

CCITT SGXV
Working Party XV/1
Specialist Group on Coding for Visual Telephony

Source : JAPAN

Title : Simulation results of Reference Model 6 at $p=5$ and $p=24$

1 Introduction

In this document we present simulation results of RM6 for five sequences at $p=5,24$ and RM4 for two sequences at $p=5,24$ to compare with RM6.

2 Simulation

The statistics of RM6 and RM4 are shown on following pages. Table 1 shows the comparison with RM4. In respect of SNR, RM4 and RM6 are reaching more or less the same performance at high transmission rate. Figure 2, 4 and 5 show that SNR is slightly falling down with elapsing time at the rate of $p=24$.

For the subjective impression, RM6 shows granular noises in the region of back ground for "Miss America" at $p=24$.

Table 1: comparison with RM4

sequence	MISS AMERICA				SALESMAN			
No. of coded frames	74		149		224		448	
Frame rate	15 Hz		30 Hz		15 Hz		30 Hz	
Transmission rate	$p=5$		$p=24$		$p=5$		$p=24$	
Reference Model	RM4	RM6	RM4	RM6	RM4	RM6	RM4	RM6
RMS of luminance	2.5	2.45	2.0	2.21	3.7	3.40	3.2	3.18
SNR of luminance (dB)	40.2	40.36	41.9	41.25	36.8	37.50	38.1	38.08

3 Conclusion

For the simulation results, RM6 has a capability of taking the place of RM4 at the rate of $p \times 64\text{kbps}$ where $p \geq 5$.

Table 2: Simulation results at $p=5$

Statistics RM6

Bit-rate : $p=5$

Institute : G.C.T.

Date : December 6, 1988

Frame-rate : 15 Hz

ITEM		blue	claire	miss	sales	swing
SNR for luminance	Y	38.49	43.24	40.36	37.50	36.79
SNR for chrominance	U	41.60	43.27	39.63	42.82	39.70
	V	40.44	45.94	41.92	43.74	39.84
RMS for luminance	Y	3.03	1.76	2.45	3.40	3.69
RMS for chrominance	U	2.12	1.75	2.66	1.84	2.64
	V	2.42	1.29	2.04	1.66	2.60
Mean value of step size		8.22	6.51	8.34	8.57	8.40
Mean value of number of non-zero coefficients	Y	4.99	5.02	3.27	5.22	2.52
	C	1.86	2.34	2.26	1.66	2.39
	Y and C	4.28	4.37	2.82	4.71	2.54
Mean value of number of zeroes before the last NZ	Y	12.32	9.24	9.10	14.27	34.24
	C	5.87	5.98	4.40	3.44	12.61
	Y and C	10.84	8.45	7.01	12.72	32.87
Block type of MACRO	Intra	0	0	0	1	0
	Fixed	158	163	65	178	127
	Fixed MC	0	0	1	0	1
	Coded	220	194	260	187	261
	Coded MC	17	38	70	31	7
Block type of Y	Fixed	1136	1097	986	1092	981
	Fixed MC	13	18	91	17	13
	Coded	377	333	314	365	571
	Coded MC	57	136	192	106	19
Block type of C	Fixed	663	645	384	712	740
	Coded	129	147	408	79	51
Number of bits	Macro attr.	1700	1638	2481	1472	1779
	EOB	1673	1749	2605	1546	1838
	MV	92	182	347	177	67
	Coeff. DC	1	0	0	5	2
	Coeff. Y	13021	13798	9558	15285	14930
	Coeff. U	456	1254	3370	451	644
	Coeff. V	812	542	1398	199	380
	TOTAL	17758	19166	19762	19137	19643

Table 3: Simulation results at p=24

Statistics RM6
Bit-rate : p=24

Institute : G.C.T.
Date : December 6, 1988
Frame-rate : 30 Hz

ITEM		blue	claire	miss	sales	swing
SNR for luminance	Y	42.06	45.26	41.25	38.08	37.68
SNR for chrominance	U	42.93	45.24	40.22	42.92	41.91
	V	42.14	47.31	42.84	43.90	42.00
RMS for luminance	Y	2.01	1.39	2.21	3.18	3.33
RMS for chrominance	U	1.82	1.40	2.49	1.82	2.05
	V	1.99	1.10	1.84	1.63	2.03
Mean value of step size		4.40	4.00	5.76	7.13	5.93
Mean value of number of non-zero coefficients	Y	5.84	5.04	4.36	5.06	3.81
	C	2.36	2.19	3.65	2.13	2.38
	Y and C	4.16	4.25	4.07	4.79	3.76
Mean value of number of zeroes before the last NZ	Y	19.14	10.82	31.76	40.03	42.28
	C	9.61	6.99	8.25	4.79	11.50
	Y and C	14.55	9.74	22.33	36.87	40.81
Block type of MACRO	Intra	0	0	0	0	0
	Fixed	20	94	13	71	17
	Fixed MC	0	0	0	0	0
	Coded	369	281	299	280	368
	Coded MC	7	21	85	45	11
Block type of Y	Fixed	937	990	705	680	437
	Fixed MC	2	4	26	11	13
	Coded	619	511	540	724	1100
	Coded MC	27	80	313	169	33
Block type of C	Fixed	197	561	221	703	730
	Coded	595	231	571	88	61
Number of bits	Macro attr.	2945	2189	2748	2014	2335
	EOB	3230	2380	3631	2516	2967
	MV	33	82	557	217	102
	Coeff. DC	0	0	0	0	0
	Coeff. Y	24612	17832	28680	41673	40766
	Coeff. U	5041	1849	9039	775	770
	Coeff. V	6843	845	2871	286	451
	TOTAL	42706	25179	47528	47485	47394

Table 4: Simulation results of RM4

Statistics RM4

Institute : FUJITSU LIMITED

Date : December 6, 1988

Items		Miss America		Salesman		
		p=5 (15Hz)	p=24 (30Hz)	p=5 (15Hz)	p=24 (30Hz)	
RMS for luminance		2.5	2.0	3.7	3.2	
SNR for luminance		40.2	41.9	36.8	38.1	
Mean value of step size		11.1	6.5	10.9	8.3	
Mean value of the number of non-zero coefficients		2.6	3.7	4.0	4.1	
Mean value of the number of zeroes before the last non-zero coefficient		6.9	15.3	12.0	24.2	
Block type of Y	Fixed	988	518	1013	400	
	Intra	1	0	5	1	
	Filtered Fixed	82	161	32	35	
	Non filt Fixed MC	57	24	9	19	
	Filtered Fixed MC	59	4	12	3	
	Non filt Inter	152	275	340	688	
	Filtered Inter	71	243	51	148	
	Non filt Inter MC	85	237	60	209	
	Filtered Inter MC	88	120	61	81	
	Filtered	300	529	157	267	
Block type of C	Fixed	329	118	681	655	
	Intra	1	0	0	0	
	Filtered Fixed	82	52	41	33	
	Non filt Inter	164	198	46	62	
	Filtered Inter	216	424	24	41	
	Filtered	298	476	65	74	
Number of bits	Attributes	Y	3002	4657	2646	4577
		Cr	718	906	299	281
		Cb	1003	1148	432	517
		Total	4723	6711	3377	5375
	Classification indexes		797	1753	1036	2255
	EOB		1560	2997	1176	2462
	Motion Vectors		2315	3086	1138	2498
	Coefficients	Y	6346	21780	12580	34309
		Cr	1474	3018	192	285
		Cb	2675	8649	376	759
		Total	10495	33447	13148	35353
	Total		19890	47994	19876	47942

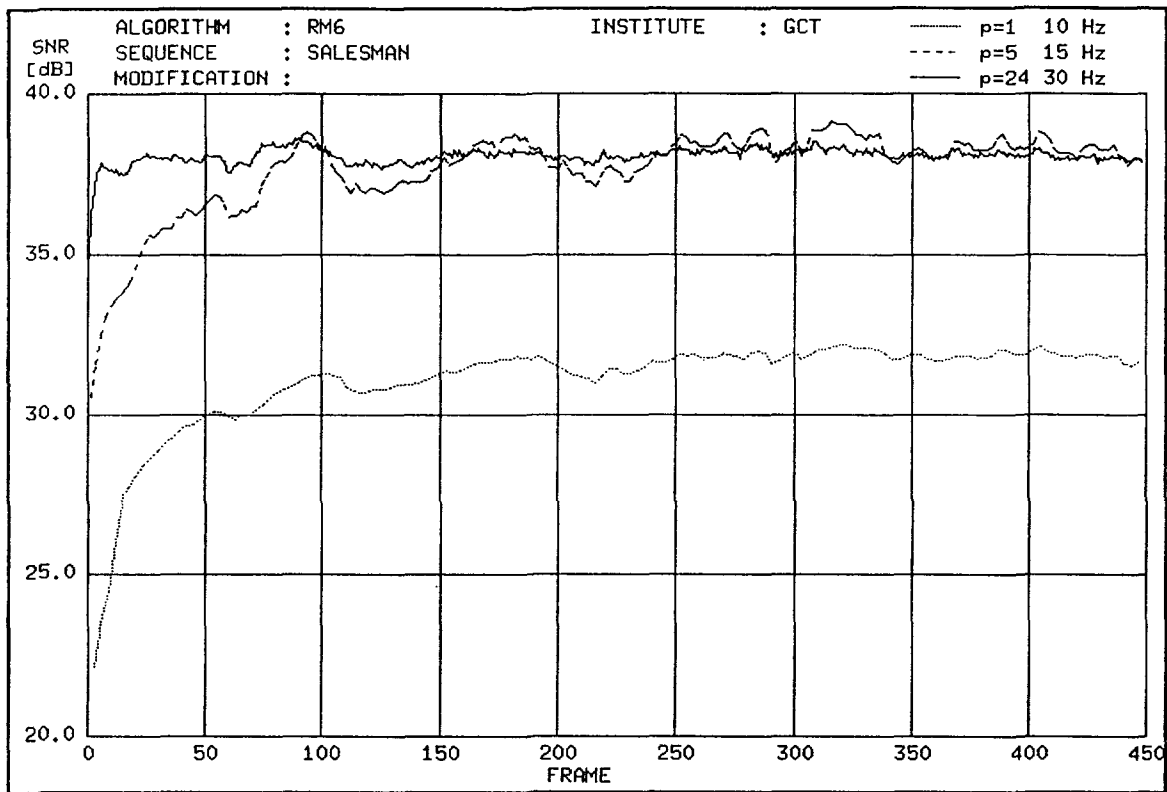


Figure 1: SNR of coded frames "SALESMAN"

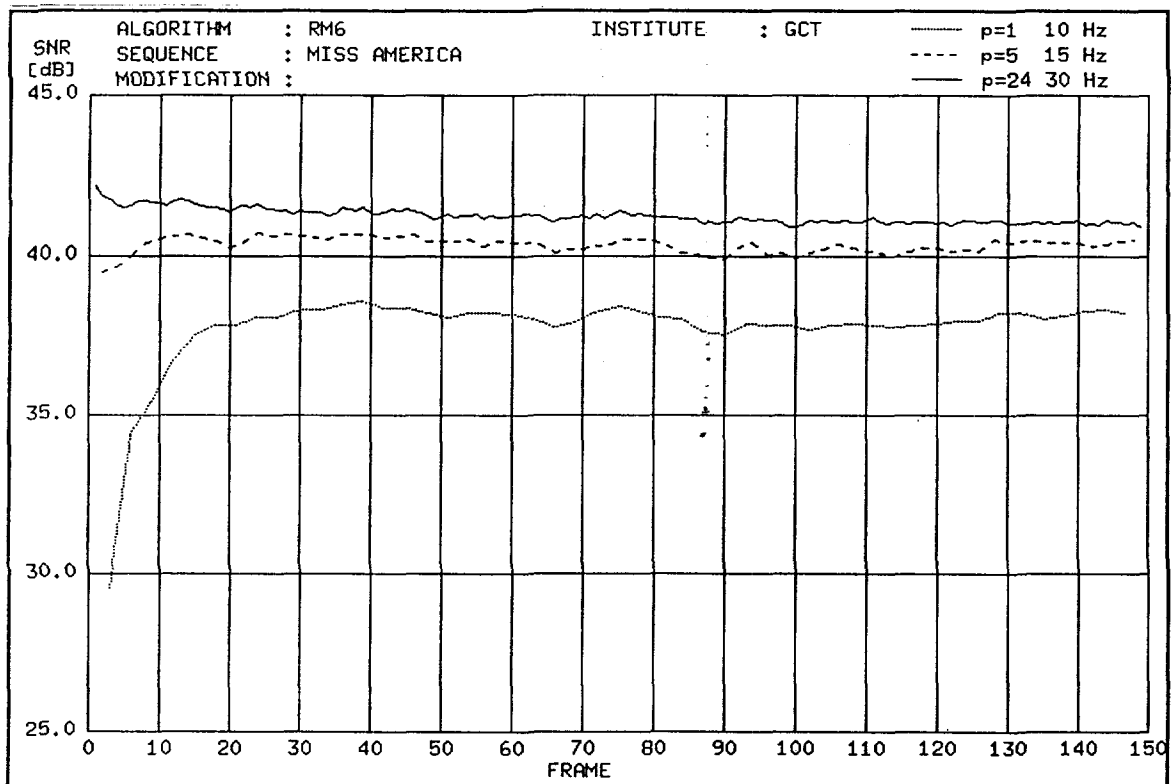


Figure 2: SNR of coded frames "MISS AMERICA"

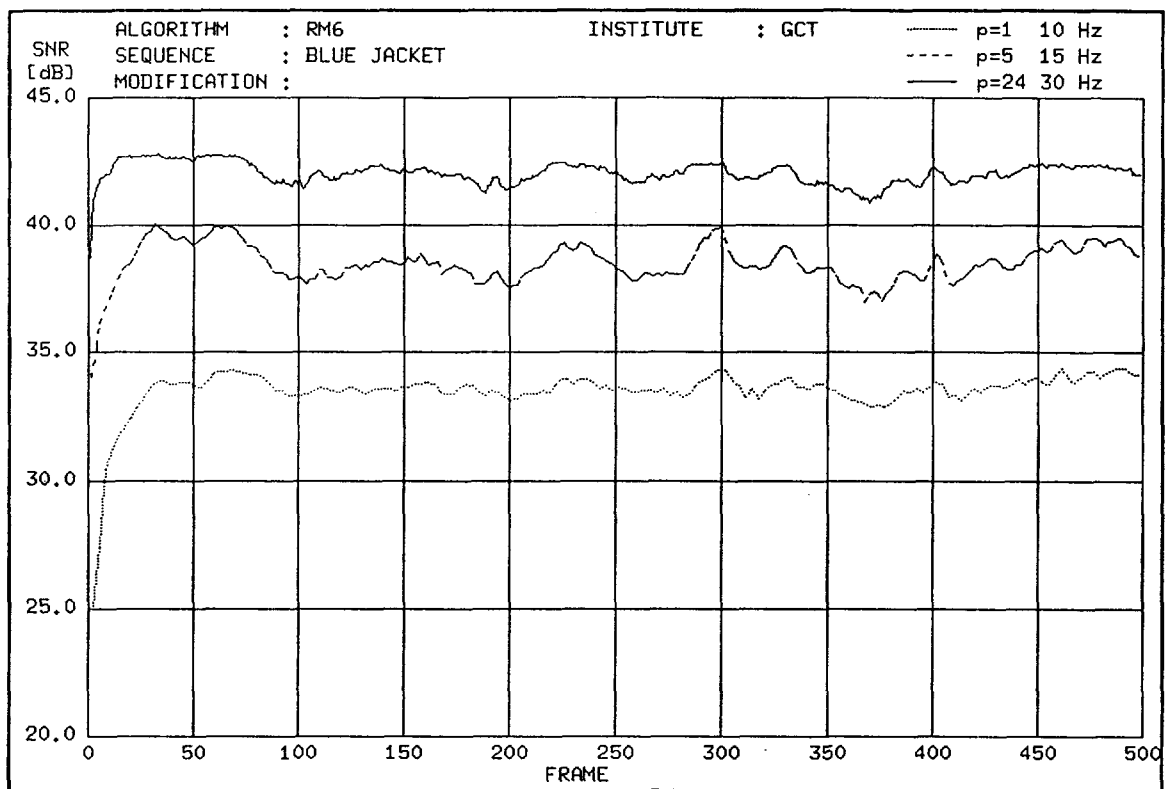


Figure 3: SNR of coded frames "BLUE JACKET"

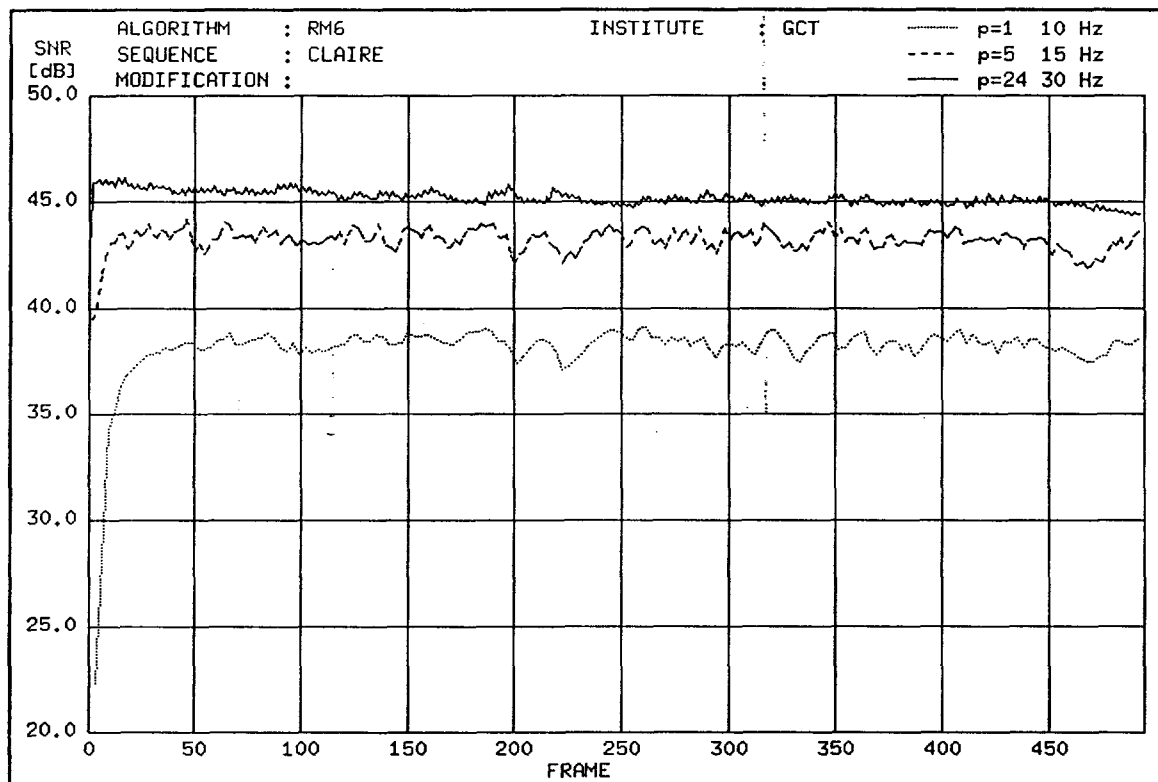


Figure 4: SNR of coded frames "CLAIRE"

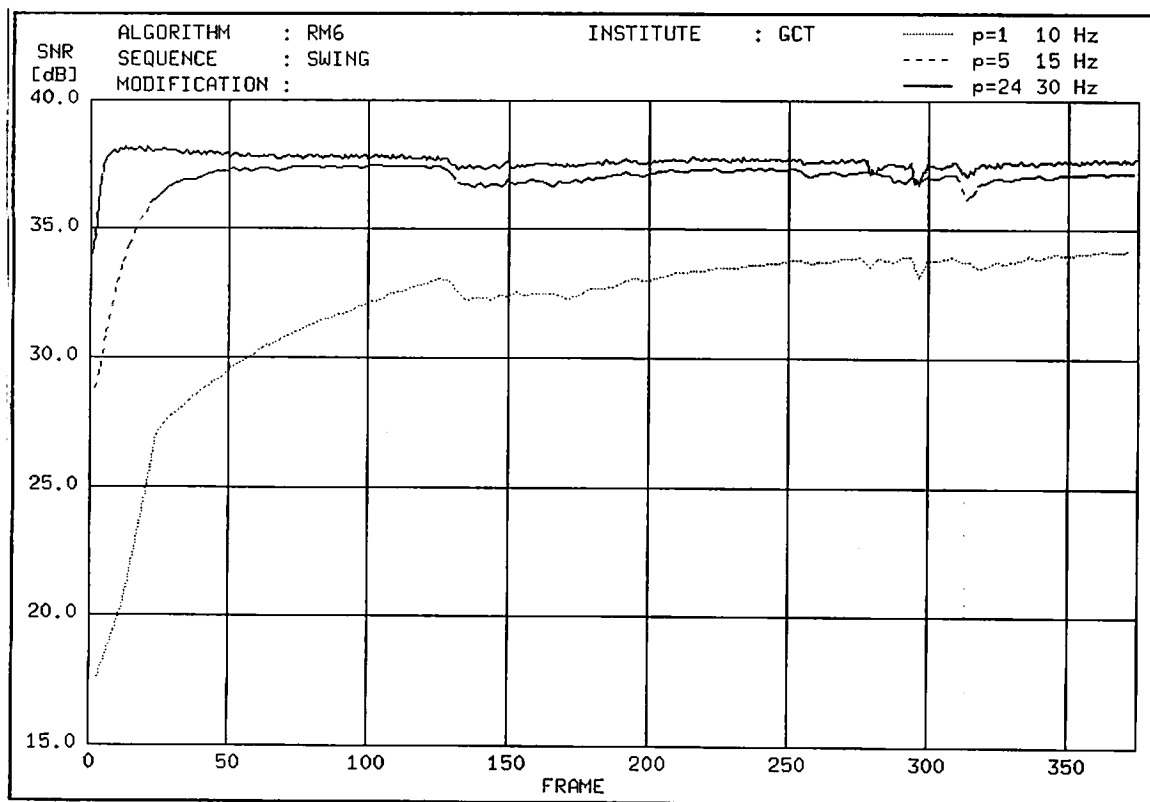


Figure 5: SNR of coded frames "SWING"

TABLE 3-1

			Claire								Miss America							
			2 nd		3 rd		15 th		Mean		2 nd		3 rd		15 th		Mean	
			RM 6	Impro	RM 6	Impro	RM 6	Impro	RM 6	Impro	RM 6	Impro	RM 6	Impro	RM 6	Impro	RM 6	Impro
1. RMS for Luminance			9.38	6.79	4.89	4.92	3.06	3.04	3.19	38.14	4.83	4.79	4.30	4.19	3.04	3.01	3.25	3.20
2. SNR for Luminance for Chrominance (U) for Chrominance (V)			28.68	31.48	34.33	34.27	38.41	38.45	38.04	38.18	34.43	34.50	35.45	35.67	38.44	38.54	37.86	38.02
			34.90	35.18	35.86	35.86	39.13	39.15	38.96	39.96	36.36	36.39	36.84	36.86	38.30	38.40	37.86	37.97
			38.71	38.69	39.04	39.12	42.07	42.00	42.18	42.16	35.63	35.72	36.99	37.12	39.67	39.67	38.76	38.99
3. Mean value of step size			56.55	56.44	48.88	48.55	16.00	15.66	18.79	18.61	54.00	53.22	39.44	37.77	16.33	15.77	19.70	18.72
4. Mean value of the number of non-zero coefficients			Y	2.63	2.68	2.13	1.93	2.88	2.75	3.14	3.16	1.91	1.91	1.84	1.64	2.53	2.77	2.32
			C	1.23	1.23	1.07	1.09	1.61	1.37	1.66	1.67	2.04	2.09	1.60	1.67	1.39	1.25	1.38
5. Mean value of the number of zeros before the last NZ-coefficient			Y	3.20	3.24	7.13	8.37	6.43	5.89	5.86	5.95	1.59	1.60	2.93	2.48	4.06	3.84	3.71
			C	0.80	0.80	1.42	1.29	4.06	4.17	2.77	2.88	3.66	3.62	2.88	3.11	1.64	1.40	1.95
6. Block type of macro	Fixed		286	281	270	266	262	248	276	275	254	252	270	264	231	222	212	218
	Coded MC		80	82	44	40	29	20	47	38	81	81	33	36	44	31	76	48
	Fixed MC		19	22	24	22	6	1	6	5	43	43	12	13	9	4	22	12
	Coded		9	9	57	67	99	127	68	78	18	20	80	82	112	139	86	118
	Intra		2	2	1	1	0	0	0	0	0	0	1	1	0	0	0	0
7. Block type of Y	Fixed		1166	1146	1225	1241	1278	1241	1267	1277	1065	1062	1288	1260	1273	1314	1114	1209
	Coded MC		223	230	81	71	83	53	125	99	149	153	41	53	99	64	132	81
	Fixed MC		173	186	191	177	57	31	86	72	347	343	139	143	113	76	261	158
	Coded		22	22	87	95	166	218	106	136	23	26	116	128	99	130	78	135
8. Block type of UV	Fixed		771	771	754	751	761	752	755	753	750	749	721	724	688	682	683	671
	Coded		21	21	38	41	31	40	37	39	42	43	71	68	104	130	109	121
9. Number of bit	Macro attributes		601	703	798	789	921	851	793	706	782	879	908	820	1180	1104	1212	1112
	End of block		680	696	632	632	804	896	762	778	648	668	752	812	968	1072	1012	1064
	Motion vectors		1142	832	541	550	187	99	310	261	1421	992	364	409	277	204	606	387
	DC coefficients		16	16	8	8	0	0	1	1	0	0	8	8	0	0	1	1
	Coefficients	Y	3355	3535	2028	1945	3728	3818	3767	3872	1465	1527	1303	1344	2645	2766	2370	2526
		U	98	98	134	135	166	210	191	204	86	91	181	172	375	433	296	357
		V	24	24	43	55	80	85	86	88	349	360	398	416	208	224	342	391
		TOTAL	3477	3657	2205	2135	3974	4113	4044	4165	1900	1978	1882	1932	3228	3423	3008	3274
TOTAL		5916	5904	4184	4114	5886	5959	5910	5910	4751	4517	3914	3981	5653	5803	5838	5838	