AVC-161

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

ISO/IEC JTC1/SC2/WG11
MPEG225 257 289
18 Nov. 1991

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(This is jointly proposed by
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Title: Algorithm description for proposal
(Preregistration number: #31)
Purpose: Proposal
Relevant group: MPEG/VIDEO

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1 INTRODUCTION

This document proposes a hybrid coding comprising motion compensation and DCT based on SM3.
It features:

1) The lines are rearranged in a block before DCT.

2) A proper quantizer matrix and a modified zigzag scanning order are selectable depending on luminance and chrominance component in their intra or non-intra modes. Furthermore, the selection is allowed every sequence.

Block diagrams of encoder, decoder, predictor, and adaptive predictor are shown in Figure 7, Figure 8, Figure 9, and Figure 10, respectively.
Flow charts of encoder and decoder are shown in Figure 11 and Figure 12, respectively.

Note: This proposal is results of collaboration by Sharp, GCT, Waseda, Toppan, NEC, and NHK.

2 ALGORITHM

2.1 Source Formats

A picture consists of video components Y, Cb, and Cr.
The number of active lines is 480 for both luminance(Y) and chrominance(Cb and Cr) component.
The number of active pixels per line is 704 for luminance, and 352 for chrominance, respectively.
Picture rate is 30 pictures/sec.

2.2 Layered Structure of Video Data

2.2.1 Sequence

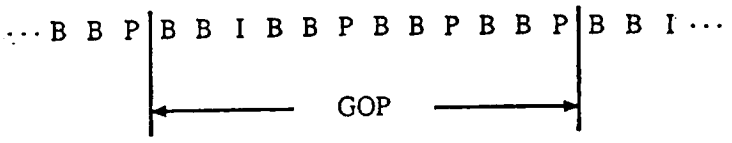
A sequence consists of a number of concatenated Group of Pictures.

2.2.2 Group of Pictures

A Group of Pictures(GOP) consists of 12 pictures, beginning with the B-picture first appearing after the last P-picture of the previous GOP and before I-picture, and ending with P-picture prior to the next I-picture(see Figure 1).

2.2.3 Picture

Pictures can be intra, predicted, or interpolated frames. The arrangement of pictures in a GOP in this proposal is shown in Figure 1.



I : intra
P : predicted
B : interpolated(bidirectionally predicted)

Figure 1: The arrangement of pictures in a GOP

A picture consists of 60 slices. The arrangement of these slices in a picture is shown in Figure 2.

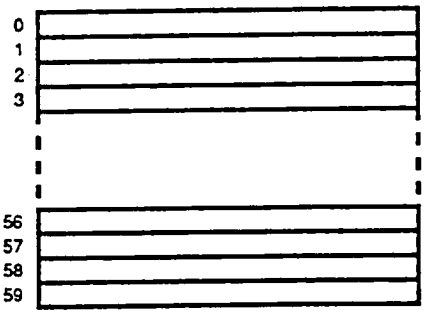


Figure 2: The arrangement of slices in a picture

2.2.4 Slice

A slice consists of a row of 44 macroblocks starting at the left side of the picture, and ending at the right side as depicted in Figure 3.

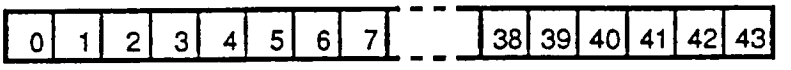


Figure 3: Slice structure

2.2.5 Macroblock

A macroblock(MB) consists of 4 blocks, comprising 2 Y blocks, 1 Cb block, and 1 Cr block as depicted in Figure 4.
Motion compensation and modification of quantizer parameter(qp) are based on MBs.

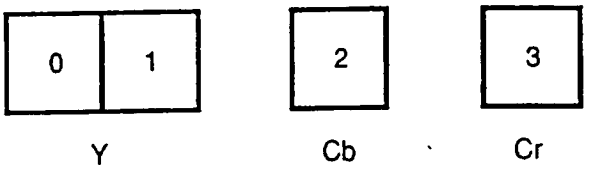


Figure 4: Macroblock structure

2.2.6 Block

A block is an orthogonal 8-pixel by 8-line section of a Y, Cb, or Cr component.
Transform and quantization are based on blocks.

2.3 Motion Estimation and Compensation

Motion estimation is performed for only luminance pixels in each MB.
First, full search is carried out over integer-pixels, and then the eight neighboring half-pixel positions are evaluated.
In this proposal, the integer part of the absolute values of horizontal and vertical components of a motion vector must not exceed $i \times 14.0$ (where i is the distance between two pictures).
Motion compensation is performed on the basis of SM3.

2.4 Prediction

Prediction and prediction mode selection are based on SM3.
Intra pictures are inserted at regular intervals to prevent the error accumulation.
A predictive-coded (P) picture is a picture which is coded using forward prediction only.
A bidirectionally predictive-coded (B) picture is a picture which is coded using forward and backward prediction.
Prediction is performed in each MB. For P-picture, MBs are classified into three modes, comprising intra, motion compensation-on, and motion compensation-off. For B-picture, MBs are also classified into four modes named intra, forward prediction, backward prediction, and interpolated prediction.

2.5 Transform

Blocks are transformed with 2-dimensional DCT. Before the DCT, the scanning lines are rearranged within a block as explained in the following and as depicted in Figure 5.
First, even lines 0, 2, 4, and 6 are moved to lines 0, 1, 2, and 3 respectively, on the upper half of the rearranged block. Second, odd lines 1, 3, 5, and 7 are placed in lines 7, 6, 5, and 4 respectively in the reverse sequence on the lower half of the rearranged block.
The division of picture into two fields allows to decrease the possible occurrence of high frequency components in vertical direction caused by DCT, while the reversed rearrangement in the second field suppresses the generation of high frequency energy on the boundary of two fields(i.e. between line 3 and line 4 in the rearranged block).

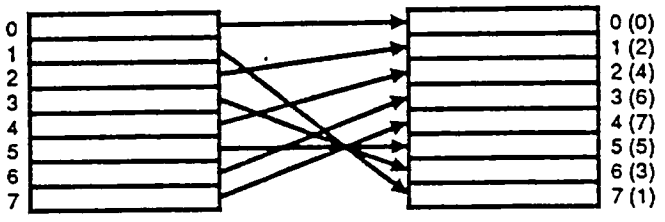


Figure 5: Rearrangement of the scanning lines

2.6 Quantization

A proper quantizer matrix and zigzag scanning order is selected for each sequence.
4 quantizer matrices and 4 zigzag scanning orders are available for selection for each sequence, depending on Y, Cb, and Cr components in either intra or non-intra mode.
However the result of experiments proved that the quantizer matrix with 16 in all elements can be applicable to all components in the non-intra mode.

2.7 Rate Control

The bit rate is controlled by altering the quantizer parameter qp in a MB.
The original image is once pre-scanned and qp is calculated by the following equation:

$$qp = (\log_2 sd) \times a + b,$$

where sd is the standard deviation of Y in each MB, and a and b are constants and selectable for each sequence.

3 FUNCTIONALITY

3.1 Compatibility

PPD Fig.3 (d) SWITCHABLE
This proposal is not compatible with SM3.

3.2 Random Access

Random access feature of this proposal is based on SM3.

3.3 Coding / Decoding Delay

Table 1: Coding / decoding delay

module	delay
motion estimation	3 frames + 8 lines
rearrangement	8 lines
DCT	8 lines
quantization	8 lines
VLC1	8 lines
VLC2	8 lines
quantization^{-1}	8 lines
DCT^{-1}	8 lines
rearrangement^{-1}	8 lines
VLC1^{-1}	8 lines
VLC2^{-1}	8 lines
adaptive predictor	3 frames + 8 lines
predictor	3 frames + 8 lines
standard deviation	8 lines
rate control	1 frame
total delay	3 frames + 8 lines

4 SYNTAX

Syntax diagram is shown in Figure 6. Fixed length codes and variable length codes are shown in Table 2 to 18

Table 2: Start codes

name	hexadecimail value
picture_start_code	00000100
slice_start_codes	00000101
(including slice_vertical_positions)	↕
	through
	0000013B
user_data_start_code	000001B2
sequence_start_code	000001B3
sequence_error_code	000001B4
extension_start_code	000001B5
sequence_end_code	000001B7
group_start_code	000001B8

Table 3: Fixed length codes for pel_aspect_ratio

pel_aspect_ratio	height/width	example
0000	forbidden	
0001	1.0000	VGA etc.
0010	0.6735	
0011	0.7175	
0100	0.7615	
0101	0.8055	
0110	0.8495	
0111	0.8935	
1000	0.9375	CCIR601, 625line
1001	0.9815	
1010	1.0255	
1011	1.0695	
1100	1.1135	CCIR601, 525line
1101	1.1575	
1110	1.2015	

Table 4: Fixed length codes for picture_rate

picture_rate	pictures per second
0000	forbidden
0001	23.976
0010	24
0011	25
0100	29.97
0101	30
0110	50
0111	59.94
1000	60

Table 5: Fixed length codes for picture_coding_type

picture_coding_type	coding method
001	intra-coded (I)
010	predictive-coded (P)
011	bidirectionally-predictive (B)
100	dc intra-coded (D)

Table 6: Variable length code for macroblock_address_increment

macroblock_address_ increment VLC code	increment value	macroblock_address_ increment VLC code	increment value
1	1	0000 0101 10	17
011	2	0000 0101 01	18
010	3	0000 0101 00	19
0011	4	0000 0100 11	20
0010	5	0000 0100 10	21
0001 1	6	0000 0100 011	22
0001 0	7	0000 0100 010	23
0000 111	8	0000 0100 001	24
0000 110	9	0000 0100 000	25
0000 1011	10	0000 0011 111	26
0000 1010	11	0000 0011 110	27
0000 1001	12	0000 0011 101	28
0000 1000	13	0000 0011 100	29
0000 0111	14	0000 0011 011	30
0000 0110	15	0000 0011 010	31
0000 0101 11	16	0000 0011 001	32
		0000 0011 000	33
		0000 0001 000	macroblock escape

Table 7: Variable length code for macroblock_type in intra-coded pictures(I-pictures)

VLC code	macroblock_quant
1	0
01	1

Table 8: Variable length code for macroblock_type in predictive-coded pictures(P-pictures)

VLC code	macroblock_ quant	macroblock_ motion_forward	macroblock_ pattern	Intra
1	0	1	1	0
01	0	0	1	0
001	0	1	0	0
00011	0	0	0	1
00010	1	1	1	0
00001	1	0	1	0
000001	1	0	0	1

Table 9: Variable length code for macroblock_type in bidirectionally predictive-coded pictures(B-pictures)

VLC code	macroblock_ quant	macroblock_ motion_ forward	macroblock_ motion_ backward	macroblock_ pattern	Intra
10	0	1	1	0	0
11	0	1	1	1	0
010	0	0	1	0	0
011	0	0	1	1	0
0010	0	1	0	0	0
0011	0	1	0	1	0
00011	0	0	0	0	1
00010	1	1	1	1	0
000011	1	1	0	1	0
000010	1	0	1	1	0
000001	1	0	0	0	1

Table 10: Variable length code for macroblock_type in dc intra-coded pictures(D-pictures)

VLC code	macroblock_quant
1	0

Table 11: Variable length codes for coded_block_pattern

coded_block_pattern VLC code	cbp	coded_block_pattern VLC code	cbp
0	12	1100 0010 0	5
10	8	1100 0011 0	9
111	4	1100 0010 10	3
1101	14	1100 0010 11	7
1100 10	13	1100 0011 10	1
1100 11	15	1100 0011 11	11
1100 000	10		
1100 010	6		
1100 011	2		

Table 12: Variable length codes for motion_hirizontal_forward, motion_vertical_forward, motion_horizontal_backward, and motion_vertical_backward when forward_f or backward_f is 1.

motion VLC code (NOTE)	little		big	
	b=0	b=1	b=1	b=0
0000 0011 001 b	-31	-32	32	33
0000 0011 011 b	-29	-30	34	35
0000 0011 101 b	-27	-28	36	37
0000 0011 111 b	-25	-26	38	39
0000 0100 001 b	-23	-24	40	41
0000 0100 011 b	-21	-22	42	43
0000 0100 11 b	-19	-20	44	45
0000 0101 01 b	-17	-18	46	47
0000 0101 11 b	-15	-16	48	49
0000 0111 b	-13	-14	50	51
0000 1001 b	-11	-12	52	53
0000 1011 b	-9	-10	54	55
0000 111 b	-7	-8	56	57
0001 1 b	-5	-6	58	59
0011 b	-3	-4	60	61
011 b	-1	-2	62	63
1	0			
010 b	1	2	-62	-63
0010 b	3	4	-60	-61
0001 0 b	5	6	-58	-59
0000 110 b	7	8	-56	-57
0000 1010 b	9	10	-54	-55
0000 1000 b	11	12	-52	-53
0000 0110 b	13	14	-50	-51
0000 0101 10 b	15	16	-48	-49
0000 0101 00 b	17	18	-46	-47
0000 0100 10 b	19	20	-44	-45
0000 0100 010 b	21	22	-42	-43
0000 0100 000 b	23	24	-40	-41
0000 0011 110 b	25	26	-38	-39
0000 0011 100 b	27	28	-36	-37
0000 0011 010 b	29	30	-34	-35
0000 0011 000 b	31	N/A	N/A	-33
NOTE - For VLC code 1, no b extension bit follows.				

Table 13: Variable length codes for motion_hirizontal_forward, motion_vertical_forward, motion_horizontal_backward, motion_vertical_backward when forward_f or backward_f is 2.

motion VLC code	little				big			
(NOTE)	bb=00	bb=01	bb=10	bb=11	bb=11	bb=10	bb=01	bb=00
0000 0011 001 bb	-61	-62	-63	-64	64	65	66	67
0000 0011 011 bb	-57	-58	-59	-60	68	69	70	71
0000 0011 101 bb	-53	-54	-55	-56	72	73	74	75
0000 0011 111 bb	-49	-50	-51	-52	76	77	78	79
0000 0100 001 bb	-45	-46	-47	-48	80	81	82	83
0000 0100 011 bb	-41	-42	-43	-44	84	85	86	87
0000 0100 11 bb	-37	-38	-39	-40	88	89	90	91
0000 0101 01 bb	-33	-34	-35	-36	92	93	94	95
0000 0101 11 bb	-29	-30	-31	-32	96	97	98	99
0000 0111 bb	-25	-26	-27	-28	100	101	102	103
0000 1001 bb	-21	-22	-23	-24	104	105	106	107
0000 1011 bb	-17	-18	-19	-20	108	109	110	111
0000 111 bb	-13	-14	-15	-16	112	113	114	115
0001 1 bb	-9	-10	-11	-12	116	117	118	119
0011 bb	-5	-6	-7	-8	120	121	122	123
011 bb	-1	-2	-3	-4	124	125	126	127
1	0							
010 bb	1	2	3	4	-124	-125	-126	-127
0010 bb	5	6	7	8	-120	-121	-122	-123
0001 0 bb	9	10	11	12	-116	-117	-118	-119
0000 110 bb	13	14	15	16	-112	-113	-114	-115
0000 1010 bb	17	18	19	20	-108	-109	-110	-111
0000 1000 bb	21	22	23	24	-104	-105	-106	-107
0000 0110 bb	25	26	27	28	-100	-101	-102	-103
0000 0101 10 bb	29	30	31	32	-96	-97	-98	-99
0000 0101 00 bb	33	34	35	36	-92	-93	-94	-95
0000 0100 10 bb	37	38	39	40	-88	-89	-90	-91
0000 0100 010 bb	41	42	43	44	-84	-85	-86	-87
0000 0100 000 bb	45	46	47	48	-80	-81	-82	-83
0000 0011 110 bb	49	50	51	52	-76	-77	-78	-79
0000 0011 100 bb	53	54	55	56	-72	-73	-74	-75
0000 0011 010 bb	57	58	59	60	-68	-69	-70	-71
0000 0011 000 bb	61	62	63	N/A	N/A	-65	-66	-67
NOTE - For VLC of 1, no bb extension bits follows.								

Table 14: Variable length codes for motion_hirizontal_forward, motion_vertical_forward, motion_horizontal_backward, motion_vertical_backward when forward_f or backward_f is 3.

motion VLC code	little						big					
(NOTE)	bbb =00	bbb =01	bbb =100	bbb =101	bbb 110	bbb 111	bbb =111	bbb =110	bbb =101	bbb 110	bbb =01	bbb =00
0000 0011 001 bbb	-91	-92	-93	-94	-95	-96	96	97	98	99	100	101
0000 0011 011 bbb	-85	-86	-87	-88	-89	-90	102	103	104	105	106	107
0000 0011 101 bbb	-79	-80	-81	-82	-83	-84	108	109	110	111	112	113
0000 0011 111 bbb	-73	-74	-75	-76	-77	-78	114	115	116	117	118	119
0000 0100 001 bbb	-67	-68	-69	-70	-71	-72	120	121	122	123	124	125
0000 0100 011 bbb	-61	-62	-63	-64	-65	-66	126	127	128	129	130	131
0000 0100 11 bbb	-55	-56	-57	-58	-59	-60	132	133	134	135	136	137
0000 0101 01 bbb	-49	-50	-51	-52	-53	-54	138	139	140	141	142	143
0000 0101 11 bbb	-43	-44	-45	-46	-47	-48	144	145	146	147	148	149
0000 0111 bbb	-37	-38	-39	-40	-41	-42	150	151	152	153	154	155
0000 1001 bbb	-31	-32	-33	-34	-35	-36	156	157	158	159	160	161
0000 1011 bbb	-25	-26	-27	-28	-29	-30	162	163	164	165	166	167
0000 111 bbb	-19	-20	-21	-22	-23	-24	168	169	170	171	172	173
0001 1 bbb	-13	-14	-15	-16	-17	-18	174	175	176	177	178	179
0011 bbb	-7	-8	-9	-10	-11	-12	180	181	182	183	184	185
011 bbb	-1	-2	-3	-4	-5	-6	186	187	188	189	190	191
1	0											
010 bbb	1	2	3	4	5	6	-186	-187	-188	-189	-190	-191
0010 bbb	7	8	9	10	11	12	-180	-181	-182	-183	-184	-185
0001 0 bbb	13	14	15	16	17	18	-174	-175	-176	-177	-178	-179
0000 110 bbb	19	20	21	22	23	24	-168	-169	-170	-171	-172	-173
0000 1010 bbb	25	26	27	28	29	30	-162	-163	-164	-165	-166	-167
0000 1000 bbb	31	32	33	34	35	36	-156	-157	-158	-159	-160	-161
0000 0110 bbb	37	38	39	40	41	42	-150	-151	-152	-153	-154	-155
0000 0101 10 bbb	43	44	45	46	47	48	-144	-145	-146	-147	-148	-149
0000 0101 00 bbb	49	50	51	52	53	54	-138	-139	-140	-141	-142	-143
0000 0100 10 bbb	55	56	57	58	59	60	-132	-133	-134	-135	-136	-137
0000 0100 010 bbb	61	62	63	64	65	66	-126	-127	-128	-129	-130	-131
0000 0100 000 bbb	67	68	69	70	71	72	-120	-121	-122	-123	-124	-125
0000 0011 110 bbb	73	74	75	76	77	78	-114	-115	-116	-117	-118	-119
0000 0011 100 bbb	79	80	81	82	83	84	-108	-109	-110	-111	-112	-113
0000 0011 010 bbb	85	86	87	88	89	90	-102	-103	-104	-105	-106	-107
0000 0011 000 bbb	91	92	93	94	95	N/A	N/A	-97	-98	-99	-100	-101

NOTE - For VLC of 1, no bbb extension bits follows. Two or three bbb extension bits may follow as indicated in the heading.

Table 15: Variable length codes for dct_dc_size_luminance

VLC code	dct_dc_size_luminance
100	0
00	1
01	2
101	3
110	4
1110	5
11110	6
111110	7
1111110	8

Table 16: Variable length codes for dct_dc_size_chrominance

VLC code	dct_dc_size_chrominance
00	0
01	1
10	2
110	3
1110	4
11110	5
111110	6
1111110	7
11111110	8

Table 17a: Variable length codes for dct_coeff_first and dct_coeff_next

dct_coeff_first and dct_coeff_next variable length code (NOTE1)	run	level
10	end_of_block	
1 s (NOTE2)	0	1
11 s (NOTE3)	0	1
011 s	1	1
0100 s	0	2
0101 s	2	1
0010 1 s	0	3
0011 1 s	3	1
0011 0 s	4	1
0001 10 s	1	2
0001 11 s	5	1
0001 01 s	6	1
0001 00 s	7	1
0000 110 s	0	4
0000 100 s	2	2
0000 111 s	8	1
0000 101 s	9	1
0000 01	escape	
0010 0110 s	0	5
0010 0001 s	0	6
0010 0101 s	1	3
0010 0100 s	3	2
0010 0111 s	10	1
0010 0011 s	11	1
0010 0010 s	12	1
0010 0000 s	13	1
0000 0010 10 s	0	7
0000 0011 00 s	1	4
0000 0010 11 s	2	3
0000 0011 11 s	4	2
0000 0010 01 s	5	2
0000 0011 10 s	14	1
0000 0011 01 s	15	1
0000 0010 00 s	16	1

NOTE1 - The last bit 's' denotes the sign of the level, '0' for positive, '1' for negative.

NOTE2 - This code is used if the coefficient is the first one.

NOTE3 - This code is used if the coefficient is not the first one.

Table 17b: Variable length codes for dct_coeff_first and dct_coeff_next(continued)

dct_coeff_first and dct_coeff_next variable length code (NOTE)	run	level
0000 0001 1101 s	0	8
0000 0001 1000 s	0	9
0000 0001 0011 s	0	10
0000 0001 0000 s	0	11
0000 0001 1011 s	1	5
0000 0001 0100 s	2	4
0000 0001 1100 s	3	3
0000 0001 0010 s	4	3
0000 0001 1110 s	6	2
0000 0001 0101 s	7	2
0000 0001 0001 s	8	2
0000 0001 1111 s	17	1
0000 0001 1010 s	18	1
0000 0001 1001 s	19	1
0000 0001 0111 s	20	1
0000 0001 0110 s	21	1
0000 0000 1101 0 s	0	12
0000 0000 1100 1 s	0	13
0000 0000 1100 0 s	0	14
0000 0000 1011 1 s	0	15
0000 0000 1011 0 s	1	6
0000 0000 1010 1 s	1	7
0000 0000 1010 0 s	2	5
0000 0000 1001 1 s	3	4
0000 0000 1001 0 s	5	3
0000 0000 1000 1 s	9	2
0000 0000 1000 0 s	10	2
0000 0000 1111 1 s	22	1
0000 0000 1111 0 s	23	1
0000 0000 1110 1 s	24	1
0000 0000 1110 0 s	25	1
0000 0000 1101 1 s	26	1

NOTE - The last bit 's' denotes the sign of the level, '0' for positive, '1' for negative.

Table 17c: Variable length codes for dct_coeff_first and dct_coeff_next(continued)

dct_coeff_first and dct_coeff_next variable length code (NOTE)	run	level
0000 0000 0111 11 s	0	16
0000 0000 0111 10 s	0	17
0000 0000 0111 01 s	0	18
0000 0000 0111 00 s	0	19
0000 0000 0110 11 s	0	20
0000 0000 0110 10 s	0	21
0000 0000 0110 01 s	0	22
0000 0000 0110 00 s	0	23
0000 0000 0101 11 s	0	24
0000 0000 0101 10 s	0	25
0000 0000 0101 01 s	0	26
0000 0000 0101 00 s	0	27
0000 0000 0100 11 s	0	28
0000 0000 0100 10 s	0	29
0000 0000 0100 01 s	0	30
0000 0000 0100 00 s	0	31
0000 0000 0011 000 s	0	32
0000 0000 0010 111 s	0	33
0000 0000 0010 110 s	0	34
0000 0000 0010 101 s	0	35
0000 0000 0010 100 s	0	36
0000 0000 0010 011 s	0	37
0000 0000 0010 010 s	0	38
0000 0000 0010 001 s	0	39
0000 0000 0010 000 s	0	40
0000 0000 0011 111 s	1	8
0000 0000 0011 110 s	1	9
0000 0000 0011 101 s	1	10
0000 0000 0011 100 s	1	11
0000 0000 0011 011 s	1	12
0000 0000 0011 010 s	1	13
0000 0000 0011 001 s	1	14

NOTE - The last bit 's' denotes the sign of the level, '0' for positive, '1' for negative.

Table 17d: Variable length codes for dct_coeff_first and dct_coeff_next(continued)

dct_coeff_first and dct_coeff_next variable length code (NOTE)	run	level
0000 0000 0001 0011 s	1	15
0000 0000 0001 0010 s	1	16
0000 0000 0001 0001 s	1	17
0000 0000 0001 0000 s	1	18
0000 0000 0001 0100 s	6	3
0000 0000 0001 1010 s	11	2
0000 0000 0001 1001 s	12	2
0000 0000 0001 1000 s	13	2
0000 0000 0001 0111 s	14	2
0000 0000 0001 0110 s	15	2
0000 0000 0001 0101 s	16	2
0000 0000 0001 1111 s	27	1
0000 0000 0001 1110 s	28	1
0000 0000 0001 1101 s	29	1
0000 0000 0001 1100 s	30	1
0000 0000 0001 1011 s	31	1
NOTE - The last bit 's' denotes the sign of the level, '0' for positive, '1' for negative.		

Table 18: Encoding of run and level following escape code as a 20-bit fixed length code (-127 ≤ level ≤ 127) or as a 28-bit fixed length code (-255 ≤ level ≤ -128,128 ≤ level ≤ 255)

fixed length code	run
0000 00	0
0000 01	1
0000 10	2
...	...
...	...
...	...
...	...
...	...
...	...
1111 11	63

fixed length code	level
forbidden	-256
1000 0000 0000 0001	-255
1000 0000 0000 0010	-254
...	...
1000 0000 0111 1111	-129
1000 0000 1000 0000	-128
1000 0001	-127
1000 0010	-126
...	...
1111 1110	-2
1111 1111	-1
forbidden	0
0000 0001	1
...	...
0111 1111	127
0000 0000 1000 0000	128
0000 0000 1000 0001	129
...	
0000 0000 1111 1111	255

5 IMPLEMENTATION

5.1 Picture Buffer

Table 19: Picture and display buffers

	encoder		decoder	
	size	number	size	number
picture buffer	3.1Mbits	4	3.1Mbits	2
	1.6Mbits	8	1.6Mbits	4
display buffer	5.6Mbits	1	5.6Mbits	1
data buffer	60Kbits	1	60Kbits	1

5.2 Coded Data Buffer

size : 5.4Mbits

5.3 Implementation for Each Module

5.3.1 Motion Estimation

Motion estimation is performed on the basis of SM3.

size × width of memory	15.4Kbits (on chip)
memory bandwidth	58MHz
number and width of addition per second	23GOPS 16bits
number and width of multiplication per second	73KOPS 16bits

5.3.2 Rearrangement

Rearrangement is performed as shown in Figure 13.

size × width of memory	2.5Kbits (on chip)
memory bandwidth	21MHz
number and width of addition per second	23MOPS 8bits

5.3.3 DCT

DCT is performed on the basis of SM3 except for zigzag scanning order.

size × width of memory	2.9Kbits (on chip)
memory bandwidth	82MHz
number and width of addition per second	140MOPS 32bits
number and width of multiplication per second	80MOPS 32bits
table size	450bits (fixed)
	2.1Kbits (download)
number of table lookup per second	81MOPS (fixed)
	81MOPS (download)

5.3.4 Quantizer

Quantization is performed on the basis of SM3 except for selectable quantizer matrix depending on luminance and chrominance components in intra mode(see Figure 15).

size × width of memory	50bits (on chip)
memory bandwidth	60MHz
number and width of addition per second	38MOPS 32bits
number and width of multiplication per second	21MOPS 32bits
table size	1.1Kbits (download)
number of table lookup per second	1.7MOPS
	81MOPS (download)

5.3.5 VLC1

VLC1 is performed on the basis of SM3.

size × width of memory	250bits (on chip)
memory bandwidth	39MHz
number and width of addition per second	40MOPS 13bits
table size	28Kbits (fixed)
number of table lookup per second	41MOPS

5.3.6 VLC2

VLC2 is performed on the basis of SM3.

size × width of memory	150bits (on chip)
memory bandwidth	1.1MHz
number and width of addition per second	1.5MOPS 16bits
number and width of multiplication per second	502KOPS 16bits
table size	1.5Kbits (fixed)
number of table lookup per second	1.0MOPS

5.3.7 Quantizer^{-1}

Quantization^{-1} is performed on the basis of SM3 except for selectable quantizer matrix depending on luminance and chrominance components in intra mode(see Figure 16).

size × width of memory	50bits (on chip)
memory bandwidth	41MHz
number and width of addition per second	39MOPS 32bits
number and width of multiplication per second	22MOPS 32bits
table size	1.1Kbits (download)
number of table lookup per second	1.7MOPS
	81MOPS (download)

5.3.8 DCT^{-1}

DCT^{-1} is performed on the basis of SM3 except for zigzag scanning order.

size × width of memory	2.9Kbits (on chip)
memory bandwidth	82MHz
number and width of addition per second	140MOPS 32bits
number and width of multiplication per second	82MOPS 32bits
table size	2.1Kbits (download) 450bits (fixed)
number of table lookup per second	82MOPS (download) 82MOPS (fixed)

5.3.9 $Rearrangement^{-1}$

$Rearrangement^{-1}$ is performed as shown in Figure 14.

size × width of memory	2.5Kbits (on chip)
memory bandwidth	21MHz
number and width of addition per second	25MOPS 8bits

5.3.10 $VLC1^{-1}$

$VLC1^{-1}$ is performed on the basis of SM3.

size × width of memory	450bits (on chip)
memory bandwidth	21MHz
number and width of addition per second	46MOPS 16bits
table size	28Kbits (fixed)
number of table lookup per second	390MOPS

5.3.11 $VLC2^{-1}$

$VLC2^{-1}$ is performed on the basis of SM3.

size × width of memory	300bits (on chip)
memory bandwidth	1.1MHz
number and width of addition per second	8.3MOPS 16bits
number and width of multiplication per second	1.0MOPS 16bits
table size	1.5Kbits (fixed)
number of table lookup per second	5.0MOPS

5.3.12 Adaptive Predictor

Adaptive prediction is performed on the basis of SM3.

size × width of memory	5.0Kbits (on chip)
memory bandwidth	96MHz
number and width of addition per second	130MOPS 32bits
number and width of multiplication per second	57MOPS 32bits

5.3.13 Predictor

Prediction is performed on the basis of SM3.

size × width of memory	2.6Kbits (on chip)
memory bandwidth	170MHz
number and width of addition per second	360MOPS 16bits

5.3.14 Rate Control

Rate control is performed as shown in Figure 17.

size × width of memory	200bits (on chip)
memory bandwidth	21MHz
number and width of addition per second	31MOPS 24bits
number and width of multiplication per second	11MOPS 24bits
table size	1.2Mbits (fixed)
number of table lookup per second	79KOPS

5.4 Global

The constants a and b used for bit rate control are modified for each application. They are set in sequence header. The range is 0.1 to 4.0 in 0.1 unit for a, and 2.0 to 10.0 in 0.1 unit for b, respectively. They are multiplied by 10, and a is coded in 6 bits and b is coded in 7 bits.
Quantizer matrices and modified zigzag scanning orders are also changeable for each application. All of them consist of 64 elements. They are set in the following order in sequence header.

1) quantizer matrix for Y in intra

2) quantizer matrix for Cb and Cr in intra

3) quantizer matrix for Y in non-intra

4) quantizer matrix for Cb and Cr in non-intra

5) zigzag scanning order for Y in intra

6) zigzag scanning order for Cb and Cr in intra

7) zigzag scanning order for Y in non-intra

8) zigzag scanning order for Cb and Cr in non-intra

The elements of quantizer matrices are coded in 8 bits and the elements of zigzag scanning orders are coded in 6 bits.
Any adjustment of above coding parameters is non-automatic. The parameters used to generate the pictures submitted are shown in next section.

6 PARAMETERS OF TEST MATERIAL SEQUENCE

quantizer matrix for Y and C in non-intra of all sequences

16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16
16	16	16	16	16	16	16	16

Flower Garden

4Mbps : a = 0.9, b = 7.9

9Mbps : a = 2.95, b = 3.9

quantizer matrix for Y in intra

8	14	14	15	15	16	16	18
20	15	20	18	20	28	18	20
26	20	30	16	33	30	25	20
33	31	38	25	35	40	28	35
36	30	55	55	40	33	50	35
55	80	70	40	70	90	50	90
90	90	60	70	49	100	79	100
65	90	127	127	110	110	127	127

quantizer matrix for C in intra

8	12	16	16	16	18	16	16
18	20	20	20	18	18	20	20
18	20	20	18	26	20	18	26
22	28	18	28	20	26	28	30
22	25	20	20	30	22	29	20
35	25	32	20	20	40	25	31
45	32	22	35	30	50	36	40
26	24	55	35	40	40	60	70

zigzag scanning order for Y in intra

0	2	9	19	30	37	43	52
7	11	15	22	31	38	44	49
1	4	14	23	33	39	50	54
10	12	21	28	35	42	47	55
3	6	17	27	36	46	56	57
8	18	24	29	41	48	58	59
5	16	25	32	40	51	60	61
13	20	26	34	45	53	62	63

zigzag scanning order for C in intra

0	1	3	7	16	26	39	50
9	10	11	17	24	32	37	52
2	4	6	13	22	34	43	57
14	15	18	21	33	41	46	59
5	8	12	19	28	35	44	56
25	27	30	36	42	51	55	60
20	23	29	38	47	49	54	61
31	40	45	48	53	58	62	63

zigzag scanning order for Y in non-intra

0	4	15	23	27	34	40	47
10	14	17	25	32	36	41	49
2	7	18	29	37	48	54	58
12	16	22	26	35	43	45	55
1	8	19	31	42	51	57	60
6	13	20	30	38	46	53	61
3	9	24	33	44	52	59	62
5	11	21	28	39	50	56	63

zigzag scanning order for C in non-intra

0	2	3	5	12	16	23	27
8	9	11	15	30	38	46	54
1	4	10	19	29	37	42	49
13	20	21	25	34	45	52	60
6	14	24	35	43	50	55	61
18	26	31	36	41	48	56	59
7	22	28	40	44	51	57	62
17	32	33	39	47	53	58	63

Mobile & Calender

4Mbps : a = 0.95, b = 7.0

9Mbps : a = 2.9, b = 3.8

quantizer matrix for Y in intra

8	16	16	18	16	16	16	18
19	16	18	16	20	20	23	18
20	20	28	20	20	20	28	25
28	25	33	28	30	30	34	33
38	35	35	36	33	40	40	43
43	40	50	50	45	50	64	65
50	60	61	74	59	49	100	80
83	100	79	100	79	120	107	121

quantizer matrix for C in intra

8	12	16	16	16	16	18	16
16	18	16	16	20	18	16	20
18	16	20	26	16	20	20	18
26	20	28	16	20	20	26	20
18	30	20	28	20	18	22	28
29	25	35	25	31	30	22	25
32	32	40	25	26	35	45	36
40	30	50	55	40	40	60	70

zigzag scanning order for Y in intra

0	2	5	9	24	31	41	53
16	19	20	21	33	38	45	55
1	4	6	11	27	36	48	58
13	17	25	29	37	43	49	59
3	7	10	15	35	44	52	60
12	23	28	34	42	47	54	61
8	14	22	30	40	50	56	62
18	26	32	39	46	51	57	63

zigzag scanning order for C in intra

0	1	3	5	8	11	17	38
12	18	22	28	29	34	36	51
2	4	7	10	14	20	27	46
15	21	25	31	41	43	47	57
6	9	13	16	23	32	37	52
26	35	39	45	49	53	56	61
19	24	30	40	44	48	55	60
33	42	50	54	58	59	62	63

zigzag scanning order for Y in non-intra

0	1	5	6	24	30	40	53
20	18	16	14	29	35	44	57
3	8	10	12	34	39	48	58
17	19	25	26	36	42	49	59
2	7	9	13	37	45	52	60
15	23	27	32	43	47	55	61
4	11	22	31	41	50	54	62
21	28	33	38	46	51	56	63

zigzag scanning order for C in non-intra

0	1	3	5	8	13	18	37
12	15	19	24	30	31	35	47
2	4	7	11	16	26	34	49
17	22	27	32	39	42	46	54
6	9	14	20	28	36	43	55
21	33	40	45	50	52	62	59
10	23	29	38	44	48	58	61
25	41	51	57	60	53	56	63

Popple

9Mbps : a = 2.9, b = 4.1

quantizer matrix for Y in intra

8	12	12	12	14	14	16	16
18	16	18	18	19	18	20	28
20	20	20	20	20	28	23	20
28	25	25	28	33	35	35	30
30	36	33	34	40	35	38	40
43	45	43	50	50	50	50	49
64	65	59	60	61	74	83	80
79	100	100	79	100	107	120	121

quantizer matrix for C in intra

8	12	16	12	16	16	16	16
16	16	16	16	16	16	18	20
18	18	20	16	20	18	20	20
26	18	20	20	20	16	20	22
20	26	18	30	26	25	28	18
28	29	25	25	35	30	22	31
25	32	40	32	26	45	35	36
30	50	40	40	40	55	60	70

zigzag scanning order for Y in intra

0	1	2	4	6	15	29	47
18	20	16	14	30	36	46	55
3	5	7	9	21	28	43	56
19	23	25	31	39	45	51	60
8	10	11	13	33	41	50	59
17	26	32	37	44	49	57	62
12	22	27	35	42	52	54	61
24	34	38	40	48	53	58	63

zigzag scanning order for C in intra

0	1	2	4	5	7	12	31
11	15	18	20	22	27	32	43
3	6	9	10	13	19	29	46
16	26	28	30	37	42	48	56
8	14	17	21	25	34	39	52
23	38	40	45	49	54	59	58
24	33	36	41	47	51	55	60
35	44	50	53	57	61	62	63

zigzag scanning order for Y in non-intra

0	2	1	3	4	5	13	48
23	19	16	12	10	11	21	56
6	8	7	9	14	17	26	58
45	34	31	29	25	27	36	59
15	20	18	22	24	30	49	60
43	50	42	40	37	39	54	61
28	33	35	38	52	53	57	63
32	41	44	47	46	51	55	62

zigzag scanning order for C in non-intra

0	1	2	3	4	6	14	26
10	13	7	8	15	16	22	37
5	9	11	12	17	21	33	44
25	29	24	28	35	39	48	60
18	20	23	27	34	41	53	59
31	40	38	42	49	51	58	62
19	30	36	46	50	52	54	56
32	45	43	47	55	57	61	63

Table Tennis

4Mbps : a = 1.7, b = 7.0

9Mbps : a = 4.0, b = 3.0

quantizer matrix for Y in intra

8	8	12	10	20	30	40	50
10	10	12	20	25	20	50	80
8	10	12	14	18	24	50	79
12	14	14	30	25	18	40	100
10	10	12	16	36	25	59	79
14	16	16	35	50	25	100	102
10	12	14	24	30	61	83	107
16	16	20	43	64	74	100	121

quantizer matrix for C in intra

8	16	20	20	30	32	40	44
20	20	40	40	44	44	44	60
16	16	20	36	36	40	40	48
40	40	40	40	50	50	50	70
20	20	20	36	40	40	40	52
56	56	56	60	64	70	80	80
52	52	52	58	62	64	72	80
60	70	80	90	100	110	120	127

zigzag scanning order for Y in intra

0	2	7	5	18	30	41	54
19	33	34	43	36	22	47	61
1	8	11	23	20	24	46	57
12	31	21	44	15	4	35	59
3	9	17	29	39	26	51	58
13	32	25	45	38	10	52	60
6	14	27	40	42	53	55	62
16	28	37	49	50	48	56	63

zigzag scanning order for C in intra

0	1	3	4	11	13	17	33
9	12	20	26	44	41	38	35
2	5	8	16	21	28	40	36
14	19	24	27	48	45	42	37
6	7	10	23	31	49	46	39
22	32	34	43	52	53	50	47
15	18	29	51	56	57	54	55
25	30	58	59	60	61	62	63

zigzag scanning order for Y in non-intra

7	22	28	27	14	10	15	54
18	48	55	58	31	8	23	61
11	33	38	45	16	5	17	59
20	41	32	43	4	0	2	56
19	36	42	49	21	9	24	60
26	46	35	44	6	1	3	57
12	37	50	53	40	30	39	63
25	47	51	52	34	13	29	62

zigzag scanning order for C in non-intra

0	2	4	8	18	12	11	16
3	13	20	31	38	40	42	47
1	5	10	19	30	32	28	33
6	22	26	37	60	49	53	54
9	17	23	29	39	51	46	59
14	25	35	48	56	57	58	55
7	21	27	34	52	41	43	44
15	24	36	45	50	61	62	63

7 STATISTICS

Number of bits(NOB) and SNR of Flower Garden (4Mbps)

frame No.	NOB	SNR Y	SNR U	SNR V	frame No.	NOB	SNR Y	SNR U	SNR V	frame No.	NOB	SNR Y	SNR U	SNR V
0	451272	30.61	34.14	34.87	50	50504	27.51	31.68	32.64	100	65896	26.73	30.92	31.86
1	56808	28.92	32.97	33.92	51	170648	28.71	32.06	32.77	101	71720	26.44	30.94	31.87
2	57272	28.71	32.63	33.76	52	80248	26.08	30.94	32.32	102	254064	28.60	31.04	31.70
3	138864	29.61	32.90	33.76	53	71128	26.39	31.11	32.23	103	63992	26.44	30.54	31.38
4	57920	28.64	32.31	33.41	54	181968	28.82	31.11	31.88	104	73128	25.96	30.74	31.41
5	59312	28.45	32.17	33.18	55	51184	27.94	30.84	31.71	105	253032	28.37	30.84	31.36
6	186984	29.29	32.08	32.92	56	57672	27.82	31.10	31.88	106	67768	26.31	31.54	32.12
7	55112	28.74	31.85	32.75	57	211520	28.76	30.90	31.64	107	62992	26.78	31.73	32.51
8	54952	28.47	31.66	32.65	58	51848	28.65	32.26	32.85	108	545872	29.34	33.18	33.52
9	157696	29.11	31.81	32.60	59	51112	29.07	32.45	33.14	109	59968	27.24	32.28	32.83
10	60136	27.69	31.68	32.82	60	509816	29.84	33.55	33.98	110	56208	27.20	31.58	32.32
11	66448	27.36	32.57	33.46	61	58640	27.62	32.64	33.33	111	241568	28.48	31.34	31.97
12	477080	30.14	34.07	34.59	62	55480	27.44	31.88	32.81	112	62448	26.51	31.14	31.81
13	54864	28.39	32.52	33.49	63	231264	28.84	31.60	32.41	113	53072	26.97	30.73	31.57
14	54488	28.27	32.50	33.27	64	52880	28.43	31.50	32.29	114	249680	28.39	30.94	31.50
15	163608	29.11	32.54	33.19	65	49032	28.03	31.17	31.99	115	58488	26.92	30.97	31.49
16	60208	27.49	31.83	32.83	66	201008	28.61	31.13	31.81	116	55872	26.95	30.64	31.34
17	68296	27.00	31.92	32.81	67	49776	28.27	31.16	31.81	117	245136	28.34	30.76	31.30
18	218824	29.07	31.69	32.49	68	50928	28.30	31.11	31.84	118	47832	26.62	32.27	32.65
19	55656	28.04	31.43	32.29	69	162704	28.61	31.07	31.81	119	47840	28.78	32.31	32.83
20	54976	27.94	31.35	32.17	70	51664	28.93	32.50	32.98	120	545384	29.36	33.23	33.54
21	181968	28.76	31.42	32.08	71	48272	28.61	32.30	33.00	121	53192	27.94	32.35	33.08
22	53136	28.66	32.54	33.22	72	527760	29.50	33.39	33.68	122	57144	27.49	31.93	32.67
23	55824	28.24	32.67	33.49	73	49736	28.29	32.55	33.18	123	228000	28.56	31.43	32.14
24	490656	29.99	33.90	34.27	74	55168	28.01	32.37	33.08	124	50176	27.88	31.13	31.96
25	58728	27.93	32.68	33.45	75	189120	28.58	31.81	32.59	125	48176	27.79	31.05	31.76
26	53920	28.52	32.69	33.42	76	50928	28.18	31.60	32.37	126	167896	28.27	31.07	31.69
27	135864	29.23	32.81	33.41	77	51480	28.37	31.56	32.35	127	61320	26.83	31.05	31.69
28	54424	28.42	32.26	33.12	78	177624	28.60	31.31	32.00	128	50464	27.17	30.74	31.53
29	51136	28.26	32.14	32.94	79	50424	28.25	31.09	31.89	129	245096	28.30	30.83	31.36
30	164128	29.08	32.17	32.77	80	48792	27.94	31.02	31.85	130	47632	28.48	32.16	32.59
31	53888	28.34	31.75	32.66	81	154200	28.64	31.19	31.83	131	47576	28.68	32.38	32.80
32	55720	28.04	31.75	32.58	82	51632	28.24	31.92	32.52	132	559968	29.08	33.07	33.36
33	176080	28.92	31.73	32.45	83	53064	28.54	32.37	33.01	133	48928	28.22	32.24	32.84
34	56528	28.27	32.68	33.53	84	523280	29.72	33.43	33.78	134	50112	27.93	31.88	32.67
35	49496	28.89	32.79	33.62	85	50232	29.12	32.71	33.15	135	174224	28.34	31.70	32.44
36	493456	29.97	33.85	34.24	86	51712	28.52	32.23	32.86	136	46000	28.06	31.60	32.44
37	50792	28.93	32.99	33.70	87	165512	28.80	32.13	32.65	137	46456	27.93	31.60	32.38
38	53568	28.39	32.66	33.40	88	49352	28.63	31.78	32.39	138	126320	28.24	31.50	32.19
39	140656	28.96	32.65	33.32	89	51672	28.40	31.55	32.29	139	47728	27.67	31.02	31.91
40	55960	28.33	32.31	33.07	90	151400	28.58	31.50	32.13	140	49464	27.31	30.88	31.81
41	51440	28.11	31.93	32.80	91	52840	28.29	31.22	31.95	141	144512	28.21	31.10	31.83
42	196688	28.84	31.79	32.53	92	52344	27.82	30.97	31.70	142	44808	29.00	32.44	32.96
43	59072	27.34	31.71	32.49	93	200944	28.52	31.03	31.63	143	44856	28.90	32.34	32.90
44	57048	27.30	31.33	32.29	94	49880	28.85	32.27	32.83	144	561016	29.07	32.96	33.31
45	226456	28.70	31.27	32.00	95	51728	28.46	32.19	32.77	145	50448	27.85	32.28	32.85
46	53528	28.46	32.35	32.94	96	526760	29.71	33.39	33.74	146	51616	27.23	31.77	32.48
47	52440	28.81	32.68	33.23	97	67496	26.93	32.29	32.99	147	185720	28.17	31.28	31.94
48	513392	29.68	33.58	34.03	98	65528	26.87	31.59	32.46	148	44880	27.98	31.15	31.77
49	52056	28.02	32.23	33.15	99	253640	28.69	31.43	32.09	149	27920	28.01	30.89	31.47

Number of bits(NOB) and SNR of Flower Garden (9Mbps)

frame No.	NOB	SNR Y	SNR U	SNR V
0	856080	35.21	38.38	38.36
1	93176	32.54	35.80	36.10
2	95160	32.45	35.47	35.82
3	383424	35.02	36.49	36.41
4	93864	32.53	35.07	35.32
5	101144	32.29	35.18	35.28
6	511120	35.19	35.96	35.56
7	85768	32.95	35.06	34.96
8	83640	32.73	34.92	34.90
9	420216	34.79	35.77	35.34
10	109624	31.57	34.19	34.34
11	145560	31.20	35.17	35.35
12	907632	34.68	38.15	38.02
13	94696	32.06	35.27	35.51
14	88456	32.04	35.26	35.32
15	470224	34.85	36.06	35.72
16	111728	31.42	34.32	34.40
17	150856	31.08	34.74	34.65
18	605176	35.03	35.79	35.18
19	95816	31.86	34.72	34.56
20	90112	31.86	34.55	34.46
21	519648	34.68	35.48	34.97
22	86456	32.17	35.21	35.17
23	100592	31.69	35.26	35.55
24	935720	34.53	38.08	37.74
25	111488	31.36	35.33	35.62
26	90760	32.18	35.61	35.66
27	390280	34.68	36.29	35.98
28	91264	32.19	35.15	35.12
29	83192	32.05	35.05	34.93
30	448200	34.77	35.86	35.29
31	85264	32.28	34.63	34.55
32	96128	31.85	34.59	34.54
33	478664	34.76	35.63	35.03
34	104984	31.60	35.46	35.50
35	76552	32.23	35.69	35.88
36	943840	34.49	38.02	37.69
37	78448	32.24	36.00	36.12
38	91536	31.92	35.49	35.49
39	416112	34.49	36.15	35.77
40	93920	32.04	35.47	35.16
41	85016	31.99	35.07	34.85
42	552840	34.76	35.67	34.98
43	117328	31.19	34.74	34.50
44	114216	31.23	34.61	34.47
45	627448	34.70	35.50	34.73
46	88176	31.92	35.11	34.80
47	89216	32.13	35.98	35.64
48	978240	34.21	37.76	37.53
49	90928	31.64	35.12	35.39
50	89440	31.49	34.51	34.65
51	508664	34.61	35.72	35.22
52	190584	30.67	33.45	33.72
53	163352	30.72	34.06	33.98
54	550416	34.59	35.56	34.58
55	89192	31.70	34.44	33.98
56	108128	31.70	34.91	34.37
57	586480	34.76	35.27	34.54
58	83808	32.18	35.06	34.80
59	83416	32.37	35.77	35.63
60	971920	34.44	37.77	37.52
61	123576	31.17	35.56	35.46
62	107952	31.24	34.72	34.74
63	640152	34.88	35.62	34.89
64	86176	32.25	35.07	34.55
65	77696	32.04	34.56	34.33
66	568576	34.62	35.20	34.53
67	74080	32.32	34.46	34.13
68	80696	32.32	34.71	34.34
69	440568	34.40	35.15	34.59
70	81456	32.27	35.72	35.42
71	77824	31.81	35.36	35.34
72	1011272	34.00	37.58	37.24
73	83456	31.27	35.38	35.43
74	100160	31.18	35.39	35.31
75	559072	34.39	35.49	35.01
76	83048	31.73	34.75	34.48
77	80320	32.23	34.91	34.62
78	501064	34.43	35.23	34.63
79	76224	32.37	34.56	34.24
80	76984	32.13	34.44	34.24
81	426064	34.37	35.20	34.61
82	82304	31.76	34.28	34.27
83	93168	31.73	35.67	35.49
84	995960	34.35	37.64	37.32
85	80056	32.55	36.02	35.78
86	83752	32.29	35.50	35.29
87	476536	34.52	35.74	35.28
88	75472	32.66	34.89	34.64
89	79608	32.57	34.87	34.60
90	417720	34.24	35.27	34.78
91	82872	32.34	34.69	34.33
92	85880	31.91	34.47	34.10
93	543784	34.47	35.09	34.45
94	77808	32.29	35.26	35.09
95	88808	31.80	35.22	35.07
96	1002672	34.34	37.61	37.27
97	155064	30.85	35.09	34.95
98	142416	30.96	34.55	34.32
99	696792	34.86	35.48	34.57
100	146552	30.75	34.05	33.68
101	164880	30.67	34.15	33.83
102	690016	34.74	35.26	34.39
103	149408	30.42	33.72	33.40
104	182592	30.11	33.96	33.51
105	705832	34.60	35.12	34.31
106	173376	30.26	34.32	33.96
107	148944	30.35	34.42	34.37
108	1044768	33.85	37.38	37.05
109	131264	30.73	35.30	35.15
110	117512	30.92	34.69	34.31
111	686632	34.61	35.33	34.50
112	144480	30.37	34.08	33.65
113	111360	30.83	33.99	33.68
114	701048	34.50	35.16	34.24
115	128536	30.67	34.41	33.81
116	119056	30.65	34.02	33.65
117	685712	34.48	35.04	34.18
118	76024	32.01	35.55	35.00
119	76424	32.08	35.81	35.45
120	1041408	33.90	37.46	37.07
121	99248	31.18	35.28	35.30
122	114480	31.12	35.11	34.81
123	648208	34.65	35.41	34.56
124	80520	31.84	34.66	34.19
125	77184	31.72	34.60	34.05
126	479104	34.10	35.02	34.26
127	128576	30.62	34.34	33.95
128	96112	31.08	34.10	33.95
129	689728	34.48	35.11	34.27
130	74696	31.91	35.07	34.73
131	73376	31.90	35.70	35.44
132	1072072	33.53	37.33	36.92
133	82496	31.38	35.36	35.47
134	85048	31.47	35.19	35.12
135	527792	34.17	35.47	34.90
136	72688	31.84	34.92	34.72
137	70664	31.86	34.91	34.69
138	382648	33.80	35.25	34.73
139	77280	31.52	34.41	34.15
140	83536	31.25	34.30	34.05
141	434600	33.93	35.07	34.42
142	66048	32.44	35.73	35.49
143	66880	32.25	35.68	35.50
144	1074968	33.49	37.31	36.90
145	94128	30.84	35.37	35.36
146	103936	30.64	34.79	34.65
147	595392	34.14	35.20	34.44
148	65472	32.10	34.62	34.07
149	23568	33.68	34.84	34.11

Number of bits(NOB) and SNR of Mobile & Calender (4Mbps)

frame No.	NOB	SNR Y	SNR U	SNR V
0	611816	28.24	34.37	35.14
1	60512	26.35	33.52	33.99
2	59752	26.17	33.15	33.50
3	229464	28.10	32.70	33.37
4	61168	26.34	32.47	32.89
5	58664	26.25	32.34	32.75
6	236032	28.06	32.18	32.79
7	62168	26.08	32.07	32.54
8	59192	26.21	31.95	32.41
9	228840	28.10	31.92	32.46
10	56104	26.77	33.39	33.77
11	54408	26.91	33.61	34.11
12	613088	28.18	34.37	35.11
13	52936	26.80	33.70	34.15
14	55000	26.68	33.42	33.86
15	167560	28.01	33.61	34.17
16	46992	27.11	33.05	33.47
17	47216	27.07	33.26	33.66
18	182768	28.23	32.97	33.45
19	48832	27.06	32.64	33.01
20	48776	27.06	32.80	33.20
21	189120	28.21	32.54	33.09
22	48008	27.66	33.75	34.15
23	43792	27.94	33.93	34.40
24	613264	28.18	34.31	35.07
25	42408	28.03	33.55	34.04
26	43288	27.65	33.78	34.20
27	150136	28.33	33.26	33.80
28	43104	27.65	32.91	33.37
29	41864	27.70	33.43	33.81
30	155016	28.30	32.68	33.21
31	47984	26.87	33.01	33.40
32	45272	26.85	32.84	33.32
33	125632	28.25	32.55	33.11
34	47928	27.31	33.90	34.37
35	46000	27.48	33.82	34.35
36	616640	28.12	34.30	35.02
37	47240	27.09	33.57	34.06
38	49664	26.80	33.68	34.14
39	167696	28.17	33.63	34.13
40	46576	27.49	33.19	33.53
41	45632	27.45	33.46	33.84
42	179080	28.29	32.98	33.44
43	49240	27.18	32.77	33.16
44	47824	27.15	32.92	33.24
45	174816	28.19	32.46	32.91
46	48688	27.35	33.67	33.96
47	46656	27.59	33.87	34.17
48	619520	28.15	34.21	34.89
49	44336	27.45	33.66	33.96
50	48848	26.98	33.69	34.01
51	163952	28.26	33.18	33.66
52	52312	26.84	32.88	33.19
53	53448	26.75	33.04	33.29
54	159936	28.24	32.53	33.01
55	53952	26.77	32.50	32.89
56	52480	26.69	32.45	32.86
57	194776	28.13	32.13	32.54
58	51296	27.31	33.50	33.88
59	49840	27.35	33.56	33.87
60	627056	28.13	34.16	34.79
61	49400	27.25	33.47	33.83
62	48648	27.18	33.39	33.66
63	195136	28.15	32.87	33.36
64	49608	27.07	32.74	33.10
65	49904	26.94	32.59	32.86
66	215016	28.10	32.27	32.79
67	52280	26.77	32.33	32.71
68	50968	26.67	32.22	32.56
69	211032	28.11	31.98	32.47
70	51760	27.11	33.28	33.61
71	51704	27.17	33.53	33.75
72	627840	28.05	34.20	34.78
73	54528	26.68	33.47	33.80
74	53640	26.64	33.08	33.37
75	219912	28.05	32.73	33.12
76	55232	26.59	32.52	32.75
77	53904	26.55	32.32	32.52
78	199832	28.13	32.18	32.63
79	52056	26.79	32.30	32.63
80	47936	26.95	32.13	32.43
81	172288	28.13	32.08	32.46
82	46120	27.36	33.69	34.01
83	48632	27.13	33.82	34.20
84	625592	28.09	34.14	34.74
85	45696	26.95	33.47	33.85
86	48264	27.03	33.46	33.80
87	148752	28.15	33.27	33.65
88	49768	26.98	33.13	33.39
89	48248	26.96	32.87	33.13
90	167272	28.30	32.75	33.13
91	51448	26.78	32.58	32.85
92	50752	26.85	32.38	32.65
93	191248	28.20	32.36	32.73
94	51424	27.45	33.78	34.01
95	48112	27.66	33.65	33.90
96	629456	28.04	34.13	34.69
97	45424	27.44	33.80	34.03
98	45168	27.35	33.66	33.87
99	161696	28.11	33.61	33.96
100	45000	27.70	33.22	33.48
101	43472	27.60	33.09	33.31
102	165984	28.27	33.01	33.35
103	42576	27.79	32.82	33.01
104	45464	27.51	32.75	32.93
105	164544	28.35	32.69	32.99
106	48176	27.58	33.80	33.92
107	48936	27.67	33.72	33.78
108	624648	28.15	34.13	34.64
109	48456	27.20	33.64	33.75
110	45200	27.41	33.36	33.42
111	174280	28.43	33.09	33.35
112	51808	27.01	32.91	33.02
113	48552	27.13	32.74	32.78
114	159640	28.36	32.94	33.22
115	50640	27.08	32.55	32.71
116	49712	27.03	32.73	32.82
117	137200	28.51	32.65	32.91
118	46448	28.16	33.41	33.56
119	42464	28.44	33.69	33.85
120	620776	28.39	34.05	34.61
121	47480	27.49	33.28	33.41
122	51328	27.25	33.27	33.36
123	143568	28.38	33.37	33.78
124	52320	27.46	32.78	32.91
125	50104	27.58	32.69	32.76
126	145288	28.54	32.88	33.23
127	50664	27.77	32.69	32.92
128	49680	27.67	32.70	32.85
129	129392	28.60	32.67	33.01
130	46312	28.65	33.87	34.07
131	47752	28.24	33.97	34.17
132	618480	28.75	33.85	34.47
133	46848	28.10	33.28	33.65
134	46464	28.13	33.33	33.71
135	127792	28.79	33.41	33.87
136	45472	28.15	32.90	33.10
137	47600	27.85	32.94	33.23
138	118376	28.73	33.00	33.40
139	45312	28.09	32.77	33.01
140	46104	27.83	32.71	32.90
141	149264	28.34	32.69	33.08
142	46176	28.40	33.61	33.91
143	44616	28.24	33.67	33.95
144	632224	28.28	33.92	34.48
145	42744	28.16	33.17	33.43
146	44136	27.93	33.44	33.73
147	140408	28.59	32.93	33.30
148	47928	27.32	32.79	32.98
149	30560	28.45	32.27	32.69

Number of bits(NOB) and SNR of Mobile & Calender (9Mbps)

frame No.	NOB	SNR Y	U	V	frame No.	NOB	SNR Y	U	V	frame No.	NOB	SNR Y	U	V
0	1242328	35.33	37.78	38.50	50	92184	30.49	36.03	36.39	100	73256	31.12	35.50	35.92
1	135792	29.40	35.37	36.06	51	415664	33.37	35.75	36.40	101	68272	31.08	35.34	35.78
2	133024	29.29	35.04	35.64	52	107832	30.03	34.91	35.41	102	428584	33.31	35.60	36.18
3	576824	33.42	35.22	36.10	53	105256	30.10	35.30	35.63	103	64064	31.28	35.09	35.52
4	135504	29.43	34.30	35.03	54	404704	33.14	35.07	35.73	104	78136	31.11	35.02	35.45
5	129784	29.34	34.35	35.03	55	110280	29.84	34.74	35.29	105	427192	33.27	35.29	35.87
6	595536	33.38	34.83	35.67	56	104856	29.84	34.70	35.19	106	88736	30.55	35.82	36.12
7	138152	29.32	34.19	34.88	57	494168	33.25	34.79	35.46	107	88240	30.60	35.92	36.21
8	128992	29.36	34.15	34.80	58	93848	30.16	35.56	36.03	108	1271792	35.27	37.51	38.11
9	576592	33.33	34.68	35.43	59	94560	30.10	35.76	36.25	109	86096	30.37	36.06	36.38
10	121632	29.85	35.35	35.89	60	1271496	35.24	37.57	38.18	110	78088	30.57	35.60	35.92
11	116448	29.91	35.63	36.28	61	91552	30.14	35.75	36.12	111	425880	33.50	35.74	36.25
12	1247632	35.26	37.75	38.43	62	89336	30.13	35.67	36.11	112	97112	30.18	35.16	35.42
13	112704	30.00	35.83	36.42	63	496072	33.36	35.44	36.19	113	92976	30.11	34.84	35.17
14	117944	29.87	35.48	36.08	64	93208	29.98	34.93	35.47	114	407944	33.31	35.63	36.23
15	405544	33.17	36.02	36.75	65	90768	29.84	34.70	35.21	115	94648	30.12	34.72	35.16
16	89088	30.40	35.05	35.64	66	548824	33.37	34.91	35.64	116	97840	30.07	35.01	35.38
17	86904	30.35	35.27	35.82	67	103504	29.74	34.50	35.01	117	353208	33.20	35.40	35.99
18	461736	33.32	35.43	36.16	68	101280	29.65	34.44	34.93	118	75672	31.43	35.68	36.00
19	88232	30.26	34.77	35.28	69	539480	33.30	34.74	35.41	119	67832	31.71	35.90	36.28
20	86888	30.31	34.94	35.47	70	100808	29.94	35.18	35.65	120	1257440	35.40	37.49	38.15
21	482176	33.34	35.12	35.86	71	101440	29.97	35.61	36.08	121	91920	30.48	35.47	35.80
22	81696	30.82	35.90	36.37	72	1278088	35.21	37.54	38.16	122	95464	30.39	35.61	35.91
23	72576	31.08	36.00	36.56	73	115272	29.70	35.62	36.07	123	320072	33.26	36.06	36.66
24	1250512	35.27	37.69	38.40	74	112520	29.70	35.10	35.64	124	100056	30.40	34.83	35.25
25	63072	31.60	35.91	36.40	75	547568	33.34	35.21	35.90	125	87616	30.83	34.85	35.29
26	65408	31.20	36.32	36.77	76	113520	29.69	34.70	35.10	126	379496	33.33	35.46	36.16
27	375944	33.23	35.90	36.48	77	108400	29.71	34.51	34.92	127	82736	31.23	35.10	35.60
28	64344	31.04	35.09	35.66	78	510928	33.25	34.80	35.46	128	79656	31.17	35.12	35.60
29	58672	31.20	35.85	36.30	79	103288	29.98	34.75	35.25	129	323232	33.19	35.32	35.97
30	398432	33.15	35.22	35.90	80	85584	30.24	34.47	34.91	130	74336	31.60	36.27	36.55
31	95928	29.85	35.36	35.79	81	433976	33.08	34.82	35.45	131	83112	30.92	36.53	36.84
32	93360	29.80	35.02	35.63	82	87896	30.52	35.87	36.26	132	1244672	35.54	37.40	38.10
33	301464	32.89	35.25	35.94	83	99544	30.04	36.26	36.69	133	76984	31.21	35.84	36.33
34	91144	30.09	35.90	36.44	84	1276512	35.27	37.54	38.15	134	77080	31.13	35.75	36.35
35	88216	30.29	36.07	36.63	85	97120	30.00	35.79	36.24	135	293720	33.50	36.18	36.83
36	1256080	35.26	37.68	38.36	86	97480	30.23	35.63	36.14	136	78456	30.95	35.07	35.54
37	97120	30.04	36.05	36.50	87	367224	33.15	35.86	36.49	137	80088	30.72	35.22	35.76
38	106304	29.82	36.00	36.53	88	100048	29.96	35.45	35.85	138	295960	33.38	35.58	36.27
39	379800	33.34	36.45	37.06	89	95136	30.05	35.11	35.54	139	68888	31.27	35.14	35.68
40	82096	30.62	35.35	35.82	90	430000	33.24	35.35	35.97	140	70184	31.02	35.12	35.60
41	77440	30.78	35.79	36.25	91	100696	29.89	34.88	35.30	141	378616	33.17	35.31	36.09
42	458288	33.41	35.56	36.17	92	96720	29.87	34.57	35.00	142	69296	31.82	35.82	36.28
43	86784	30.37	34.99	35.41	93	475000	33.23	35.04	35.63	143	69968	31.33	35.74	36.18
44	82048	30.31	35.35	35.69	94	93040	30.59	36.04	36.37	144	1279064	35.33	37.38	38.03
45	453392	33.24	35.10	35.73	95	80200	30.88	36.00	36.33	145	63504	31.81	35.54	36.05
46	90984	30.33	35.78	36.17	96	1282040	35.23	37.53	38.12	146	67056	31.77	36.04	36.52
47	84112	30.52	36.11	36.40	97	76288	31.27	36.35	36.66	147	354920	33.45	35.67	36.30
48	1260680	35.28	37.63	38.27	98	77496	31.17	36.27	36.59	148	84848	30.23	35.09	35.56
49	79392	30.81	35.94	36.37	99	379576	33.20	36.25	36.82	149	27840	33.18	34.96	35.70

Number of bits(NOB) and SNR of Popple (9Mbps)

frame No.	NOB	SNR Y	U	V	frame No.	NOB	SNR Y	U	V	frame No.	NOB	SNR Y	U	V
0	509904	34.83	41.49	41.34	50	120824	33.12	37.26	37.97	100	276104	31.70	33.29	33.41
1	127616	33.00	37.22	37.74	51	272112	35.33	39.20	39.34	101	281992	31.80	33.25	33.42
2	128064	32.99	37.18	37.57	52	123072	32.85	37.01	37.68	102	587360	34.53	36.27	36.32
3	282344	35.26	39.21	39.18	53	125088	32.85	36.98	37.53	103	284088	31.53	33.09	33.14
4	125584	33.05	36.88	37.38	54	285992	35.33	38.73	38.81	104	291944	31.66	32.92	33.03
5	123296	33.03	36.82	37.35	55	126816	32.80	36.79	37.32	105	595336	34.45	36.04	35.97
6	263616	35.15	38.76	38.77	56	126536	32.75	36.79	37.20	106	294736	31.52	32.92	33.09
7	117592	33.12	36.71	37.29	57	296960	35.36	38.62	38.68	107	297256	31.56	32.81	33.03
8	118552	33.00	36.82	37.31	58	132456	32.93	37.07	37.47	108	796888	35.26	39.66	39.75
9	270864	35.15	38.50	38.58	59	128152	33.04	37.22	37.69	109	299024	31.50	32.92	33.08
10	124344	33.01	37.22	37.55	60	499008	35.01	41.44	41.41	110	291240	31.67	32.90	33.05
11	125376	33.00	37.27	37.68	61	140600	32.81	37.37	37.74	111	556752	34.37	36.49	36.46
12	535704	34.69	41.22	41.18	62	145040	32.73	37.17	37.63	112	301840	31.52	32.73	32.86
13	125864	32.97	37.29	37.71	63	311280	35.51	38.99	39.18	113	297640	31.75	32.77	32.93
14	120024	32.87	37.16	37.57	64	136160	32.76	36.49	37.14	114	566488	34.33	36.03	36.07
15	285768	35.22	39.09	39.13	65	139280	32.66	36.44	37.02	115	305096	31.56	32.67	32.81
16	119544	33.05	36.99	37.47	66	312528	35.49	38.62	38.67	116	308752	31.68	32.64	32.76
17	117648	33.04	36.87	37.47	67	142680	32.74	36.12	36.88	117	561336	34.22	35.81	35.78
18	268416	35.17	38.63	38.76	68	141296	32.81	35.79	36.57	118	298072	31.42	32.72	32.90
19	118816	33.13	36.79	37.39	69	328424	35.54	38.38	38.49	119	304056	31.54	32.86	33.00
20	117536	32.96	36.85	37.34	70	143984	32.88	35.74	36.53	120	849320	35.08	39.48	39.53
21	274560	35.22	38.54	38.59	71	145088	32.93	35.65	36.54	121	299088	31.08	32.94	33.09
22	119872	33.13	37.24	37.76	72	472168	35.59	41.64	41.68	122	297800	31.23	32.97	33.13
23	123800	33.15	37.28	37.91	73	153496	33.32	35.50	36.13	123	566560	34.06	36.26	36.16
24	517128	34.86	41.37	41.34	74	158576	33.42	35.30	35.97	124	302832	30.95	32.79	32.96
25	122680	33.10	37.40	37.82	75	340272	35.64	38.82	38.80	125	308776	31.16	32.79	32.93
26	127784	33.06	37.25	37.60	76	164864	33.86	35.32	35.68	126	586408	33.95	35.77	35.74
27	270160	35.30	39.20	39.29	77	164896	33.83	35.25	35.56	127	288384	30.98	32.85	33.03
28	122440	33.19	37.07	37.51	78	336496	35.57	38.29	38.12	128	296584	31.16	32.91	32.99
29	127624	33.19	37.03	37.47	79	166592	33.99	35.13	35.31	129	574736	33.93	35.62	35.54
30	266264	35.29	38.87	38.92	80	170704	33.83	35.09	35.21	130	297696	31.04	32.94	33.01
31	124320	33.20	36.90	37.48	81	341208	35.52	37.72	37.56	131	310072	31.21	33.02	33.20
32	121048	33.18	36.92	37.41	82	177624	34.03	35.19	35.34	132	890128	34.81	39.14	39.26
33	275240	35.31	38.73	38.80	83	177376	34.07	35.22	35.41	133	300136	30.93	33.11	33.32
34	125336	33.15	37.39	37.98	84	463864	36.56	41.62	41.35	134	302912	30.96	32.93	33.10
35	121704	33.06	37.42	37.93	85	186000	34.11	35.01	35.23	135	630984	33.94	36.13	36.12
36	515360	34.86	41.35	41.37	86	196568	34.07	34.93	35.12	136	297560	30.80	32.99	33.08
37	123912	33.14	37.39	38.03	87	368968	35.63	38.29	38.11	137	296600	30.90	32.96	33.11
38	121232	33.07	37.30	37.92	88	204592	33.83	34.51	34.63	138	622056	33.80	35.72	35.67
39	272744	35.24	39.11	39.37	89	216584	33.63	34.30	34.51	139	306520	30.86	32.91	33.05
40	117128	33.22	37.00	37.61	90	427552	35.29	37.46	37.38	140	291912	31.06	32.98	33.06
41	118504	33.10	36.94	37.59	91	218448	33.33	34.05	34.28	141	640440	33.81	35.50	35.51
42	269784	35.24	38.76	38.95	92	234064	33.19	34.02	34.18	142	301112	30.82	33.15	33.32
43	116168	33.15	37.07	37.57	93	472664	35.09	37.06	36.99	143	297824	31.11	33.09	33.31
44	116448	33.02	36.81	37.46	94	238440	32.67	33.87	34.08	144	904600	34.80	39.16	39.29
45	265520	35.16	38.52	38.72	95	249744	32.56	33.80	34.03	145	311632	30.87	33.16	33.40
46	118864	33.10	37.25	37.82	96	654144	35.74	40.31	40.39	146	295416	31.10	33.10	33.28
47	117952	33.13	37.41	38.06	97	253192	32.15	33.68	33.93	147	600304	33.84	35.98	36.09
48	522160	34.79	41.35	41.31	98	260680	32.16	33.68	33.89	148	272040	30.82	33.10	33.32
49	119752	33.02	37.42	37.97	99	547640	34.81	36.99	37.09	149	32416	33.95	35.56	35.63

Number of bits(NOB) and SNR of Table Tennis (4Mbps)

frame No.	NOB	SNR Y	SNR U	SNR V	frame No.	NOB	SNR Y	SNR U	SNR V	frame No.	NOB	SNR Y	SNR U	SNR V
0	669392	29.04	38.80	40.35	50	78976	32.75	37.01	36.00	100	55688	31.40	37.53	36.91
1	41152	27.99	38.23	39.03	51	154496	33.26	38.09	37.71	101	55160	31.19	37.44	36.77
2	40296	28.07	38.19	38.98	52	85200	32.30	36.46	35.50	102	129624	31.37	37.31	37.11
3	235968	29.25	38.37	39.54	53	84640	32.31	36.40	35.23	103	51120	31.32	37.47	37.04
4	40168	28.29	38.05	38.46	54	167656	32.97	37.38	36.87	104	50088	31.00	37.46	37.06
5	44752	27.87	37.88	38.23	55	85936	32.25	36.27	35.06	105	121704	31.30	37.30	37.01
6	309728	28.96	37.91	38.90	56	87008	32.23	35.92	34.98	106	40336	32.01	38.41	38.03
7	56280	27.11	37.78	38.27	57	169904	32.75	36.96	36.54	107	38408	31.89	38.42	38.05
8	82288	26.68	37.70	38.07	58	79144	32.69	36.02	35.41	108	525032	31.92	38.50	38.58
9	356496	29.03	37.53	38.37	59	73104	32.86	36.20	35.45	109	37104	31.95	38.45	38.26
10	58440	27.18	37.63	38.06	60	418848	35.67	38.58	38.47	110	38152	31.89	38.40	38.08
11	63064	27.20	38.11	38.78	61	75480	33.13	36.45	35.44	111	92048	31.96	38.38	38.27
12	678704	29.05	38.70	40.05	62	76192	32.90	36.02	35.19	112	38120	31.98	38.33	38.19
13	77632	26.89	38.15	38.85	63	151016	33.01	37.36	36.95	113	39104	31.68	38.31	38.16
14	74744	26.78	37.86	38.46	64	79656	32.50	35.99	35.23	114	91528	31.78	38.32	38.20
15	371264	29.12	37.91	38.99	65	79664	32.31	35.80	35.10	115	39568	31.58	38.31	38.06
16	48832	27.34	37.69	38.15	66	163608	32.59	36.79	36.40	116	41312	31.28	38.25	38.01
17	58392	26.91	37.62	38.13	67	60976	31.20	37.06	36.12	117	85768	31.50	38.27	38.09
18	322704	28.97	37.65	38.62	68	53304	31.43	37.22	36.32	118	43264	32.05	38.33	37.88
19	54032	27.30	37.60	38.14	69	453336	32.34	37.34	37.08	119	42096	31.69	38.43	37.92
20	57392	27.15	37.49	38.00	70	52496	32.27	37.83	36.80	120	531560	32.00	38.43	38.38
21	323960	28.95	37.44	38.30	71	52920	32.31	37.82	36.80	121	45120	30.65	38.24	37.68
22	83760	26.42	37.67	38.27	72	477320	33.24	38.13	37.71	122	46120	30.92	38.13	37.58
23	107248	26.03	37.76	38.52	73	50296	32.40	38.00	37.21	123	135768	31.91	38.06	37.97
24	635016	29.86	38.80	40.05	74	49360	32.26	38.00	37.35	124	53664	29.64	37.96	37.49
25	97024	26.78	37.58	38.14	75	78792	32.76	38.06	37.74	125	41224	31.29	38.09	37.62
26	87320	27.38	37.57	37.97	76	49056	32.27	37.99	37.52	126	168192	31.82	37.94	37.72
27	333352	30.05	37.91	38.60	77	47064	32.25	37.96	37.50	127	52384	29.66	38.06	37.73
28	84504	28.06	37.46	37.90	78	58800	32.70	37.97	37.64	128	44264	30.34	38.05	37.72
29	82832	28.24	37.44	37.89	79	46824	32.41	37.89	37.50	129	160928	31.62	37.90	37.53
30	267032	30.25	37.69	38.41	80	47912	32.36	37.90	37.50	130	43864	31.19	38.50	38.17
31	81856	28.84	37.53	37.68	81	51984	32.68	37.92	37.59	131	43192	31.03	38.42	38.20
32	78576	29.16	37.60	37.67	82	47592	32.94	38.08	37.66	132	546840	32.15	38.38	38.48
33	242248	30.74	38.03	38.29	83	43736	33.00	38.16	37.82	133	39280	31.06	38.35	38.09
34	67528	30.20	37.82	37.90	84	476600	33.22	38.10	37.84	134	47264	30.08	38.22	37.90
35	62416	30.82	38.14	37.96	85	43344	32.65	38.15	37.78	135	133704	31.91	38.11	37.89
36	441288	33.64	40.08	40.52	86	44760	32.51	38.08	37.66	136	47960	30.06	38.08	37.69
37	63840	31.40	38.36	38.03	87	60752	32.83	38.13	37.90	137	40272	30.92	37.94	37.55
38	66440	31.54	38.11	37.83	88	44360	32.51	38.10	37.61	138	143352	31.76	37.96	37.61
39	147448	32.16	38.68	38.64	89	44664	32.53	38.07	37.51	139	40696	31.00	37.99	37.78
40	72752	31.62	37.75	37.04	90	46776	32.83	38.10	37.82	140	47224	30.00	37.90	37.63
41	74200	31.70	37.62	36.78	91	44688	32.59	38.09	37.66	141	140464	31.61	37.81	37.52
42	147168	32.26	38.18	37.79	92	43944	32.51	38.06	37.56	142	48832	30.12	38.33	38.14
43	83112	31.76	37.30	36.30	93	41728	32.76	38.08	37.84	143	46952	30.26	38.37	38.32
44	86768	31.85	37.34	36.15	94	43088	33.09	38.22	37.80	144	559648	32.04	38.22	38.50
45	165272	32.57	37.96	37.39	95	41928	33.07	38.22	37.89	145	46480	30.15	38.18	37.84
46	82104	32.63	37.50	36.14	96	480592	33.23	38.08	37.87	146	49376	30.00	38.04	37.68
47	75200	33.02	37.70	36.42	97	70000	29.49	37.14	36.33	147	136296	31.80	38.04	37.99
48	384944	35.78	39.86	39.66	98	55720	30.38	37.31	36.58	148	51288	29.79	37.96	37.34
49	78560	33.01	37.37	36.22	99	494016	31.82	37.47	37.37	149	31800	31.62	37.92	37.64

Number of bits(NOB) and SNR of Table Tennis (9Mbps)

frame No.	NOB	SNR Y	SNR U	SNR V	frame No.	NOB	SNR Y	SNR U	SNR V	frame No.	NOB	SNR Y	SNR U	SNR V
0	1255288	34.24	40.41	42.55	50	136440	34.44	38.96	39.02	100	87536	33.91	39.45	39.63
1	122120	31.47	39.69	41.30	51	427576	36.33	40.90	41.45	101	84712	33.81	39.35	39.49
2	121376	31.60	39.69	41.26	52	150144	34.16	38.73	38.70	102	367872	35.62	39.59	40.17
3	727472	35.81	40.08	42.07	53	148536	34.21	38.55	38.42	103	75304	34.00	39.55	39.81
4	99352	31.96	39.58	40.91	54	466936	36.34	40.53	40.96	104	77936	33.88	39.55	39.79
5	99064	31.64	39.37	40.81	55	150592	34.15	38.47	38.37	105	338568	35.60	39.62	40.09
6	853096	36.14	39.69	41.64	56	151296	34.17	38.31	38.28	106	55536	34.40	40.20	40.50
7	136872	31.05	39.29	40.72	57	486200	36.27	40.23	40.63	107	54016	34.32	40.28	40.54
8	240112	30.62	39.08	40.39	58	138016	34.35	38.34	38.37	108	943432	35.95	40.32	40.81
9	964224	36.25	39.28	41.06	59	128192	34.41	38.35	38.30	109	47248	34.37	40.19	40.48
10	156800	31.10	38.97	40.37	60	774592	38.63	41.22	41.53	110	47384	34.36	40.17	40.42
11	197272	30.96	39.61	41.03	61	128696	34.53	38.36	38.28	111	293872	35.90	40.36	40.92
12	1269248	34.24	40.34	42.38	62	132416	34.41	38.14	38.11	112	47840	34.50	40.27	40.64
13	236816	31.01	39.38	40.85	63	443664	36.12	40.46	40.71	113	48160	34.36	40.24	40.68
14	218120	30.72	39.21	40.49	64	135880	34.09	38.12	38.00	114	264632	35.74	40.31	40.85
15	1008568	36.57	39.62	41.37	65	137248	34.00	38.03	37.98	115	52168	34.40	40.15	40.37
16	133848	31.13	39.24	40.45	66	484792	36.05	40.11	40.49	116	56088	34.20	40.12	40.34
17	176776	30.87	39.21	40.40	67	129256	33.76	39.36	39.30	117	254000	35.54	40.27	40.78
18	911256	36.32	39.44	41.14	68	106488	33.88	39.44	39.37	118	62504	34.48	40.18	40.30
19	157488	31.21	39.14	40.34	69	879832	36.34	39.94	40.16	119	63832	34.31	40.08	40.21
20	163888	31.26	39.09	40.31	70	80696	34.57	39.95	39.72	120	951152	35.99	40.25	40.66
21	889288	36.12	39.38	40.98	71	81272	34.63	39.90	39.73	121	81512	33.41	39.77	39.86
22	259360	30.66	38.81	40.30	72	882688	36.81	40.34	40.50	122	78952	33.58	39.84	39.90
23	338192	30.67	38.70	40.16	73	72320	34.59	40.05	40.04	123	365336	35.87	40.19	40.36
24	1183240	34.66	40.60	42.43	74	68504	34.48	40.05	40.04	124	117320	32.98	39.58	39.66
25	295816	30.77	38.43	39.93	75	261360	36.15	40.42	40.48	125	65304	33.90	39.78	39.97
26	249888	31.00	38.52	39.84	76	66968	34.43	40.21	40.29	126	428008	35.72	40.14	40.47
27	857736	35.90	39.91	41.26	77	64488	34.56	40.16	40.26	127	117840	32.96	39.71	40.09
28	213592	31.24	38.55	39.77	78	206040	36.05	40.37	40.48	128	83184	33.10	39.82	40.08
29	204304	31.33	38.51	39.73	79	61232	34.69	40.20	40.34	129	413928	35.69	40.08	40.44
30	734000	35.77	39.86	41.10	80	63232	34.65	40.18	40.32	130	74368	33.79	40.28	40.41
31	188584	31.57	38.77	39.74	81	190112	36.07	40.36	40.56	131	70360	33.51	40.08	40.14
32	173064	31.81	38.84	39.81	82	62472	35.04	40.33	40.37	132	959344	36.13	40.24	40.69
33	676152	35.84	40.22	41.22	83	57176	35.04	40.41	40.51	133	65400	33.62	40.01	40.02
34	142064	32.30	39.08	39.88	84	880808	36.79	40.31	40.52	134	102592	33.26	40.04	40.08
35	129256	32.70	39.33	40.01	85	56112	34.69	40.31	40.44	135	366296	36.07	40.29	40.61
36	823928	36.91	41.93	42.91	86	58168	34.60	40.19	40.31	136	101432	33.28	39.66	39.87
37	121592	33.05	39.52	40.10	87	225632	36.11	40.36	40.50	137	65048	33.71	39.66	39.94
38	123416	33.24	39.32	40.01	88	58176	34.75	40.33	40.50	138	370576	35.95	40.10	40.48
39	462000	35.95	40.72	41.63	89	57408	34.81	40.29	40.44	139	63064	33.78	39.73	40.26
40	133032	33.32	39.28	39.63	90	179872	36.16	40.54	40.77	140	95384	33.16	39.76	40.15
41	131088	33.37	39.13	39.47	91	56744	34.78	40.36	40.51	141	379840	35.87	39.94	40.29
42	468728	36.01	40.55	41.21	92	56944	34.76	40.34	40.47	142	105712	33.30	40.08	40.24
43	149472	33.61	39.10	39.18	93	164872	36.09	40.53	40.89	143	96944	33.31	40.06	40.46
44	149944	33.73	39.09	39.20	94	55368	35.17	40.48	40.51	144	977312	36.11	40.18	40.70
45	484992	36.17	40.52	41.15	95	55280	35.18	40.48	40.59	145	99560	33.19	40.00	39.97
46	138440	34.23	39.29	39.32	96	884496	36.78	40.35	40.59	146	112200	33.19	39.73	39.68
47	127720	34.49	39.52	39.40	97	173240	32.70	39.01	39.16	147	364928	35.97	40.27	40.64
48	723064	38.59	42.16	42.56	98	117752	33.01	39.16	39.27	148	114568	33.08	39.86	39.90
49	133632	34.56	39.32	39.35	99	957960	36.19	39.61	40.28	149	29304	35.60	40.11	40.48

* Cumulative bit count once every 0.4 second

Frame No.	Flower Garden 4Mbps	Flower Garden 9Mbps	Mobile & Calender 4Mbps	Mobile & Calender 9Mbps
0 - 11	1402776	2978776	1778120	4030608
12 - 23	1498928	3321392	1544088	3333120
24 - 35	1400568	2992496	1401896	2946496
36 - 47	1491104	3298096	1519752	3254448
48 - 59	1543280	3522648	1544696	3363424
60 - 71	1521464	3330672	1652512	3627768
72 - 83	1459928	3173136	1631920	3596584
84 - 95	1450896	3088256	1526576	3309176
96 - 107	1826016	4358544	1485896	3131880
108 - 119	1723984	4022816	1479048	3149088
120 - 131	1602056	3602640	1434664	2975136
132 - 143	1383376	3021752	1382504	2803912

Frame No.	Popple 9Mbps	Table Tennis 4Mbps	Table Tennis 9Mbps
0 - 11	2317152	1998024	4973048
12 - 23	2327552	2258664	5762848
24 - 35	2321728	2119704	5047696
36 - 47	2273616	1505592	3314352
48 - 59	2379920	1529568	3240624
60 - 71	2585368	1717496	3514832
72 - 83	2824272	1048736	2056592
84 - 95	3477488	976632	1905384
96 - 107	4624472	1642456	3274928
108 - 119	4887184	1113096	2181160
120 - 131	4978256	1366280	2847264
132 - 143	5178184	1322840	2771632

MOBILE & CALENDAR 4Mbps

-----number(/MB)-----

	total	I-picture	P-picture	B-picture
qp avr	19.31	11.71	12.14	22.02
non 0 coeff	5.73	42.17	7.32	0.47
0 coeff	10.61	38.90	24.58	1.66
EOB	0.78	4.00	1.25	0.18

-----number of MB type(/picture)-----

		I-picture	P-picture	B-picture
c fixed	fixed	1128.85	232.64	466.37
c+Q MC+c	Int+c	1511.15	734.90	42.36
no MC+c	Int+no c		14.59	1256.36
MC+no c	Back+c		728.03	15.57
Intra	Back+no c		13.82	373.10
MC+c+Q	For+c		856.26	16.03
no MC+c+Q	For+no c		30.79	260.22
Intra+Q	Intra		28.97	7.07
	Int+c+Q			94.96
	Back+c+Q			32.52
	For+c+Q			30.91
	Intra+c+Q			33.53

-----bit number(bit/picture)-----

	total	I-picture	P-picture	B-picture
overhead	364372			
DC Y	3624.95	36184.31	702.87	592.50
DC Cb	1628.84	16090.46	298.38	294.39
DC Cr	1691.36	16831.85	293.51	296.17
AC Y	64958.73	396195.47	106905.10	6703.97
AC Cb	1772.88	69317.08	6929.97	251.30
AC Cr	8638.14	70182.30	9374.64	512.67
Motion Vector	22615.01	0.00	18558.03	27010.28
MB Type	6246.75	4151.15	7625.36	5986.34
MBA	2728.80	2640.00	2652.18	2769.41
Block Pattern	2096.95	0.00	6267.36	769.54
qp	2436.62	7555.77	4580.13	984.51
total bit	124439.03	619148.38	164288.53	46151.27

FLOWER GARDEN 4Mbps

-----number(/MB)-----

	total	I-picture	P-picture	B-picture
qp avr	21.82	12.61	13.28	26.[illegible]
non 0 coeff	5.66	34.80	9.29	0.[illegible]
0 coeff	8.03	30.93	18.32	1.[illegible]
EOB	0.90	4.00	1.60	0.[illegible]

-----number of MB type(/picture)-----

		I-picture	P-picture	B-picture
c fixed	fixed	1172.00	336.67	399.[illegible]
c+Q MC+c	Int+c	1468.00	838.62	42.[illegible]
no MC+c	Int+no c		14.67	1311.[illegible]
MC+no c	Back+c		437.13	14.[illegible]
Intra	Back+no c		9.56	329.[illegible]
MC+c+Q	For+c		942.33	18.[illegible]
no MC+c+Q	For+no c		39.90	271.89
Intra+Q	Intra		21.13	14.25
	Int+c+Q			112.[illegible]
	Back+c+Q			35.[illegible]
	For+c+Q			43.[illegible]
	Intra+c+Q			36.29

-----bit number(bit/picture)-----

	total	I-picture	P-picture	B-picture
overhead	364864			
DC Y	3680.49	36694.08	483.36	595.[illegible]
DC Cb	1578.30	14582.62	259.21	425.25
DC Cr	1397.36	13030.54	207.36	369.72
AC Y	64088.54	335701.53	123046.84	6928.31
AC Cb	8567.53	58661.98	12549.74	660.45
AC Cr	5068.56	42184.15	5273.82	259.67
Motion Vector	25732.94	0.00	19777.64	31289.66
MB Type	6328.53	4108.00	7265.08	6253.44
MBA	2694.50	2640.00	2579.26	2745.51
Block Pattern	1993.39	0.00	5934.79	740.44
qp	2641.27	7340.00	5016.79	1134.[illegible]
total bit	122771.43	514941.97	182293.89	51501.89

MOBILE & CALENDAR 9Mbps

-----number(/MB)-----

	total	I-picture	P-picture	B-picture
qp avr	9.43	5.69	5.72	11.33
non 0 coeff	14.33	80.88	22.28	2.81
0 coeff	24.91	74.33	46.93	10.19
EOB	1.34	4.00	2.19	0.68

-----number of MB type(/picture)-----

		I-picture	P-picture	B-picture
c fixed	fixed	1889.00	128.92	399.41
c+Q MC+c	Int+c	751.00	1578.90	208.12
no MC+c	Int+no c		69.85	814.49
MC+no c	Back+c		211.10	97.95
Intra	Back+no c		33.72	274.51
MC+c+Q	For+c		507.38	99.40
no MC+c+Q	For+no c		85.54	223.72
Intra+Q	Intra		24.49	51.30
	Int+c+Q			201.15
	Back+c+Q			91.04
	For+c+Q			82.63
	Intra+c+Q			96.28

-----bit number(bit/picture)-----

	total	I-picture	P-picture	B-picture
overhead	364050			
DC Y	4518.02	36184.31	940.05	1850.17
DC Cb	2127.96	16090.46	389.97	1012.95
DC Cr	2153.92	16831.85	380.59	961.25
AC Y	180410.81	854048.88	313745.94	43573.91
AC Cb	22501.12	169108.23	29301.23	1215.85
AC Cr	22773.13	158479.16	31504.51	2138.79
Motion Vector	19022.46	0.00	18239.44	21746.29
MB Type	6572.27	3391.00	5632.54	7337.03
MBA	2719.38	2640.00	2647.46	2757.00
Block Pattern	4023.19	0.00	9890.74	2292.47
qp	2659.03	3755.00	3067.56	2355.49
total bit	259481.28	1260528.88	415760.03	87241.19

FLOWER GARDEN 9Mbps

-----number(/MB)-----

	total	I-picture	P-picture	B-picture
qp avr	9.16	5.39	5.50	11.04
non 0 coeff	14.60	62.77	28.50	3.14
0 coeff	20.17	50.81	45.77	6.48
EOB	1.51	4.00	2.59	0.78

-----number of MB type(/picture)-----

		I-picture	P-picture	B-picture
c fixed	fixed	1866.62	235.18	338.35
c+Q MC+c	Int+c	773.38	1491.97	311.51
no MC+c	Int+no c		113.28	771.29
MC+no c	Back+c		99.28	135.72
Intra	Back+no c		15.89	238.13
MC+c+Q	For+c		618.23	130.78
no MC+c+Q	For+no c		54.72	207.92
Intra+Q	Intra		11.64	45.56
	Int+c+Q			232.35
	Back+c+Q			94.98
	For+c+Q			98.08
	Intra+c+Q			35.31

-----bit number(bit/picture)-----

	total	I-picture	P-picture	B-picture
overhead	364521			
DC Y	3894.88	36694.08	435.67	1037.23
DC Cb	1713.88	14582.62	229.54	641.28
DC Cr	1523.58	13030.54	181.82	570.04
AC Y	176792.98	625228.38	377620.94	42852.29
AC Cb	29691.68	148706.53	57409.38	3925.18
AC Cr	24112.83	136843.84	43958.82	2156.98
Motion Vector	23885.52	0.00	19688.38	28534.54
MB Type	6590.94	3413.38	5529.44	7401.79
MBA	2695.39	2640.00	2623.26	2730.05
Block Pattern	4409.75	0.00	10320.97	2711.80
qp	2719.06	3866.92	3422.95	2303.63
total bit	278030.47	985006.25	521421.12	94864.59

TABLE TENNIS 4Mbps

-----number(/MB)-----

	total	I-picture	P-picture	B-picture
qp avr	15.56	9.14	9.48	18.70
non 0 coeff	5.39	34.77	8.35	0.52
0 coeff	9.68	37.19	21.30	1.73
EOB	0.81	4.00	1.15	0.27

-----number of MB type(/picture)-----

		I-picture	P-picture	B-picture
c fixed	fixed	1882.31	573.74	315.15
c+Q MC+c	Int+c	757.69	590.49	118.12
no MC+c	Int+no c		218.95	1526.11
MC+no c	Back+c		712.23	25.91
Intra	Back+no c		116.82	379.01
MC+c+Q	For+c		306.28	30.55
no MC+c+Q	For+no c		74.82	243.82
Intra+Q	Intra		46.67	51.15
	Int+c+Q			76.90
	Back+c+Q			30.59
	For+c+Q			18.58
	Intra+c+Q			20.11

-----bit number(bit/picture)-----

	total	I-picture	P-picture	B-picture
overhead	364749			
DC Y	3240.68	27153.15	1823.36	734.92
DC Cb	1307.77	9064.54	943.90	458.26
DC Cr	1365.17	10075.23	987.62	399.42
AC Y	72367.24	433684.16	124109.00	6533.43
AC Cb	2831.54	14276.08	5065.21	518.87
AC Cr	4606.16	18560.51	9088.77	1113.75
Motion Vector	27676.18	0.00	19685.23	34258.90
MB Type	5941.72	3397.69	5934.69	6268.66
MBA	2661.31	2640.00	2513.21	2720.65
Block Pattern	1999.74	0.00	4801.56	1183.32
qp	1345.58	3788.46	2138.85	730.93
total bit	125343.09	522639.59	177091.38	54921.14

TABLE TENNIS 9Mbps

-----number(/MB)-----

	total	I-picture	P-picture	B-picture
qp avr	6.62	3.94	3.96	7.58
non 0 coeff	13.90	60.85	24.68	3.79
0 coeff	24.56	46.63	48.01	12.79
EOB	1.50	4.00	2.30	0.88

-----number of MB type(/picture)-----

		I-picture	P-picture	B-picture
c fixed	fixed	2381.38	124.69	209.46
c+Q MC+c	Int+c	258.62	1276.64	379.64
no MC+c	Int+no c		706.38	777.19
MC+no c	Back+c		115.85	154.31
Intra	Back+no c		176.03	334.36
MC+c+Q	For+c		153.56	147.31
no MC+c+Q	For+no c		74.41	231.03
Intra+Q	Intra		12.33	160.50
	Int+c+Q			128.98
	Back+c+Q			53.68
	For+c+Q			43.43
	Intra+c+Q			20.11

-----bit number(bit/picture)-----

	total	I-picture	P-picture	B-picture
overhead	364024			
DC Y	3880.63	27153.15	2064.56	1608.90
DC Cb	1632.81	9064.54	1088.82	893.62
DC Cr	1682.06	10075.23	1141.21	819.15
AC Y	205228.62	815367.38	391679.38	56175.83
AC Cb	11185.94	43359.85	22616.15	2714.97
AC Cr	15182.98	47927.23	30504.05	5151.64
Motion Vector	23807.42	0.00	18765.36	28769.54
MB Type	6474.44	2898.62	5131.26	7443.75
MBA	2688.77	2640.00	2651.59	2709.20
Block Pattern	4042.75	0.00	8027.00	3034.61
qp	1228.77	1293.08	1201.54	1230.98
total bit	277035.19	959779.12	484870.91	110552.18

POPPLE 9Mbps

-----number(/MB)-----

	total	I-picture	P-picture	B-picture
qp avr	8.59	5.28	5.34	10.25
non 0 coeff	12.70	36.14	19.18	6.99
0 coeff	21.56	43.85	37.30	12.70
EOB	2.44	4.00	2.01	2.40

-----number of MB type(/picture)-----

		I-picture	P-picture	B-picture
c fixed	fixed	2081.15	758.03	80.99
c+Q MC+c	Int+c	558.85	899.05	395.52
no MC+c	Int+no c		261.15	410.21
MC+no c	Back+c		174.54	78.77
Intra	Back+no c		22.95	128.35
MC+c+Q	For+c		477.21	88.68
no MC+c+Q	For+no c		28.31	109.14
Intra+Q	Intra		18.77	612.25
	Int+c+Q			371.60
	Back+c+Q			80.53
	For+c+Q			79.89
	Intra+c+Q			204.07

-----bit number(bit/picture)-----

	total	I-picture	P-picture	B-picture
overhead	364138			
DC Y	7893.21	28116.92	644.72	8087.17
DC Cb	4613.99	15331.00	350.72	4878.18
DC Cr	3831.11	14749.92	429.72	3740.03
AC Y	106338.40	317682.16	195466.56	45324.01
AC Cb	52654.26	123423.77	83267.05	31929.72
AC Cr	47440.27	115054.62	74549.64	28457.40
Motion Vector	34486.87	0.00	25203.49	42431.79
MB Type	8169.94	3198.85	4699.90	10130.29
MBA	2824.91	2640.00	2568.62	2644.51
Block Pattern	7727.56	0.00	10140.79	7789.75
qp	3337.44	2794.23	2621.41	3680.44
total bit	279117.97	622991.50	399942.62	189093.30

* Paper listing

```
-rw-r--r--  1 aono  users  5397657  Oct  15  16:26  fg9data.data
-rw-r--r--  1 aono  users  2428213  Oct  15  19:13  mfgdata.data
-rw-r--r--  1 aono  users  5418543  Oct  15  15:39  mpodata.data
-rw-r--r--  1 aono  users  2441003  Oct  15  16:08  mvfdata.data
-rw-r--r--  1 aono  users  2458453  Oct  15  15:48  tte4
-rw-r--r--  1 aono  users  5378435  Oct  15  19:21  tte9
-rw-r--r--  1 aono  users  5233026  Oct  15  14:42  update.data
```

fg9data.data	:	Flower Garden (9Mbps)
mfgdata.data	:	Flower Garden (4Mbps)
mpodata.data	:	Popple (9Mbps)
mvfdata.data	:	Mobile & Calender (4Mbps)
tte4	:	Table Tennis (4Mbps)
tte9	:	Table Tennis (9Mbps)
update.data	:	Mobile & Calender (9Mbps)

8 CONCLUSION

The main features of this coding scheme can be summarized as follows:

1) It is based on a hybrid coding comprising motion compensation and DCT.

2) The lines are rearranged in a block before DCT.

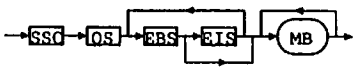
3) A proper quantizer matrix and a modified zigzag scanning order are selectable depending on luminance and chrominance component in their intra or non-intra modes. Furthermore, the selection is allowed every sequence.

9 REFERENCES

(1) MPEG Video Simulation Model Three (SM3)

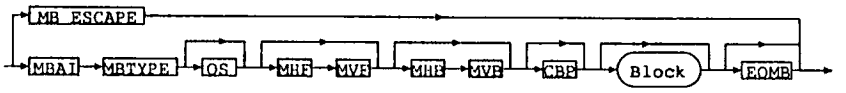
(2) MPEG VIDEO COMMITTEE DRAFT

Slice Layer (SLICE)



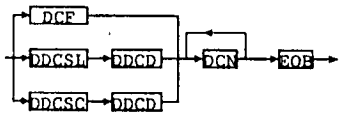
SSC slice_start_code EBS extra_bit_slice
QS quantizer_scale EIS extra_information_slice

Macroblock Layer (MB)



MB ESCAPE	macroblock_escape	MHB	macroblock_horizontal_backward
MBAI	macroblock_address_increment	MVB	macroblock_vertical_backward
MBTYPE	macroblock_type	CBP	coded_block_pattern
MHF	macroblock_horizontal_forward	EOMB	end_of_macroblock
MVF	macroblock_vertical_forward		

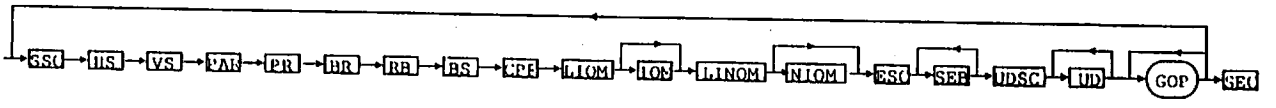
Block Layer (Block)



DCF	dct_coef_first	DCN	dct_coeff_next
DDCSL	dct_dc_size_luminance	EOB	end_of_block
DDCD	dct_dc_differencial		
DDCSC	dct_dc_size_chrominance		

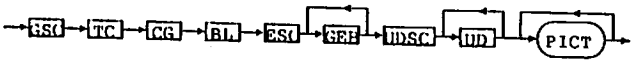
Figure 6: Syntax Diagram(continued)

Video Sequence Layer



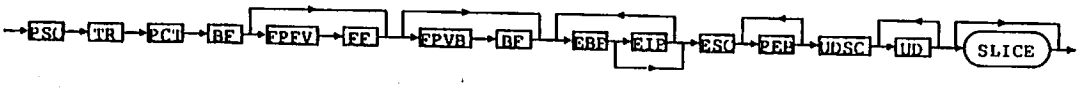
SSC	sequence_start_code	RB	reserved bit	NIQM	non_intra_quantizer_matrix
HS	horizontal_size	BS	buffre size	ESC	extension_start_code
VS	vertical_size	CPF	constrained_parameter_flag	SEB	sequence_extension_byte
PAR	pel_aspect_ratio	LIQM	load_intra_quantizer_matrix	UDSC	user_data_start_code
PR	picture_rate	IQM	intra_quantizer_matrix	UD	user_data
BR	bit rate	LNIQM	load_non_intra_quantizer_matrix	SEC	sequence_end_code

Groupe of Pictures Layer (GOP)



GSC	group_start_code	BL	broken_link
TC	time_code	GEB	group_extension_byte
CG	closed_gop		

Picture Layer (PICT)



PSC	picture_start_code	FPBV	full_pel_backward_vector
TR	temporal_reference	BF	backward_f
PCT	picture_coding_type	EBP	extra_bit_picture
BF	buffer_fullness	EIP	extra_infomation_picure
FPFV	full_pel_forward_vector	PEB	picture_extension_byte
FF	forward_f		

Figure 6: Syntax Diagram

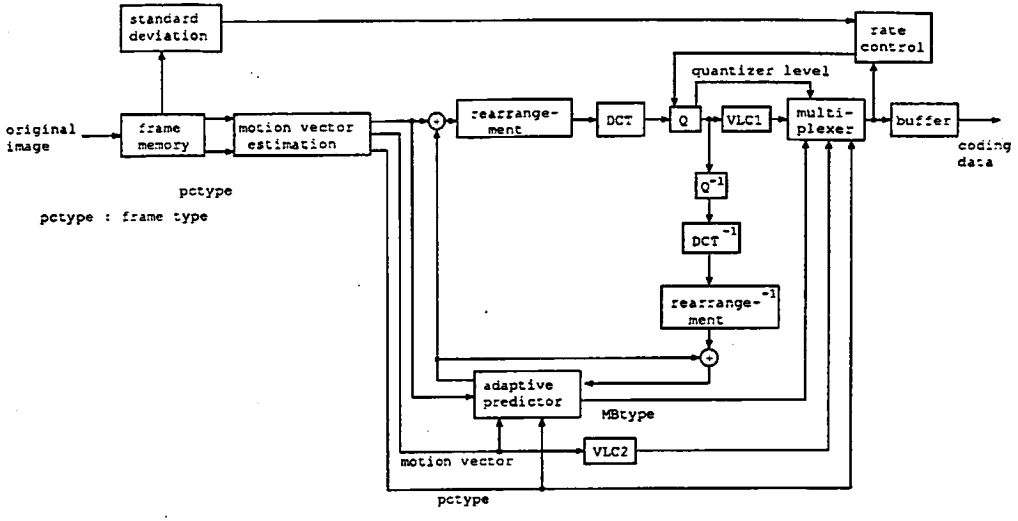


Figure 7: Block diagram of encoder

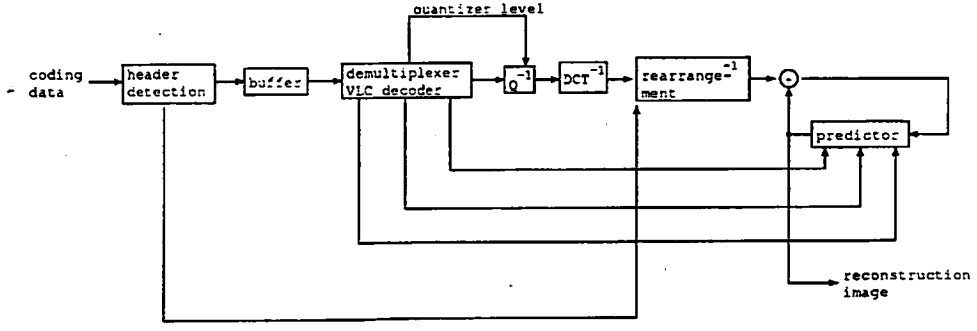


Figure 8: Block diagram of decoder

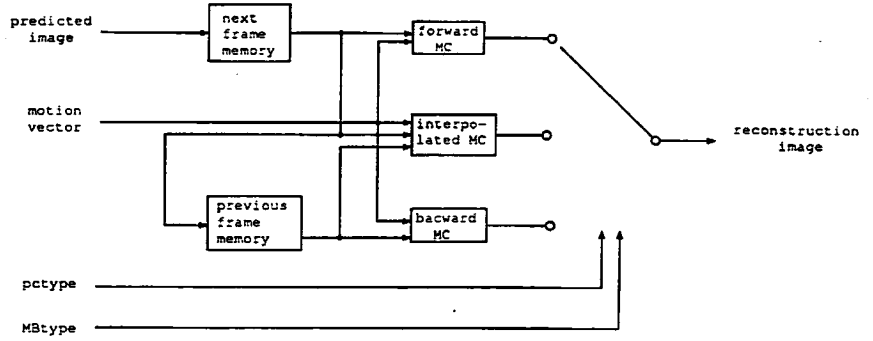


Figure 9: Block diagram of predictor

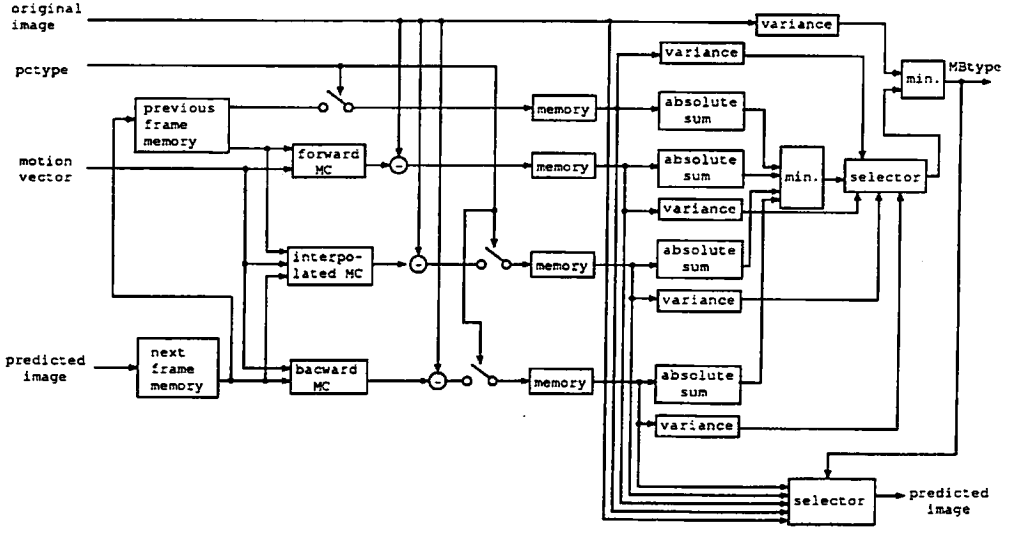


Figure 10: Block diagram of adaptive predictor

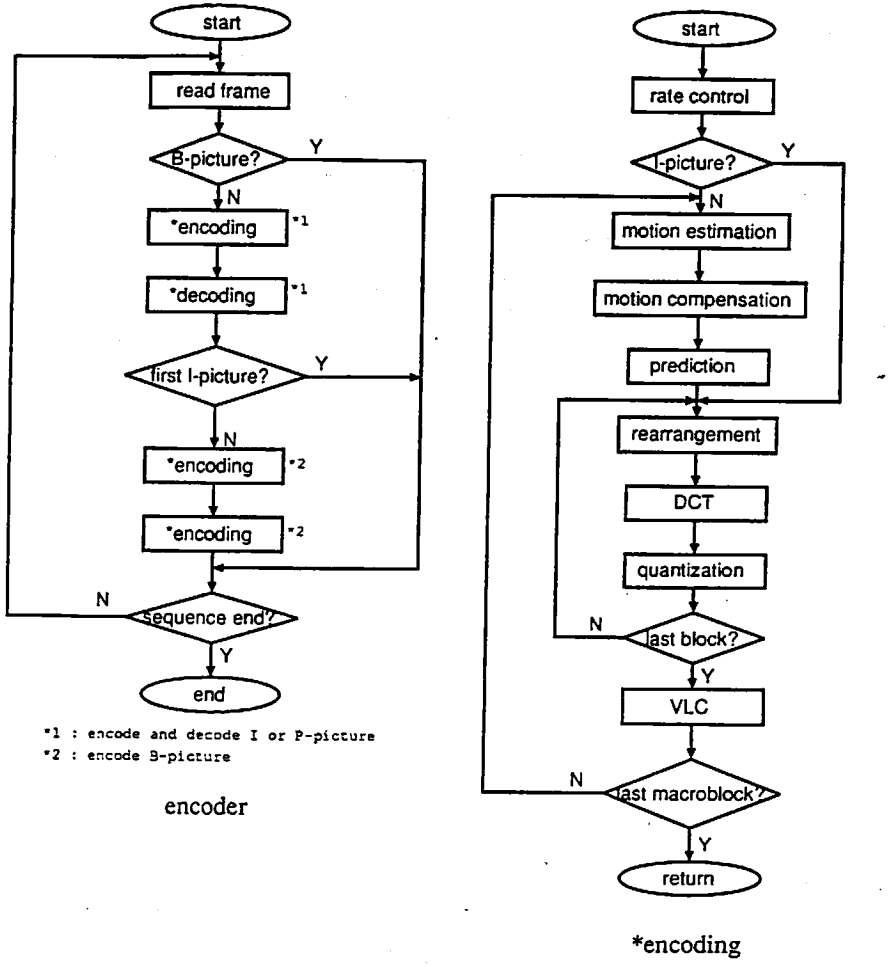


Figure 11: Flow of encoder

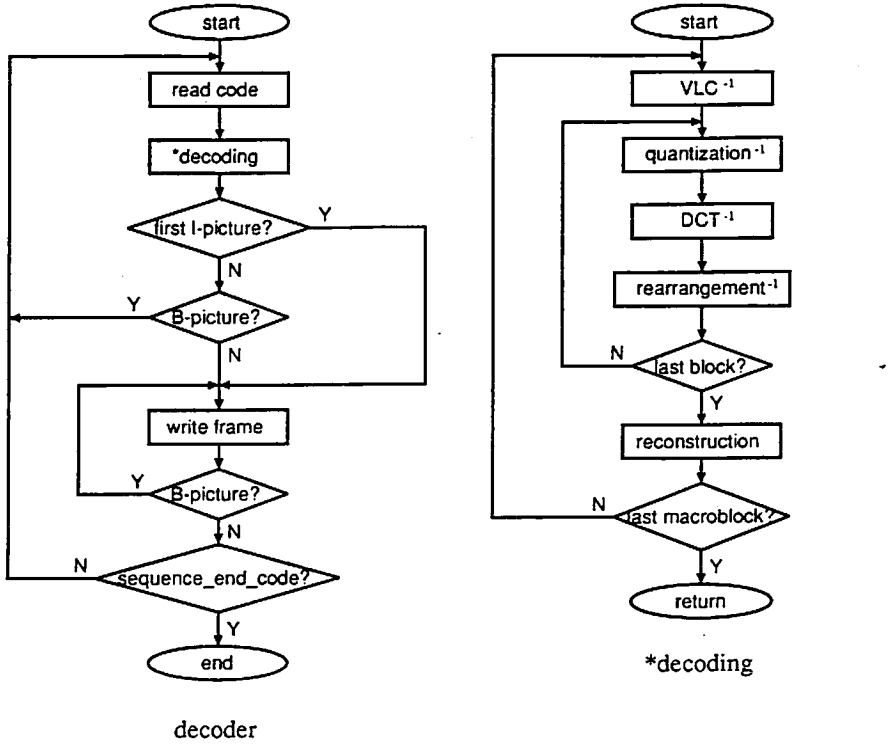


Figure 12: Flow of decoder

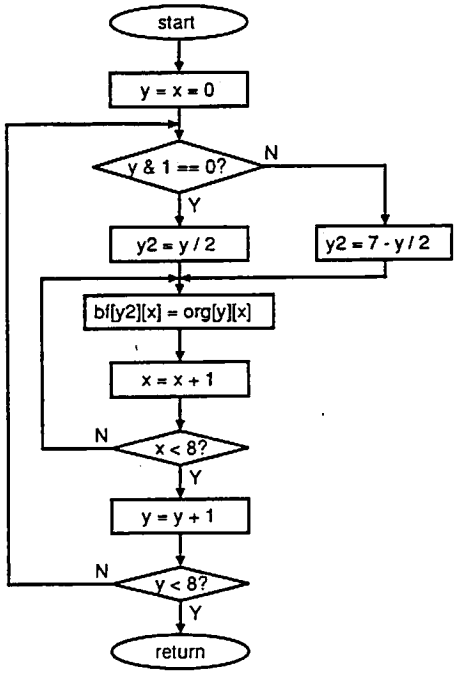


Figure 13 : Flow of rearrangement

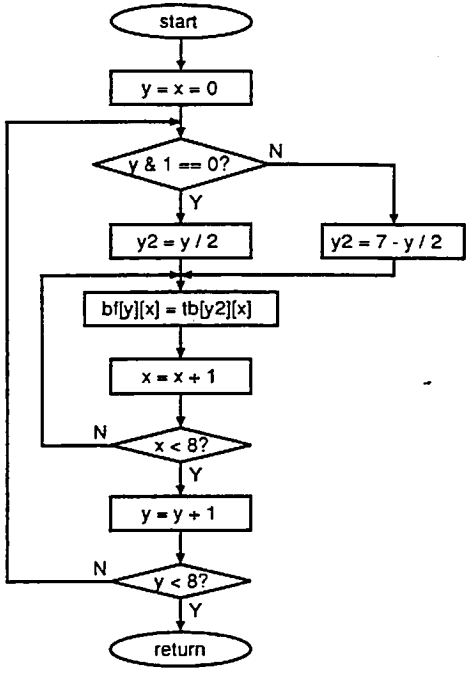


Figure 14 : Flow of rearrangement $^{-1}$

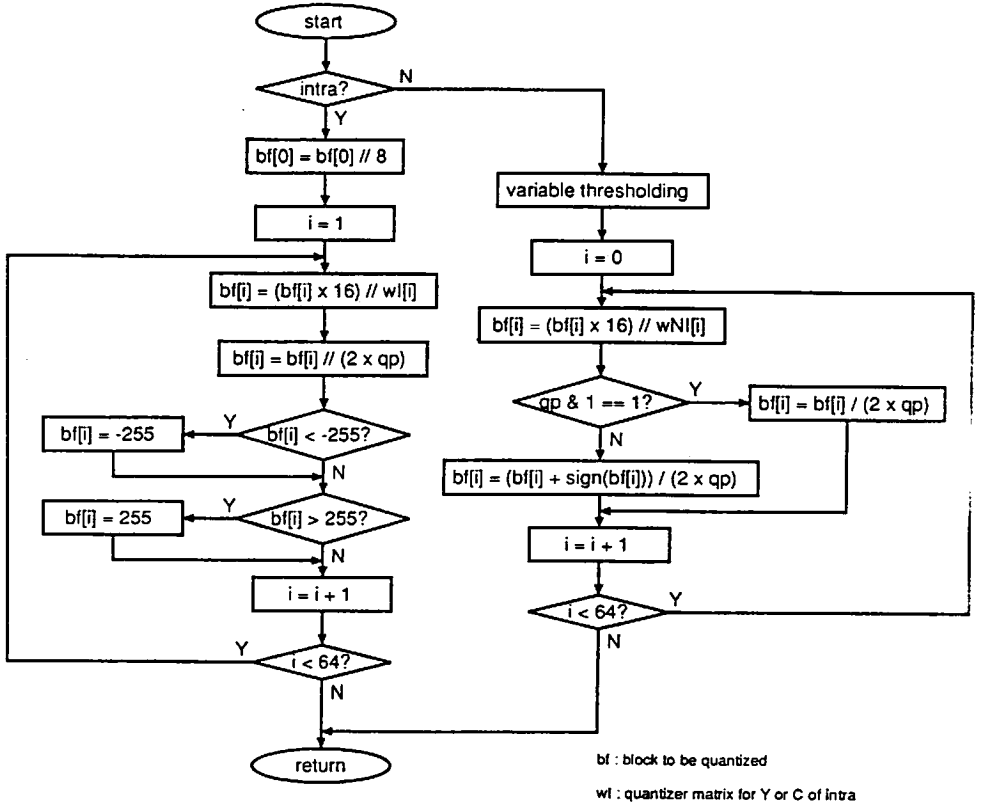


Figure 15: Flow of quantization

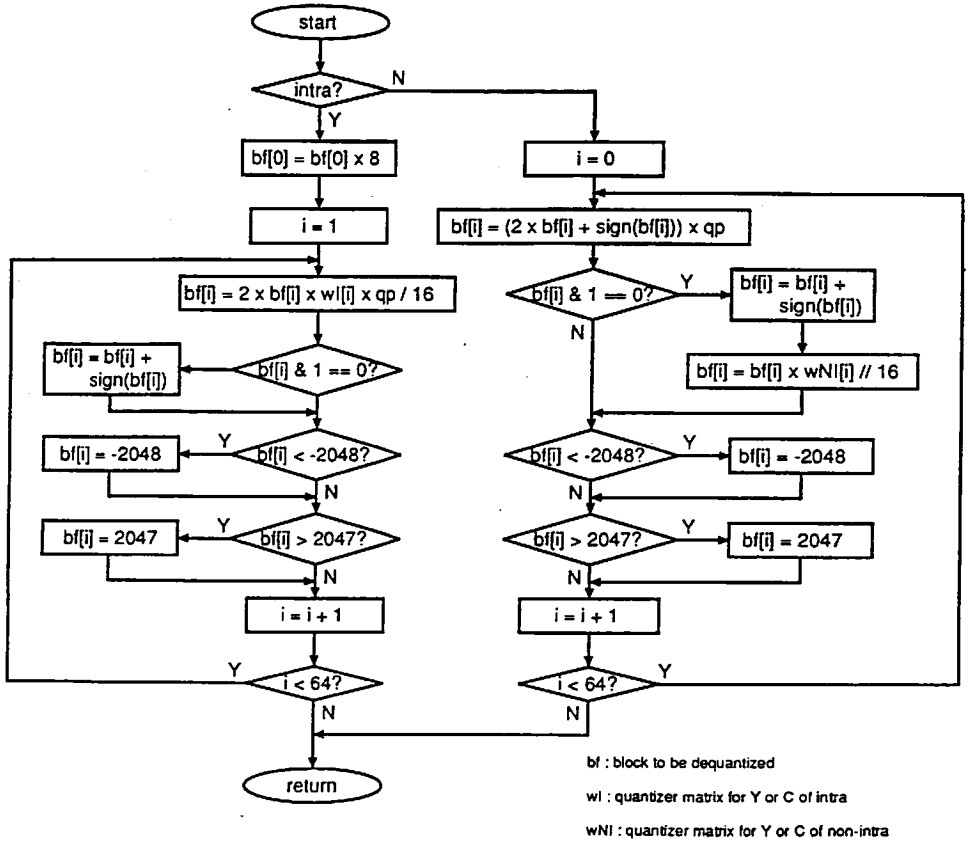


Figure 16: Flow of quantization^{-1}

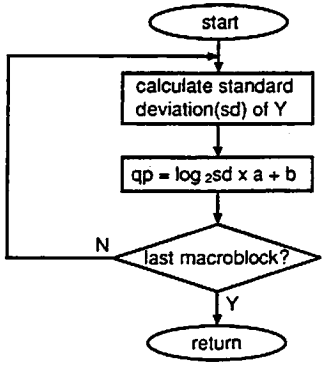


Figure 17: Flow of rate control