DATA COMPRESSION

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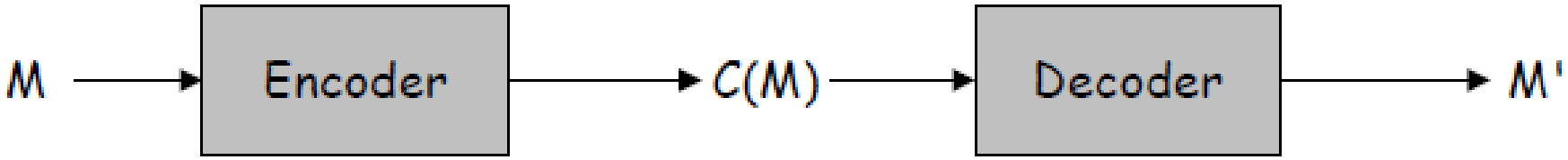
INTRODUCTION - DATA COMPRESSION

To save TIME when transmitting it.
To save SPACE when storing it.



FIXED and VARIABLE length encoding.

a			b			r			a			c			a			d			a			b			r			a		
0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	0

3-bit fixed length coding: $3 \times 11 = 33$ bits

a	b			r		a	c			a	d			a	b			r		a
1	0	0	1	0	1	1	0	0	0	0	1	0	0	0	1	1	0	0	1	0	1	1

variable length coding: 23 bits

char	encoding
a	1
b	001
c	0000
d	0001
r	01

RUN-LENGTH ENCODING (RLE)

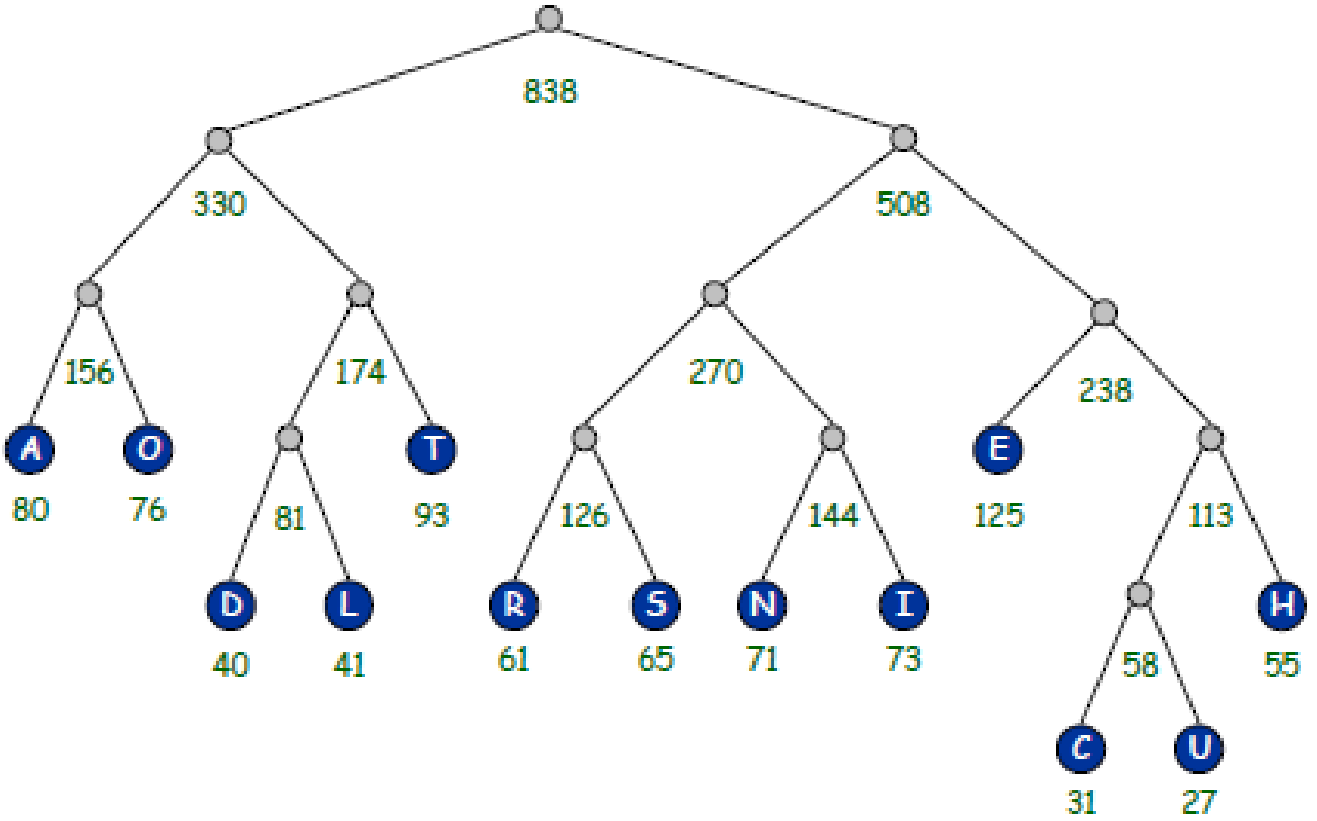
1) Exploit long runs of repeated characters.
2) Replace run by count followed by repeated character, but don't bother if run is less than 3.

INPUT– AAAABBBAABBBBBCCCCCCCCCDABCBAAABBBBCCCD

OUTPUT– 4A3BAA5B8CDABCB3A4B3CD

HUFFMAN CODING

Char	Freq	Huff
E	125	110
T	93	011
A	80	000
O	76	001
I	73	1011
N	71	1010
S	65	1001
R	61	1000
H	55	1111
L	41	0101
D	40	0100
C	31	11100
U	27	11101
Total	838	3.62

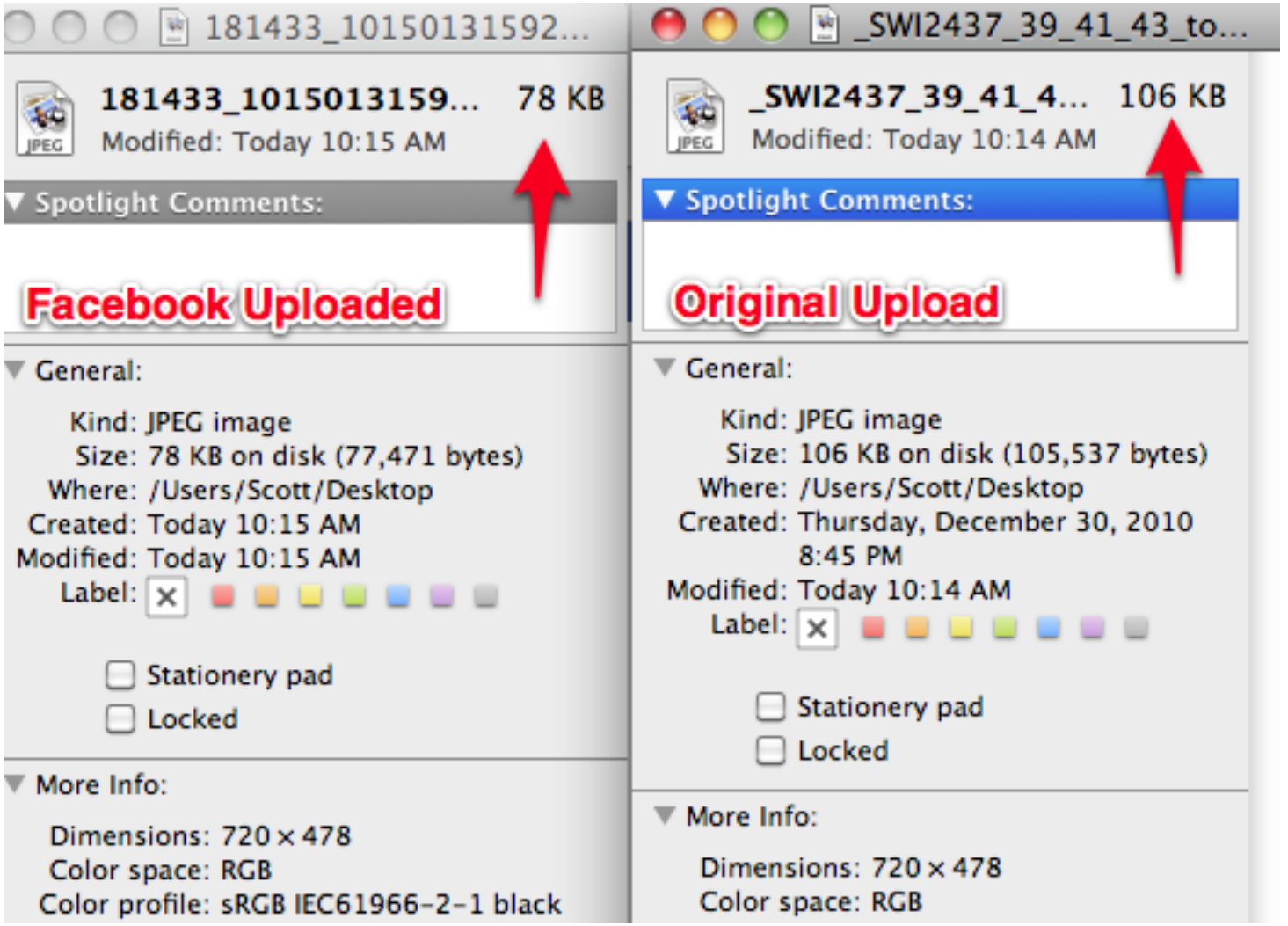


JPEG compression

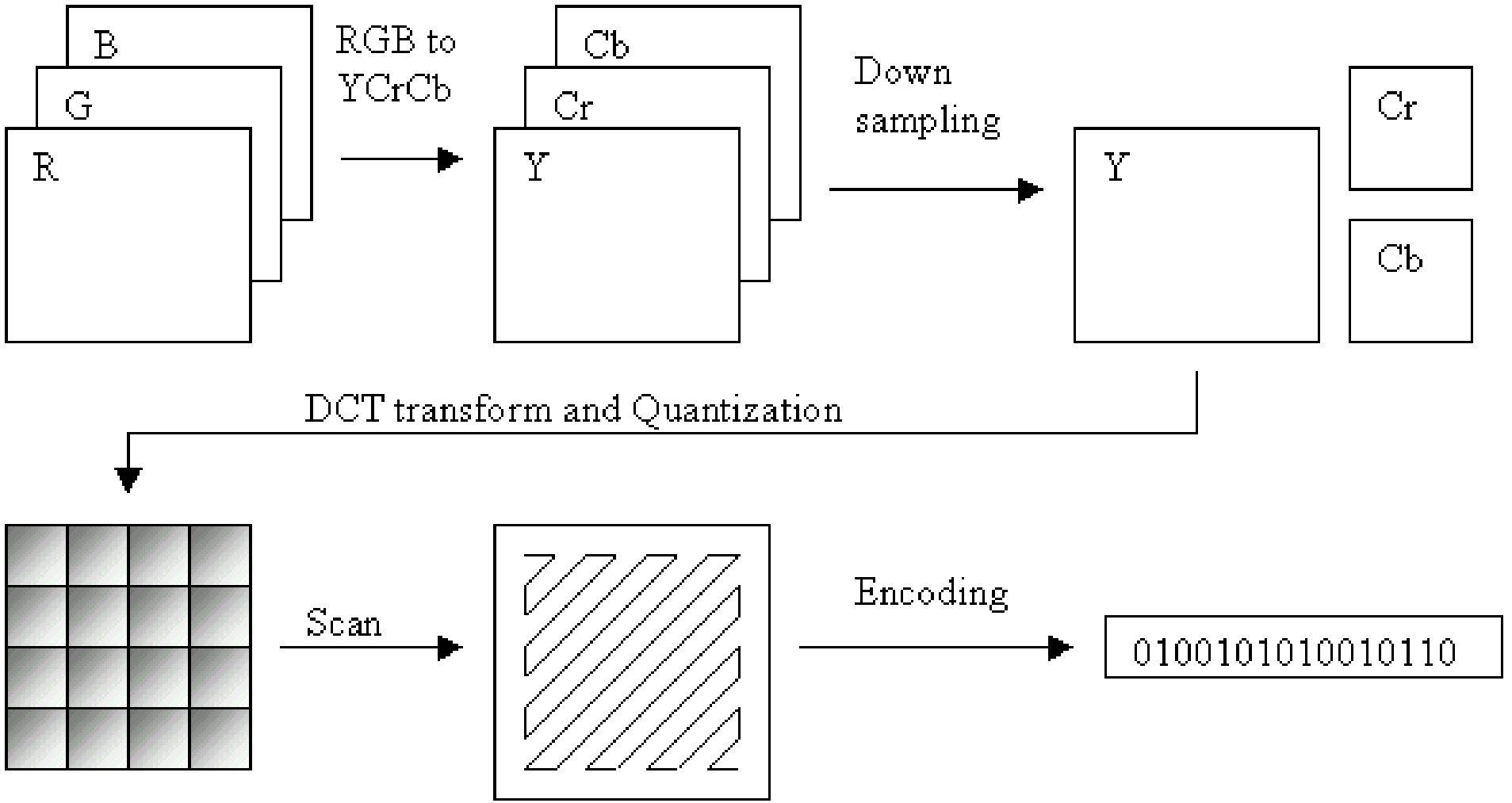
Web Applications:

1) Flickr by Yahoo.
2) Facebook Photos.
3) Picassa by Google.

Facebook photos



The JPEG compression (LOSSY)

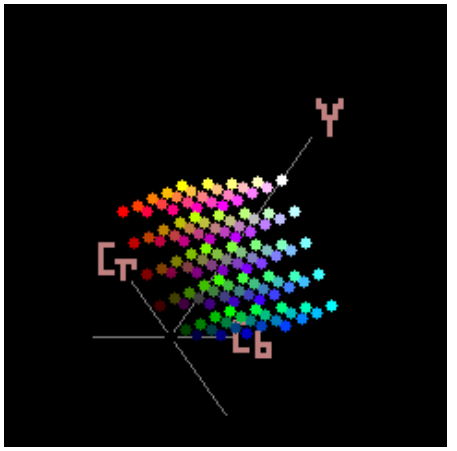


RGB encoded to Y-Cb-Cr.

Y – the grayscale component or brightness.

Cb – blue-difference.

Cr – red-difference.



luma signal (Y′) that can be stored with high resolution or transmitted at high bandwidth,

(CB and CR), the chroma components can be bandwidth-reduced, subsampled, compressed, or otherwise treated separately for improved system efficiency.

Down-sampling

Reduce the spatial resolution of the Cb and Cr Components .

Human eye perceives the Luma (Y) component better.

Discrete cosine transform

Each 8×8 block of each component (Y, Cb, Cr) is converted to a frequency-domain representation.

$$G_{u,v} = \sum_{x=0}^{7} \sum_{y=0}^{7} \alpha(u)\alpha(v) g_{x,y} \cos\left[\frac{\pi}{8}\left(x + \frac{1}{2}\right)u\right] \cos\left[\frac{\pi}{8}\left(y + \frac{1}{2}\right)v\right]$$

Quantization

$$B_{j,k} = \text{round}\left(\frac{G_{j,k}}{Q_{j,k}}\right) \text{ for } j = 0, 1, 2, \ldots, 7; k = 0, 1, 2, \ldots, 7$$

$$G = \begin{bmatrix} -415.38 & -30.19 & -61.20 & 27.24 & 56.13 & -20.10 & -2.39 & 0.46 \\ 4.47 & -21.86 & -60.76 & 10.25 & 13.15 & -7.09 & -8.54 & 4.88 \\ -46.83 & 7.37 & 77.13 & -24.56 & -28.91 & 9.93 & 5.42 & -5.65 \\ -48.53 & 12.07 & 34.10 & -14.76 & -10.24 & 6.30 & 1.83 & 1.95 \\ 12.12 & -6.55 & -13.20 & -3.95 & -1.88 & 1.75 & -2.79 & 3.14 \\ -7.73 & 2.91 & 2.38 & -5.94 & -2.38 & 0.94 & 4.30 & 1.85 \\ -1.03 & 0.18 & 0.42 & -2.42 & -0.88 & -3.02 & 4.12 & -0.66 \\ -0.17 & 0.14 & -1.07 & -4.19 & -1.17 & -0.10 & 0.50 & 1.68 \end{bmatrix}$$

$u \longrightarrow$

$\downarrow v.$

$$Q = \begin{bmatrix} 16 & 11 & 10 & 16 & 24 & 40 & 51 & 61 \\ 12 & 12 & 14 & 19 & 26 & 58 & 60 & 55 \\ 14 & 13 & 16 & 24 & 40 & 57 & 69 & 56 \\ 14 & 17 & 22 & 29 & 51 & 87 & 80 & 62 \\ 18 & 22 & 37 & 56 & 68 & 109 & 103 & 77 \\ 24 & 35 & 55 & 64 & 81 & 104 & 113 & 92 \\ 49 & 64 & 78 & 87 & 103 & 121 & 120 & 101 \\ 72 & 92 & 95 & 98 & 112 & 100 & 103 & 99 \end{bmatrix}.$$

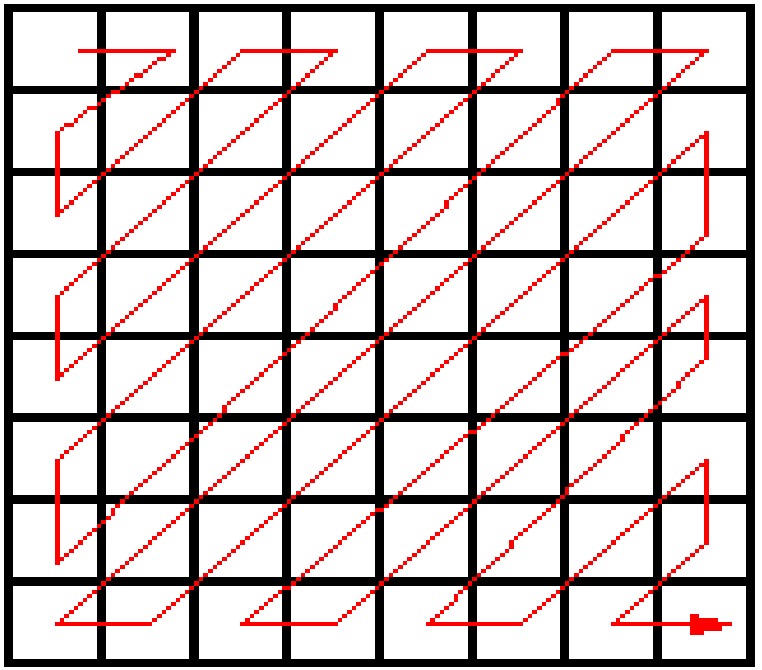
QUANTIZED MATRIX

The advantage of the DCT is its tendency to aggregate most of the signal in one corner of the result.

$$B = \begin{bmatrix} -26 & -3 & -6 & 2 & 2 & -1 & 0 & 0 \\ 0 & -2 & -4 & 1 & 1 & 0 & 0 & 0 \\ -3 & 1 & 5 & -1 & -1 & 0 & 0 & 0 \\ -3 & 1 & 2 & -1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}.$$

ENTROPY ENCODING

1) Involves arranging the image components in a "zigzag" order employing run-length encoding (RLE) algorithm that groups similar frequencies together, inserting length coding zeros.



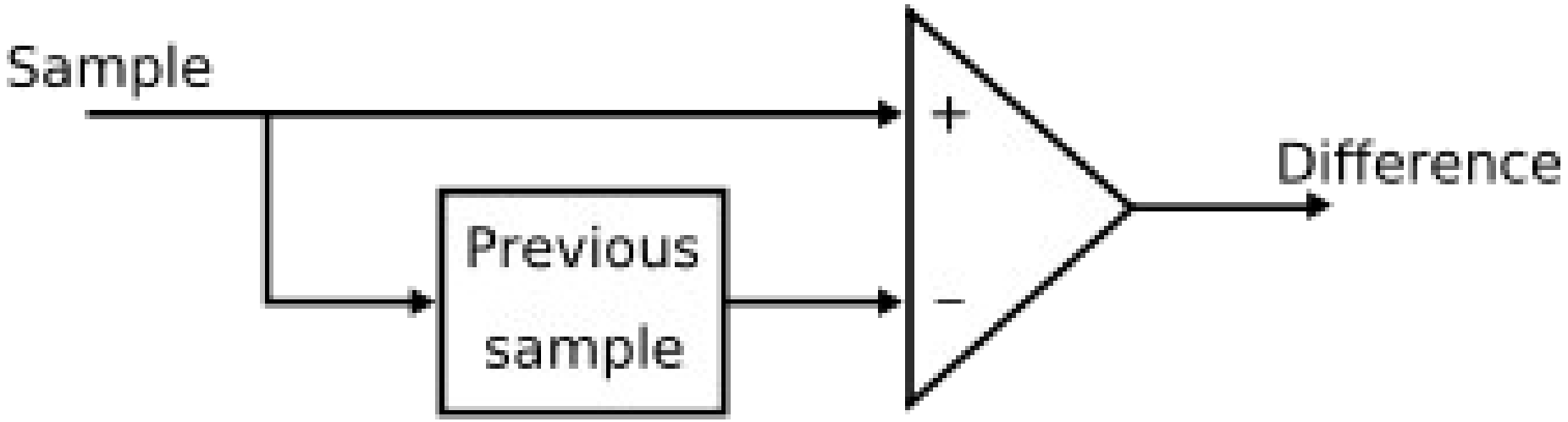
JPEG LOSSLESS

simple predictive coding model called differential pulse code modulation (DPCM).

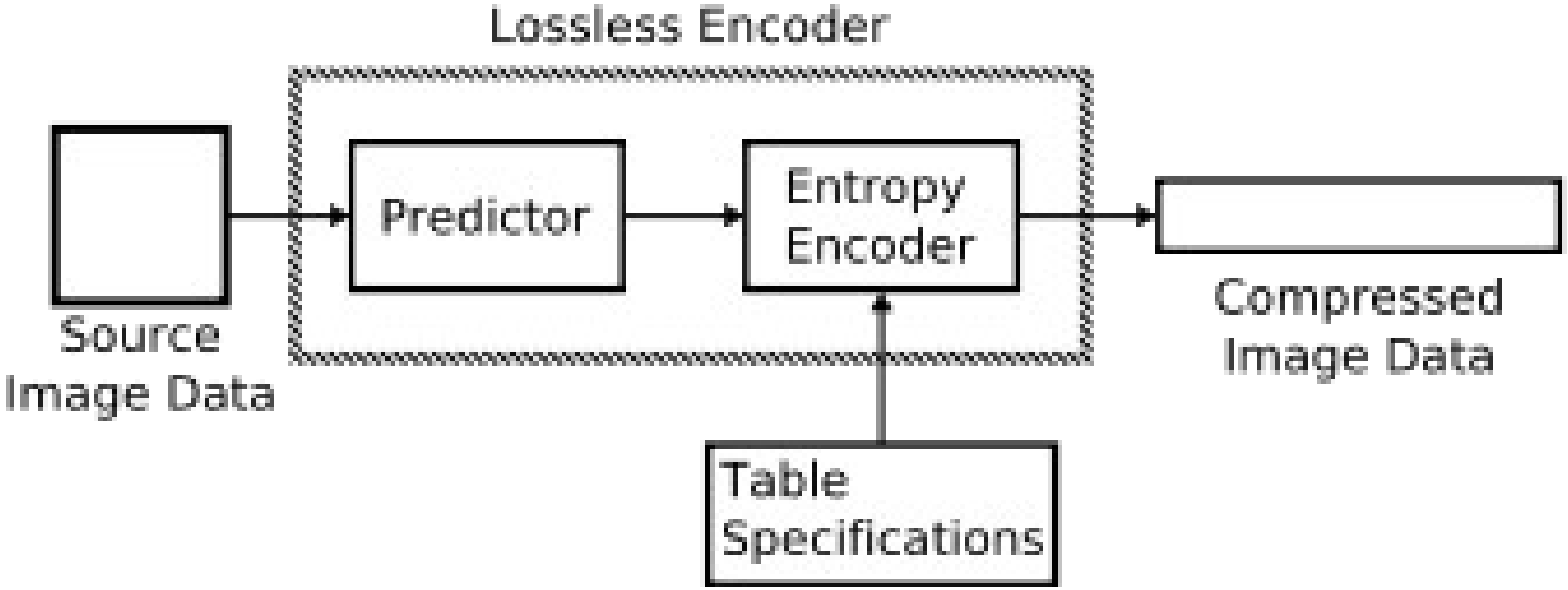
predictions of the sample values are estimated from the neighboring samples that are already coded in the image.

DPCM encodes the differences between the predicted samples instead of encoding each sample independently.

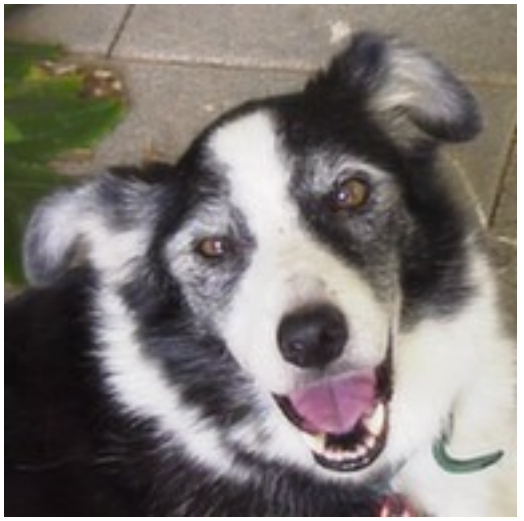
JPEG LOSSLESS



JPEG LOSSLESS



STEP 1



Original image (Lossless PNG) 60.1 kb uncompressed is 108.5 KB

STEP 2

Low compression (84% less information than uncompressed PNG, 9.37 KB)

STEP 2

Low compression (84% less information than uncompressed PNG, 9.37 KB)

STEP 3

Medium compression (92% less information than uncompressed PNG, 4.82 KB)

STEP 4

High compression (98% less information than uncompressed PNG, 1.14 KB)

Perceptual noise shaping

- There are certain sounds that the human ear cannot hear.
- There are certain sounds that the human ear hears much better than others.
- If there are two sounds playing simultaneously, we hear the louder one but cannot hear the softer one.

AUDIO COMPRESSION
MP3

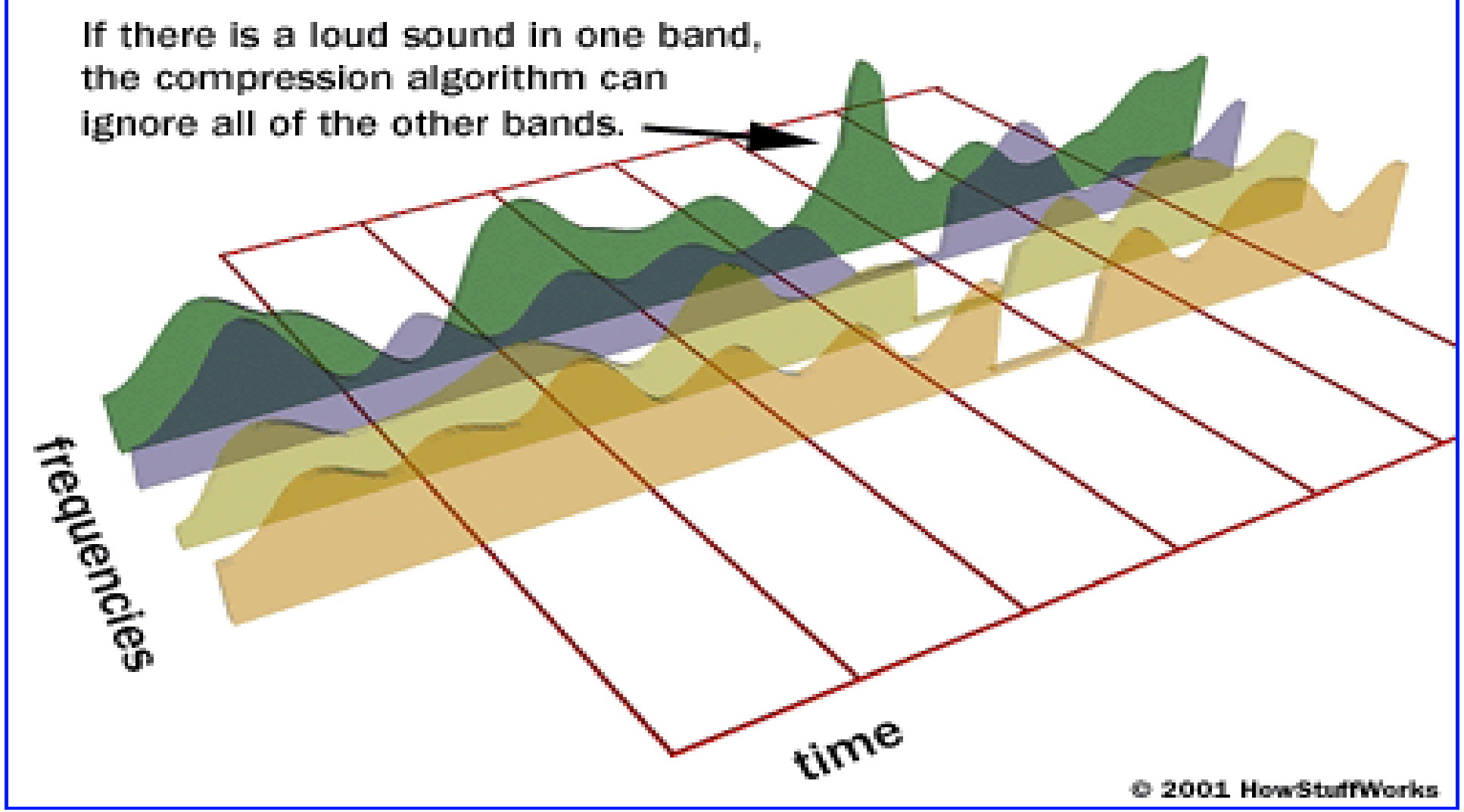
1)Patented digital audio encoding format.

2)A form of lossy data compression.

Applications:

Playback of music on digital audio players.

How MP3 Files Work



THE 2-PASS COMPRESSION

- **Run all of the psycho-acoustic models, discarding data in the process.**

- **Compress what's left to shrink the storage space required by any redundancies.**

- **The second step, the Huffman coding.**

VIDEO COMPRESSION CONCEPTS

A ***motion picture*** is a rapid sequence of a set of frames which each frame is a picture.

A ***frame*** is a spatial combination of pixels, and

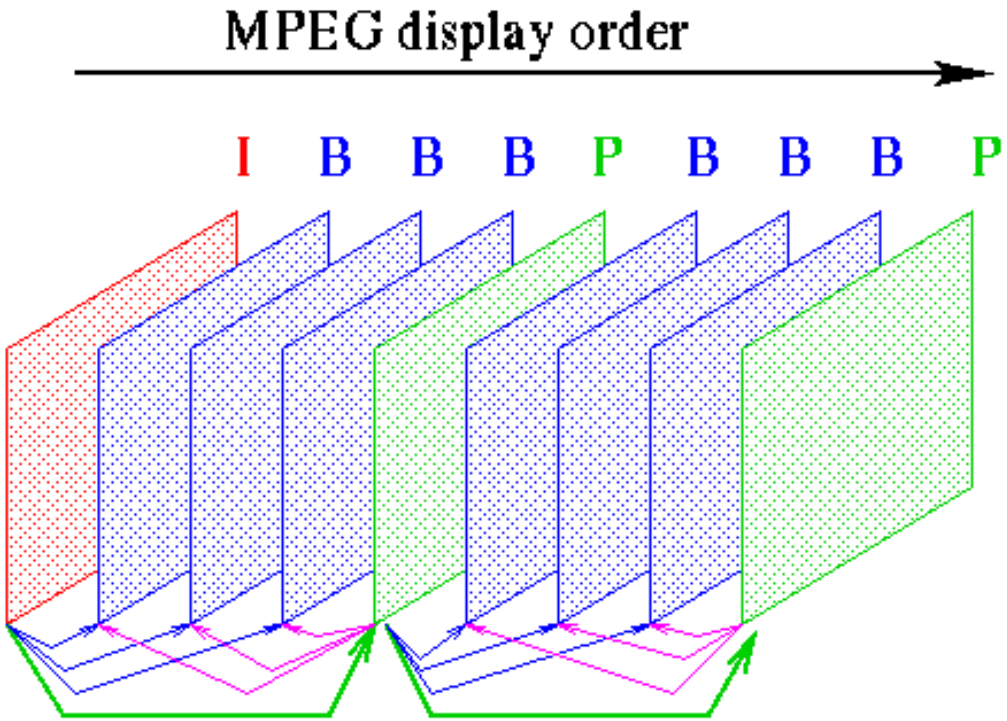
A **video** is a temporal combination of frames that are sent one after another.

1) SPATIAL COMPRESSION.

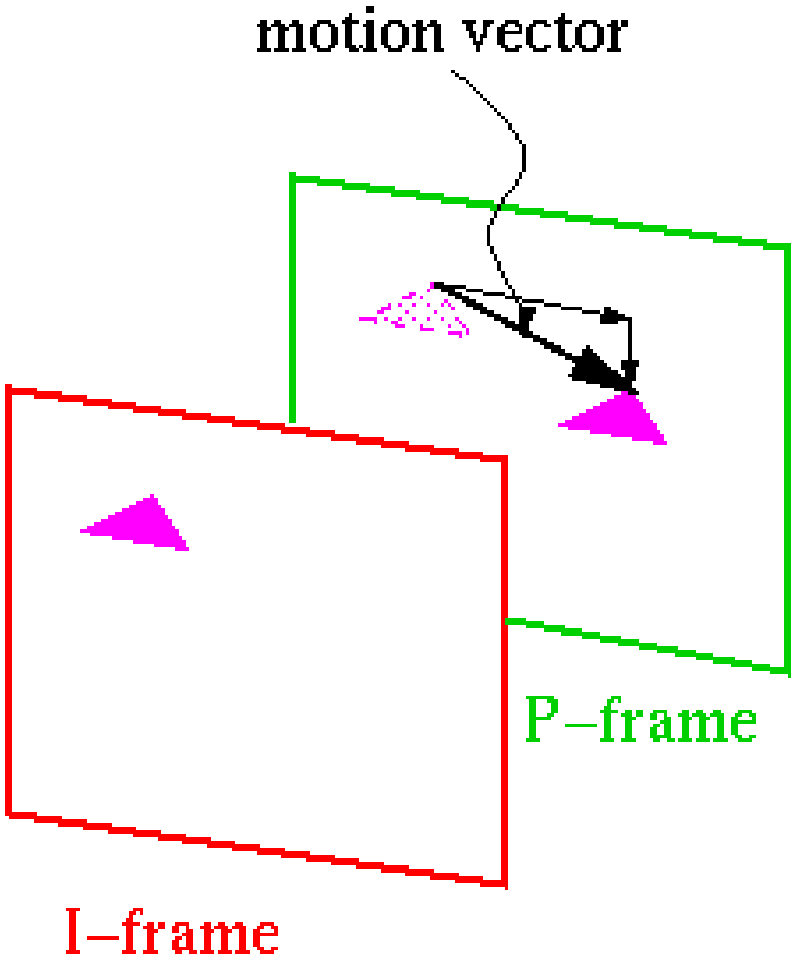
Each frame is independently compressed.

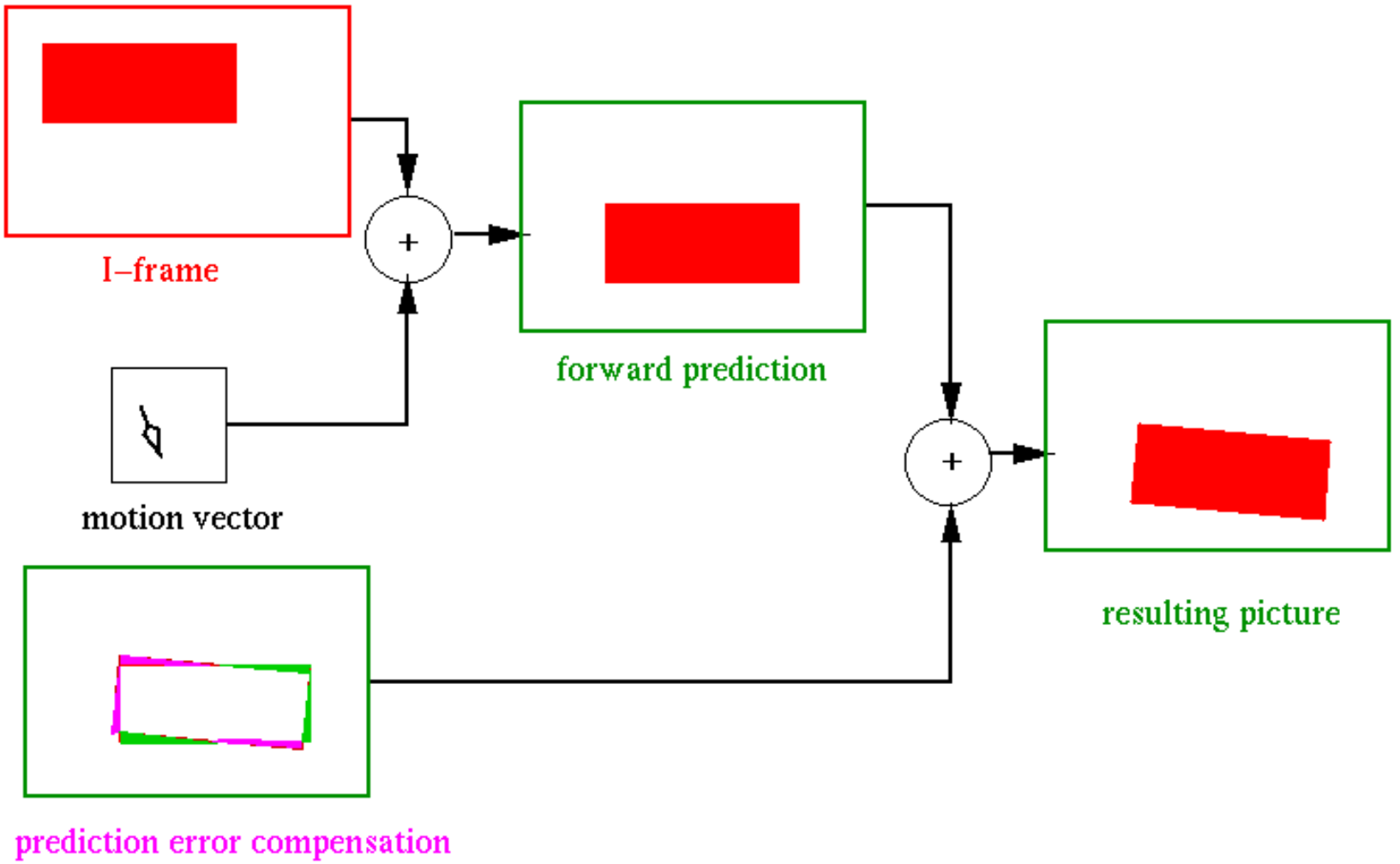
2) TEMPORAL COMPRESSION.

Redundant frames are removed.


MPEG display order
I B B B P B B B P
forward prediction of P –frames
forward prediction of B–frames
backward prediction of B–frames

What does "prediction" mean?




I–frame
forward prediction
motion vector
resulting picture
prediction error compensation

VIDEO COMPRESSION:
H.264/MPEG-4 AVC

STORAGE:

Blu-ray Discs.

STREAMING:

Metacafe, YouTube, iTunes.

WEB SOFTWARES:

Adobe Flash Player and Microsoft Silverlight.

BROADCAST SERVICES:

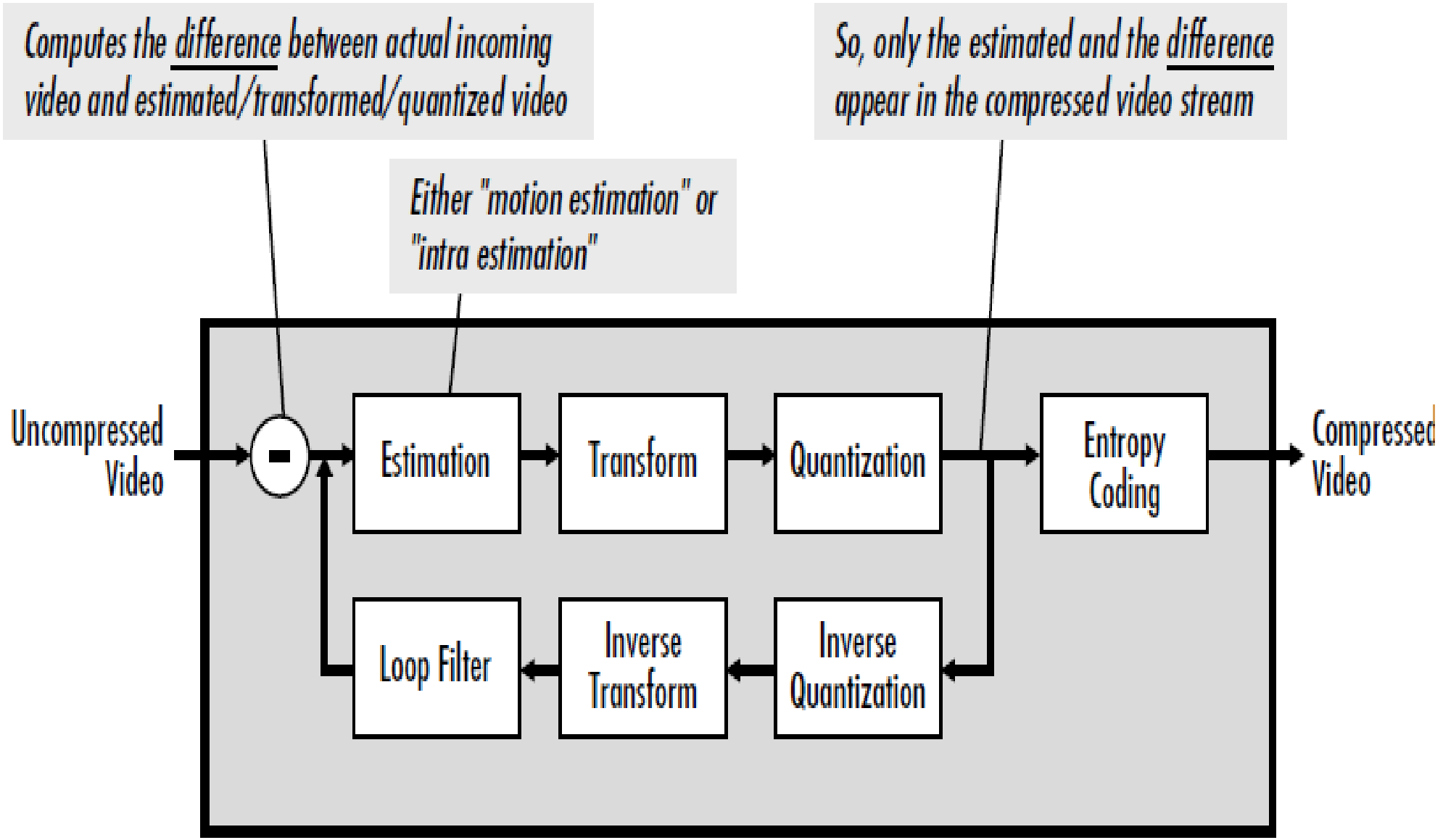
DVB and SBTVD

H.264/MPEG-4 AVC

THE PROCESS

- Motion Estimation and Intra Estimation
- Transform (and Inverse Transform)
- Quantization (and Inverse Quantization)
- Loop Filter
- Entropy Coding

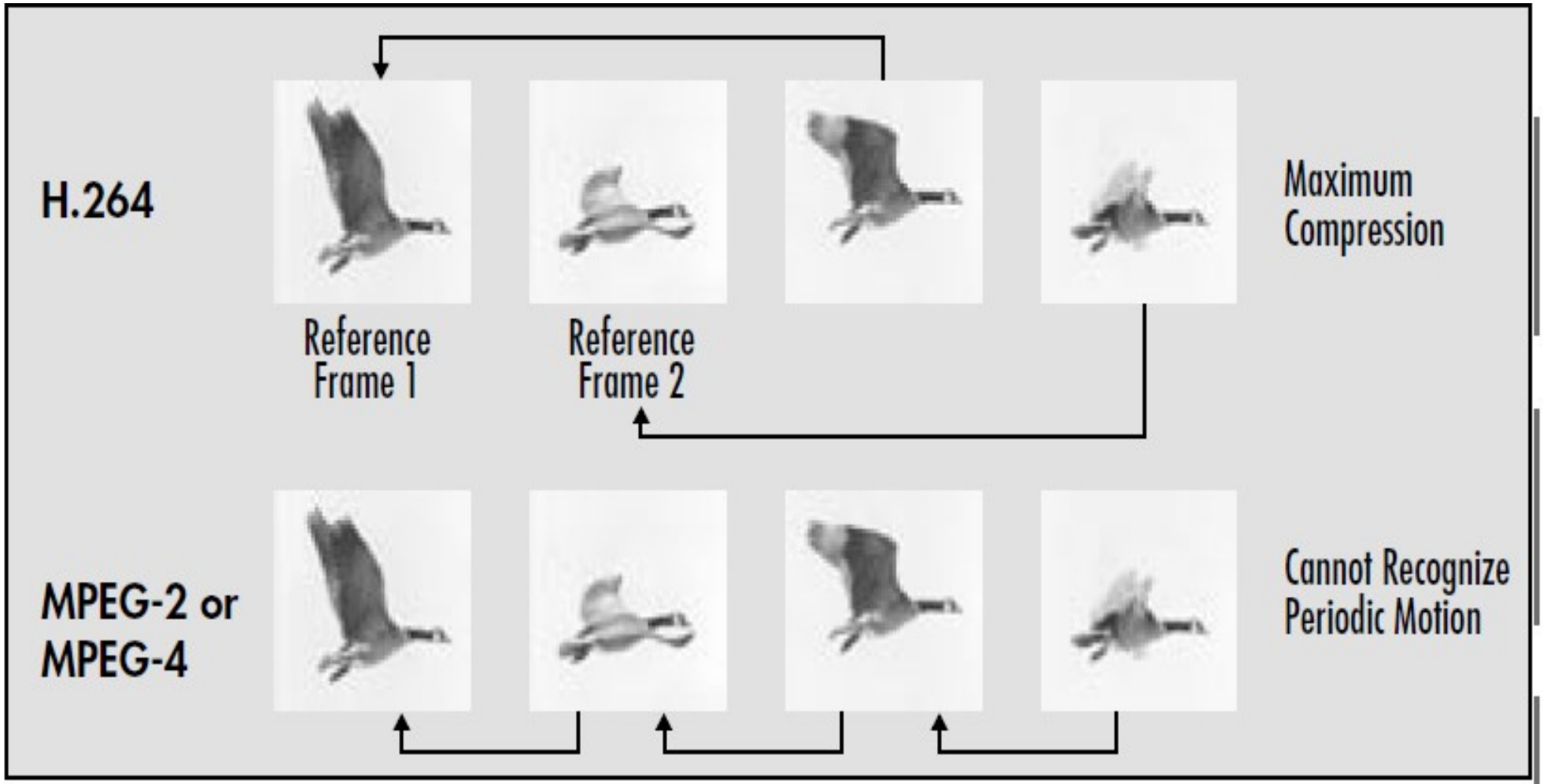
H.264/MPEG-4 AVC – Overview Block Diagram



Superior Motion Estimation

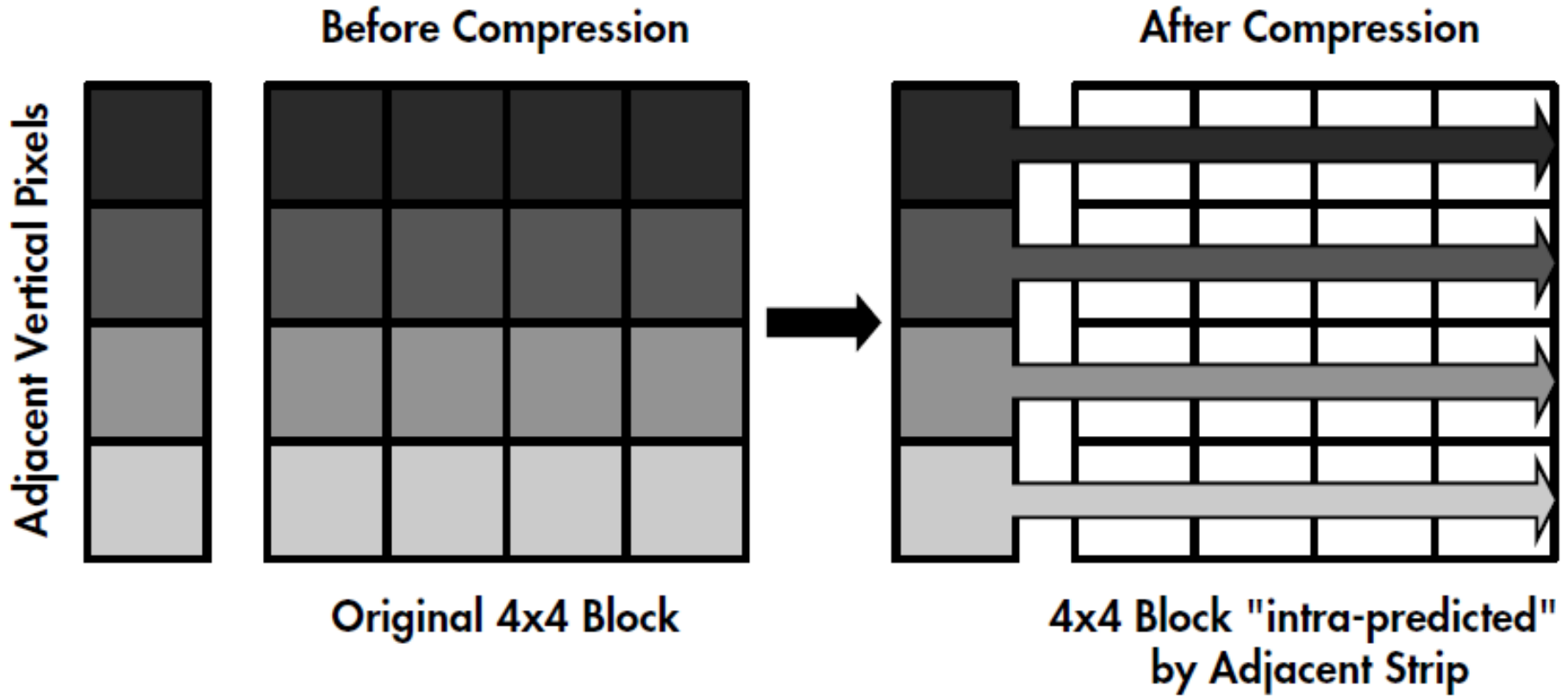
Macroblock Partitioning	Characteristics	Video Standard
	· Arbitrary block shapes · Small block sizes (4x4) · 1/4, 1/8 pel motion vector → **Strong motion isolation**	H.264
	· Square block shapes · Medium block sizes (8x8) · 1/8 pel motion vector → **Moderate motion isolation**	MPEG-4
	· Square block shapes · Large block sizes (16x16) · 1/2 pel motion vector → **Weak motion isolation**	MPEG-2

Multiple Reference Frames



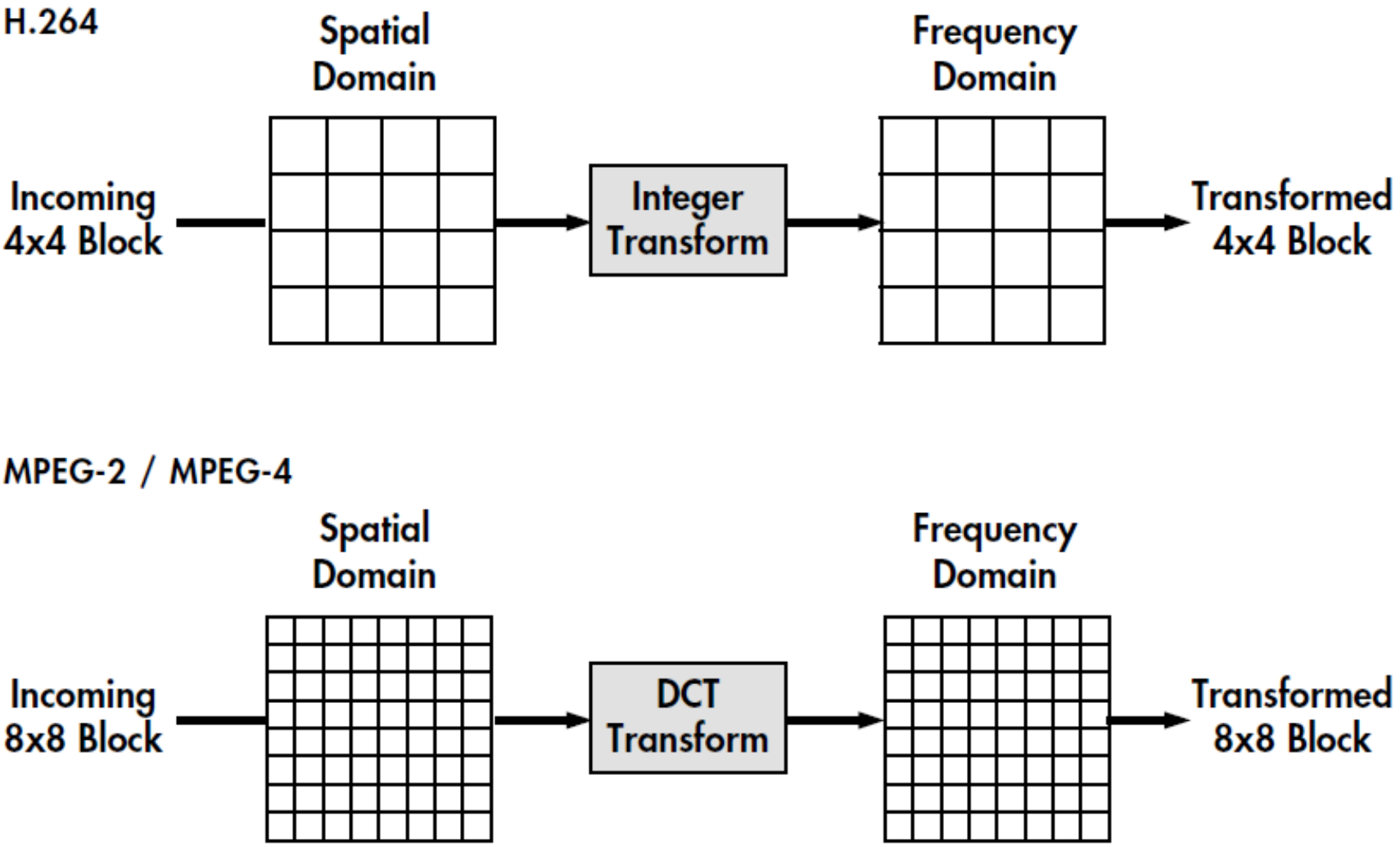
The difference between the predicted block and the actual block is then coded, which results in far fewer bits than if only the original block was coded.

INTRA-ESTIMATION

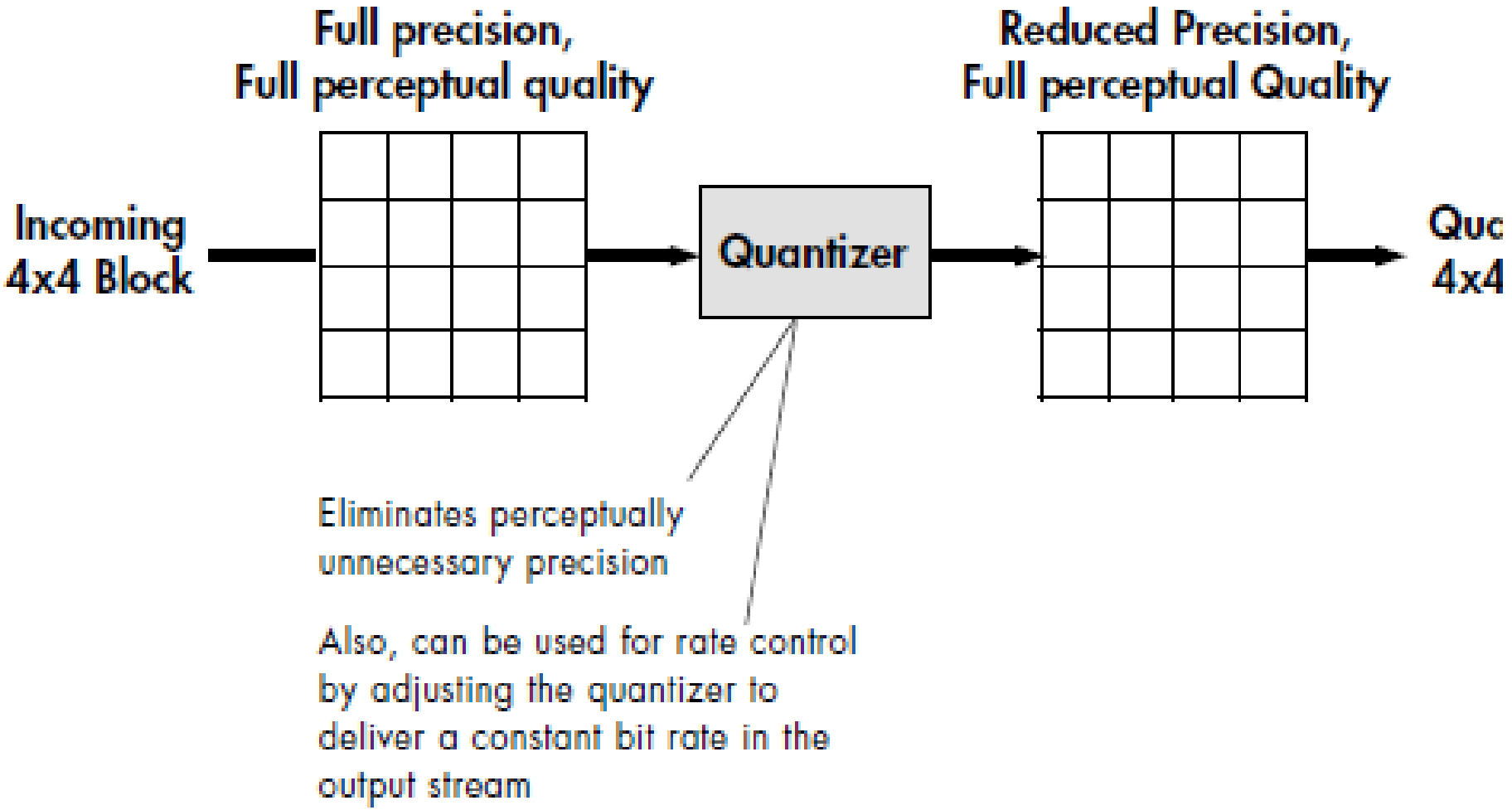


The difference between the predicted block and the actual block is then coded, which results in far fewer bits than if only the original block was coded.

INTEGER transform



QUANTIZATION



LOOP FILTER

The de-blocking filter that operates on both 16x16 macroblocks and 4x4 block boundaries.

In the case of macroblocks,

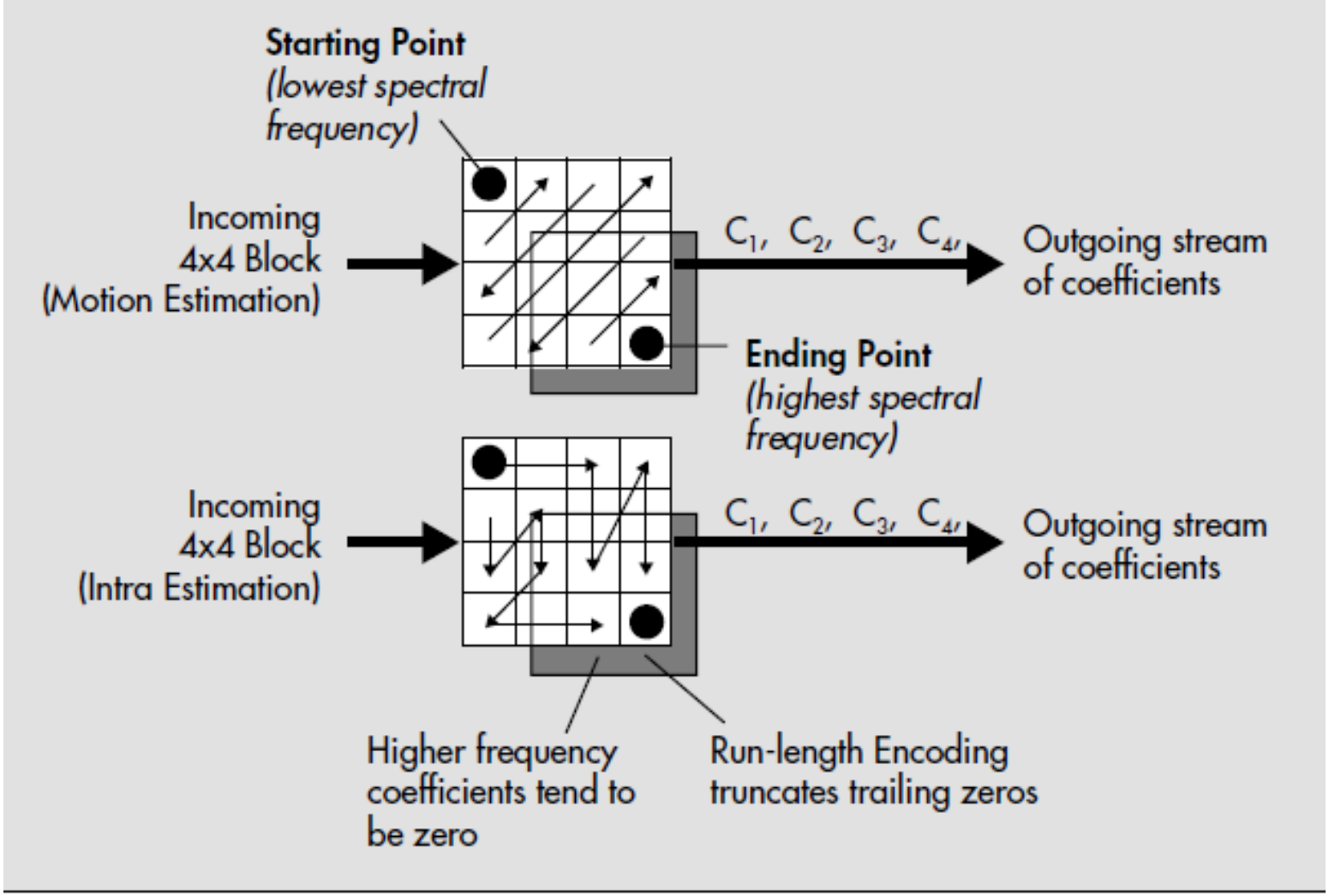
Remove artifacts that may result from adjacent macroblocks having different estimation types

(e.g. motion vs. intra estimation), and/or different quantizer scale.

In the case of blocks,

Remove artifacts that may be caused by transform/quantization and from motion vector differences between adjacent blocks.

ENTROPY ecoding – serialization of components



CONCLUSION

Most people know that a compressed ZIP file is smaller than the original file, but repeatedly compressing the file will in fact usually increase in size.

Lossless data compression must be applied for text files.

Audio-Visual data may be compressed with lossy data compression, thanks to the limitations in human sensory perceptions.

Compression of data is inevitable for transferring data over networks to minimise network usage and therefore, costs.

The trade-offs between information is completely scenario-dependent.

REFERENCES

http://scottwyden.com/facebooks-photo-upload-compression/

http://oreilly.com/catalog/mp3/chapter/ch02.html

http://www.cs.auckland.ac.nz/~jmor159/PLDS210/huffman.

MP3: The Definitive Guide (O'Reilly).

www.winzip.com/wz_jpg_comp.pdf

http://dvd-hq.info/data_compression.php

THANK YOU