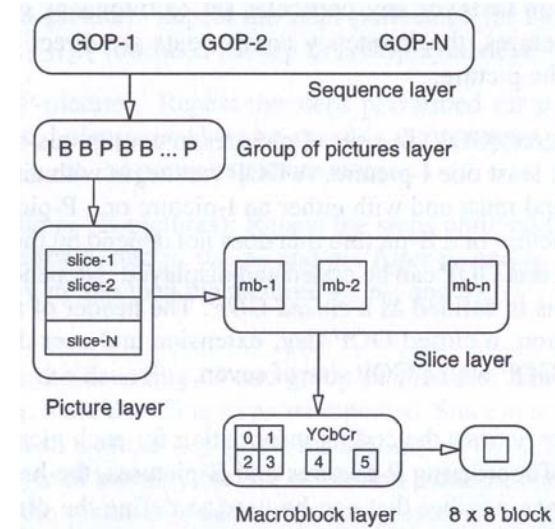
– **A sequence layer**
– **A group of pictures layer**
– **A picture layer**
– **A slice layer**
– **A macroblock layer**
– **A block layer**

Macroblock Layer

0	1
2	3

Y

4
Cb

5
Cr
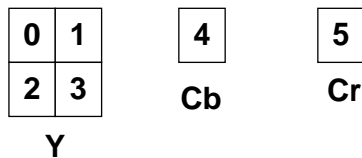
- **16x16 motion compensation unit**
- **A macroblock header includes:**
  - type
  - motion vector
  - *quantizer_scale_code*
  - coded block pattern
    - » indicates which blocks in the MB are coded