

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

Document n°481

Oslo , March 7-10 , 1989

SOURCE: FRANCE,N,UK,S,NL,FRG,I

TITRE: Proposal for a new 63 pattern block addressing technique

1. INTRODUCTION:

In CCITT doc 357 and 409 various block addressing methods were presented with simulation results. It was found and proposed to include the most efficient one : the 7 pattern technique using a special TYPE3 VLC.

However, the complete 63 pattern technique can take into account the redundancy due to the following consideration : "in a coded sub-block there is at least one event to transmit". In other words, the first event can not be EOB when using 63 patterns.

Then we propose a method to combine the 63 pattern block addressing with a special coding for the first event : a special 2D-VLC without EOB is employed for encoding the first event.

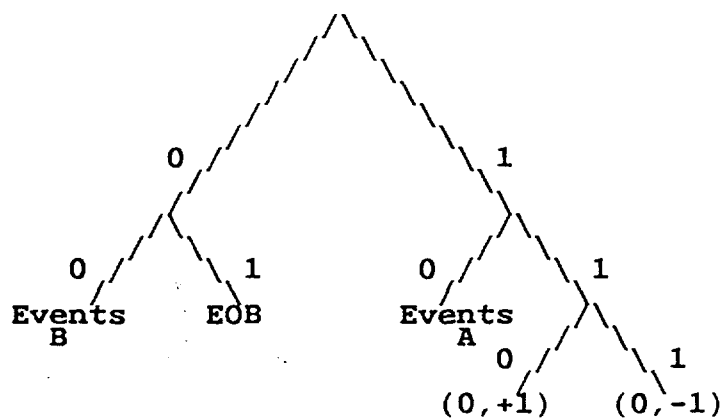
2. THE NEW METHOD

To take advantage of the previous consideration, it is necessary to proceed in two steps :

- internal modification of the current RM7 2D-VLC.
- design of the special 2D VLC for the first event.

2.1 Internal modification of the current 2D VLC.

The current RM7 2D-VLC as defined in doc 446 is organized as follows :

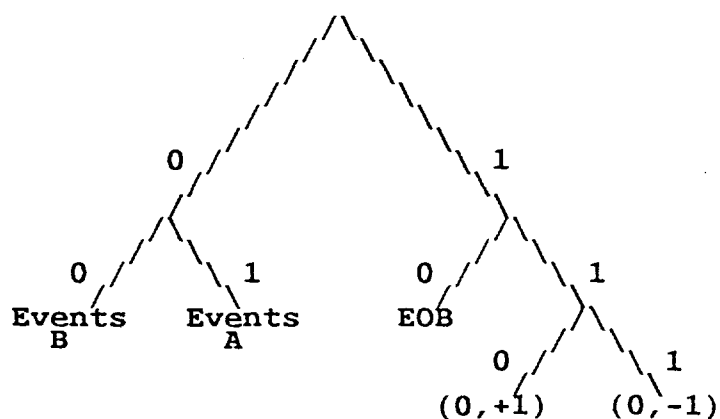


Run	Level	Codeword	
		01	(EOB)
0	-1	111	
0	1	110	
1	-1	1011	}
1	1	1010	}
2	-1	10011	}
2	1	10010	}
0	-2	10001	}
0	2	10000	}
3	-1	001111	}
3	1	001110	}
etc ...			}
			}
			}
			}

Events
A

Events
B

It is proposed to reorganize the RM7 2D-VLC as follows and to call it VLC2.



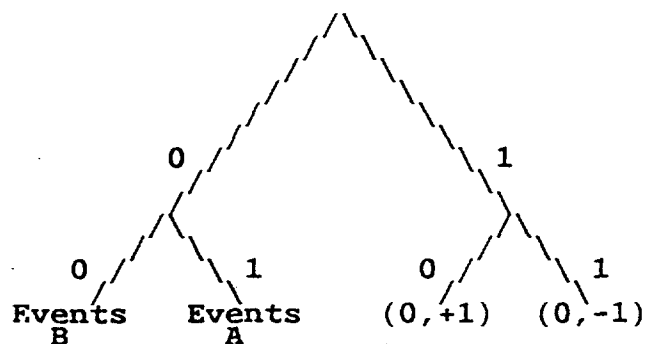
- Events B are unchanged.
- Events A are modified in the sense that their two first bits are inverted , but the lengths of the codewords are unchanged.

VLC2

Run	Level	Codeword	10 (EOB)	
0	-1	111		
0	1	110		
1	-1	0111	}	
1	1	0110	}	
2	-1	01011	}	Events A
2	1	01010	}	
0	-2	01001	}	
0	2	01000	}	
3	-1	001111	}	
3	1	001110	}	
			}	Events B
etc ...			}	

2.2 Design of a special 2D-VLC for the first event

Lets call VLC1 the 2D-VLC for the first event. It is very easily derived from VLC2 by removing the EOB word and modifying the two first codewords:



<u>VLC1</u>			
Run	Level	Codeword	
0	-1	11	
0	1	10	
1	-1	0111	}
1	1	0110	}
2	-1	01011	}
2	1	01010	}
0	-2	01001	}
0	2	01000	}
3	-1	001111	}
3	1	001110	}
etc ...			}
			}

Events
A

Events
B

In order to minimize the modifications between the two 2D VLC , we propose to adopt VLC1 for the first event and VLC2 for the other events.

Luminance and chrominance blocks are coded using the same VLC.

3. Simulation results

This new method has been simulated at 64 Kbit/s at CIF and QCIF formats. The simulation results are presented in Table 1. The new method gives a saving over RM7 for all the sequences. Besides, there is a gain in terms of SNR when the new method is incorporated in the coding algorithm.

Comparison : RM7 and 63 patterns + different 2D-VLCs

The following figures are the mean values of the number of bits per coded Macro block.

a) CIF format

Sequence		RM7	New method
MISS A	Coeff Y	17.496	16.864
	Coeff C	3.926	3.557
	EOB	6.387	4.063
	Pattern	3.186	5.457
	Total	30.994	29.638
	Gain		+1.056
CLAIRE	Coeff Y	35.163	34.188
	Coeff C	2.511	2.356
	EOB	6.725	4.794
	Pattern	2.408	4.937
	Total	46.807	46.275
	Gain		+0.533
TREVOR	Coeff Y	24.652	23.723
	Coeff C	0.397	0.330
	EOB	6.585	4.743
	Pattern	2.131	4.576
	Total	33.765	33.371
	Gain		+0.394
SALESMAN	Coeff Y	34.547	33.882
	Coeff C	0.768	0.706
	EOB	6.157	4.168
	Pattern	2.171	4.643
	Total	43.634	43.399
	Gain		+0.235
BLUE JACK	Coeff Y	58.968	58.301
	Coeff C	5.820	5.678
	EOB	6.608	4.719
	Pattern	2.518	5.081
	Total	73.915	73.719
	Gain		+0.136

b) QCIF format

Sequence		RM7	New method
MISS A	Coeff Y	97.389	96.603
	Coeff C	23.143	22.675
	EOB	8.082	6.158
	Pattern	3.270	6.007
	Total	131.885	131.443
	Gain		+0.442
CLAIRE	Coeff Y	117.150	116.175
	Coeff C	15.422	15.202
	EOB	7.478	5.699
	Pattern	2.506	5.226
	Total	142.555	142.302
	Gain		+0.253
TREVOR	Coeff Y	114.382	113.497
	Coeff C	4.006	3.851
	EOB	7.997	6.571
	Pattern	2.371	4.627
	Total	128.756	128.545
	Gain		+0.211
SALESMAN	Coeff Y	131.067	130.263
	Coeff C	5.681	5.502
	EOB	7.444	5.643
	Pattern	2.399	4.940
	Total	146.591	146.348
	Gain		+0.243
BLUE JACK	Coeff Y	171.172	170.441
	Coeff C	16.449	16.200
	EOB	7.471	5.580
	Pattern	2.708	5.389
	Total	197.800	197.610
	Gain		+0.190

Sequence		CIF	QCIF
MISS A 48 coded frames	Nb of coded MB	7123	1940
	Gain per MB	+ 1.056	+ 0.442
	Gain per frame	157	18
CLAIRE 158 coded frames	Nb of coded MB	17041	5925
	Gain per MB	+ 0.533	+ 0.253
	Gain per frame	57	9
TREVOR 28 coded frames	Nb of coded MB	3502	1232
	Gain per MB	+ 0.394	+ 0.211
	Gain per frame	49	9
SALESMAN 148 coded frames	Nb of coded MB	17164	5486
	Gain per MB	+ 0.235	+ 0.243
	Gain per frame	27	9
BLUE JACK 165 coded frames	Nb of coded MB	12065	4338
	Gain per MB	+ 0.136	+ 0.190
	Gain per frame	10	5

CONCLUSION : As the 63 pattern technique requires less hardware and brings a gain in terms of bits and SNR , we propose to remove the 7 pattern technique and to replace it by the 63 pattern method in combination with 2D-VLC.

The TYPE3 VLC is given in annex 1.

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ANNEX 1 : 63 PATTERNS VLC

Pattern number : $32*Y1 + 16*Y2 + 8*Y3 + 4*Y4 + 2*U + V$

Pattern	Length	Codeword
60	3	000
4	4	0010
8	4	0011
16	4	0100
32	4	0101
12	5	01100
48	5	01101
20	5	01110
40	5	01111
28	5	10000
44	5	10001
52	5	10010
56	5	10011
1	5	10100
61	5	10101
2	5	10110
62	5	10111
24	6	110000
36	6	110001
3	6	110010
63	6	110011
5	7	1101000
9	7	1101001
17	7	1101010
33	7	1101011
6	7	1101100
10	7	1101101
18	7	1101110
34	7	1101111
7	8	11100000
11	8	11100001
19	8	11100010
35	8	11100011
13	8	11100100
49	8	11100101
21	8	11100110
41	8	11100111
14	8	11101000
50	8	11101001
22	8	11101010
42	8	11101011
15	8	11101100
51	8	11101101
23	8	11101110
43	8	11101111
25	8	11110000
37	8	11110001
26	8	11110010
38	8	11110011
29	8	11110100
45	8	11110101
53	8	11110110
57	8	11110111
30	8	11111000
46	8	11111001
54	8	11111010
58	8	11111011
31	8	11111100
47	8	11111101
27	9	111111100
39	9	111111101
55	9	111111110
59	9	111111111

■ : coded
b? :

U V
C_b C_r



Y1Y2
Y3Y4

-

5

5

6

4

7

7

8

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63 Patterns codeword length

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	MISS A. 10 Hz	MISS A. 10 Hz
R.M.S. Y C	3.30 3.00	3.26 2.97
S.N.R. Y C	37.77 38.59	37.88 38.68
Step size	18.83	18.14
Nbr of non zeroes	Y: 2.60 C: 1.38	2.64 1.41
Nbr of zeroes	Y: 4.26 C: 1.74	4.35 1.78
MACRO BLOCK TYPE		
Overflow	0	0
Fixed	225	220
Fixed MC	22	21
Inter	75	79
Inter MC	72	73
Intra	0	0
NUMBER OF BITS		
MB Attributes	677	692
E O B	1418	1466
Motion vectors	618	616
Coefficients : Y C	2606 580	2635 487
Total	5899	5896

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	MISS A. 10 Hz	MISS A. 10 Hz
S.N.R.(QCIF) Y C	37.62 38.89	38.08 39.07
S.N.R.(CIF) Y C	34.55 37.56	34.75 37.69
Step size	25.56	24.75
Nbr of non zeroes	Y: 8.53 C: 4.55	8.43 4.51
Nbr of zeroes	Y: 10.14 C: 8.96	10.04 8.68
MACRO BLOCK TYPE		
Overflow	2	2
Fixed	50	49
Fixed MC	6	6
Inter	25	26
Inter MC	13	13
Intra	0	0
NUMBER OF BITS		
MB Attributes	179	183
E O B	441	504
Motion vectors	92	91
Coefficients : Y C	4030 1017	4274 623
Total	5759	5675

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	CLAIRE 10 Hz	CLAIRE 10 Hz
R.M.S. Y	3.11	3.10
C	2.48	2.47
S.N.R. Y	38.27	38.31
C	40.24	40.26
Step size	19.10	18.97
Nbr of non zeroes	Y: 3.26 C: 1.70	3.31 1.70
Nbr of zeroes	Y: 5.93 C: 2.69	6.00 2.81
MACRO BLOCK TYPE		
Overflow	0	0
Fixed	280	280
Fixed MC	7	7
Inter	61	61
Inter MC	46	46
Intra	0	0
NUMBER OF BITS		
MB Attributes	530	530
E O B	987	1059
Motion vectors	348	350
Coefficients : Y	3785	3770
C	280	221
Total	5930	5930

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	CLAIRE 10 Hz	CLAIRE 10 Hz
S.N.R.(QCIF) Y	37.82	38.04
C	41.43	41.87
S.N.R.(CIF) Y	33.35	33.41
C	39.56	39.81
Step size	21.50	21.28
Nbr of non zeroes	Y: 8.35 C: 5.30	8.30 5.38
Nbr of zeroes	Y: 11.45 C: 10.71	11.26 10.94
MACRO BLOCK TYPE		
Overflow	2	2
Fixed	57	56
Fixed MC	1	1
Inter	29	30
Inter MC	8	8
Intra	0	0
NUMBER OF BITS		
MB Attributes	172	176
E O B	375	419
Motion vectors	48	47
Coefficients : Y	4365	4485
C	589	411
Total	5549	5538

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	TREVOR 10 Hz	TREVOR 10 Hz
R.M.S. Y C	6.07 2.61	5.86 2.58
S.N.R. Y C	32.46 39.79	32.77 39.89
Step size	39.32	38.85
Nbr of non zeroes	Y: 2.11 C: 1.04	2.12 1.04
Nbr of zeroes	Y: 3.17 C: .11	3.14 .11
MACRO BLOCK TYPE		
Overflow	2	2
Fixed	235	235
Fixed MC	36	35
Inter	26	27
Inter MC	79	81
Intra	14	14
NUMBER OF BITS		
MB Attributes	572	573
E O B	1061	1137
Motion vectors	1006	1012
Coefficients : Y C	2775 564	2717 546
Total	5978	5985

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	TREVOR 10 Hz	TREVOR 10 Hz
S.N.R.(QCIF) Y C	34.17 40.57	34.00 40.63
S.N.R.(CIF) Y C	31.72 39.74	31.63 39.79
Step size	26.31	26.24
Nbr of non zeroes	Y: 6.48 C: 1.92	6.53 2.08
Nbr of zeroes	Y: 10.76 C: 2.76	10.13 2.55
MACRO BLOCK TYPE		
Overflow	0	0
Fixed	49	50
Fixed MC	3	3
Inter	18	16
Inter MC	24	24
Intra	2	2
NUMBER OF BITS		
MB Attributes	176	172
E O B	468	488
Motion vectors	197	193
Coefficients : Y C	5052 167	4910 120
Total	6060	5883

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	SALESMAN 10 Hz	SALESMAN 10 Hz
R.M.S. Y	6.72	6.71
C	2.82	2.82
S.N.R. Y	31.58	31.59
C	39.14	39.14
Step size	26.25	26.31
Nbr of non zeroes	Y: 2.90	2.90
	C: 1.25	1.32
Nbr of zeroes	Y: 9.05	9.16
	C: 1.73	2.12
MACRO BLOCK TYPE		
Overflow	0	0
Fixed	272	272
Fixed MC	7	7
Inter	77	77
Inter MC	34	34
Intra	4	4
NUMBER OF BITS		
MB Attributes	572	570
E O B	968	1023
Motion vectors	271	275
Coefficients : Y	3949	3908
C	171	154
Total	5931	5930

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	SALESMAN 10 Hz	SALESMAN 10 Hz
S.N.R.(QCIF) Y	34.41	34.46
C	41.28	41.33
S.N.R.(CIF) Y	28.41	28.43
C	30.64	30.64
Step size	22.84	22.72
Nbr of non zeroes	Y: 8.69	8.80
	C: 2.49	2.63
Nbr of zeroes	Y: 16.58	16.22
	C: 6.08	5.61
MACRO BLOCK TYPE		
Overflow	3	3
Fixed	58	57
Fixed MC	0	0
Inter	31	31
Inter MC	4	4
Intra	0	0
NUMBER OF BITS		
MB Attributes	169	171
E O B	363	390
Motion vectors	29	29
Coefficients : Y	4807	4882
C	212	127
Total	5580	5599

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	BL. JA. 10 Hz	BL. JA. 10 Hz
R.M.S. Y	5.57	5.59
C	3.19	3.18
S.N.R. Y	33.22	33.19
C	38.05	38.07
Step size	30.76	30.36
Nbr of non zeroes	Y: 5.27 C: 2.31	5.39 2.21
Nbr of zeroes	Y: 10.10 C: 5.19	10.24 5.34
MACRO BLOCK TYPE		
Overflow	5	4
Fixed	311	310
Fixed MC	6	6
Inter	52	54
Inter MC	19	19
Intra	1	1
NUMBER OF BITS		
MB Attributes	362	368
E O B	670	743
Motion vectors	159	157
Coefficients : Y	4271	4369
C	469	304
Total	5931	5941

Statistics : RM7 vs 63 pattern + new VLC
 Bit rate : 59.4 Kbit/s
 Source : CNET - FRANCE TELECOM
 Date : 2/20/1989

Sequence Frame rate	BL. JA. 10 Hz	BL. JA. 10 Hz
S.N.R.(QCIF) Y	34.56	34.74
C	40.26	40.40
S.N.R.(CIF) Y	30.43	30.49
C	37.80	37.89
Step size	28.27	27.64
Nbr of non zeroes	Y: 13.02 C: 4.22	12.86 4.13
Nbr of zeroes	Y: 17.20 C: 12.20	17.05 12.68
MACRO BLOCK TYPE		
Overflow	8	7
Fixed	64	64
Fixed MC	0	0
Inter	22	23
Inter MC	2	2
Intra	0	0
NUMBER OF BITS		
MB Attributes	117	123
E O B	255	297
Motion vectors	17	17
Coefficients : Y	4550	4709
C	408	230
Total	5347	5376