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Digital Broadcasting and Broadband Technologies (Master Studies)
Erasmus+ Project No. 561688-EPP-1-2015-1-XK-EPPKA2-CBHE-JP

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DBBT

Digital Broadcasting & Broadband Technologies

Digitalni radiodifuzni sistemi i tehnologije

Izvorno kodovanje - video

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Kodovanje video signala

KAKO SE MOŽE POSTIĆI ZAHTEVANI REDUKOVANI PROTOK PODATAKA, ZA PRENOS DTV SADRŽAJA?

KORIŠĆENJEM DVE TEHNIKE:

- **REDUKCIJE KOLIČINE PODATAKA**
- **KOMPRESIJA PODATAKA**

- **Redukcija količine podataka = ireverzibilan (nepovratan) gubitak nepotrebnih informacija**
- **Kompresija podataka = kompresija i kodovanje neophodnih informacija na efikasan način.**

Kodovanje video signala

- Full resolution broadcast:
  - Bitrates:

    SQCIF 192x144@15fps = 10Mbps

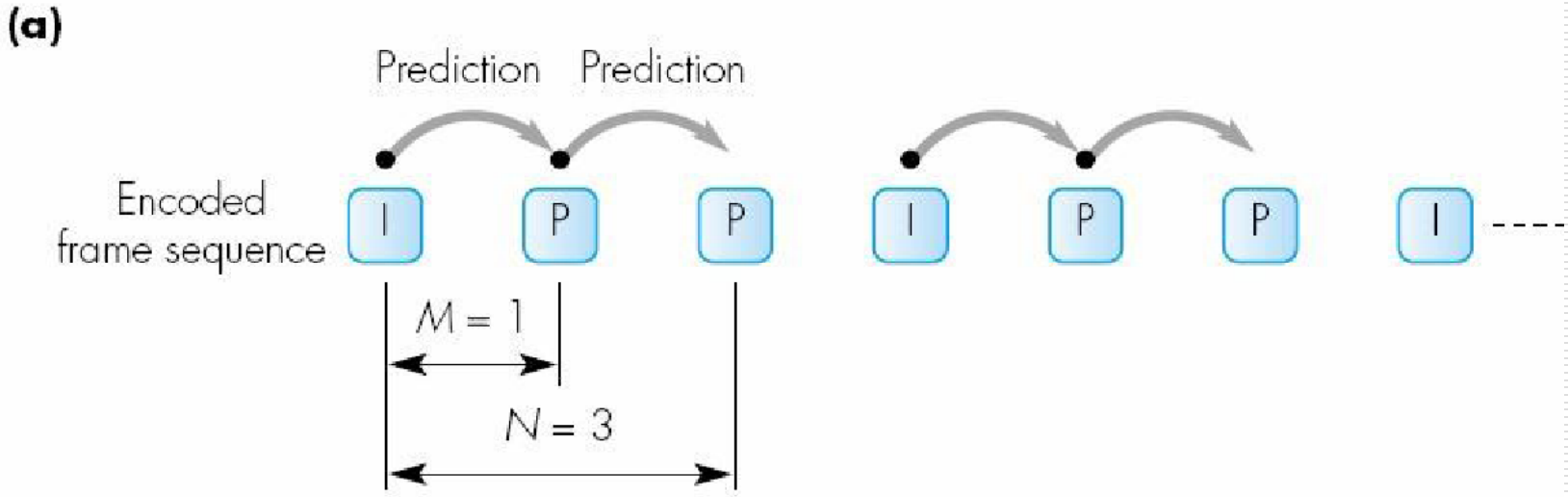
    DVB 720x480@25fps = 162Mbps
- Standard digital broadcast channel - 8MHz
- How to compress DVB video?
- High redundancy in space and time

Kodovanje video signala

- Independent frame coding: MJPEG 10:1-20:1
- High correlation between successive frames
- Prediction in time: estimate frame pixels
- Improved by motion estimation/compensation

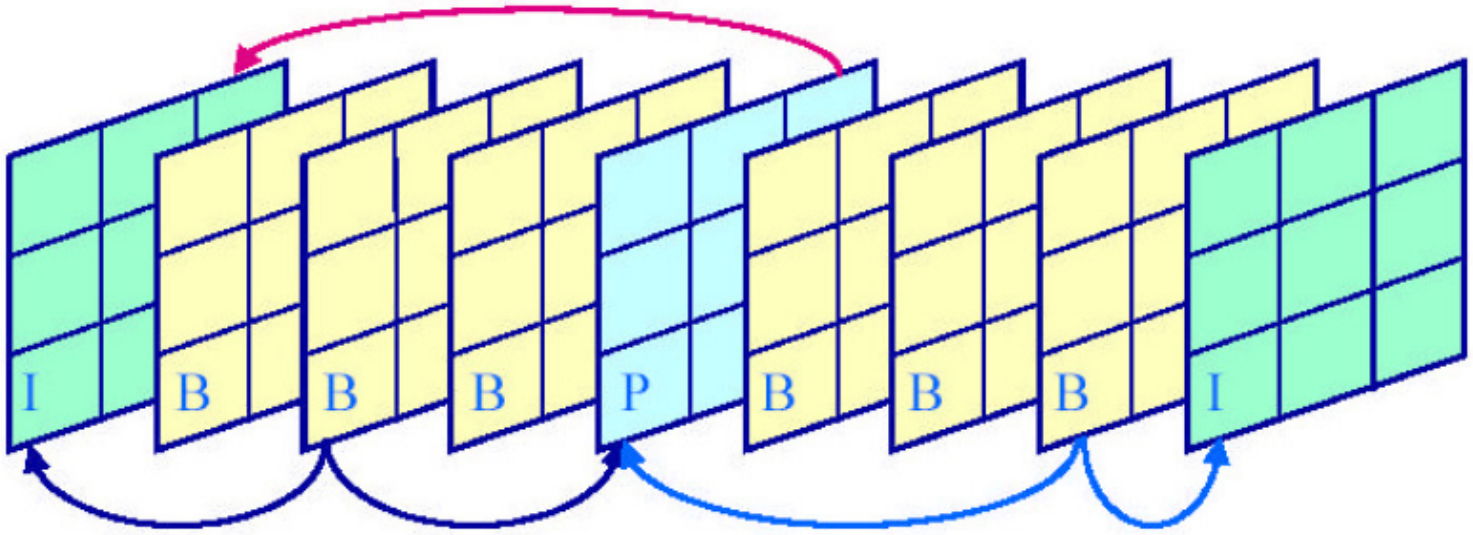
Vremenska predikcija – tipovi frejmova

- Intracoded I-frames: N=3-12, shot changes
- Predicted P-frames: M=1-3, error propagation



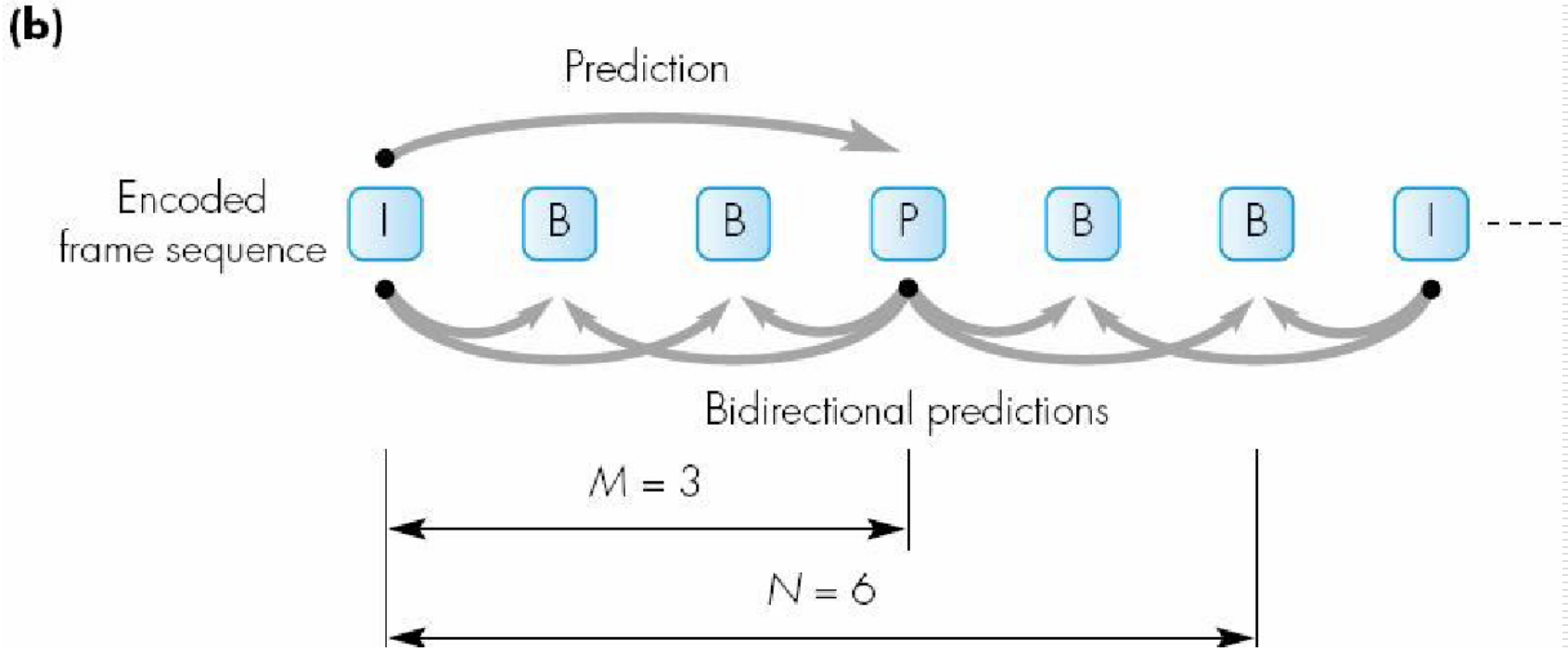
Vremenska predikcija – tipovi frejmova

- Postoje 3 tipa slika u MPEG toku podataka
  - I - Intra kodirana slika (JPEG)
  - P - Predikovana slika od prethodne I ili P slike
  - B - Bi-direkciona predikovana slika (interpolirana)



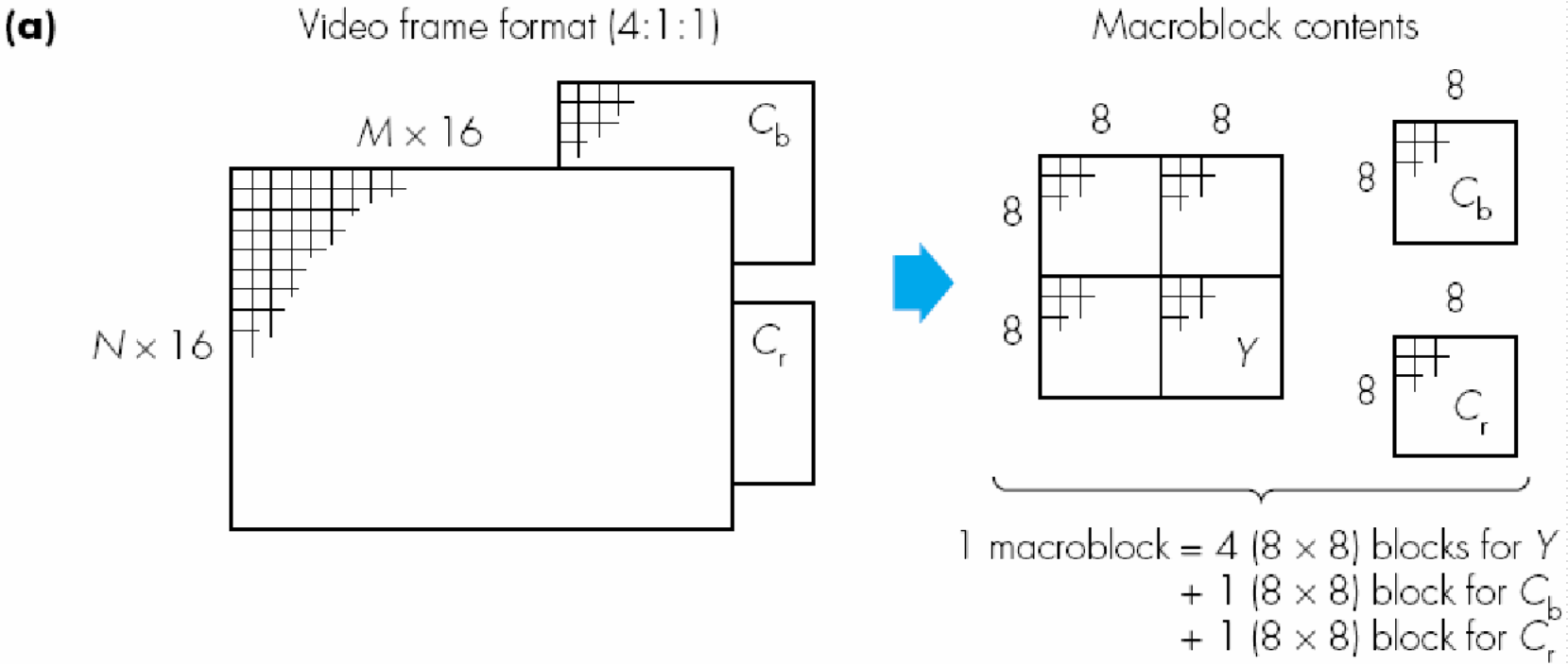
Kodovanje video signala

- Bi-directionally predicted B-frames, highest compr.
- D-frames - DC coeff. based FFW/REW low-res
- GOP
  - display order: IBBPBBPBBI
  - coding order: IPBBPBBIBB

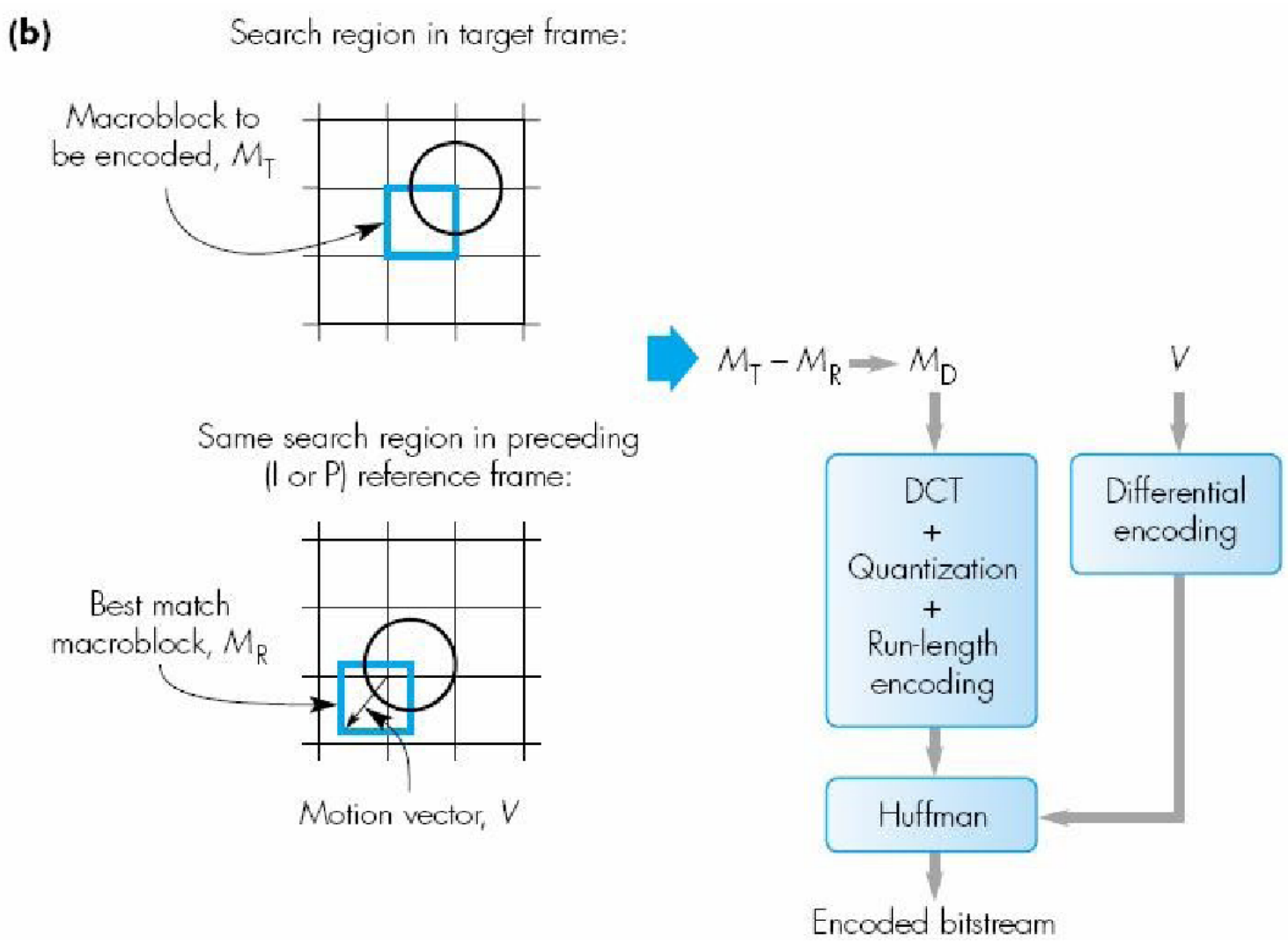


Procena / kompenzacija kretanja

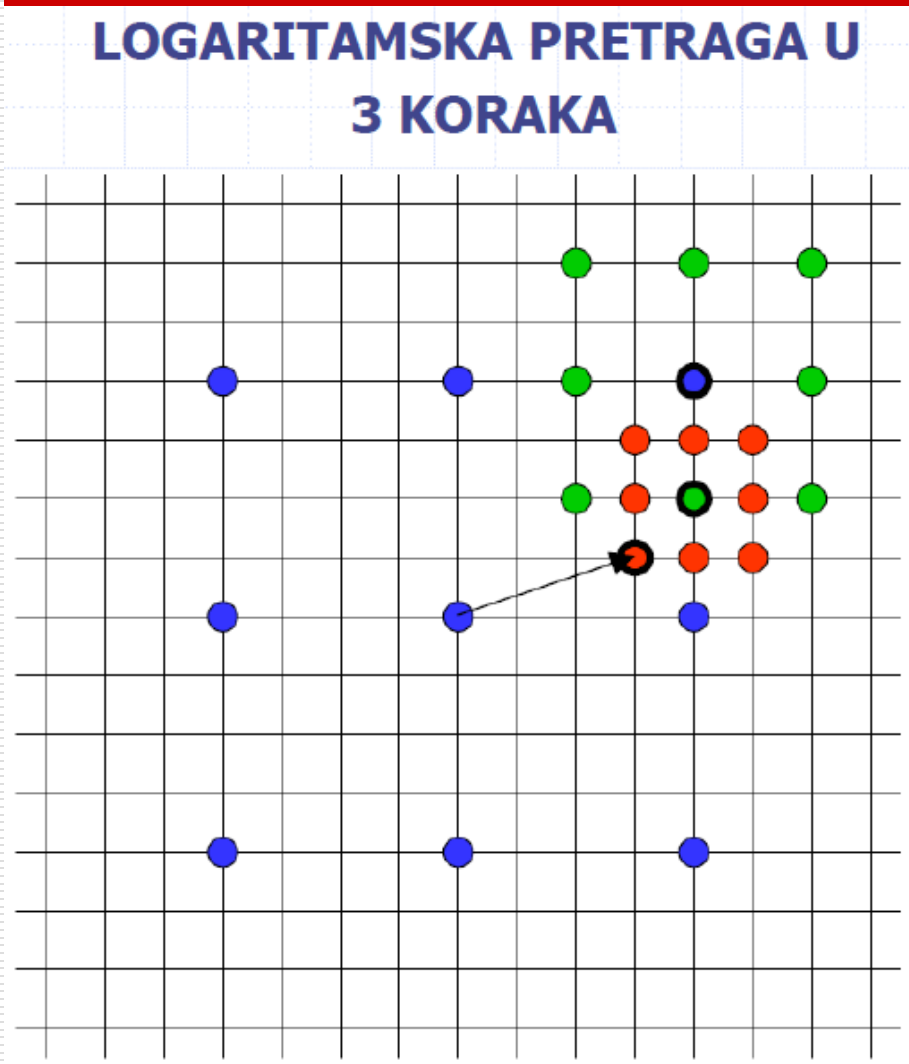
- MPEG-1/2 Block based, MPEG-4 Object based
- MacroBlock:
  - 4xY+2x(Cr+Cb)
  - 8x8 blocks



Procena / kompenzacija kretanja



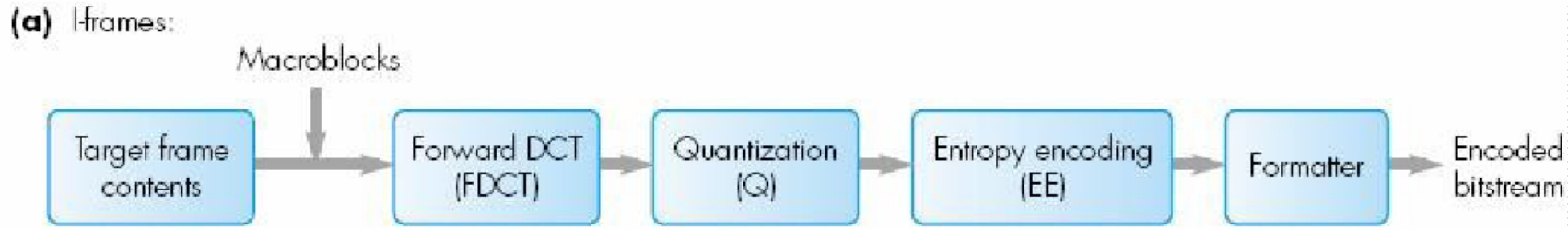
Procena/kompenzacija kretanja



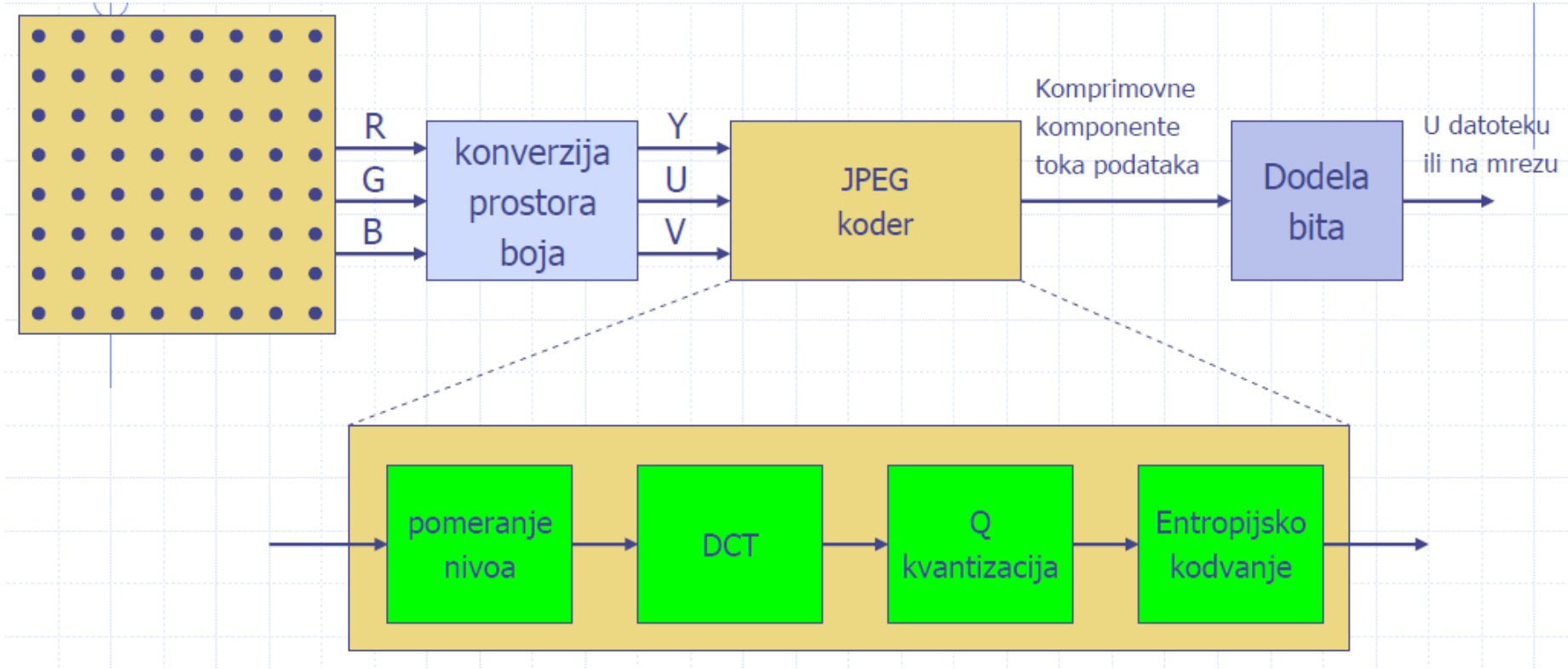
- **Cilj**: smanjiti broj tacaka u kojima racunamo razliku
- Primer: oblast pretrage (±7, ±7) oblst pretrage
- Pretraga se vrsi u tri koraka (od grublje, ka finijoj):
  - Korak 1: **o** (±4 piksela)
  - Korak 2: **o** (±2 piksela)
  - Korak 3: **o** (±1 piksela)
- Nalazi se najbolje poklapanje u svakoj tacki
- U sledecem koraku to je pocetna tacka
- Ubrzanje je - DRASTICNO

Kodovanje I frejmova

- JPEG like encoding
- DCT 8x8 blocks : grouping informaition
- Zig-zag scanning
- Quantisation
- Entropy encoding

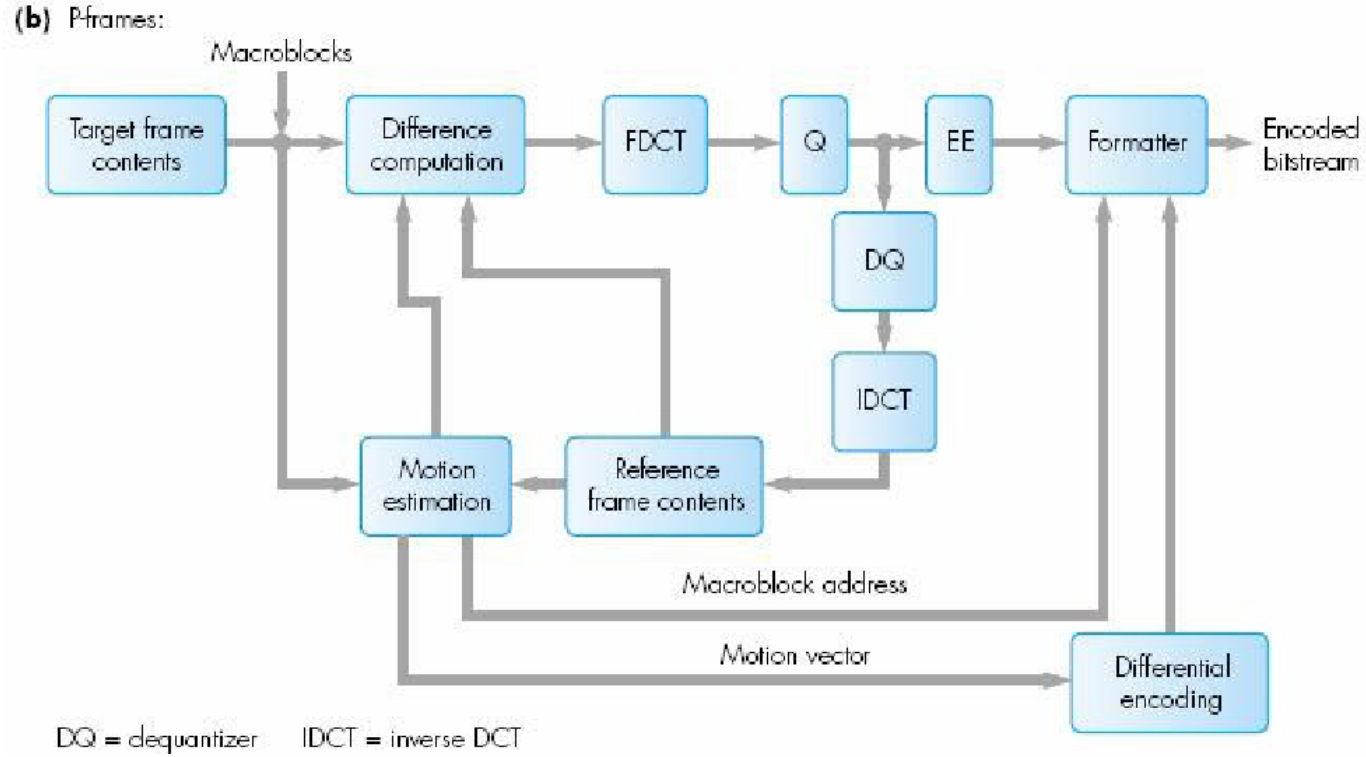


Kodovanje I frejmova



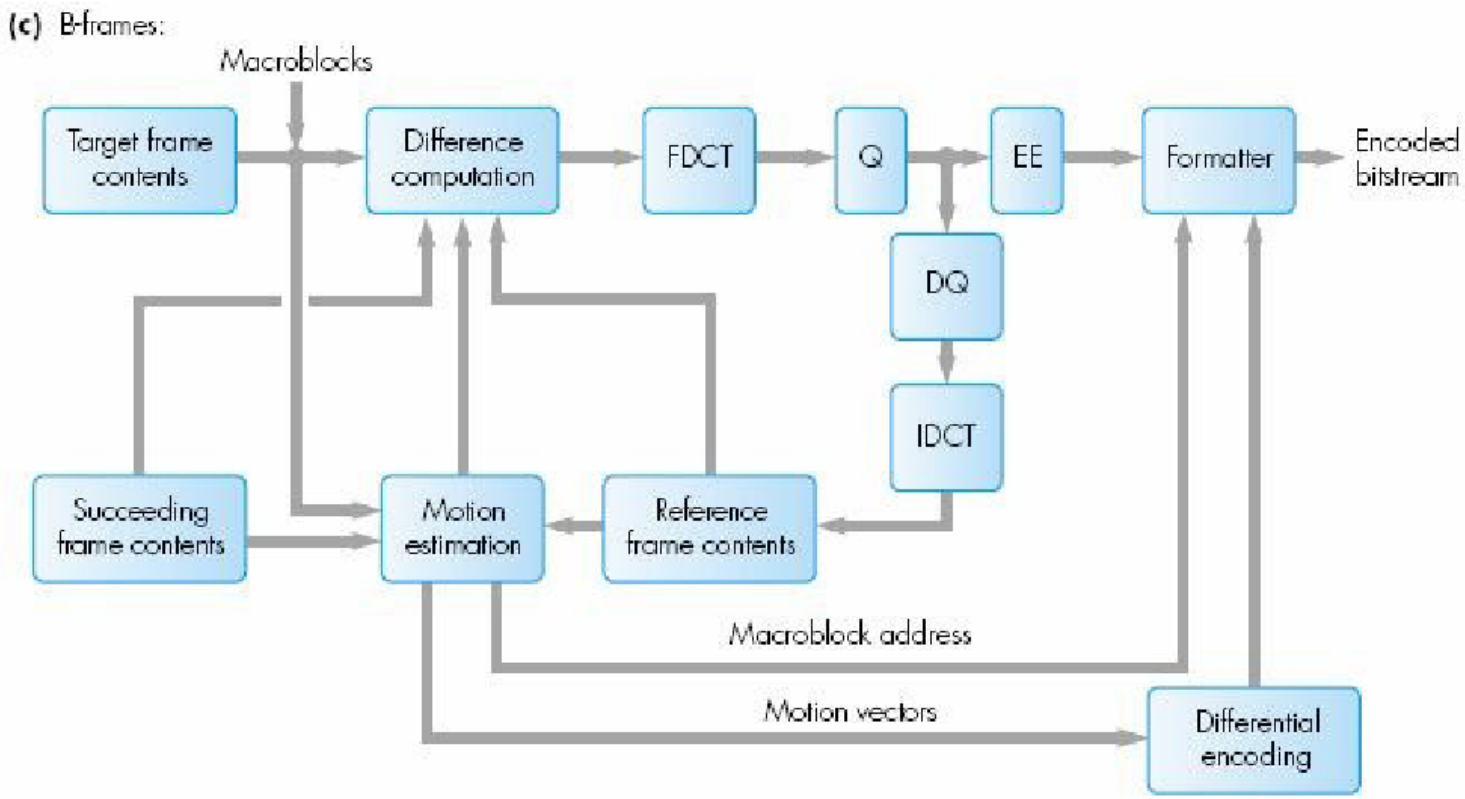
Kodovanje P frejmova

- Cases:
  - No encoding if error is smaller than thershold
  - MV and prediction error is transferred
  - No close match: no prediction, DCT JPEG encoding



Kodovanje B frejmova

- Similar to P frame encoding
- Prediction values are determined by interpolation between two reference frames

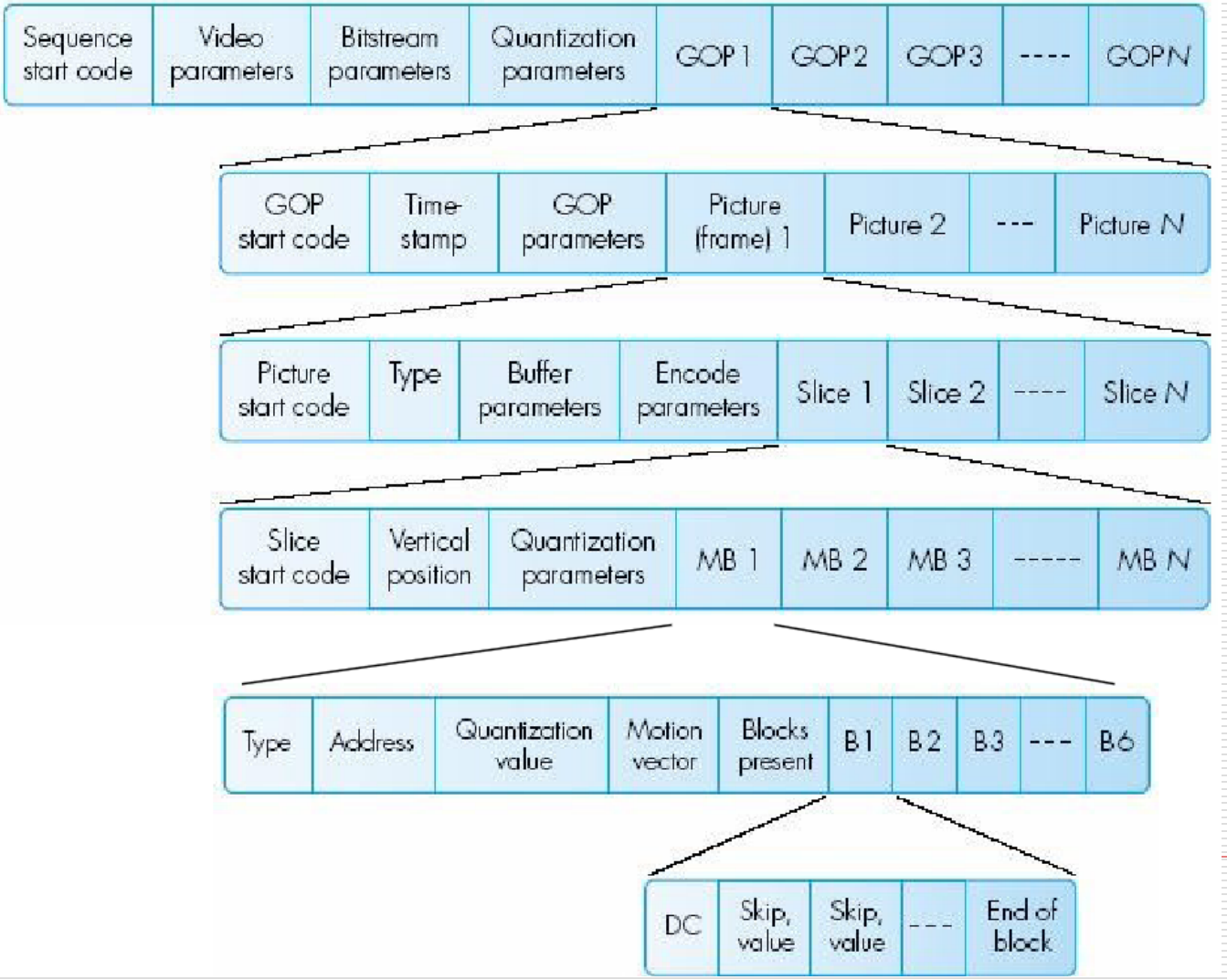


MPEG-1, MPEG-2

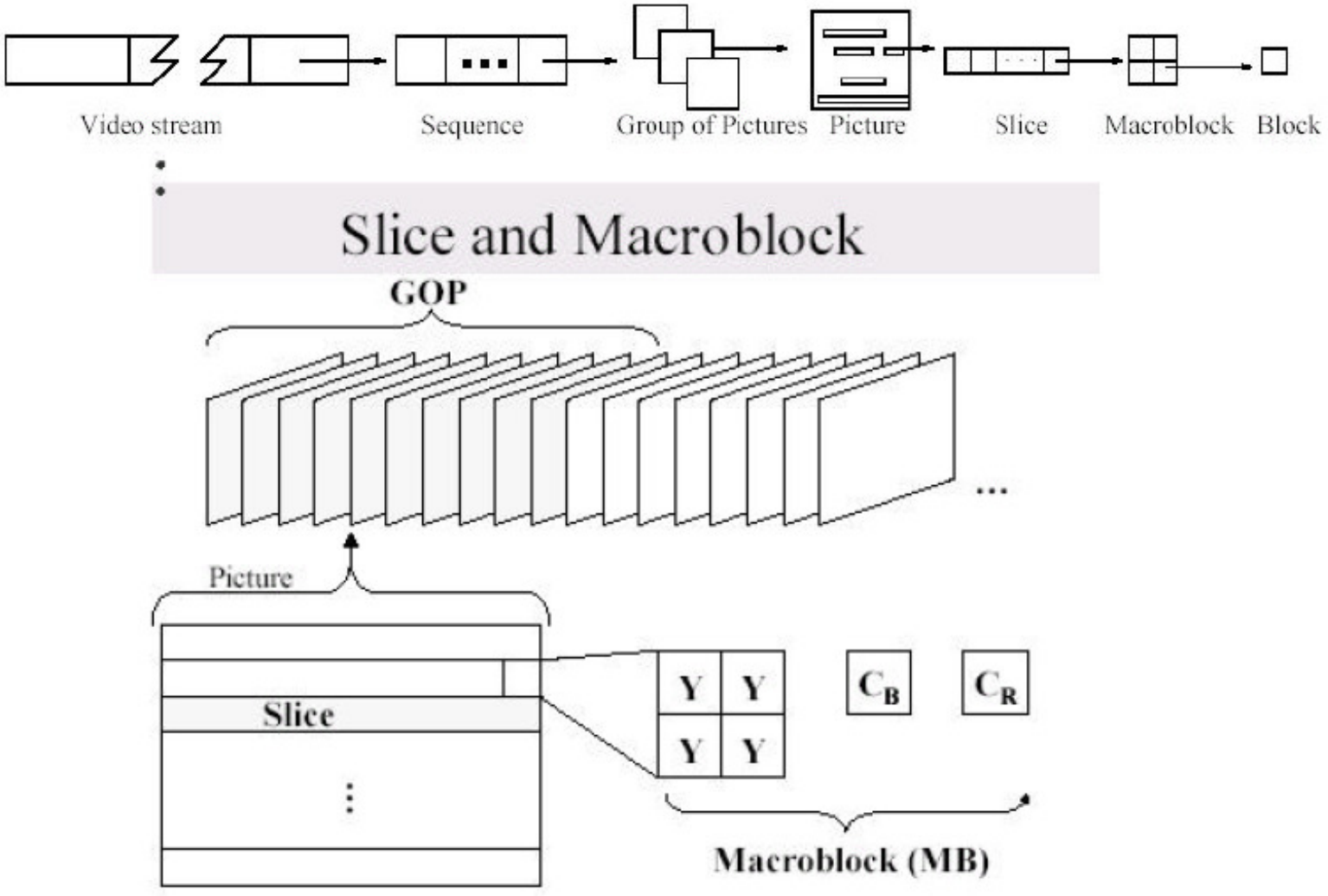
- ISO 11172 standard: SIF 352x288 pixel
- VHS quality audio and video
- 1.5 Mbps
- 1x700MB CD for a feature movie VCD standard
- Slice structure 22MB/line

- ISO 13818
- Levels:
  - Low – 352x288 to 4Mbps
  - Main – 720x576 CD audio, 4:2:0, 15-20Mbps
  - High 1440, 4:2:0, 1440x1152, HDTV, 60-80Mbps
  - High: 4:2:0, 1920x1152, HDTV, 80-100Mbps

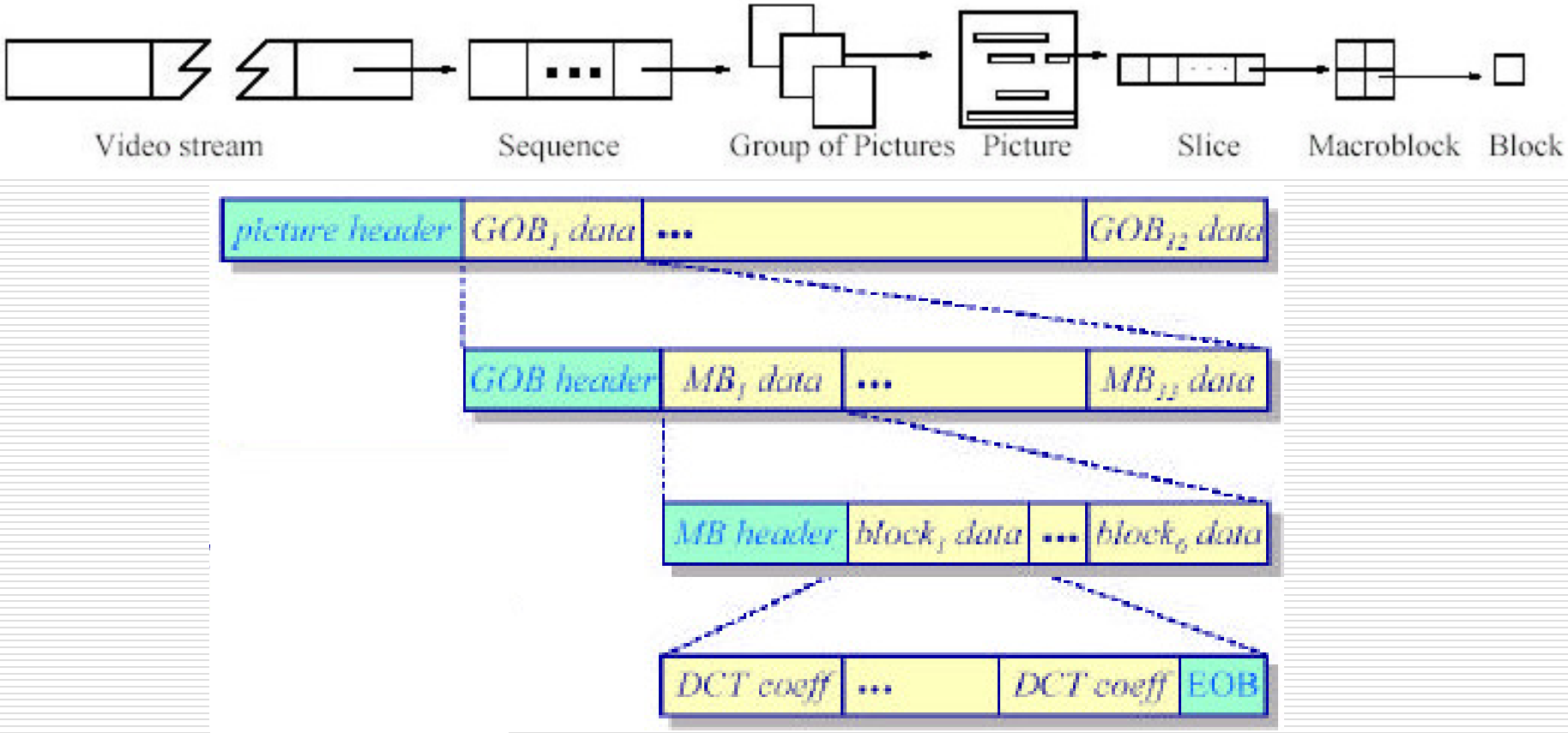
MPEG struktura bit stream-a



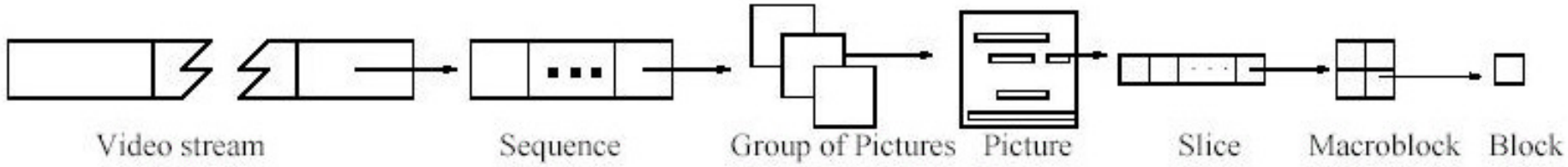
MPEG-2 struktura podataka



MPEG-2 tok podataka



MPEG-2 tok podataka



Sequence - Parametri dekodiranja (bitska brzina, velicina bafera, rezolucija slike, broj okvira u sek.)

Group of Picture - Slucajna tacka pristupa u tok podataka

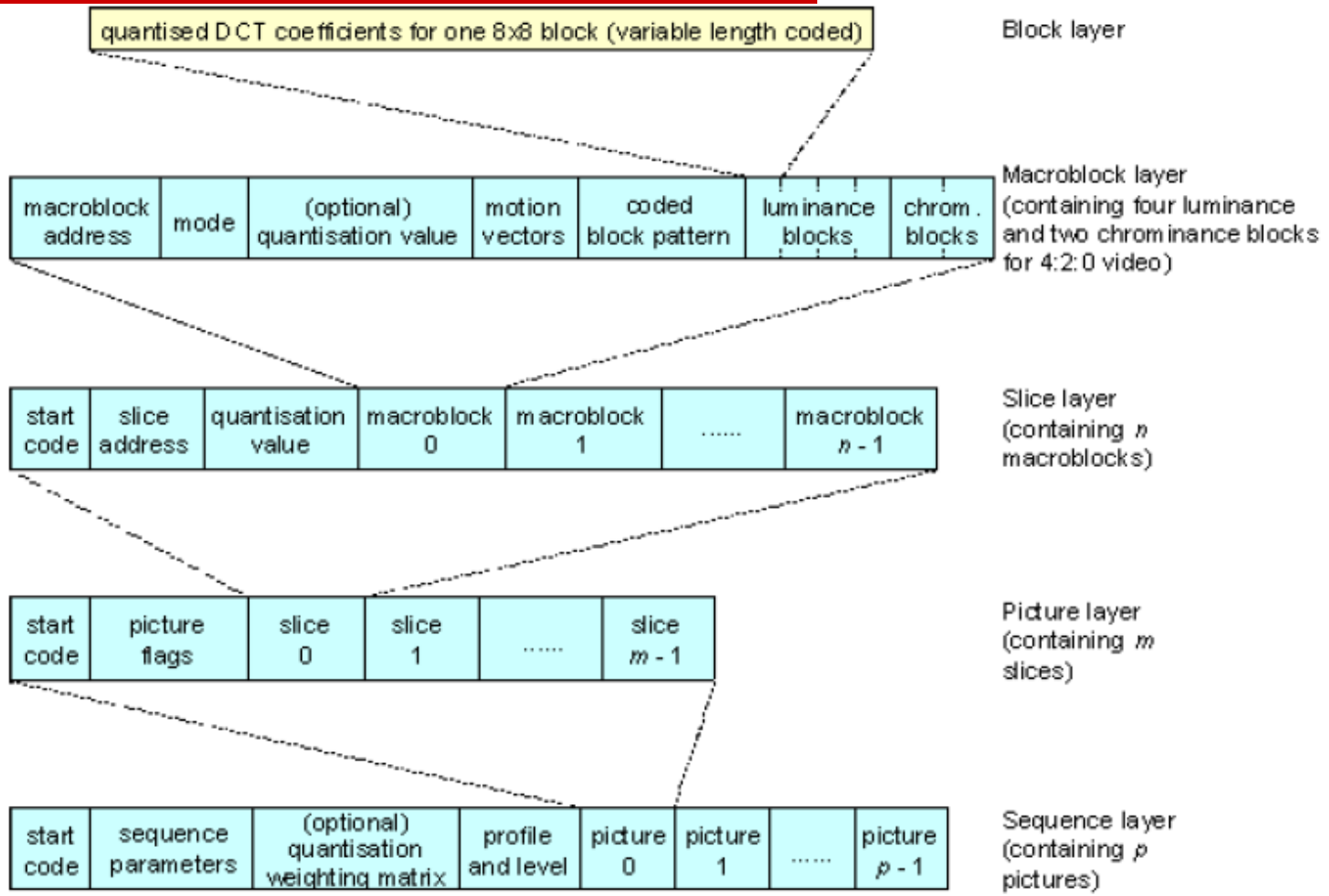
Picture - Tip slike i osnovni podaci o slici

Slice - Pozicija i informacija o stanju kako bi se dekoder mogao re-sinhronizovati

Macroblock - Kodovani vektori pomeraja

Block - Kodovani DCT koeficijenti, korak kvantizacije i sl.

MPEG-2 tok podataka



Each picture is divided into *m* horizontal slices, each comprising *n* macroblocks. For 4:2:0 video, each macroblock contains four luminance and two chrominance 8x8 blocks of quantised DCT coefficients.

MPEG-2 MP@ML

- Digital Television Broadcasting
- 4:2:0 720x480@30Hz or 720x576@25Hz
- 4-15Mbps
- Frame and Field mode – supports interlaced scanning

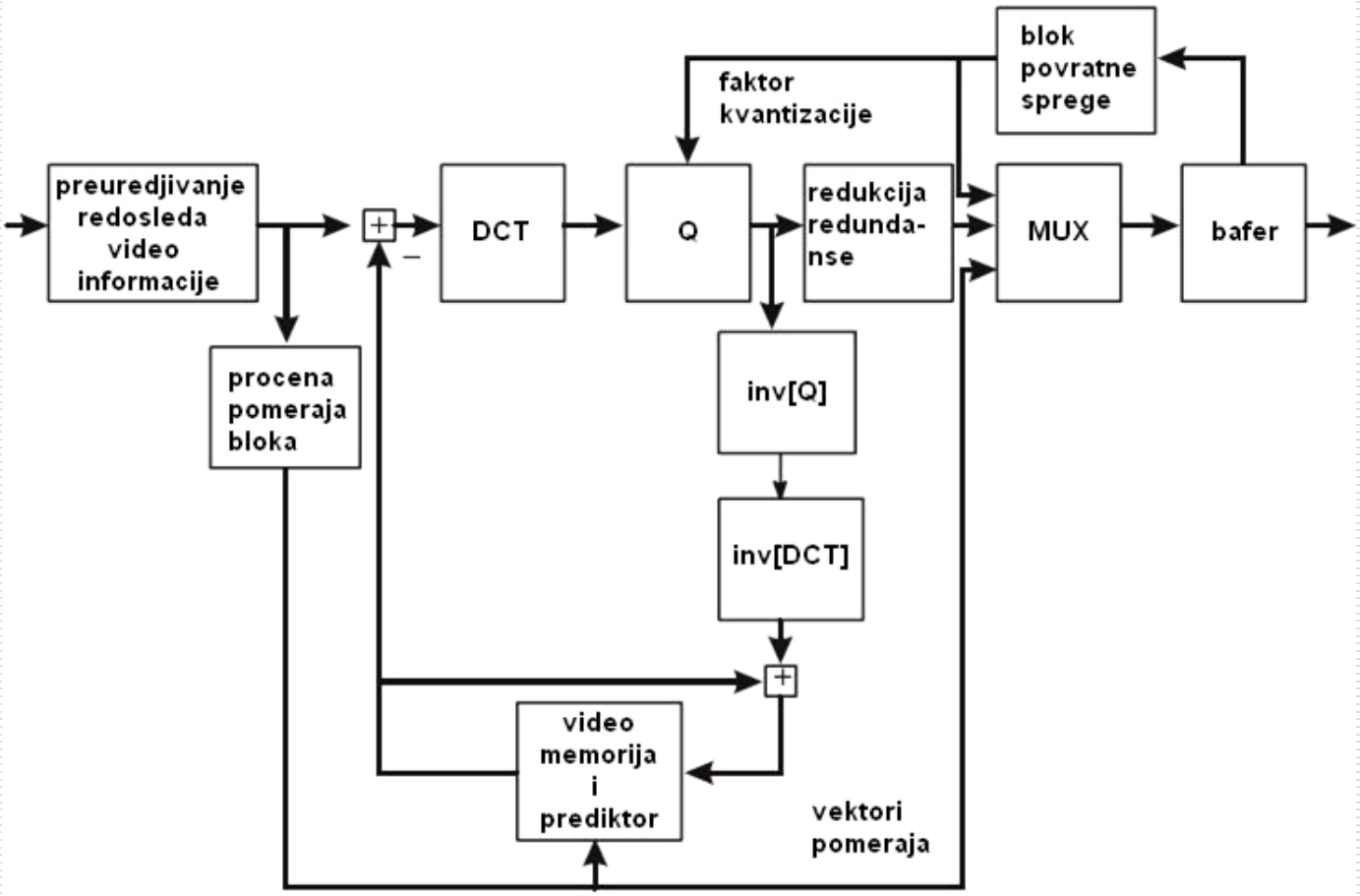
MPEG-2 HDTV

- ATV (USA), DVB(EU), MUSE(Japan)
- 16/9 1920x1152 widescreen
- Grand Alliance 1280x720, MP@HL + Dolby AC-3
- DVB – 1440x1152 (2xPAL), SSP@H1440, Layer II
- MUSE 1920x1035, MP@HL

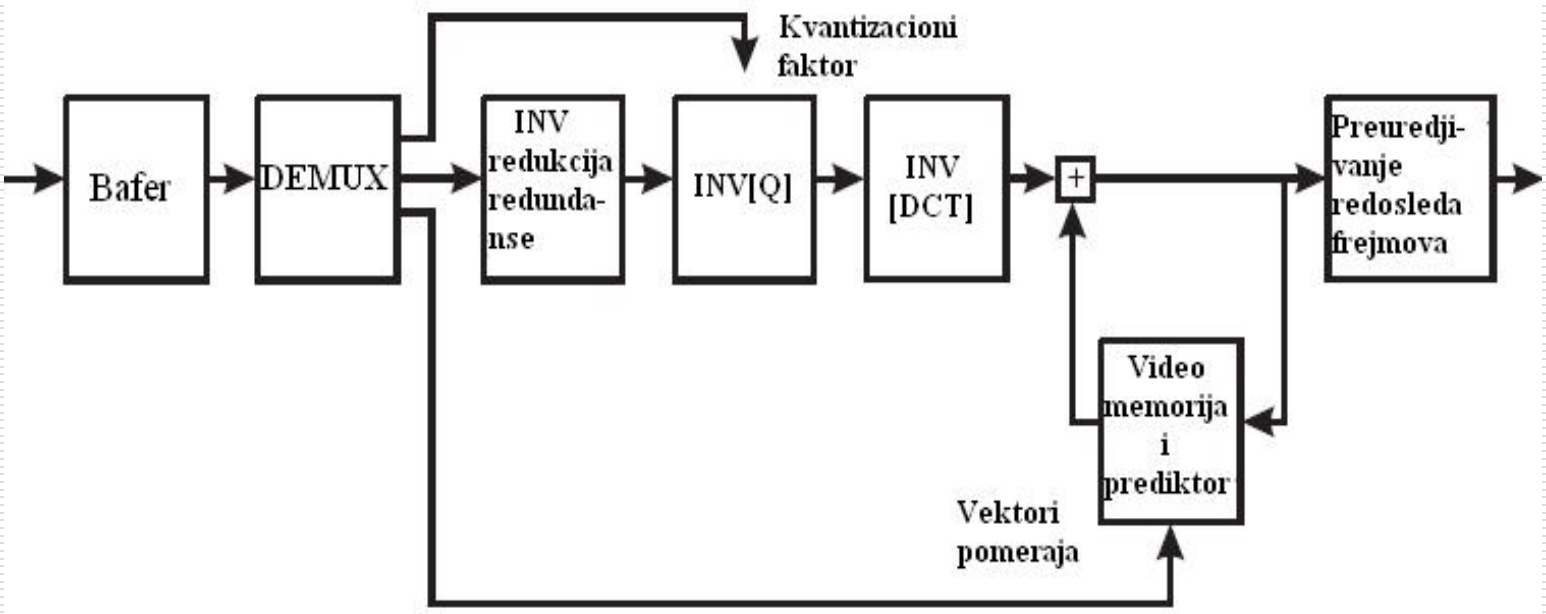
STA JE NOVO U MPEG-2?

- Podrzava vece bitske brzine 80-100 Mbit/s za HDTV
- Podrzan je veci broj aplikacija
- Interlaced i progresivno skaniranje
- Razlici fornmati: 4:2:2, 4:2:0, 4:4:4
- Fleksibilna kvantizaciona sema
- Skalabilni bitski tok podataka
- Razni profili i nivoi

MPEG-2 koder


blok
povratne
sprege
faktor
kvantizacije
preuredjivanje
redosleda
video
informacije
DCT
Q
redukcija
redunda-
nse
MUX
bafer
procena
pomeraja
bloka
inv[Q]
inv[DCT]
video
memorija
i
prediktor
vektori
pomeraja

MPEG-2 dekoder



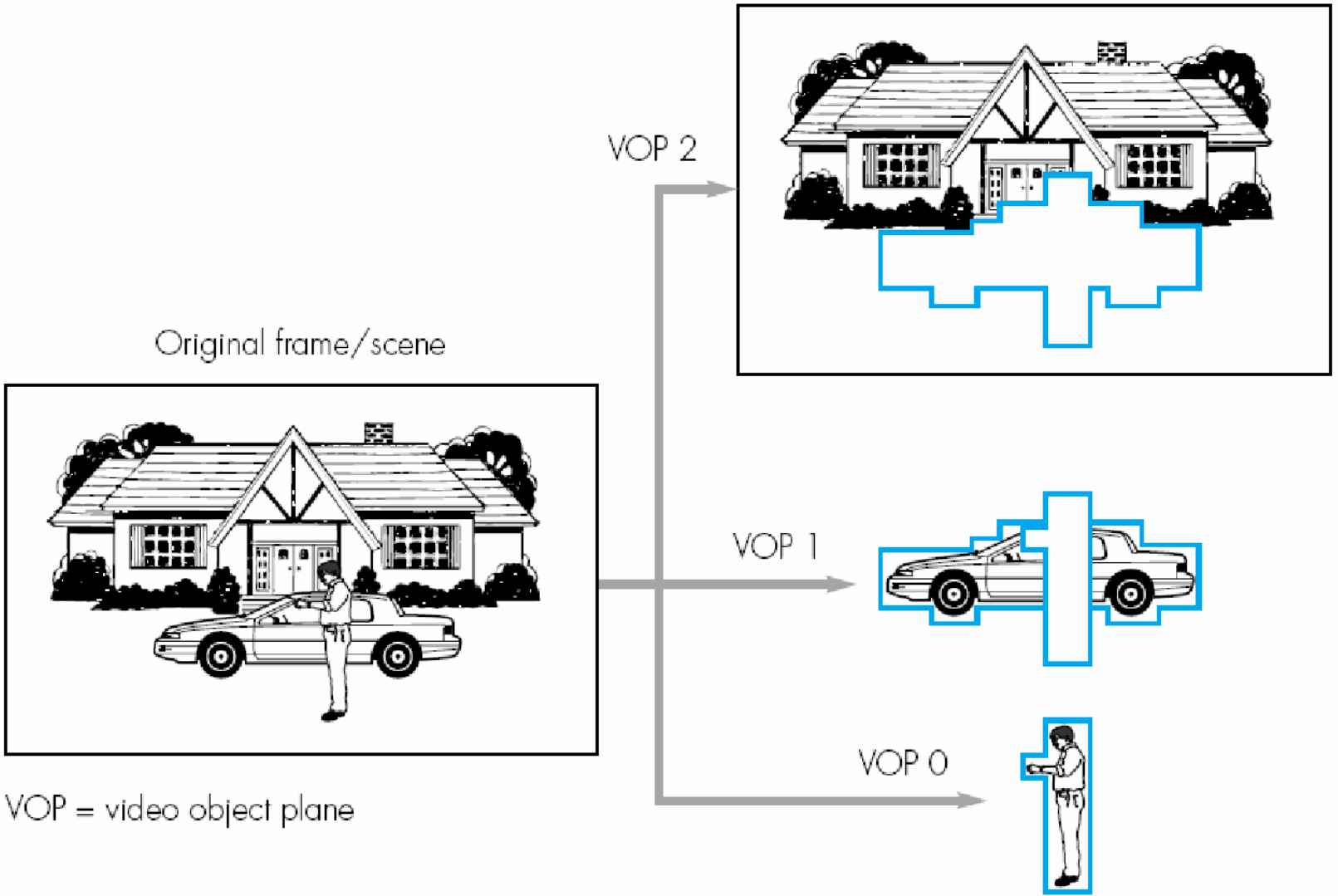
MPEG-2 – profili i nivoi

Profil	Nizak-nivo	Osnovni nivo	Visoki-1440 nivo	Visok nivo
Prost	—	720 × 576 (15 Mbps)	—	—
Osnovni	352 × 288 (4 Mbps)	720 × 576 (15 Mbps)	1,440 × 1152 (60 Mbps)	1,920 × 1,152 (80 Mbps)
SNR skalabilni	352 × 288 (4 or 3 Mbps)	720 × 576 (15 or 10 Mbps)	—	—
Prostorno skalabilni	—	—	1,440 × 1,152 or 720 × 576 (60 or 40.15 Mbps)	—
Visok	—	720 × 576 or 352 × 288 (20 or 15.40 Mbps)	1,440 × 1,152 or 720 × 576 (80 or 60.20 Mbps)	1,920 × 1,152 or 960 × 576 (100 or 80.25 Mbps)

MPEG-4

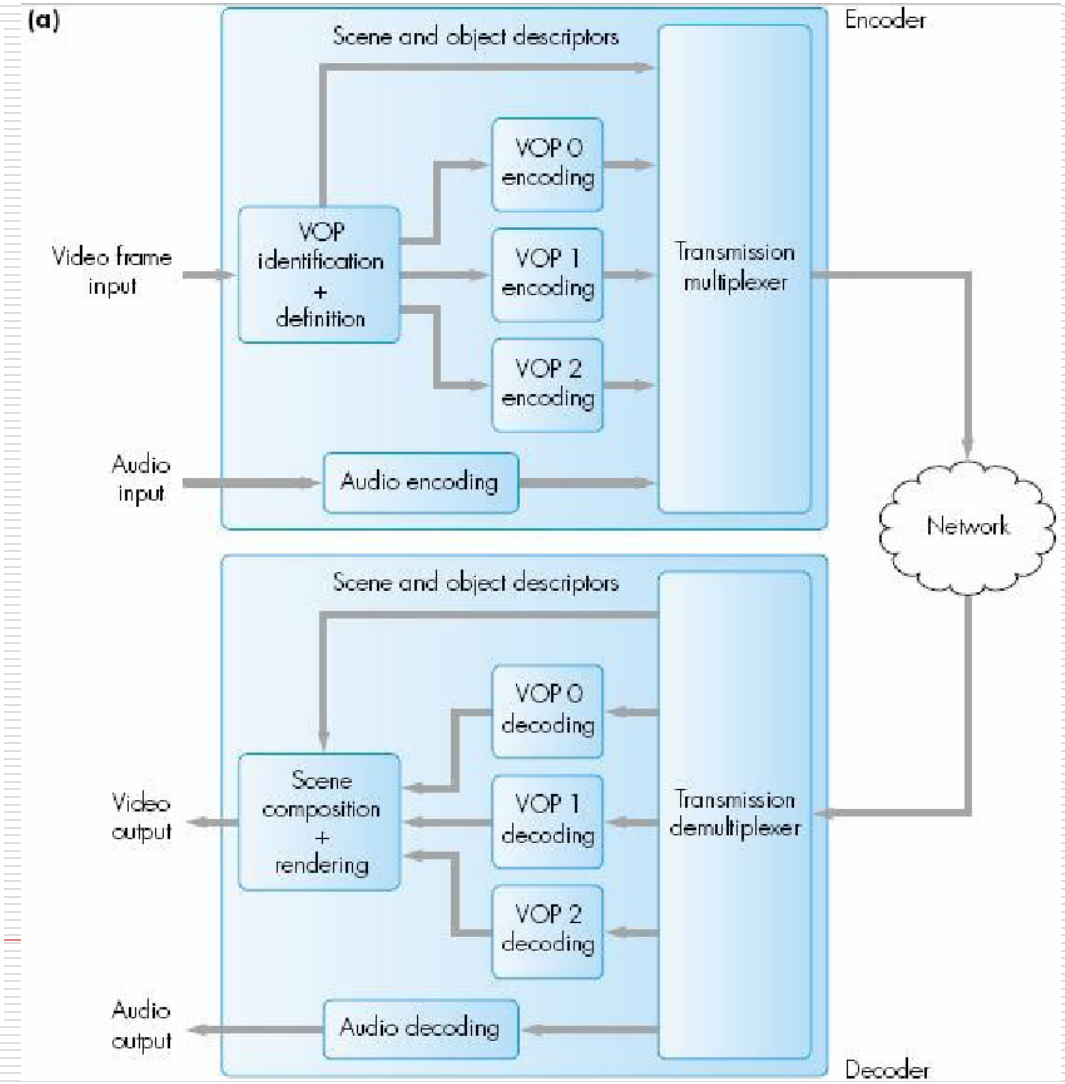
- Conceptually different – audio and video objects
- Interaction – language Binary Format Foe Scenes BIFS
- Highest level – scene descriptor
- Visual Object Plane – VOP
- Semantic segmentation – not really achieved!!!

MPEG 4



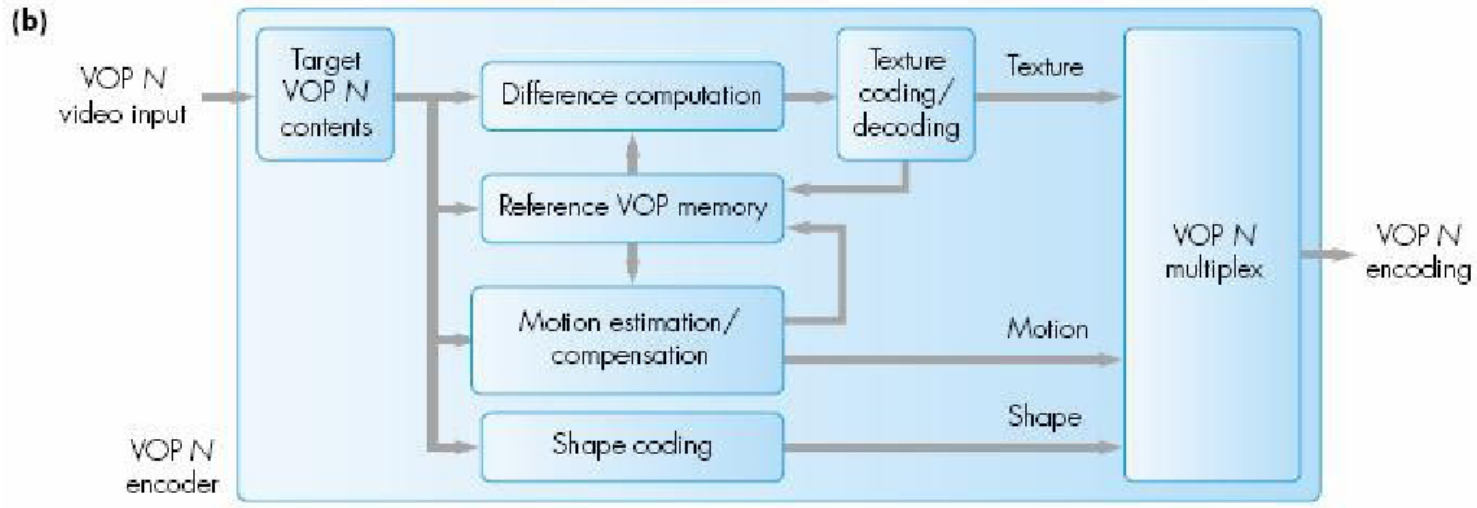
Kodovanje video signala

- VOP identification + definition
- Error resilience
  - Packets
- Reversible VLC

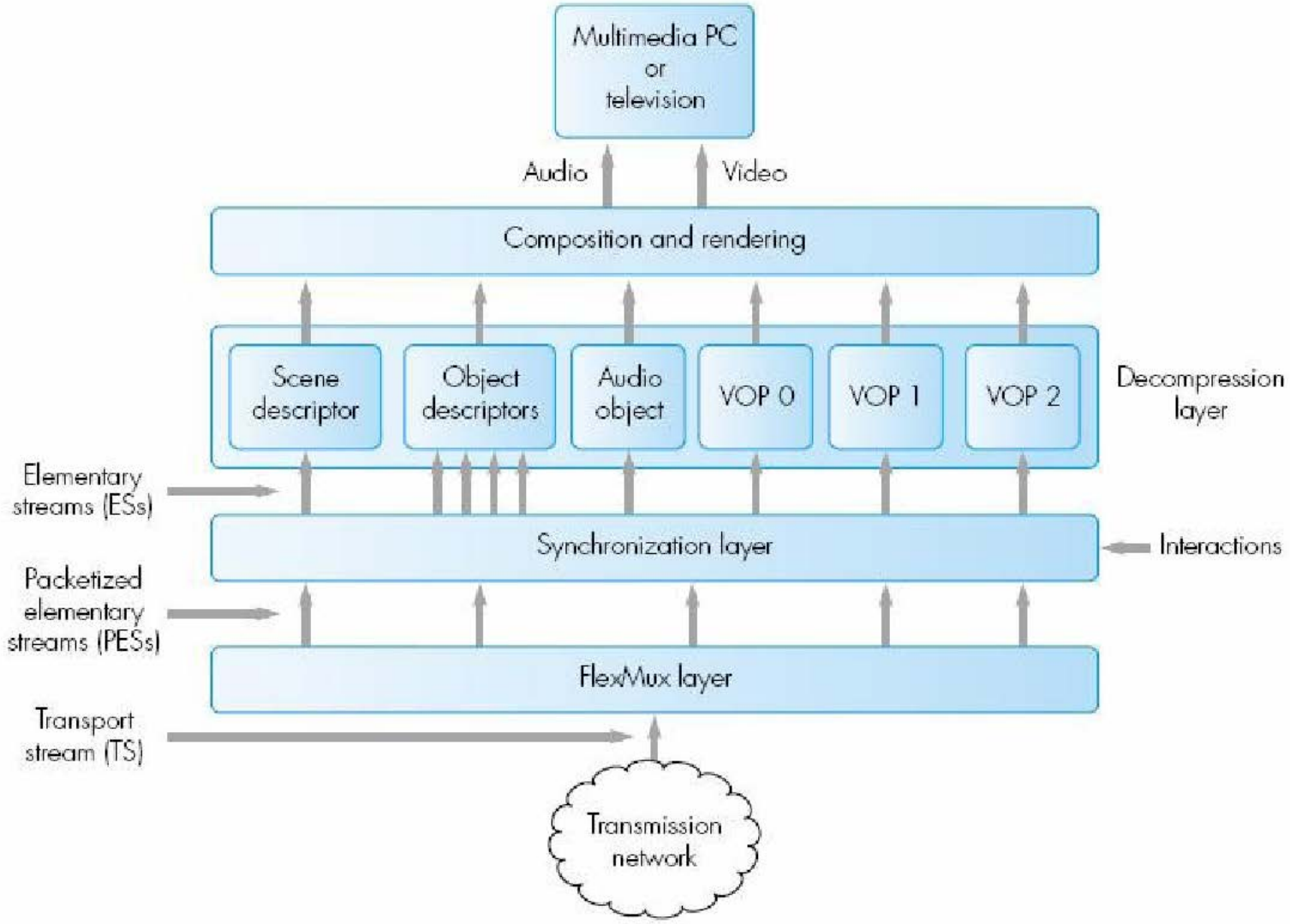


VOP koder

- More detailed motion estimation
- Shape coding
- Texture coding
- Main question still – meaningful segmentation



MPEG 4 dekoder



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