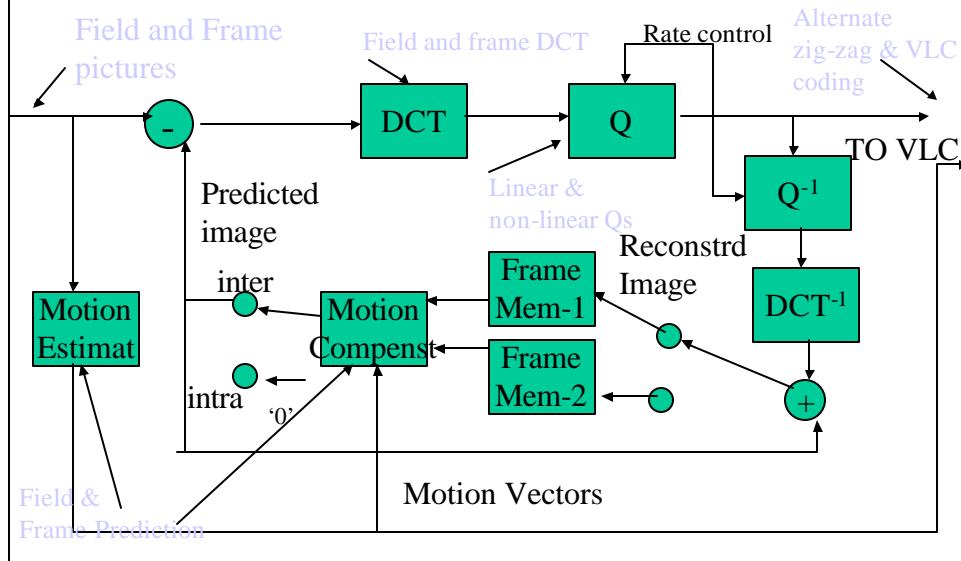


MPEG-2

MPEG-2 Video

MPEG-2 video = MPEG-1 Video+Enhancements

MPEG-2 Enhancements



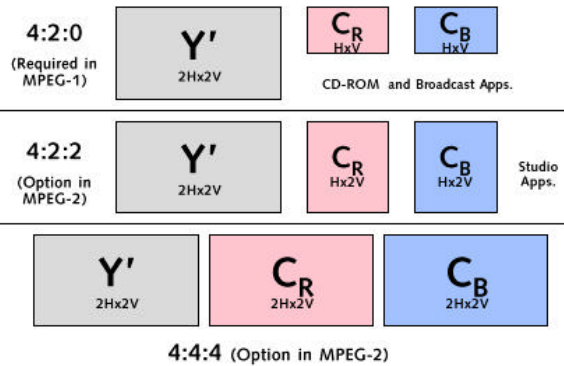
Features

- It allows for interlaced inputs, higher-definition inputs, and alternative subsampling of chroma channels
- It offers a scalable bitstream
- It provides improved quantization and coding options

Chroma Subsampling

- 4:2:0
- 4:2:2
- 4:4:4

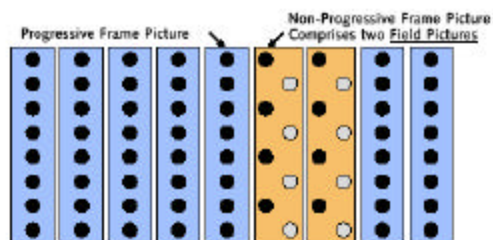
Chroma Formats and Picture Sizes



Coding Interlaced Video

- MPEG-2 accepts both progressive and interlaced inputs.
 - Two new pictures
 - frame pictures (two fields are encoded together as a composite frame)
 - field pictures (every field can be encoded independently)
 - Field/frame DCT options per MB
 - New MC prediction modes for interlaced video

Frame and Field Pictures



Non-Progressive Sequences may contain Both Frame Pictures and Field Pictures. This structure is optional in MPEG-2.

Frame Pictures

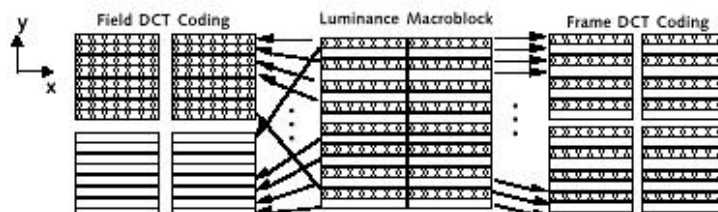
- Frame pictures are obtained by interleaving lines of even and odd fields to form composite frames.
 - Frame pictures can be I-, P- or B-type.
- Field pictures are simply the even or odd fields treated as separate pictures.
 - Each field picture can be I-,P- or B-type.

Picture types in MPEG-2

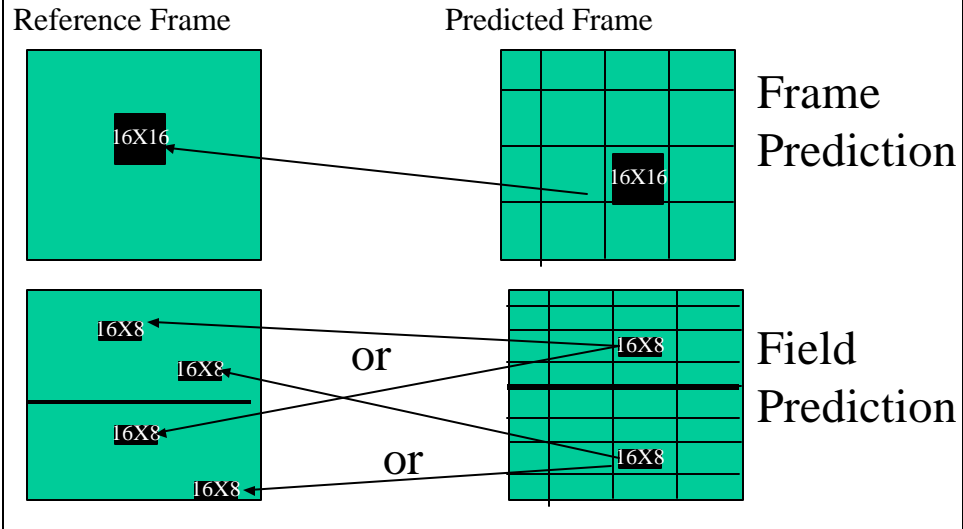
- Progressive Video
 - Frame Picture, I, P, or B type
- Interlaced Video
 - Frame picture
 - I, P, or B type
 - Field picture
 - I, P or B type

Field and Frame DCT

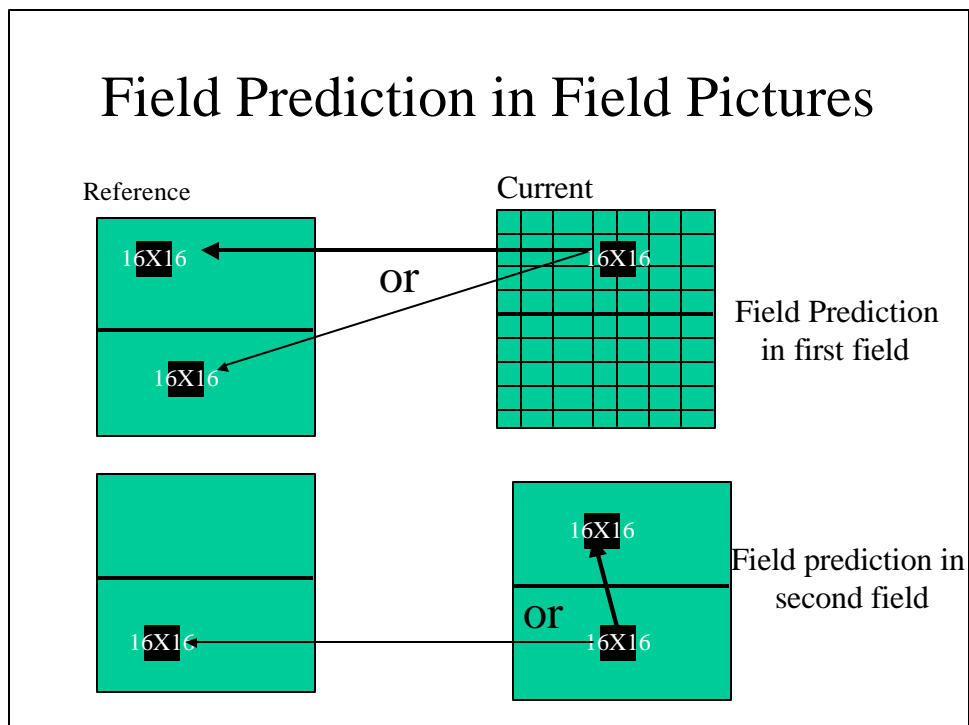
- Field DCT
 - suitable for macroblocks containing high motion
- Frame DCT
 - little or no motion, but containing high spatial activity



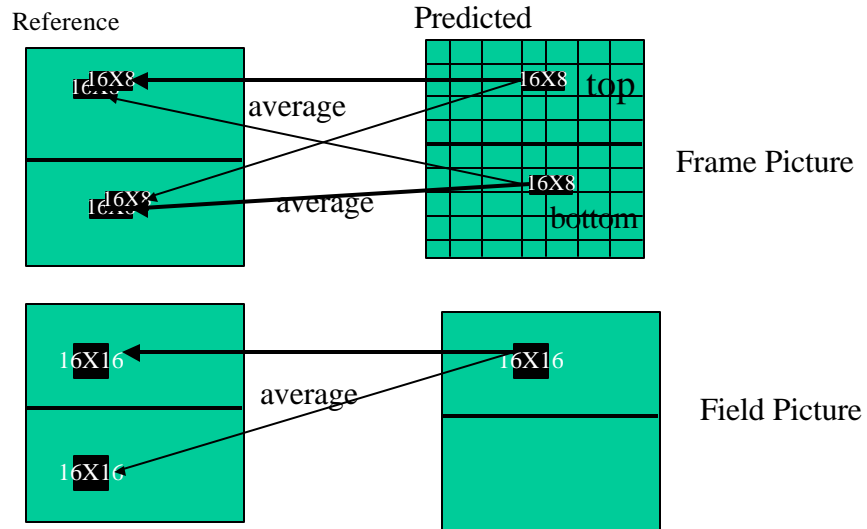
Prediction in Frame Pictures



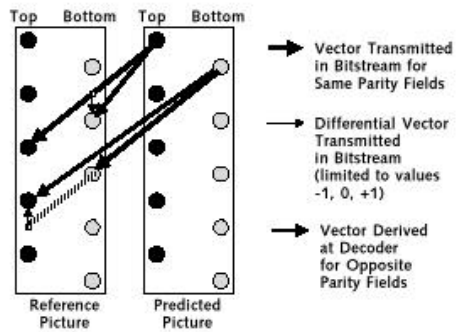
Field Prediction in Field Pictures



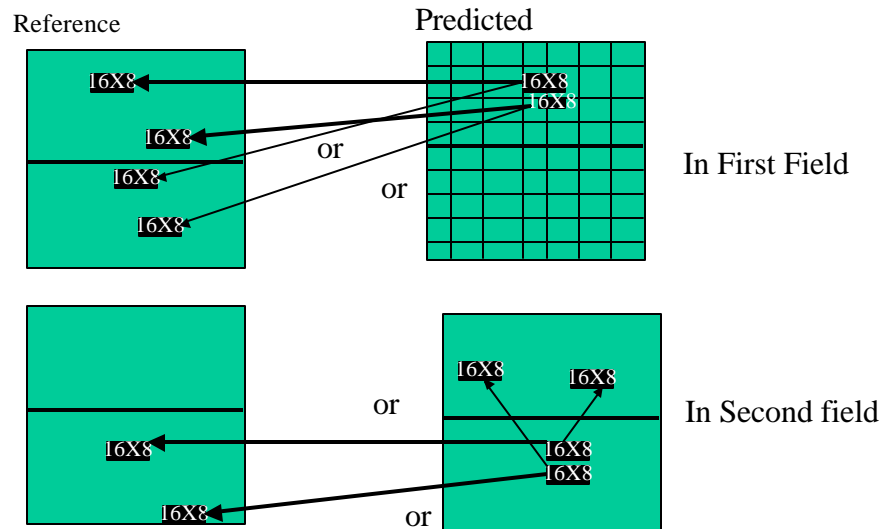
Dual-Prime Prediction



Dual-Prime Prediction in V-T



16X8 Motion Compensation

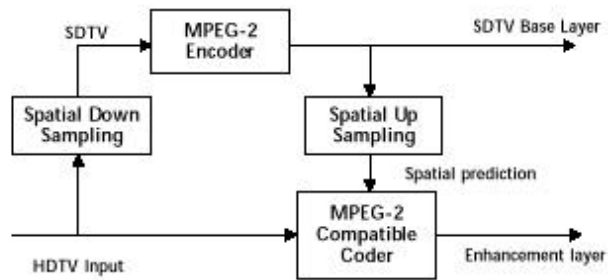


Scalable Extensions

- It is the ability to decode only certain part of bit-stream to obtain video at the desired resolution.
 - Spatial Scalability
 - SNR Scalability
 - Temporal Scalability
 - Data Partitioning
 - Hybrid Scalability

Spatial Scalability

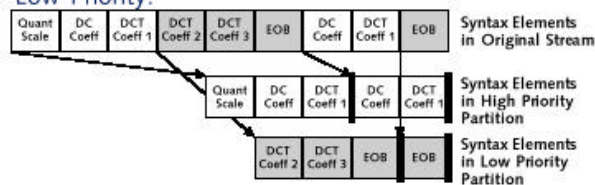
- A single video source is split into a
 - Base Layer (lower spatial resolution)
 - Enhancement Layer (higher spatial resolution)
- MPEG-1 can be used for coding the Base Layer



Example of Spatially Scalable Encoder

Data Partitioning

- A single video source is split into a
 - High-Priority Partition that can be better protected
 - Low-Priority Partition
- Priority Breakpoints specify which syntax elements (e.g., 2nd DCT coefficient and higher) are coded as Low Priority.

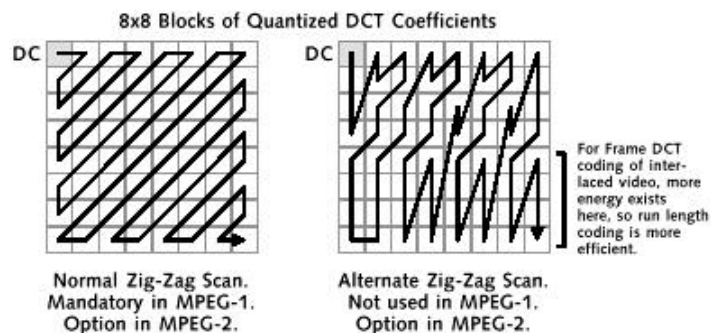


Example of Data Partitioning Encoder

Other Improvements

- Alternate Scan (better fit for interlaced video)
- Finer quantization of DCT
 - 11 bits for DC coefficient (8 in MPEG-1)
 - AC coefficients are quantized [-2048, 2047] (MPEG-1 [-256, 255])
 - In non-intra macroblocks all coefficients are quantized into [-2048, 2047] (in MPEG-1 [-256,255])

Ziz-zag Scans



Other Improvements

- **Finer adjustment of MQUANT**
 - in addition to integers between 1 and 31, an optional set of 31 values between .5 and 56

MQUANT

.5	1.0	1.5	2.0	2.5
2.5	3.0	3.5	4.0	5.0
6.0	7.0	8.0	9.0	10.0
11.0	12.0	14.0	16.0	18.0
20.0	24.0	26.0	28.0	32.0
36.0	40.0	44.0	48.0	52.0
56.0				

Parameter Constraints for levels

Level	Max pixels	Max lines	Max fps
Low	352	288	30
Main	720	576	30
High-1440	1440	1152	60
High	1920	1152	60

Profiles

- Simple
 - no B frames
 - only main level
 - max bitrate 15 Mbps
- Main
 - all four levels
 - max bitrates 4, 15, 60 and 80 Mbps
 - no scalability allowed

Profiles

- SNR Scalable
 - supports main and low levels with maximum bitrates of 4(3) and 15(10) Mbps.
- Spatial Scalable
 - only high-1440 level with max bitrate of 60(15) Mbps
- High
 - main 20(4), high-1440 80(20), High 100(25)

Profiles and Levels

Level	Profile						
	Simple	Main	SNR	Spatial		High	4:2:2
High		1920H 1152V 60Hz	ATSC Formats		1920H 1152V 60Hz	960H 576V 30Hz	Future Compliance Point
High-1440		1440H 1152V 60Hz		1440H 1152V 60Hz	720H 576V 30Hz	1440H 1152V 60Hz	720H 576V 30Hz
Main	720H 576V 30Hz	720H 576V 30Hz	720H 576V 30Hz		720H 576V 30Hz	352H 288V 30Hz	720H 512V/608V 30Hz
Low		352H 288V 30Hz	352H 288V 30Hz				

Key: Max H Size
Max V Size
Max Frame Rate

Notes: 1) A split box shows constraints on Enhancement Layer (left) and Base Layer (right)
2) In general, a compliant decoder must also handle all lower Profile and Level compliance points.

ATSC Video Formats (HDTV)

- 1920 X 1080 (16:9)
 - 24 fps progressive
 - 30 fps progressive
 - 30 fps interlaced (CBS & NBC)
- 1280 X 720 (16:9)
 - 24 fps progressive
 - 30 fps progressive (ABC & Fox)
 - 60 fps interlaced

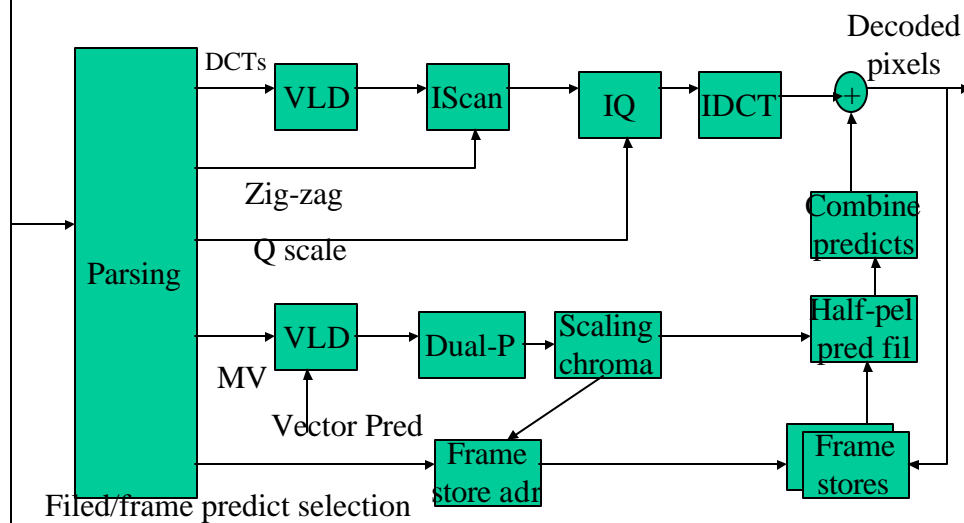
ATSC Video Formats (SDTV)

- 704 X 480 (16:9)
 - 24 fps progressive
 - 30 fps progressive
 - 30 fps interlaced
 - 60 progressive
- 704 X 480 (16:9)
 - 24 fps progressive
 - 30 fps progressive
 - 30 fps interlaced
 - 60 progressive

ATSC Video Formats (SDTV)

- 640 X 480 (4:3)
 - 24 fps progressive
 - 30 fps progressive
 - 30 fps interlaced
 - 60 progressive

MPEG-2 Decoding



MPEG-1 & MPEG -2 Artifacts

- Blockiness
 - poor motion estimation
 - seen during dissolves and fades
- Mosquito Noises
 - edges of objects (high frequency DCT terms)
- Dirty Window
 - streaks or noise remain stationary while objects move

MPEG-1 & MPEG -2 Artifacts

- Wavy Noise
 - seen during pans across crowds
 - coarsely quantized high frequency terms cause errors

Where MPEG-2 will fail?

- Motions which are translation
 - zooms
 - rotations
 - non-rigid (smoke)
 - dissolves
- Others
 - shadows
 - scene cuts
 - changes in brightness