AVC-163

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ORGANISATION INTERNATIONALE DE NORMALISATION
ISO/IEC JTC1/SC2/WG11
CODING OF MOVING PICTURES AND ASSOCIATED AUDIO

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Source: Jean-François VIAL (THOMSON-CSF/LER)
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Purpose: Proposal
Groups: All
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Proposal registration number: 34

This proposal is submitted by THOMSON-CSF/LER.
It has been developed within the European contract RACE 1018 HIVITS, and presented in the European EUREKA 625 VADIS / COST 211ter collaboration.

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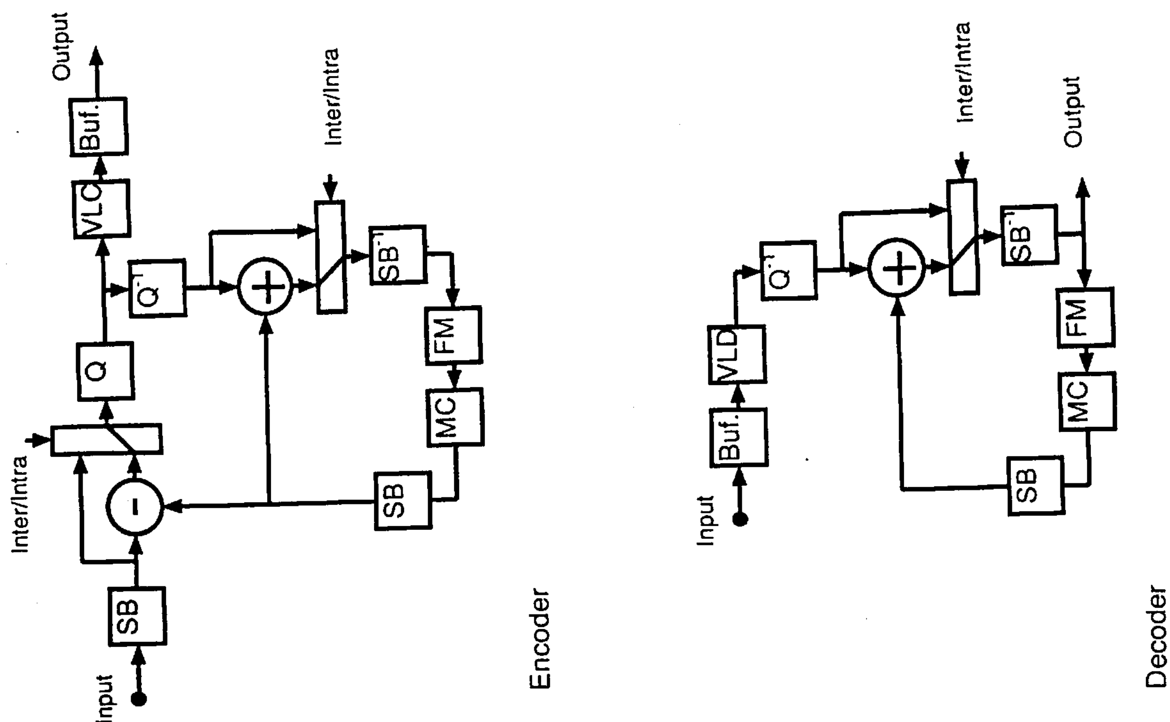
VIDEO INPUT	Standards	HDP or HDI or EDP or (16/9) 4:2:2 or (4/3) 4:2:2 or 16/9 (VT)
	Coding (according to EU 95)	HDP : 1920 pixels x 1152 lines — 50 frames/s non interlaced HDI : 1920 pixels x 1152 lines — 50 fields:s (interlaced by 2) EDP : 960 pixels x 576 lines — 50 frames/s 16/9 4:2:2: 960 pixels x 576 lines — 50 fields/s (interlaced by 2) 4/3 4:2:2: 720 pixels x 288 lines — 50 frames/s 16/9 VT : 480 pixels x 288 lines — 50 frames/s
	Interface	Bit parallel or bit serial according to EU95
VIDEO OUTPUT	Standards	HDP or HDI or EDP or (16/9) 4:2:2 or (4/3) 4:2:2 or 16/9 VT
	Coding (according to EU95)	HDP HDI 16/9 4:2:2 4/3 4:2:2 16/9 VT
	Interface	Bit parallel or bit serial according to EU95
SIGNAL PRE PROCESSING	Interlaced Standards	The interlaced signals (HDI and 4:2:2) require to be processed into progressive like signals before encoding
	Subsampling	No subsampling of the progressive input signal is performed
SIGNAL POSTPROCESSING	Interlaced Standards	Displaying the decoded information according to an interlaced standard requires progressive to interlace conversion after decoding.

PROPOSAL 34 FOR MPEG-2



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CODING	Signal splitting	The signal is split into subbands according to Annex I before encoding.
	Organisation into blocks	The signal obtained in each subband is organised into blocks consisting of different number of pixels according to the subband considered (Annex II).
	Encoding modes	2 modes are used to encode the blocks (intraframe or interframe motion compensated modes) (Annex III).
	Prediction of the block	In each block processed according to interframe mode the reference block is taken from a previous frame. Its position is derived from the position of the current block by application of a displacement vector (Annex IV)
	Motion compensation	Motion compensation is applied to blocks. A single displacement vector is assigned to each block (see Annex V)
	Quantization	A different quantization characteristic is used for each subband. Its parameters are adapted to the buffer occupancy (See Annex VI).
	Variable lenght coding	VLC's are used to encode the quantized subband pixels and motion information (See Annex VII).
	Video framing	See Annex VIII.
REGULATION		For compatibility with storage some restrictions are introduced in the regulation strategy (See Annex IX).

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ANNEX I - SIGNAL SPLITTING

I-1 - SUBBAND FILTERS

Subband splitting is done according to a hierarchical structure based on the specification of an unique elementary cell. Such cells are arranged in a tree structure and some parts of the spectrum may be more or less split according to their informational content.

This elementary cell splits the input spectrum in four rectangular bands using a separable approach : Rows and columns are treated separately.

This cell and the corresponding spectrum decomposition are sketched in figure 1.

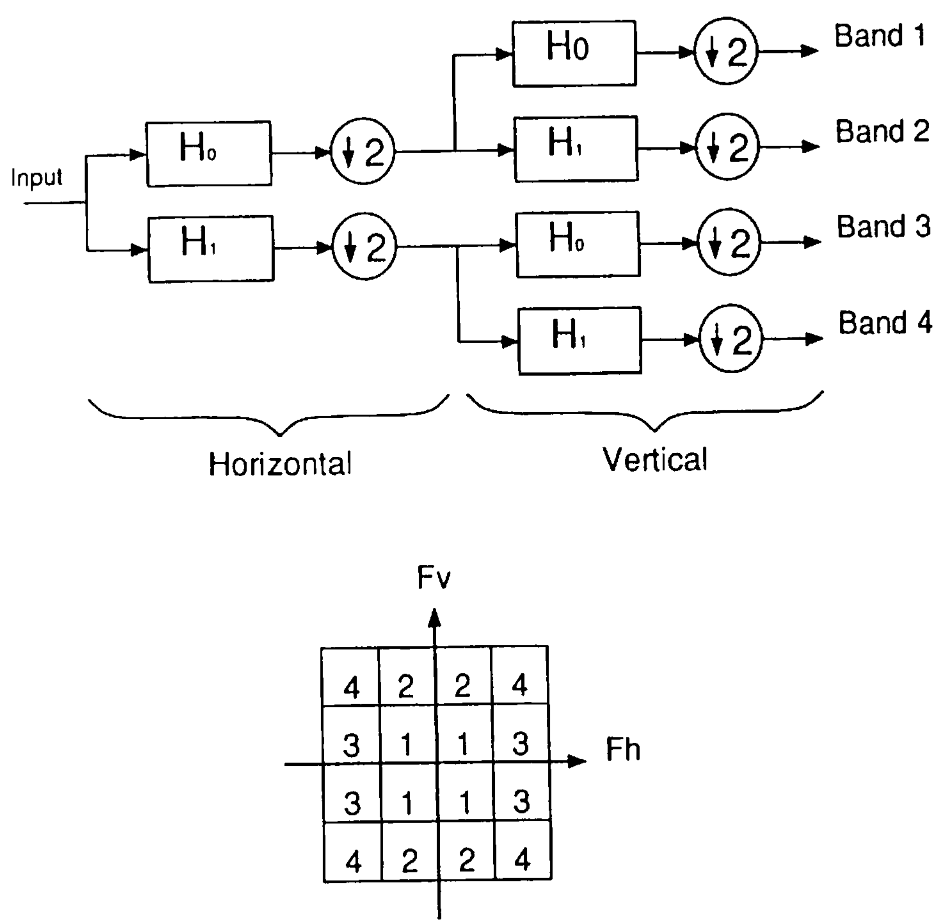


FIGURE 1 - 2D BASIC CELL - SEPARABLE 4-BAND DECOMPOSITION

Columns of the input image are filtered in the first stage (followed by subsampling of every second row). The input spectrum is thus first split into two horizontal subbands. Rows are then processed in the second stage.

H_0 and H_1 are respectively a low-pass and a high pass filter, having the same even length L. Coefficients $h_1(n)$ are deduced from H_0 as follows :

$$h_1(n) = (-1)^{L-n}\, h_0(L-1-n) \quad \text{for } n = 0 \text{ to } L-1$$

H_0 is a 16-tap linear phase filter (Quadrature Mirror Filter) whose coefficients are listed in table 1.

$h_0(0)$ =	0.001050	= $h_0(15)$
$h_0(1)$ =	-0.005055	= $h_0(14)$
$h_0(2)$ =	-0.002590	= $h_0(13)$
$h_0(3)$ =	0.027641	= $h_0(12)$
$h_0(4)$ =	-0.009666	= $h_0(11)$
$h_0(5)$ =	-0.090392	= $h_0(10)$
$h_0(6)$ =	0.097798	= $h_0(9)$
$h_0(7)$ =	0.481028	= $h_0(8)$

TABLE 1 : SUBBAND FILTER h_0

II - SPLITTING ("FORMAT INDEPENDENT SPLITTING" - FIS - SYSTEM)

II-1 - Progressive input signal

Whatever its format (HDP, EDP or VT) a progressive input image is split in the same way.

A) LUMINANCE

The luminance signal is split into 16 subbands according to the decomposition tree of figure 3. These bands will be referred to as L1 to L16 according to the numbering of figure 3.

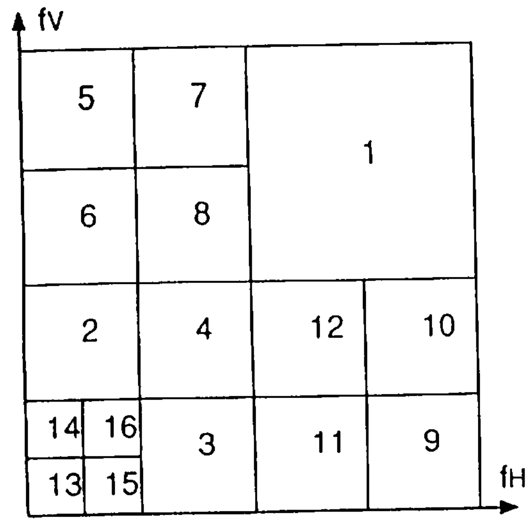


FIGURE 3 : LUMINANCE SPECTRUM DECOMPOSITION

B) CHROMINANCE

Chrominance signals CR and CB, which are subsampled by two in both directions are split into 7 subbands according to the decomposition tree of figure 4. These bands will be referred to as CR1 to CR7 and CB1 to CB7 according to the numbering of figure 4.

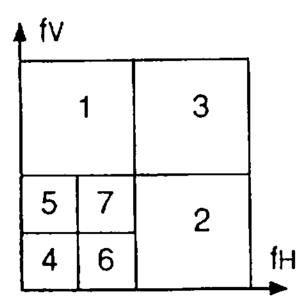


FIGURE 4 : CHROMINANCE SPECTRUM DECOMPOSITION

Luminance and chrominance bands with the same spectral position will be processed (inter/intra decision, motion vectors) and transmitted together ; however these bands do not have the same size due to the subsampling of chrominance signals.

II-2 - Interlaced input signal

An interlaced input signal is also processed in the same way regardless of its format (HDI or TV). First it is transformed into a progressive signal. This conversion may be implemented in several ways. At the moment this conversion is implemented by simply mixing two fiels together into one frame (improvement are under study).

ANNEX II - ORGANISATION INTO BLOCKS

In order to carry out inter/intra decision, which is done at the subband level, the signal obtained in each band is organized in subband blocks. This block structure is deduced from a virtual block splitting of the luminance input image.

The luminance input image, whatever its format , once tranformed into progressive, is supposed to be divided into adjacent NxN blocks, with N = 16 (in present simulations).

This block structure further determines that of each subband (luminance or chrominance bands), which is then described with the same number of blocks as the input luminance image. Each block of this input signal corresponds to one block in every subband, whose size is divided according to the subsampling factor of the considered band.

a) Luminance bands

Figure 1 gives block sizes of each luminance subband block for a 16x16 picture block at the input level.

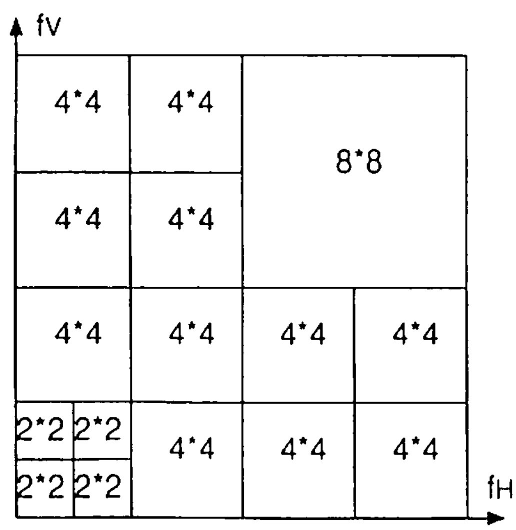


FIGURE 1 : BLOCK SIZES OF THE LUMINANCE SUBBAND DECOMPOSITION (progressive input)

Band 1 : 8 x 8

Bands 2 to 12 : 4 x 4

Bands 13 to 16 : 2 x 2

b) Chrominance bands

Due to the subsampling of input chrominance images, chrominance bands must be described with smaller blocks than corresponding luminance bands, in order to keep the same number of blocks per subband. These block sizes are described in figure 2.

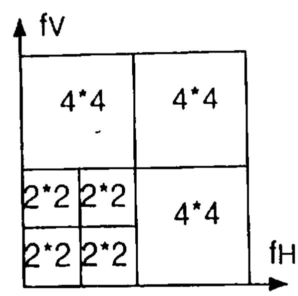


FIGURE 2 : BLOCK SIZES OF THE CHROMINANCE SUBBAND DECOMPOSITION (progressive input)

Bands 1 to 3 : 4 x 4

Bands 4 to 7 : 2 x 2

c) Macroblock

For inter/intra decision the subband blocks are grouped together in subband macroblocks. Two sets of subbands are defined :

- For bands L2 to L4 and L13 to L16 : A macroblock consists of 1 luminance subband block and 2 chrominance subband blocks (1 CR and 1 CB). Naturally, these 3 blocks represent the same area in the input image.
- For bands L1 and L5 to L12 : A macroblock consists of 1 luminance block.

ANNEX III - ENCODING MODES

2 modes are used to encode the subband blocks : intra frame and inter frame motion compensated modes.

Motion compensation is performed at the image level.

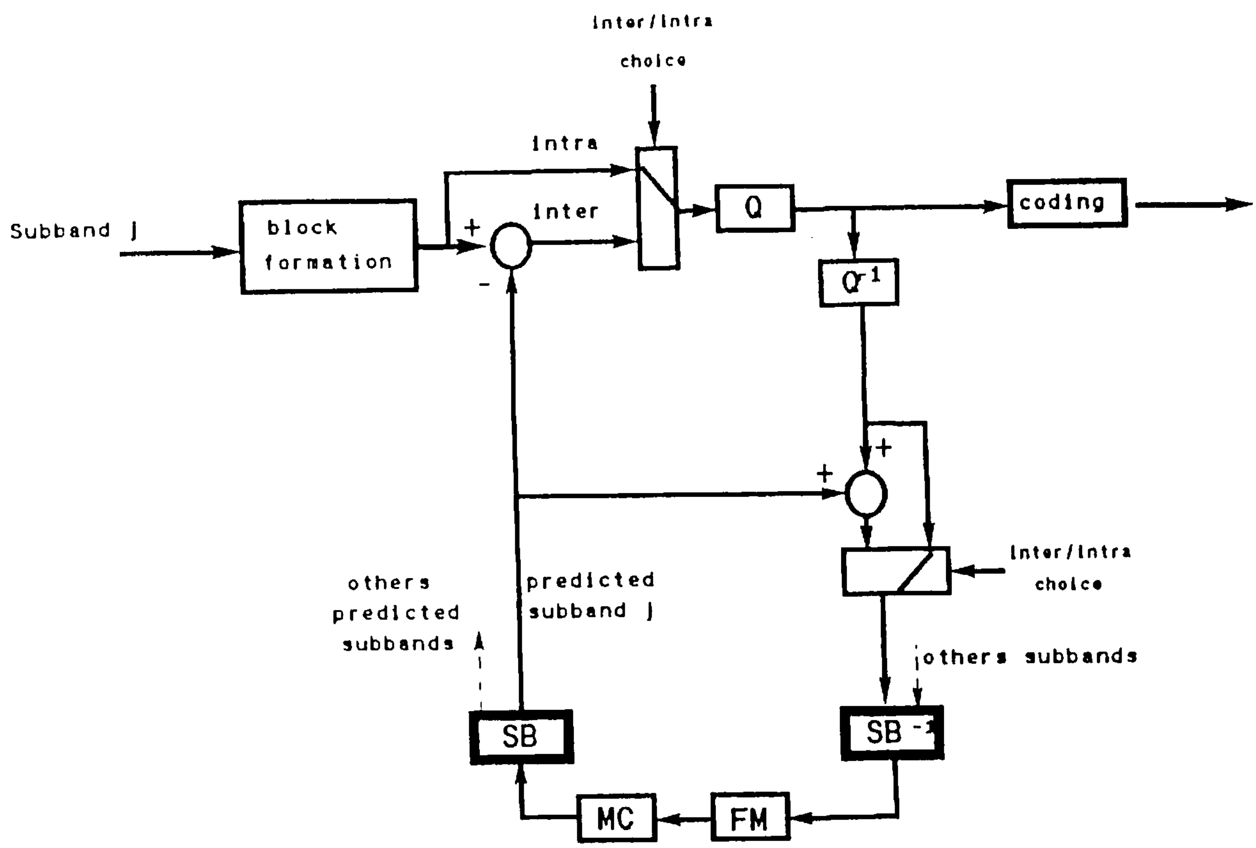


FIGURE 1 : INTRA/INTER ENCODING MODES

BLOCK FORMATION (see annex II)
Q : Quantization (see annex VI)

CODING : see annex VII

Q^{-1} It builds a subband block from the corresponding transmitted informations by assigning to the coefficients of the block the reconstruction values corresponding to the transmitted quantization level.

FM : Frame memory : It provides storage for the current decoded image which will be used as prediction reference for coding the subbands of a next image.

- MC : Motion compensation = prediction block determination.

It determines the prediction of the block currently processed for the inter-frame mode. This prediction block is computed with pixels of a previous picture according to a motion vector (see Annex V)

INTER - INTRA CHOICE : In order to reduce side information transmission, the same inter/intra choice is taken for all subband macro-blocks corresponding to the same spatial position in each subband set (see Annex II).

This chosen mode is then transmitted with the subband macro-block description.

Comments :

The choice is based on the energy of the luminance block belonging to the macro blocks of the subband set. Many criteria may be used to compute the energy, but no specification is required since it only concerns the coder side.

To avoid the temporal propagation of transmission errors effects, it is recommended to use an intra-frame refreshing processing. Besides, intra-frame refresh is also an important task for compatibility with storage media purposes as described in Annex IX.

ANNEX IV PREDICTION OF THE BLOCK

According to the block organization described in ANNEX II, a choice between intra frame mode and inter frame motion compensated mode is taken for each subband-block (see ANNEX III).

Two cases must thus be distinguished according to the accuracy of this motion vector :

1) When both coordinates of this vector are integer, there is no ambiguity in the definition of the prediction block. It is naturally defined by the translation of the corresponding block in the previous decoded picture.

2) If one of the coordinates of the motion vector has a non-zero fractional part, an interpolation scheme has to be used to build the prediction block.

This fractional part may equal 1/2 pel, and a classical bilinear interpolation is used.

In case of interlaced scanning, each field (i.e. one line over two in the block) is predicted by the previous field of same parity. That means that a vector of an odd number of vertical pixels for the frame corresponds to a half pixel vector for the field, and half pixel for the frame corresponds to quarter pixel for the field. Bilinear interpolation is used.

ANNEX V - MOTION COMPENSATION

Motion estimation is performed at the input image level on the luminance signal. This image is divided into NxN blocks (N = 16) and one motion vector per picture block is estimated using for instance a full search block matching algorithm. The estimation process is characterized by the following parameters :

- accuracy : 1/2 pel (1/4 pel vertically, see annex IV)

- search area : +/- 16 pels horizontally and vertically

ANNEX VI - QUANTIZATION

Luminance and chrominance informations of each band are quantized on a (subband) block basis according to the block description of ANNEX II.

Linear quantizers with different characteristics are used for each band. Two parameters, the dead zone (d) and the stepsize (s) define each quantizer as described in figure 1.

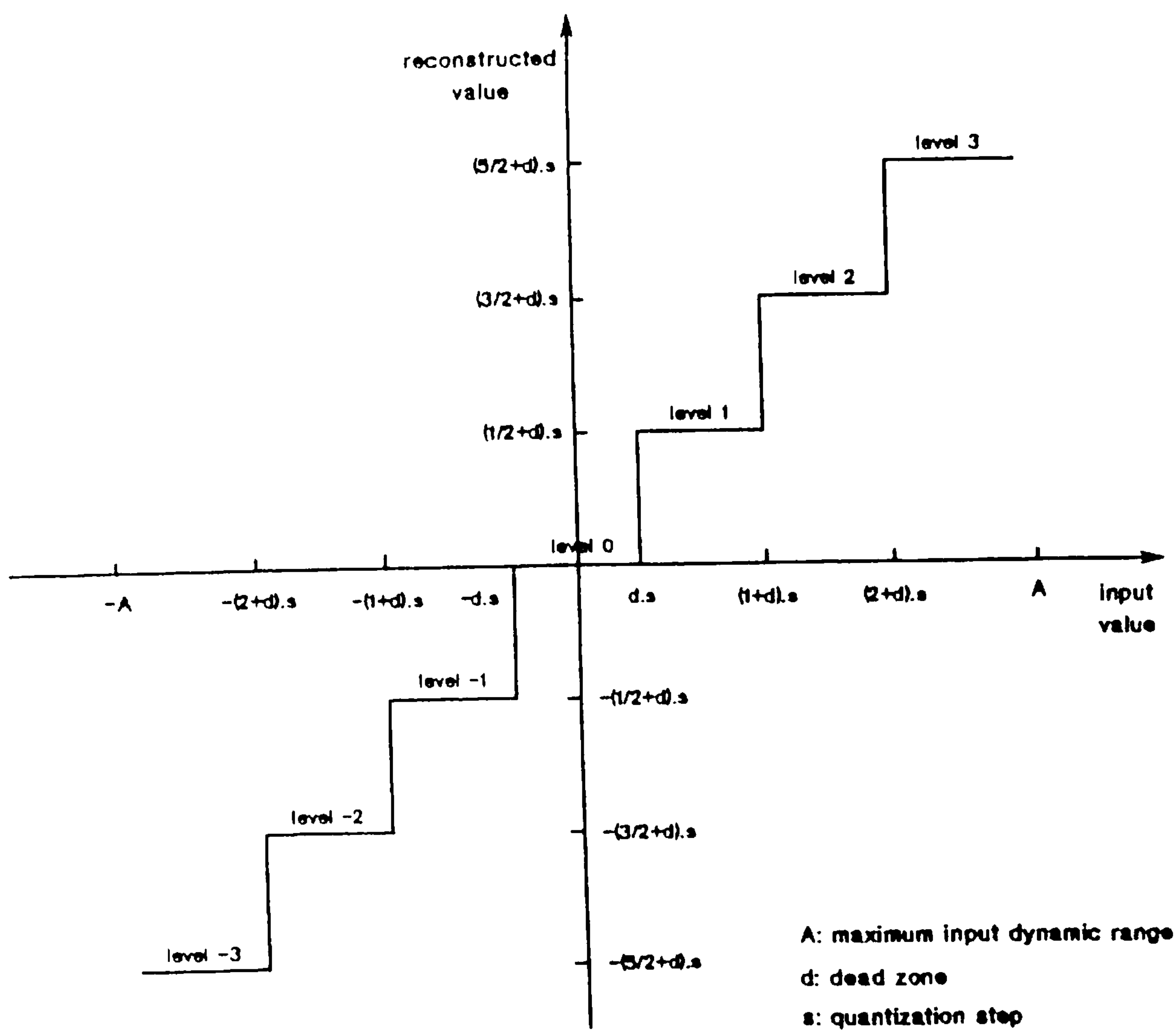


FIGURE 1 : LINEAR QUANTIZER

Furthermore, a regulation factor (f), common to all subbands determines the quantization step applied to each band q(i) according to :

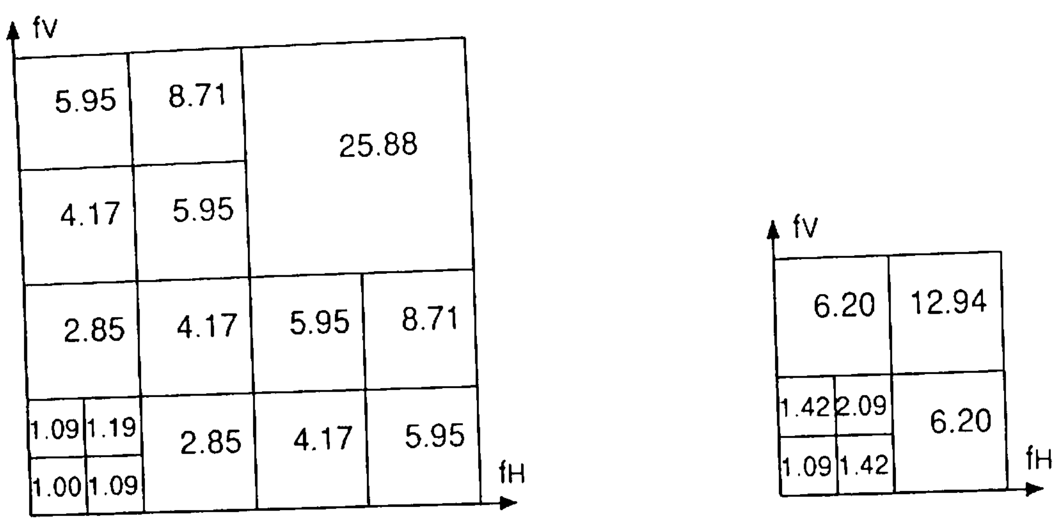
$$q(i) = f.\ s(i)$$

This regulation factor is computed according to the buffer occupancy (see ANNEX IX)
The same quantization steps are used for inter and intra blocks.

__Remark__ : *The quantization process may be improved by use of an adaptive factor (m) common to all subbands but varying from block to block according to the criticality of the corresponding block in the input luminance image (not implemented at the moment).*

Dead zones are set to 1 in all bands, both for luminance and chrominance signals.

Stepsizes s(i) used for each band are described in figure 2 for a progressive input image.



__Luminance bands__ __Chrominance bands__

__FIGURE 2__ : Stepsizes s(i) for a progressive input image

__Remark__ : *In order to minimize the reconstruction error variance, stepsizes s(i) should be chosen as :*

$$s(i) = 2^{-k_i}$$

Where k_i equals the number of times band i has undergone a 4-band split. Thus, further 4-band splitting of a band should divide the corresponding stepsize by 2.
These optimal stepsizes are not used here ; instead, some weighting is applied among the subbands. Such an approach yields in fact better visual quality of reconstructed images.

__Remark__ : *the weighting strategy described above applies to progressive originated pictures. A different (adaptive ?) strategy should be designed when pictures are obtained from interlace format.*

ANNEX VII - VARIABLE LENGTH CODING

I - GENERALITIES

Arithmetically computed variable length codes (ACVLC's) are used.

I-1 - ACVLC - Codeword Structure

An ACVLC (Arithmetically Comptuted Variable Length Code) codeword possesses the following structure :

- It is composed of a number of groups of bits. For a given codeword let k denote the number of groups constituting the codeword.
- The first k-1 groups (the prefix) of the codeword contain only "1"s. If k=1 the prefix is absent.
- The k^{th} group (the suffix) contains at least one "0".

Let l_i denote the number of bits in the i^{th} group of a codeword.

I-2 - ACVLC - Definition Of A Code

An ACVLC code is completely defined by specifying a maximum number of groups k as well as the group lengths $l_1 ... l_k$. The complete code is then the set of all ACVLC codewords which can be derived using these parameters. This code is uniquely decodable (no codeword is the prefix of an other codeword) and can be represented by a binary tree.

I-3 - ACVLC - Assignment Of Codewords

The assignment of a code word to a positive value n is as follows :

1) if $0 \leq n < S_1 = 2^{l_1} - 1$

the ACVLC codeword is as follows :

* no prefix
* the suffix is equal to n coded on l_1 bits
* the total length (prefix + suffix) is l_1

2) if $S_1 \leq n < S_2 = S_1 + 2^{l_2} - 1$
the ACVLC codeword is as follows :

* the prefix is composed of l_1 "1"s
* the suffix is equal to $n - S_1$ coded on l_2 bits
* the total length (prefix + suffix) is $l_1 + l_2$

and, more generally

3) if $S_i \leq n < S_{i+1} = S_i + 2^{l_{i+1}} - 1$
where

$$S_i = \sum_{j=1}^{i} (2^{l_j} - 1)$$

The ACVLC codeword is as follows :

* the prefix is composed of $\sum_{j=1}^{i} l_j$ "1"s
* the suffix is equal to $n - S_i$ coded on l_{i+1} bits.

In all cases :

The ACVLC codeword always ends with the LSB (Least Significant Bit) of the suffix.
This algorithm defines a one-to-one mapping between the set of all codewords of a given ACVLC code and the set of all integers n satisfying the condition :
$0 \leq n < Sk$

$$\text{where } Sk = \sum_{j=1}^{k} (2^{l_j} - 1)$$

The ACVLC codeword assigned to an integer value n using this algorithm will be denoted in what follows by ACVLC(n).

I-4 - Variable Length Coding (VLC) Modes

ACVLC is used to encode different parameters needed for the description of a block e.g.

* number of transmitted coefficients
* relative addresses
* absolute values of the coefficients
* motion vectors.

Due to the different ranges involved 3 different modes of encoding an integer λ are distinguished :

I - λ can be positive or zero
λ is encoded as ACVLC(λ).

II - λ can be positive or negative but not zero
If $\lambda > 0$, it is encoded as ACVLC (λ - 1), + "0"
If $\lambda < 0$, it is encoded as ACVLC ($|\lambda|$ - 1), + "1"

III - λ can be positive or negative or zero
If $\lambda \geq 0$, it is encoded as ACVLC (λ), + "0"
If $\lambda < 0$, it is encoded as ACLVC ($|\lambda|$ - 1), + "1"

in modes II and III an integer is encoded using an ACVLC word and the sign bit shown.

To each parameter an ACVLC tree (i.e. a set of group lengths $l_1 \ldots l_k$) and an encoding mode are associated (see paragraph 4.5)

I-5 - Transmission Rules

* Fixed length codeword
  The MSB (Most Significant Bit) is transmitted first.

* Variable length codeword
  The prefix is always transmitted first, followed by the suffix and (if present) the sign bit.

I-6 - Ranges Of ACVLC Tree Parameters

* The maximum number of groups (k) cannot exceed 8.
* The group length (l_i) of any group cannot exceed 10.

Consequently 32 bits (8 group lengths, each specified on 4 bits) are needed to completely define an ACVLC tree.

I-7 - Number Of Trees

For a given application 16 predefined ACVLC trees are sufficient, requiring 16x8x4 = 512 bits to fully specify all the VLC parameters.

I-8 - Range Of Values Encoded

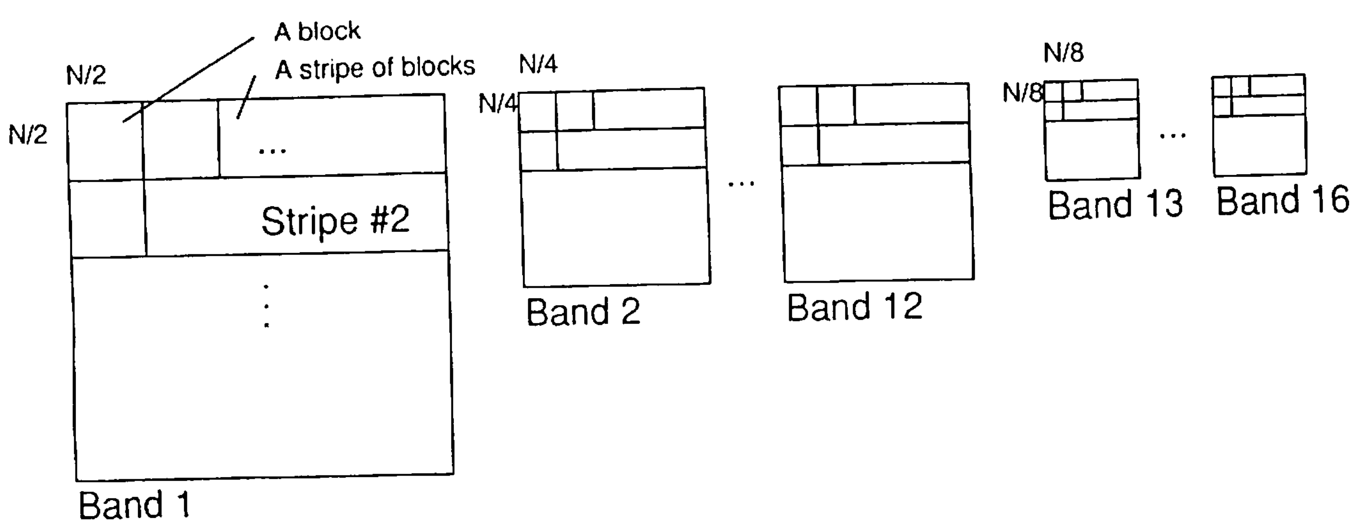
The use of VLC is restricted to values belonging to the set [-1023, +1023] (10 bits + sign).

I-9 - Maximum Codeword Length

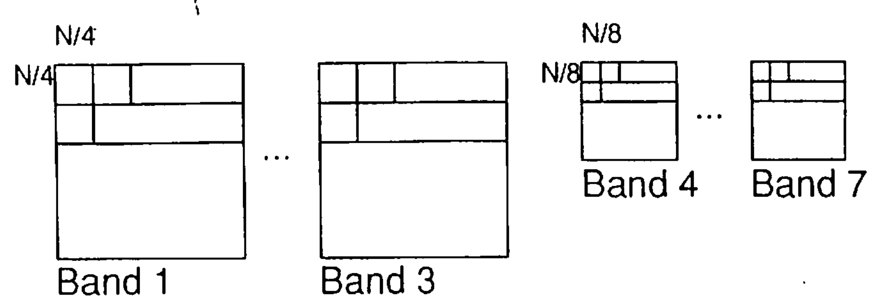
No value may be encoded on more than 32 bits.

II - SUBBAND DESCRIPTION

Once quantized, each subband is encoded using variable length codes and run length description. For this purpose, each band is split into (subband) stripes of blocks (see Annex VIII) according to the block description of annex II. This description is recalled in figure 1 for luminance and chrominance bands.



LUMINANCE BANDS



(N=16)

CHROMINANCE BANDS

Figure 1 : Band stripe decomposition

Each subband stripe of blocks is then encoded using a run length description and VLC's described above. The stripes are scanned (zero run description) according to the horizontal path shown in figure 2.

1	2	3	4	5 ...	...	480
481	482	...			...	960
961	...				...	1440
1441	...				...	1920

Figure 2 : Stripe scanning (band 2 of a HDP signal i.e. with 1920 pels per line)

The number of coefficients in a (subband) stripe thus depend upon the considered subband. It may be expressed as :

$$Nbcoef(s) = N \times NPT/S^2$$

where N is the picture blocksize in the progressive input image (N = 16), NPT is the number of pels per line of the input image and S is the subsampling factor (in both directions) of the considered subband.
The same holds for the maximal length of zero runs which varies according to the considered band (and which indeed equals Nbcoef(s)).

VLC description of a stripe

A subband stripe of blocks is described with the help of three kinds of information :

- The number of transmitted (non zero) coefficients

- The relative address

The relative address is defined as the number of consecutive zeros that precede the non zero coefficient (from the last non zero coefficient) in the 1-D description of the stripe of figure 2.

- The transmitted coefficient (non zero) amplitudes

The data framing is as follows : (for each stripe)

Nb [A] [VLC]

Where :

Nb : Number of transmitted (non zero) coefficients
The relative adresses of the transmitted coefficients (a VLC description may be used)

VLC's of transmitted coefficients

III - DESCRIPTION OF OTHER PARAMETERS

Some benefit can be obtained by encoding the motion vectors with variable length codes. Such a description highly depends on the motion estimation algorithm. For instance when motion estimation is performed on the input image (see ANNEX V), one motion vector is estimated for each 16x16 block in the input image. In order to have a zero mean probability distribution (ie to obtain an efficient VLC encoding) the motion vectors are transmitted in differential mode.

The prediction is the previous vector when it exists and zero when it does not (at the beginning of a stripe).

ANNEX VIII - VIDEO FRAMING

I - GENERAL STRUCTURE

The general structure of the video multiplex is based on the concept of subband stripe of blocks (SB) : each band is split in (subband) stripes of blocks according to the block structure of ANNEX II.

See annex VII for the decomposition into subband stripes of blocks.

The following notations will be used to designate a subband stripe of blocks :

SSBL(i)(j) will designate the stripe n°j in the luminance band n° i.

For chrominance bands, L is simply replaced by CR or CB according to :

SSBCR(i)(j) and SSBCB(i)(j)

The general structure is then described as follows (figure 2) :

FSW	00	ST	VF	VBR	BO	NSB*	NBS*
FSW	01	ST	VF	VBR	BO	NSB*	NBS*
FSW	10	ST	VF	VBR	BO	NSB*	NBS*

SSW0 [PSB1] SSW0 [PSB2] ... SSW0 [PSBk]

Where : FSW : Frame synchronisation word.

ST : System type (1 bit)

O = 50 Hz
1 = 60 Hz

VF : Video format (3 bit)

HDP	000
HDI	001
EDP	010
TV	011
VT	100

VBR : Video bit rate (4 bits)

BO : Buffer occupancy (16 bits)
Indicates the buffer occupancy at the coder at the end of the previous active frame

NSB : Number of stripes of blocks per band
NBS : Number of blocks per stripe
SSW : Stripe synchronisation word
[PSBi] : Picture stripe of blocks n°i

Each band (luminance or chrominance) possesses the same number of subband stripes of blocks. A PSB contains the descriptions of the subband stripes of blocks located at the same picture area in all the bands.

[PSBi] = SN BOS TF $[MI_1]$ $[MI_2]$ $[MV_x]$ $[MV_y]$

[SSBL(1)(i)]

...

[SSBL(16)(i)] [SBCR(16)(i)] [SBCB(16)(i)]

CRC

With the following notations :

SN : Stripe number (or PSB number) (from 1 to NSB)

BOS : Buffer occupancy.
Indicates the buffer occupancy at the coder at the end of the previous active group of stripes of blocks.

TF : Transmission factor

$[MI_k]$ = Mode identification (intra or inter) of the blocks of the considered subband stripe (same identification for luminance and chrominance blocks).

$[MV_x]$: Motion vectors in the horizontal direction estimated for the blocks of the corresponding stripe at the input image level (there are NBS such vectors)

$[MV_y]$: Motion vectors in the vertical direction estimated for the blocks of the corresponding stripe at the input image level (there are NBS such vectors)

CRC : Cyclic Redundancy Code to be applied to all bits of a Picture stripe of blocks.

[SSBL(k)(i)] : Description of the luminance stripe of blocks
[SSBCR(k)(i)] : Description of chrominance stripes of blocks
[SSBCB(k)(i)] : Description of chrominance stripes of blocks

II - DESCRIPTION OF A SUBBAND STRIPE OF BLOCKS

According to the VLC description of a subband stripe of blocks (see ANNEX VII), the video framing structure is as follows :
$[SSBL(k)(i)] = N_L \ [A_L] \ [VLC_L]$

Where,

N_L : Number of transmitted (non zero) coefficients in the corresponding stripe

$[A_L] : A_L^1 \ldots A_L^{NL}$: Relative addresses of the transmitted coefficients of the stripe

$VLC_L^1 \ldots VLC_L^{NL}$: VLC's of the transmitted coefficients of the stripe.

The same holds for chrominance stripes of blocks :

$[SSBCR(k)(i)] = N_{CR} \ [A_{CR}] \ [VLC_{CR}]$
$[SSBCB(k)(i)] = N_{CB} \ [A_{CB}] \ [VLC_{CB}]$

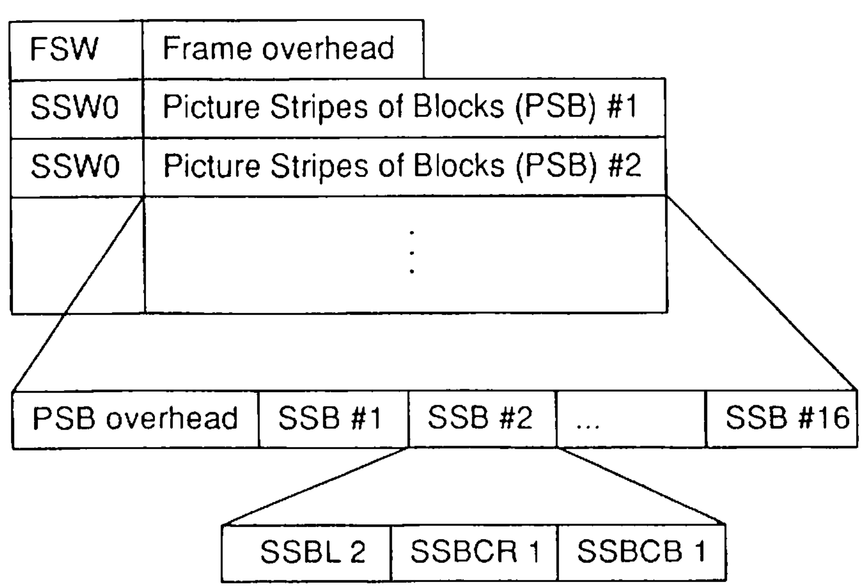


FIGURE 2 : VIDEO FRAMING GENERAL DESCRIPTION

ANNEX IX - BUFFER MEMORY

For storage applications, random access and fast forward and backward playback are made possible through the periodic coding of full pictures in intra mode.
The coded data buffer must be large enough to accept the high amount of bits needed for an entirely intra-coded picture. Five time the average number of bits per image seems sufficient :

800 Kbit at 4 Mbit/s
1.8 Mbit at 9 Mbit/s

The regulation strategy (which does not need to be part of the standard description), consists in computing the regulation factor (see Annex VI) that empties enough the buffer before intra-coded picture while avoiding buffer overflow for this picture while keeping the regulation factor as constant as possible.

Image number	Cumulative bit cost	Bit cost	Lum. coef. (%)	Chr. coef. (%)	Vectors (%)	Others (%)	SNR (dB)
1		288229	85.09	14.91	0.00	0.00	32.88
2		280825	90.56	5.64	2.65	1.15	32.93
3		301610	90.57	5.90	2.50	1.07	32.74
4		307246	90.52	5.97	2.46	1.05	32.79
5		301312	90.36	6.03	2.53	1.08	32.67
6		332610	90.32	6.44	2.27	0.97	32.88
7		318636	90.74	5.89	2.36	1.02	32.74
8		361717	91.59	5.39	2.13	0.90	32.76
9		360957	91.54	5.41	2.15	0.90	32.69
10	3645055	291813	90.82	5.45	2.65	1.00	32.16
11		787531	85.39	14.61	0.00	0.00	32.80
12		232514	89.81	5.43	3.37	1.39	31.52
13		287546	90.42	5.58	2.88	1.13	32.10
14		288294	90.58	5.39	2.90	1.12	32.08
15		386832	92.19	4.83	2.13	0.84	32.56
16		364526	92.10	4.80	2.21	0.89	32.25
17		296860	91.19	4.96	2.75	1.09	30.97
18		322296	91.06	5.40	2.53	1.01	31.25
19		318046	91.47	5.08	2.44	1.02	31.38
20	3593786	308441	90.83	5.68	2.44	1.05	31.61
21		745766	85.26	14.74	0.00	0.00	32.52
22		173085	86.82	7.80	4.31	1.07	30.89
23		292574	90.78	5.54	2.57	1.11	31.66
24		323408	90.96	5.69	2.34	1.00	32.06
25		364957	91.64	5.29	2.18	0.89	32.18
26		346094	91.64	5.09	2.34	0.94	32.14
27		315178	91.11	5.46	2.40	1.03	31.83
28		328429	91.02	5.72	2.27	0.99	32.07
29		328711	90.71	6.00	2.30	0.99	32.29
30	3528813	309696	89.90	6.66	2.39	1.05	32.69
31		863686	85.17	14.83	0.00	0.00	33.90
32		189505	87.50	6.88	3.91	1.71	31.46
33		306969	91.56	5.69	1.91	0.84	32.64
34		326293	91.50	5.17	2.33	0.99	31.99
35		219168	88.44	6.40	3.68	1.48	31.60
36		243981	88.73	6.82	3.12	1.33	32.27
37		321477	88.50	8.19	2.30	1.01	34.05
38		299736	87.87	8.58	2.46	1.08	34.87
39		327278	86.66	10.08	2.76	0.99	35.75
40	3522693	344606	85.58	11.39	2.08	0.94	36.75
41		1309519	84.32	15.68	0.00	0.00	37.99
42		179706	83.34	10.84	4.02	1.80	36.03
43		269984	86.95	9.18	2.67	1.20	35.62
44		302074	88.95	7.58	2.38	1.07	35.26
45		229619	87.14	8.31	3.14	1.41	34.44
46		301251	88.73	7.81	2.39	1.08	34.56
47		319268	89.97	6.77	2.25	1.01	34.36
48		335934	90.43	6.42	2.18	0.96	34.03
49		346092	90.93	5.91	2.16	0.94	33.51
50	3929207	334760	91.16	5.58	2.29	0.97	32.73
51		736748	84.63	15.37	0.00	0.00	32.41
52		236620	89.44	5.82	3.37	1.37	31.29
53		280128	90.05	5.88	2.92	1.16	31.09
54		294461	90.53	5.53	2.84	1.10	30.98
55		293881	89.95	6.05	2.90	1.10	30.93
56		318734	90.54	5.79	2.65	1.02	30.94
57		316974	90.45	5.92	2.61	1.02	30.91
58		305060	90.23	6.01	2.70	1.06	30.83
59		278948	89.59	6.35	2.89	1.16	31.07
60	3366207	304753	89.82	6.50	2.62	1.06	31.87
61		805638	84.42	15.58	0.00	0.00	33.16
62		181673	87.00	6.87	4.36	1.78	31.31
63		296032	90.34	5.87	2.69	1.09	32.01
64		315195	90.85	5.62	2.51	1.03	32.23
65		323737	90.49	6.00	2.51	1.00	32.37
66		311049	90.03	6.31	2.62	1.04	32.53
67		324309	90.22	6.32	2.46	1.00	32.94
68		381962	90.93	6.10	2.12	0.85	33.40
69		352944	90.86	5.94	2.28	0.92	33.18
70	3639291	366742	91.05	5.69	2.32	0.93	33.12
71		815352	84.23	15.77	0.00	0.00	33.25
72		235780	89.24	6.00	3.39	1.37	31.50
73		310603	90.28	6.09	2.59	1.04	31.82
74		288186	90.19	5.93	2.75	1.12	31.56
75		301182	90.21	6.05	2.67	1.08	31.65
76		299560	90.03	6.17	2.71	1.08	31.90
77		315793	90.24	6.16	2.58	1.03	32.51
78		356434	90.61	6.21	2.27	0.91	32.92
79		344704	90.84	5.88	2.34	0.94	32.74
80	3609962	342368	90.67	6.06	2.33	0.95	32.74
81		804960	84.14	15.86	0.00	0.00	33.06
82		201830	87.48	6.96	3.95	1.61	31.45
83		248639	87.07	8.53	3.10	1.30	32.15
84		293102	87.28	9.00	2.61	1.11	33.33
85		318861	88.36	8.21	2.41	1.02	33.97
86		351896	89.05	7.83	2.20	0.92	34.25
87		334312	88.83	7.88	2.32	0.97	34.22
88		294539	87.66	8.71	2.54	1.10	34.29
89		303337	87.48	8.94	2.52	1.07	34.65
90	3533295	387818	87.70	9.53	1.93	0.84	35.82
91		1071002	83.87	16.13	0.00	0.00	35.97
92		224944	87.14	8.10	3.31	1.44	34.78
93		243102	86.28	9.29	3.10	1.33	34.45
94		238353	85.09	10.36	3.18	1.36	34.52
95		265599	84.86	11.10	2.82	1.22	35.16
96		288748	84.58	11.70	2.59	1.12	35.94
97		347463	86.15	10.77	2.14	0.93	36.58
98		389199	88.46	8.78	1.92	0.83	36.45
99		419864	90.04	7.32	1.87	0.77	35.92
100	3828734	339960	89.93	6.82	2.30	0.95	34.40
101		856235	83.94	16.06	0.00	0.00	33.81
102		249490	89.22	6.34	3.14	1.30	32.68
103		228377	88.82	6.37	3.39	1.42	31.52
104		295549	89.53	6.71	2.66	1.10	32.01
105		271965	89.90	5.99	2.92	1.19	31.64
106		292604	90.02	6.13	2.75	1.11	31.73
107		294462	89.88	6.28	2.75	1.10	31.79
108		319499	90.21	6.20	2.58	1.01	32.19
109		297171	89.97	6.23	2.72	1.09	32.60
110	3426142	320790	89.61	6.81	2.57	1.01	32.98
111		861450	83.91	16.09	0.00	0.00	33.70
112		207529	87.81	6.68	3.95	1.56	31.52
113		317823	90.04	6.37	2.57	1.02	32.14
114		293193	89.90	6.08	2.87	1.14	31.72
115		276946	89.00	7.00	2.83	1.17	31.83
116		272536	88.79	7.27	2.76	1.19	32.35
117		312778	88.67	7.90	2.40	1.04	33.50
118		345451	89.74	7.18	2.15	0.94	34.19
119		336556	89.72	7.15	2.16	0.96	34.42
120	3510233	295971	88.81	7.63	2.46	1.09	34.69
121		1069362	83.73	16.27	0.00	0.00	35.71
122		208442	87.92	7.01	3.52	1.55	33.45
123		304723	89.67	6.85	2.41	1.06	33.42
124		251931	88.87	6.96	2.88	1.29	33.08
125		292705	89.49	6.88	2.52	1.11	33.14

Image number	Cumulative bit cost	Bit cost	Lum. coef. (%)	Chr. coef. (%)	Vectors (%)	Others (%)	SNR (dB)
1		388312	81.41	18.59	0.00	0.00	24.59
2		108173	79.41	10.71	6.88	3.00	24.63
3		116708	80.06	10.69	6.47	2.78	24.62
4		130828	81.75	10.00	5.78	2.48	24.72
5		135059	82.29	9.66	5.65	2.40	24.74
6		142919	82.87	9.59	5.27	2.27	24.78
7		141288	83.02	9.37	5.31	2.29	24.77
8		157598	84.34	8.72	4.88	2.06	24.72
9		153692	84.32	8.52	5.05	2.11	24.70
10	1611720	137143	82.69	9.37	5.57	2.36	24.70
11		438011	81.10	18.90	0.00	0.00	24.62
12		93782	76.27	11.92	8.36	3.45	24.41
13		109099	78.69	10.75	7.59	2.97	24.36
14		118831	80.10	10.15	7.03	2.73	24.35
15		153004	84.06	8.44	5.38	2.12	24.47
16		146660	83.95	8.34	5.50	2.21	24.42
17		130778	81.97	9.31	6.24	2.48	24.32
18		140252	82.69	9.18	5.82	2.31	24.36
19		139371	82.86	9.26	5.56	2.32	24.40
20	1608686	138898	82.72	9.51	5.43	2.33	24.47
21		425386	81.20	18.80	0.00	0.00	24.54
22		78047	72.01	14.29	9.55	4.15	24.33
23		122092	81.28	9.91	6.16	2.65	24.37
24		119836	80.69	10.29	6.32	2.70	24.33
25		141336	82.86	9.23	5.62	2.29	24.34
26		130459	81.70	9.61	6.21	2.48	24.27
27		133630	82.25	9.66	5.67	2.42	24.31
28		144366	82.85	9.74	5.17	2.24	24.43
29		141258	82.33	10.03	5.35	2.29	24.47
30	1572540	136130	81.61	10.56	5.44	2.38	24.53
31		469338	80.70	19.30	0.00	0.00	24.65
32		87170	74.51	13.28	8.49	3.72	24.46
33		138060	82.88	9.42	5.36	2.35	24.45
34		128228	81.89	9.64	5.94	2.53	24.40
35		92916	75.00	12.85	8.67	3.49	24.33
36		102935	77.11	12.35	7.39	3.15	24.53
37		139796	80.72	11.66	5.30	2.32	24.87
38		131761	80.27	11.67	5.60	2.46	24.91
39		141639	80.18	12.30	5.23	2.29	24.95
40	1579897	148054	79.90	13.06	4.85	2.19	25.00
41		674685	79.86	20.14	0.00	0.00	25.00
42		94283	75.47	13.44	7.66	3.44	25.01
43		74441	70.04	15.92	9.69	4.35	24.97
44		118039	79.14	11.99	6.12	2.74	25.02
45		97069	76.34	12.90	7.42	3.34	24.96
46		119613	79.46	11.83	6.01	2.71	24.96
47		132836	81.91	10.25	5.40	2.44	24.96
48		139258	82.53	9.88	5.26	2.33	24.95
49		153844	83.75	9.29	4.86	2.11	24.93
50	1714090	160022	84.10	9.07	4.80	2.02	24.89
51		424078	80.56	19.44	0.00	0.00	24.73
52		113687	79.70	10.45	7.00	2.85	24.63
53		93427	75.49	12.29	8.75	3.47	24.35
54		121252	80.05	10.39	6.89	2.67	24.34
55		112646	78.83	10.74	7.56	2.88	24.21
56		127365	80.64	10.17	6.64	2.54	24.28
57		130844	81.26	9.94	6.33	2.48	24.29
58		131975	81.00	10.31	6.24	2.46	24.35
59		126521	80.15	10.91	6.38	2.56	24.43
60	1519575	137780	81.29	10.57	5.79	2.35	24.56
61		438299	80.33	19.67	0.00	0.00	24.71
62		78833	71.46	14.39	10.04	4.11	24.46
63		119957	80.30	10.36	6.63	2.70	24.55
64		118135	80.20	10.37	6.68	2.74	24.55
65		133152	81.39	10.08	6.10	2.43	24.56
66		126025	80.29	10.68	6.46	2.57	24.59
67		134794	81.38	10.30	5.92	2.40	24.65
68		156180	83.00	9.73	5.20	2.07	24.72
69		148531	83.02	9.37	5.43	2.18	24.70
70	1603573	149667	83.21	9.25	5.37	2.16	24.81
71		457960	79.94	20.06	0.00	0.00	24.80
72		104594	78.14	11.12	7.63	3.10	24.67
73		109112	78.28	11.39	7.37	2.97	24.54
74		123567	80.47	10.48	6.42	2.62	24.54
75		118052	79.67	10.79	6.80	2.74	24.49
76		122757	80.15	10.59	6.62	2.64	24.50
77		131103	81.12	10.20	6.21	2.47	24.63
78		150983	82.89	9.59	5.37	2.15	24.74
79		145741	82.86	9.38	5.54	2.22	24.76
80	1609658	145789	82.42	9.88	5.47	2.22	24.78
81		444150	79.78	20.22	0.00	0.00	24.78
82		91568	74.75	12.99	8.71	3.54	24.63
83		96829	75.25	13.44	7.96	3.35	24.66
84		121540	78.72	12.32	6.29	2.67	24.68
85		119892	78.73	12.15	6.42	2.70	24.77
86		143898	81.16	11.21	5.39	2.25	24.92
87		134651	80.92	10.92	5.75	2.41	24.96
88		124214	79.61	11.76	6.02	2.61	25.01
89		148338	81.20	11.47	5.14	2.18	25.04
90	1576501	151421	81.77	11.16	4.93	2.14	25.16
91		544748	79.47	20.53	0.00	0.00	25.13
92		98222	76.75	12.37	7.58	3.30	25.04
93		84391	72.72	14.53	8.92	3.84	24.98
94		109331	76.69	13.40	6.94	2.96	25.06
95		98781	75.17	13.97	7.58	3.28	25.08
96		113677	76.36	14.20	6.59	2.85	25.12
97		150084	80.06	12.82	4.96	2.16	25.11
98		142891	81.84	10.66	5.23	2.27	25.08
99		168475	83.46	9.96	4.66	1.92	25.23
100	1680089	169489	83.46	10.02	4.61	1.91	25.26
101		465113	79.36	20.64	0.00	0.00	25.05
102		124998	80.91	10.23	6.27	2.59	25.02
103		74103	69.82	15.36	10.44	4.37	24.67
104		120943	80.09	10.72	6.51	2.68	24.70
105		102190	77.23	11.82	7.78	3.17	24.60
106		114460	79.21	10.94	7.03	2.83	24.59
107		129685	80.77	10.49	6.24	2.50	24.75
108		131323	80.76	10.49	6.28	2.47	24.78
109		134597	81.43	10.17	6.00	2.41	24.84
110	1549244	151832	81.91	10.52	5.44	2.13	24.96
111		466700	79.32	20.68	0.00	0.00	24.96
112		101906	76.93	11.85	8.04	3.18	24.75
113		106082	77.50	11.74	7.71	3.05	24.51
114		115172	78.96	11.17	7.06	2.81	24.57
115		107292	77.54	12.13	7.31	3.02	24.64
116		112965	78.46	12.02	6.65	2.87	24.75
117		132000	80.34	11.53	5.68	2.45	24.94
118		144713	81.97	10.67	5.13	2.24	25.00
119		143719	82.24	10.44	5.07	2.25	25.00
120	1568672	138123	81.56	10.82	5.28	2.35	25.14
121		559058	79.13	20.87	0.00	0.00	25.08
122		95213	76.18	12.73	7.70	3.40	25.00
123		88759	74.36	13.71	8.28	3.65	24.87
124		119301	79.69	11.50	6.09	2.72	24.94
125		103521	77.50	12.24	7.14	3.13	24.80

Image number	Cumulative bit cost	Bit cost	Lum. coef. (%)	Chr. coef. (%)	Vectors (%)	Others (%)	SNR (dB)
1		656574	84.15	15.85	0.00	0.00	31.14
2		304312	89.13	6.49	3.31	1.06	31.08
3		369649	89.82	6.54	2.77	0.88	31.07
4		370216	89.49	6.89	2.74	0.88	31.04
5		301334	89.07	6.47	3.38	1.08	30.59
6		277383	88.72	6.45	3.67	1.17	30.57
7		344250	89.56	6.61	2.89	0.94	30.73
8		346160	89.60	6.57	2.89	0.94	30.73
9		338758	89.68	6.40	2.97	0.96	30.66
10	3619691	311055	89.54	6.25	3.17	1.04	30.61
11		640377	84.68	15.32	0.00	0.00	30.90
12		260303	89.13	5.86	3.77	1.24	30.55
13		245607	87.59	7.17	3.92	1.32	30.76
14		298310	88.45	7.32	3.14	1.09	31.31
15		350644	89.11	7.22	2.74	0.92	31.71
16		343625	89.57	6.73	2.76	0.94	31.76
17		320112	88.45	7.57	2.96	1.01	31.83
18		372461	89.54	7.05	2.55	0.87	31.96
19		360703	89.76	6.79	2.55	0.90	31.94
20	3624509	432367	90.82	6.21	2.22	0.75	31.95
21		858540	84.55	15.45	0.00	0.00	31.95
22		265378	88.89	6.34	3.55	1.22	31.44
23		268404	88.45	6.83	3.51	1.21	31.28
24		333870	90.54	5.70	2.79	0.97	31.42
25		314074	89.49	6.38	3.10	1.03	31.27
26		233875	87.76	6.99	3.86	1.39	31.08
27		272395	88.37	7.08	3.36	1.19	31.28
28		448212	90.32	6.77	2.19	0.72	31.74
29		352459	89.93	6.39	2.77	0.92	31.47
30	3636050	258885	88.60	6.53	3.62	1.25	31.26
31		743579	84.86	15.14	0.00	0.00	31.48
32		311296	90.22	5.66	3.08	1.04	31.19
33		361097	90.73	5.69	2.68	0.90	31.25
34		264656	89.14	5.98	3.65	1.27	30.82
35		228220	87.65	6.88	4.05	1.42	30.96
36		322554	89.67	6.38	2.94	1.00	31.39
37		253497	88.07	7.06	3.59	1.28	31.57
38		321538	89.97	6.17	2.85	1.01	31.75
39		402092	89.98	6.75	2.47	0.81	32.09
40	3510285	301761	89.54	6.38	3.01	1.07	32.07
41		836777	84.78	15.22	0.00	0.00	32.25
42		318019	91.10	4.96	2.93	1.02	31.68
43		335950	90.34	5.90	2.80	0.96	31.33
44		279841	89.45	5.90	3.49	1.16	30.89
45		291726	90.48	5.30	3.23	1.11	30.76
46		373482	89.67	6.28	3.04	1.00	30.69
47		292567	90.07	5.58	3.25	1.11	30.57
48		343014	89.89	6.28	2.88	0.94	30.64
49		331401	90.13	5.88	3.07	0.90	30.56
50	3566495	213718	87.37	6.84	4.27	1.52	30.46
51		685577	84.69	15.31	0.00	0.00	30.94
52		195995	86.23	7.55	4.56	1.65	30.60
53		493300	89.72	7.58	2.04	0.66	31.54
54		351643	90.32	5.92	2.83	0.92	31.17
55		261966	88.81	6.36	3.59	1.24	30.82
56		335362	89.88	6.33	2.83	0.97	30.95
57		344773	90.18	6.04	2.83	0.94	31.00
58		330310	90.24	5.89	2.89	0.98	30.96
59		354293	90.42	5.92	2.74	0.91	30.99
60	3680150	326931	90.01	6.10	2.90	0.99	30.92
61		729083	84.75	15.25	0.00	0.00	31.14
62		201333	87.28	6.52	4.59	1.61	30.69
63		234126	87.97	6.86	3.78	1.38	31.04
64		344843	88.80	7.70	2.56	0.94	31.80
65		376227	90.42	6.38	2.34	0.86	31.84
66		369688	91.15	5.52	2.45	0.88	31.87
67		369845	91.07	5.45	2.60	0.88	31.84
68		227685	87.44	7.30	3.83	1.42	31.65
69		287776	88.45	7.33	3.09	1.13	31.72
70	3540789	400183	89.25	7.70	2.25	0.81	32.14
71		934372	84.37	15.63	0.00	0.00	32.15
72		325949	90.93	5.24	2.84	0.99	31.64
73		196131	86.58	6.99	4.78	1.65	31.10
74		270989	88.64	6.71	3.45	1.20	31.40
75		302089	88.91	6.93	3.08	1.07	31.71
76		367519	91.16	5.47	2.50	0.88	31.68
77		402112	90.91	5.94	2.45	0.81	31.57
78		318799	90.27	5.79	3.03	1.02	31.19
79		299504	90.00	5.76	3.16	1.08	31.08
80	3771074	353610	90.11	6.32	2.66	0.92	31.16
81		719551	84.67	15.33	0.00	0.00	31.25
82		186902	86.03	7.19	5.05	1.73	30.73
83		279578	89.33	6.19	3.32	1.16	31.01
84		398056	90.80	5.94	2.45	0.81	31.27
85		377789	90.63	5.85	2.66	0.86	31.12
86		267519	89.53	5.65	3.61	1.21	30.44
87		241063	87.96	6.88	3.82	1.34	30.64
88		332128	89.72	6.57	2.74	0.98	31.14
89		385178	90.58	6.06	2.52	0.84	31.31
90	3605585	417821	90.34	6.61	2.28	0.78	31.26
91		681491	84.74	15.26	0.00	0.00	30.91
92		306576	90.49	5.34	3.11	1.06	30.48
93		238963	88.46	6.07	4.11	1.36	30.04
94		309404	89.87	6.07	3.02	1.05	30.28
95		291346	89.37	6.32	3.19	1.11	30.31
96		321760	90.10	6.00	2.89	1.01	30.47
97		270346	89.27	5.92	3.61	1.20	30.46
98		280606	89.47	6.08	3.29	1.15	30.67
99		454503	90.12	7.00	2.17	0.71	31.42
100	3510939	355944	90.56	5.86	2.68	0.91	31.19
101		712461	84.80	15.20	0.00	0.00	31.20
102		230783	88.66	5.87	4.07	1.40	30.56
103		309981	90.34	5.70	2.92	1.05	30.89
104		321900	90.42	5.61	2.96	1.01	30.87
105		365693	90.72	5.73	2.67	0.89	30.96
106		361958	90.44	5.98	2.69	0.90	30.80
107		302287	89.92	5.85	3.15	1.07	30.48
108		315349	89.41	6.57	2.99	1.03	30.58
109		341947	89.71	6.57	2.77	0.95	30.80
110	3608481	346122	90.34	6.08	2.64	0.94	30.77
111		662443	84.88	15.12	0.00	0.00	30.88
112		272836	90.07	5.31	3.44	1.19	30.31
113		263264	89.03	6.12	3.62	1.23	30.44
114		288242	89.72	5.90	3.26	1.12	30.84
115		308441	89.61	6.43	2.91	1.05	31.32
116		316388	90.29	5.92	2.76	1.02	31.62
117		351435	89.82	6.72	2.54	0.92	32.06
118		399759	91.06	5.77	2.37	0.81	32.75
119		388102	90.49	6.28	2.39	0.83	32.10
120	3545564	294594	90.30	5.60	3.00	1.10	31.89
121		817638	84.47	15.53	0.00	0.00	32.14
122		331888	90.67	5.46	2.89	0.98	31.68
123		273791	89.38	6.00	3.43	1.18	31.23
124		194358	86.45	7.36	4.52	1.67	31.10
125		312040	90.18	5.86	2.92	1.04	31.41

FLOWER GARDEN @ 4Mbit/s

Image number	Cumulative bit cost	Bit cost	Lum. coef. (%)	Chr. coef. (%)	Vectors (%)	Others (%)	SNR (dB)
1		350007	80.73	19.27	0.00	0.00	25.98
2		134131	80.15	9.92	7.52	2.42	25.99
3		141784	80.99	9.52	7.21	2.29	25.84
4		135942	80.39	9.77	7.46	2.38	25.71
5		134760	80.38	9.66	7.56	2.40	25.62
6		124446	79.03	10.19	8.18	2.60	25.70
7		150058	81.80	9.41	6.63	2.16	25.81
8		146419	81.88	9.07	6.84	2.21	25.79
9		151062	81.92	9.27	6.66	2.14	25.76
10	1606409	137799	81.21	9.28	7.15	2.35	25.74
11		348891	81.19	18.81	0.00	0.00	25.82
12		103347	76.13	11.25	9.49	3.14	25.44
13		107047	76.24	11.73	9.01	3.03	25.48
14		128565	79.48	10.71	7.29	2.52	25.79
15		140291	80.56	10.27	6.86	2.31	25.97
16		150361	81.92	9.63	6.30	2.15	26.03
17		138394	80.19	10.61	6.85	2.34	26.10
18		155024	82.32	9.47	6.12	2.09	26.15
19		156709	81.97	10.08	5.88	2.07	26.28
20	1615760	187131	84.72	8.41	5.13	1.73	26.31
21		463905	81.53	18.47	0.00	0.00	26.13
22		117117	78.26	10.93	8.05	2.77	25.93
23		96655	74.58	12.31	9.76	3.35	25.80
24		125716	79.93	10.09	7.40	2.58	25.62
25		123898	79.35	10.19	7.85	2.62	25.53
26		101733	75.84	12.11	8.87	3.18	25.60
27		114181	77.57	11.58	8.01	2.84	25.74
28		191575	84.27	8.92	5.12	1.69	25.88
29		146730	81.89	9.25	6.65	2.21	25.84
30	1593834	118374	78.71	10.64	7.91	2.74	25.81
31		406983	81.26	18.74	0.00	0.00	25.90
32		115571	78.79	10.10	8.31	2.80	25.64
33		117748	78.88	10.14	8.23	2.75	25.37
34		106809	76.83	11.10	9.04	3.03	25.23
35		97519	74.74	12.46	9.49	3.32	25.36
36		150928	82.08	9.48	6.29	2.15	25.65
37		109651	76.72	11.91	8.38	2.98	25.66
38		131549	80.54	10.03	6.96	2.46	25.92
39		186396	83.90	9.03	5.33	1.74	26.04
40	1551948	129804	80.29	10.22	7.00	2.50	25.99
41		466558	81.60	18.40	0.00	0.00	25.97
42		112284	78.29	10.54	8.29	2.89	25.82
43		127434	80.46	9.62	7.38	2.54	25.39
44		125083	79.70	9.90	7.81	2.59	25.21
45		121203	79.93	9.63	7.77	2.67	24.88
46		147523	82.11	9.02	6.67	2.20	25.16
47		119785	79.23	10.14	7.93	2.70	25.30
48		145312	81.69	9.29	6.79	2.23	25.33
49		140404	81.49	9.09	7.12	2.31	25.29
50	1604832	99246	75.53	12.01	9.20	3.26	25.20
51		384660	81.25	18.75	0.00	0.00	25.35
52		92804	74.16	12.71	9.64	3.49	25.21
53		177887	84.34	8.14	5.65	1.82	25.44
54		138762	81.47	9.03	7.17	2.33	25.34
55		114384	78.36	10.58	8.22	2.83	25.32
56		138974	81.28	9.56	6.83	2.33	25.44
57		143614	81.66	9.28	6.80	2.26	25.39
58		140741	81.70	9.19	6.74	2.37	25.56
59		155262	82.91	8.75	6.26	2.09	25.58
60	1631076	143984	82.29	8.88	6.58	2.25	25.48
61		401363	81.34	18.66	0.00	0.00	25.50
62		91627	71.07	13.69	11.12	3.97	25.27
63		99957	76.16	11.74	8.86	3.24	25.21
64		130838	80.36	10.43	6.74	2.48	25.47
65		155617	83.41	8.85	5.66	2.08	25.56
66		137694	81.85	9.21	6.59	2.35	25.61
67		163881	83.89	8.27	5.86	1.98	25.51
68		135511	77.45	11.61	7.69	2.85	25.51
69		125598	79.49	10.84	7.09	2.58	25.62
70	1583161	173555	82.75	10.19	5.19	1.87	25.89
71		508197	81.23	18.77	0.00	0.00	25.81
72		141526	82.55	8.63	6.54	2.29	25.63
73		69293	65.56	16.23	13.54	4.68	25.18
74		110201	77.22	11.35	8.49	2.94	25.27
75		107844	76.98	11.38	8.63	3.00	25.27
76		146547	82.59	8.94	6.26	2.21	25.47
77		152259	83.01	8.38	6.48	2.13	25.57
78		133848	80.92	9.46	7.21	2.42	25.44
79		133009	81.19	9.26	7.11	2.44	25.39
80	1663212	160495	83.37	8.75	5.86	2.02	25.38
81		390839	81.12	18.88	0.00	0.00	25.27
82		82449	70.85	13.79	11.44	3.93	25.10
83		116838	78.94	10.34	7.95	2.77	25.30
84		147275	82.71	8.48	6.61	2.20	25.09
85		152223	82.52	8.74	6.61	2.13	25.06
86		118230	79.25	9.84	8.17	2.74	25.03
87		104625	76.71	11.41	8.79	3.10	25.07
88		142845	81.59	9.76	6.37	2.27	25.39
89		159572	83.18	8.71	6.08	2.03	25.42
90	1596015	171119	84.21	8.34	5.56	1.89	25.49
91		384475	81.37	18.63	0.00	0.00	25.33
92		126286	80.86	9.03	7.54	2.56	25.08
93		98802	75.25	11.54	9.94	3.28	24.82
94		129446	80.44	9.81	7.21	2.50	24.91
95		116996	78.88	10.40	7.95	2.77	24.78
96		135325	81.27	9.45	6.88	2.39	25.03
97		115231	78.27	10.46	8.46	2.81	25.00
98		177803	80.54	9.69	7.23	2.54	25.24
99		183830	84.25	8.62	5.37	1.76	25.38
100	1566732	147938	82.64	8.73	6.44	2.19	25.38
101		391099	81.33	18.67	0.00	0.00	25.32
102		99225	75.90	11.37	9.46	3.27	24.98
103		126944	80.90	9.42	7.13	2.55	25.02
104		129113	80.64	9.47	7.38	2.51	24.92
105		147538	82.64	8.55	6.62	2.20	24.97
106		146242	82.35	8.77	6.66	2.22	25.09
107		130815	80.86	9.37	7.29	2.48	25.01
108		131990	80.50	9.89	7.15	2.45	25.10
109		150976	81.92	9.67	6.26	2.15	25.21
110	1609667	155925	83.32	8.74	5.86	2.08	25.30
111		370911	81.51	18.49	0.00	0.00	25.29
112		112916	78.88	9.94	8.31	2.87	24.89
113		105543	76.96	10.93	9.03	3.07	24.87
114		112917	78.23	10.58	8.32	2.87	24.88
115		131859	80.78	9.94	6.87	2.46	25.17
116		128471	80.79	9.88	6.81	2.52	25.25
117		145874	82.25	9.41	6.13	2.22	25.49
118		173973	84.25	8.46	5.44	1.86	25.66
119		162789	83.86	8.45	5.70	1.99	25.65
120	1574002	130796	81.24	9.52	6.76	2.48	25.52
121		445968	81.32	18.68	0.00	0.00	25.56
122		123173	80.12	9.46	7.79	2.63	25.22
123		95570	75.60	11.63	9.44	3.25	24.94
124		89312	73.40	13.13	9.84	3.63	25.09
125		149741	82.44	9.31	6.08	2.16	25.33

TABLE TENNIS @ 9Mbit/s

Image number	Cumulative bit cost	Bit cost	Lum. coef. (%)	Chr. coef. (%)	Vectors (%)	Others (%)	SNR (dB)
1		768118	87.99	12.01	0.00	0.00	30.37
2		119529	79.07	12.23	5.99	2.71	30.40
3		122415	80.09	11.44	5.82	2.65	30.44
4		904859	87.90	10.94	0.80	0.36	39.03
5		245226	87.99	7.74	2.94	1.32	34.96
6		526539	93.64	4.29	1.45	0.62	34.38
7		763633	94.13	4.38	1.07	0.42	33.44
8		150873	62.42	28.00	7.43	2.15	29.83
9		111798	71.43	16.07	9.60	2.90	30.50
10	3883739	170749	78.86	13.18	6.06	1.90	32.45
11		460611	79.81	20.19	0.00	0.00	34.72
12		209227	82.54	10.98	4.93	1.55	34.60
13		330180	85.52	10.33	3.17	0.98	36.03
14		287045	85.24	10.10	3.53	1.13	35.94
15		312300	86.04	9.67	3.25	1.04	36.23
16		326982	85.55	10.42	3.04	0.99	36.66
17		348904	85.92	10.39	2.77	0.93	36.99
18		349777	85.36	10.88	2.83	0.93	37.09
19		358060	85.25	11.04	2.81	0.90	37.19
20	3374138	341052	84.71	11.38	2.95	0.95	37.19
21		609162	80.21	19.79	0.00	0.00	37.57
22		279442	84.18	11.05	3.61	1.16	36.95
23		329734	84.95	11.01	3.06	0.98	37.17
24		319114	85.87	10.02	3.09	1.02	37.08
25		326974	85.49	10.49	3.04	0.99	37.07
26		346702	86.10	10.17	2.79	0.93	37.21
27		348966	86.47	9.86	2.75	0.93	37.14
28		344956	86.53	9.78	2.76	0.94	37.15
29		358051	87.03	9.40	2.67	0.90	37.10
30	3625035	361934	86.17	10.27	2.66	0.90	37.01
31		660683	80.73	19.27	0.00	0.00	37.18
32		260384	84.01	10.97	3.78	1.24	36.19
33		324758	85.51	10.46	3.04	1.00	36.53
34		321458	85.56	10.30	3.13	1.01	36.34
35		326995	85.82	9.97	3.23	0.99	36.30
36		326227	85.47	10.29	3.25	0.99	36.28
37		348714	85.62	10.39	3.06	0.93	36.37
38		348053	84.90	11.07	3.10	0.93	36.35
39		340396	85.42	10.58	3.05	0.95	36.22
40	3604316	346648	85.15	10.97	2.94	0.93	36.29
41		626414	81.98	18.02	0.00	0.00	36.64
42		269076	84.23	10.74	3.83	1.20	35.80
43		317695	85.71	10.53	3.74	1.07	36.09
44		319715	85.51	10.34	3.13	1.01	36.04
45		318747	85.27	10.54	3.18	1.02	36.14
46		339407	85.46	10.65	2.94	0.95	36.28
47		346213	85.88	10.38	2.81	0.94	36.34
48		345454	85.96	10.31	2.79	0.94	36.30
49		349106	86.03	10.28	2.77	0.93	36.33
50	3576325	344498	85.55	10.73	2.77	0.94	36.36
51		643268	81.49	18.51	0.00	0.00	36.70
52		268316	84.05	11.06	3.69	1.21	35.83
53		323684	85.35	10.67	2.98	1.00	36.16
54		752574	83.56	14.40	1.62	0.43	35.58
55		85174	72.38	14.94	8.87	3.80	34.63
56		125536	79.93	11.44	6.04	2.58	35.70
57		652787	85.25	13.08	1.17	0.50	38.34
58		259733	88.72	7.12	2.92	1.25	36.89
59		302687	89.53	6.93	2.47	1.07	37.14
60	3740867	327108	90.35	6.45	2.21	0.99	37.24
61		1058238	86.08	13.92	0.00	0.00	37.40
62		186845	85.77	8.54	3.95	1.73	36.37
63		202025	85.98	8.57	3.85	1.60	36.41
64		254213	87.53	8.07	3.13	1.27	36.70
65		255085	87.14	8.45	3.14	1.27	36.68
66		321356	88.67	7.85	2.48	1.01	36.97
67		301106	88.12	8.21	2.60	1.08	36.88
68		308050	88.65	7.83	2.46	1.05	36.91
69		318890	89.21	7.45	2.33	1.02	36.98
70	3534960	329157	89.82	6.95	2.24	0.98	37.10
71		1042162	85.78	14.22	0.00	0.00	37.29
72		175667	85.87	8.26	4.03	1.84	36.17
73		265825	78.76	17.27	2.75	1.22	36.44
74		260055	80.25	15.55	2.95	1.25	36.39
75		220976	87.31	7.76	3.46	1.47	36.38
76		278951	88.90	7.18	2.76	1.16	36.75
77		317214	89.60	7.02	2.36	1.02	37.08
78		312516	89.57	7.02	2.38	1.04	37.13
79		353977	90.36	6.62	2.11	0.92	37.36
80	3564058	336715	89.94	6.90	2.19	0.96	37.30
81		1093680	85.84	14.16	0.00	0.00	37.49
82		188895	86.69	7.77	3.82	1.72	36.47
83		1025871	85.51	12.93	1.24	0.32	35.97
84		102596	75.72	13.50	7.62	3.16	34.63
85		107624	76.81	12.94	7.24	3.01	34.61
86		216649	86.78	8.20	3.52	1.50	35.51
87		182578	85.24	8.86	4.12	1.77	35.44
88		241229	87.58	8.02	3.05	1.34	35.86
89		295508	89.01	7.47	2.42	1.10	36.21
90	3733631	279001	89.09	7.18	2.57	1.16	36.18
91		1130951	87.29	12.71	0.00	0.00	36.55
92		154498	83.87	9.40	4.63	2.10	35.57
93		175568	85.56	8.54	4.06	1.85	35.68
94		260384	89.09	6.94	2.73	1.24	36.09
95		262792	89.55	6.53	2.69	1.23	36.02
96		286769	90.34	6.07	2.46	1.13	36.15
97		300303	91.26	5.33	2.33	1.08	36.18
98		355804	92.03	5.08	1.98	0.91	36.19
99		388153	91.71	5.55	1.91	0.83	36.18
100	3604617	289395	89.66	6.61	2.61	1.12	35.64
101		966593	87.18	12.82	0.00	0.00	35.97
102		173012	85.21	8.48	4.44	1.87	34.85
103		259896	89.61	6.13	3.02	1.25	35.07
104		289731	90.82	5.29	2.77	1.12	34.94
105		320132	91.93	4.72	2.37	0.99	34.84
106		319586	91.83	4.75	2.41	1.01	34.44
107		283193	91.41	4.79	2.65	1.14	33.85
108		300427	91.97	4.59	2.39	1.05	33.92
109		314885	92.03	4.52	2.41	1.03	33.83
110	3467779	224324	89.00	6.02	3.53	1.44	33.81
111		656584	85.70	14.30	0.00	0.00	34.13
112		120628	80.11	11.11	6.10	2.69	33.68
113		369923	91.74	5.37	2.01	0.88	34.87
114		286559	90.41	5.67	2.79	1.13	34.71
115		274729	89.97	6.16	2.69	1.18	34.72
116		293827	89.02	7.44	2.43	1.10	35.43
117		440228	90.96	6.69	1.62	0.74	36.35
118		441948	93.19	4.46	1.62	0.73	36.03
119		390389	93.08	4.23	1.87	0.83	35.17
120	3661290	386475	92.71	4.43	2.02	0.84	34.76
121		688596	85.59	14.41	0.00	0.00	34.34
122		181759	86.11	7.69	4.36	1.78	33.66
123		266440	89.15	6.63	3.00	1.22	34.42
124		319780	90.22	6.27	2.50	1.01	34.99
125		314654	90.12	6.28	2.56	1.03	35.09

TABLE TENNIS @ 4Mbit/s

Image number	Cumulative bit cost	Bit cost	Lum. coef. (%)	Chr. coef. (%)	Vectors (%)	Others (%)	SNR (dB)
1		288221	74.85	25.15	0.00	0.00	23.55
2		57219	59.77	22.05	12.51	5.66	23.57
3		61426	63.01	20.11	11.60	5.27	23.51
4		303045	82.53	14.02	2.38	1.07	23.97
5		88590	71.14	17.06	8.14	3.66	24.04
6		181474	83.63	10.37	4.21	1.79	24.19
7		311195	88.39	7.95	2.61	1.04	25.24
8		232082	71.45	22.32	4.83	1.40	28.48
9		72115	58.61	22.01	14.89	4.49	27.99
10	1691933	96566	67.01	18.91	10.72	3.36	28.42
11		250217	69.56	30.44	0.00	0.00	28.55
12		88050	66.00	18.60	11.72	3.68	28.44
13		117849	71.89	16.48	8.88	2.75	28.66
14		134649	74.50	15.57	7.52	2.41	28.79
15		150926	76.82	14.31	6.72	2.15	29.14
16		144306	75.42	15.46	6.88	2.25	29.23
17		143422	75.16	15.84	6.73	2.26	29.37
18		167471	75.95	16.20	5.92	1.93	29.20
19		162243	75.22	16.59	6.19	2.00	29.37
20	1508137	149004	74.26	16.81	6.76	2.17	29.19
21		352229	73.12	26.88	0.00	0.00	29.73
22		113961	71.45	16.86	8.85	2.84	28.85
23		135708	73.77	16.47	7.42	2.39	29.10
24		127629	73.78	15.95	7.73	2.54	28.78
25		130705	73.82	16.11	7.59	2.48	28.56
26		144071	75.45	15.58	6.71	2.25	28.41
27		150605	76.87	14.61	6.36	2.15	28.30
28		146406	76.56	14.74	6.49	2.21	28.17
29		154185	77.61	14.09	6.20	2.10	28.04
30	1611767	156318	76.86	14.90	6.17	2.07	27.80
31		383344	74.54	25.46	0.00	0.00	27.71
32		110950	71.26	16.95	8.86	2.92	27.47
33		124481	73.51	15.96	7.93	2.60	27.40
34		127730	74.17	15.41	7.89	2.54	27.39
35		136342	75.14	14.75	7.73	2.38	27.43
36		135245	74.67	15.14	7.85	2.40	27.36
37		143148	75.31	14.96	7.47	2.26	27.46
38		150352	75.54	15.13	7.18	2.15	27.45
39		149978	76.12	14.80	6.92	2.16	27.32
40	1611837	150317	76.02	15.04	6.79	2.16	27.31
41		355394	75.07	24.93	0.00	0.00	27.27
42		107283	71.33	16.05	9.60	3.07	27.10
43		126614	74.01	15.30	8.13	2.56	27.06
44		125881	74.48	14.98	7.96	2.57	27.09
45		129563	74.53	15.15	7.82	2.50	27.11
46		143516	75.80	14.99	6.95	2.26	27.19
47		144662	76.21	14.84	6.72	2.24	27.24
48		151880	76.93	14.59	6.34	2.13	27.30
49		150390	76.62	14.80	6.42	2.15	27.26
50	1586031	150848	76.25	15.27	6.33	2.15	27.30
51		374650	75.58	24.42	0.00	0.00	27.36
52		109068	71.48	16.48	9.07	2.97	27.30
53		125137	74.06	15.64	7.71	2.59	27.38
54		374787	77.89	18.00	3.24	0.86	26.52
55		50886	56.25	22.54	14.84	6.37	26.43
56		56350	60.16	20.62	13.47	5.75	26.45
57		135609	74.98	17.00	5.64	2.39	26.76
58		80336	69.86	16.67	9.43	4.03	26.78
59		94856	72.88	15.83	7.87	3.42	26.89
60	1658219	256540	78.03	17.89	2.82	1.26	27.11
61		606864	80.69	19.31	0.00	0.00	27.00
62		111556	76.31	14.16	6.67	2.90	26.97
63		64078	63.66	19.16	12.17	5.06	26.89
64		71562	65.31	19.06	11.11	4.53	26.88
65		87504	70.04	17.11	9.16	3.70	26.88
66		104737	73.68	15.63	7.60	3.09	26.85
67		121595	75.88	15.02	6.44	2.66	26.91
68		126077	76.58	14.83	6.07	2.57	26.96
69		132826	78.11	13.86	5.59	2.44	26.94
70	1572962	146163	79.24	13.49	5.05	2.22	26.98
71		646197	80.86	19.14	0.00	0.00	26.95
72		86307	73.07	14.98	8.20	3.75	26.92
73		74871	62.63	23.27	9.77	4.33	26.65
74		76946	65.77	20.06	9.96	4.21	26.78
75		77231	68.71	17.18	9.91	4.20	26.84
76		98347	73.08	15.80	7.82	3.29	26.91
77		115405	76.38	14.33	6.47	2.81	26.94
78		136416	79.09	13.09	5.44	2.38	26.99
79		135894	79.22	12.91	5.49	2.38	27.01
80	1586685	139071	79.01	13.34	5.31	2.33	27.03
81		723524	81.09	18.91	0.00	0.00	27.04
82		86079	72.31	15.54	9.39	3.76	27.01
83		460051	77.84	18.70	2.76	0.70	25.69
84		56178	59.47	20.85	13.91	5.77	25.61
85		54171	58.20	21.42	14.39	5.98	25.55
86		53196	58.12	21.44	14.35	6.09	25.54
87		52240	57.91	21.47	14.41	6.20	25.57
88		58500	61.94	19.93	12.59	5.54	25.68
89		67626	66.18	18.44	10.59	4.79	25.75
90	1718507	106942	74.70	15.58	6.70	3.03	25.91
91		557558	82.06	17.94	0.00	0.00	25.98
92		61672	63.97	19.17	11.61	5.25	25.94
93		55995	61.00	20.49	12.72	5.79	25.92
94		75782	69.38	16.96	9.38	4.28	25.96
95		99009	76.11	13.49	7.13	3.27	26.02
96		109273	77.91	12.67	6.45	2.97	26.08
97		132487	81.57	10.71	5.27	2.45	26.16
98		147719	83.28	9.75	4.77	2.19	26.15
99		167967	83.48	10.18	4.41	1.93	26.11
100	1547723	140261	80.63	11.67	5.39	2.31	26.05
101		563671	81.95	18.05	0.00	0.00	25.99
102		94346	74.15	14.28	8.14	3.43	25.92
103		70891	68.05	16.32	11.06	4.57	25.84
104		98269	76.33	12.21	8.16	3.30	25.87
105		107429	78.69	11.06	7.23	3.02	25.88
106		120289	80.74	10.18	6.39	2.69	25.90
107		124097	81.65	9.69	6.05	2.61	25.92
108		127000	82.23	9.44	5.80	2.55	25.96
109		136009	82.98	9.05	5.59	2.38	26.00
110	1542180	100179	76.88	11.97	7.91	3.23	26.07
111		362739	79.74	20.26	0.00	0.00	26.04
112		77549	71.02	15.32	9.49	4.18	26.06
113		123360	80.76	10.58	6.03	2.63	26.01
114		105981	77.33	12.06	7.55	3.06	25.90
115		118654	79.29	11.76	6.27	2.73	25.89
116		124082	78.49	13.14	5.76	2.61	25.90
117		169438	82.04	11.84	4.20	1.91	25.94
118		176313	85.32	8.78	4.06	1.84	25.93
119		194307	86.71	7.87	3.75	1.67	25.85
120	1639900	187477	86.24	7.87	4.16	1.73	25.73
121		426699	79.88	20.12	0.00	0.00	25.61
122		108346	77.47	12.22	7.32	2.99	25.62
123		94510	74.13	13.99	8.44	3.43	25.51
124		113210	77.70	12.37	7.07	2.86	25.47
125		113806	77.52	12.44	7.09	2.95	25.43