CCITT SGXV
Specialists Group on
Coding for Visual Telephony

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Title: VLCs for p*64 kbit/s initial compatibility check

Source: FRG, France, Italy, Netherlands, Norway, Sweden, UK

Code sets are required for initial checks with the p*64 kbit/s flexible hardware codecs. Such equipments will be programmable and code sets are probably not required for them for some months yet. However, as with the n*384 kbit/s exercise, Delta Information Systems intends to provide a Test Pattern Generator to aid hardware debugging. To have this available for use at a suitable time for hardware constructors, a set of VLCs must be agreed soon.

It is not necessary at this time to attempt to identify the optimum sets as further optimisation will take place by simulation and hardware before the recommendation is finalised. Nevertheless, the codes chosen now should be sufficiently optimal so that the initial results are not too pessimistic and also so that the optimisation phases can begin to converge from a reasonable starting point. The items requiring VLCs are:

1. Macroblock addressing
2. TYPE3
3. Motion vectors
4. Coded Block Pattern
5. Coefficient data

Codes should be comma codes to facilitate resynchronisation after errors.

1. Macroblock addressing

A previous contribution (Doc #419) has shown that the code set used for macroblock addressing is not critical. The video demultiplexer in the decoder is greatly simplified if the start code for the picture header and group of blocks header is a member of the macroblock address VLC set. 33 codes for addresses plus the start code are required. Document #291 pointed out that when the VLC table has a fixed length tail, then increased error resilience can be obtained for relative addresses in that tail at no cost to efficiency by using the absolute value.

Note that in the code set listed in table 1 the range of MBA is 1 to 33. This is the same as absolute addresses. For differential addressing, MBA is the difference between the absolute addresses of the macroblock and the last transmitted macroblock.

An additional codeword could be added to permit bit stuffing between macroblocks.

2. TYPE3

The types of macroblocks are:

Intra + coefficients
Intra + coefficients + quantiser update
Inter + coefficients
Inter + coefficients + quantiser update
Inter + motion vectors
Inter + motion vectors + coefficients
Inter + motion vectors + coefficients + quantiser update
plus any resulting from motion vectors per 8 by 8 block

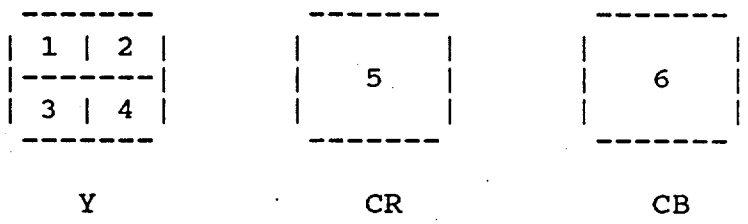
Codewords are listed in table 2.

3. Motion vectors

Motion vector components are differentially encoded. The permitted vector range is +/- 15 yielding differentials up to +/- 30. As in the n*384 kbit/s work, an arithmetic wrap can be used to reduce the number of codes, as listed in table 3.

4. Coded Block Pattern (CBP)

63 codes required.



The fixed length code for CBP is formed by 6 bits. A '1' signifies that coefficients are present for the corresponding block in the order shown above. The MSB is for block 1 and the LSB for block 6 (CB). The codewords are listed in table 4.

5. Coefficient data

The most commonly occuring combinations of zero-run and the following value are encoded with variable length codes as listed in table 5. End of Block (EOB) is in this set. Because CBP indicates those blocks with no coefficient data, EOB cannot occur as the first coefficient. Hence EOB can be removed from the VLC table for the first coefficient.

The remaining combinations of (RUN, LEVEL) are encoded with a 20 bit word consisting of 6 bits ESCAPE, 6 bits RUN and 8 bits LEVEL.

EOB	10
ESCAPE	0010 00

RUN is a 6 bit fixed length code

0	0000 00
1	0000 01
2	0000 10
.	.
.	.
63	1111 11

LEVEL is an 8 bit fixed length code

-128	1000 0000	
-127	1000 0001	
.	.	
.	.	
-2	1111 1110	
-1	1111 1111	
0	0000 0000	Redundant entry
1	0000 0001	
2	0000 0010	
.	.	
127	0111 1111	

The redundant 20 bit word for zero-run followed by zero value could be suitable for other purposes, for example bit stuffing within coefficient data.

MC vector & FLC

Codes for Macroblock Addressing

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

6 zeros

34

dummy macro block addr

Table 1

34 0000 0001 111

71

Codes for TYPE3

Intra + coeffs	0001
Intra + coeffs + quant	0000 001
Inter + coeffs	001
Inter + coeffs + quant	0000 01
Inter + vectors	01
Inter + vectors + coeffs	1
Inter + vectors + coeffs + quant	0000 1

plus any resulting from motion vectors per 8 by 8 block

Table 2

Codes for Motion Vector Component Differentials

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

Table 3

22

Codes for CBP

1	1010 0	33	1101 011
2	1011 0	34	1101 111
3	1100 10	35	1110 0011
4	0010	36	1100 01
5	1101 000	37	1111 0001
6	1101 100	38	1111 0011
7	1110 0000	39	1111 1110 1
8	0011	40	0111 1
9	1101 001	41	1110 0111
10	1101 101	42	1110 1011
11	1110 0001	43	1110 1111
12	0110 0	44	1000 1
13	1110 0100	45	1111 0101
14	1110 1000	46	1111 1001
15	1110 1100	47	1111 1101
16	0100	48	0110 1
17	1101 010	49	1110 0101
18	1101 110	50	1110 1001
19	1110 0010	51	1110 1101
20	0111 0	52	1001 0
21	1110 0110	53	1111 0110
22	1110 1010	54	1111 1010
23	1110 1110	55	1111 1111 0
24	1100 00	56	1001 1
25	1111 0000	57	1111 0111
26	1111 0010	58	1111 1011
27	1111 11100	59	1111 1111 1
28	1000 0	60	000
29	1111 0100	61	1010 1
30	1111 1000	62	1011 1
31	1111 1100	63	1100 11
32	0101		

Table 4

p. 13 / #681

23

Codes for Coefficient Data

The last bit 's' denotes the sign of the level, '0' for +ve and '1' for -ve.

RUN	LEVEL	CODE
EOB		10
0	1	1s IF FIRST COEFFICIENT
0	1	11s NOT FIRST COEFFICIENT
0	2	0100 s
0	3	0010 1s
0	4	0000 110s
0	5	0010 0110 s
0	6	0000 0101 s
0	7	0000 0010 10s
0	8	0000 0001 1101 s
0	9	0000 0001 1000 s
0	10	0000 0001 0011 s
0	11	0000 0001 0000 s
0	12	0000 0000 1101 0s
0	13	0000 0000 1100 1s
0	14	0000 0000 1100 0s
0	15	0000 0000 1011 1s
1	1	011s
1	2	0001 10s
1	3	0010 0101 s
1	4	0000 0011 00s
1	5	0000 0001 1011 s
1	6	0000 0000 1011 0s
1	7	0000 0000 1010 1s
2	1	0101 s
2	2	0000 100s
2	3	0000 0010 11s
2	4	0000 0001 0100 s
2	5	0000 0000 1010 0s
3	1	0011 1s
3	2	0010 0100 s
3	3	0000 0001 1100 s
3	4	0000 0000 1001 1s
4	1	0011 0s
4	2	0000 0011 11s
4	3	0000 0001 0010 s
5	1	0001 11s
5	2	0000 0010 01s
5	3	0000 0000 1001 0s
6	1	0001 01s
6	2	0000 0001 1110 s
7	1	0001 00s
7	2	0000 0001 0101 s

2K

8	1	0000 111s
8	2	0000 0001 0001 s
9	1	0000 101s
9	2	0000 0000 1000 1s
10	1	0010 0111 s
10	2	0000 0000 1000 0s
11	1	0000 0111 s
12	1	0000 0110 s
13	1	0000 0100 s
14	1	0000 0011 10s
15	1	0000 0011 01s
16	1	0000 0010 00s
17	1	0000 0001 1111 s
18	1	0000 0001 1010 s
19	1	0000 0001 1001 s
20	1	0000 0001 0111 s
21	1	0000 0001 0110 s
22	1	0000 0000 1111 1s
23	1	0000 0000 1111 0s
24	1	0000 0000 1110 1s
25	1	0000 0000 1110 0s
26	1	0000 0000 1101 1s

Table 5