Document #462
March 1989

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

Source: JAPAN
Title : VLC Optimization

(NO Demonstation Tape)

1. Introduction

This document addresses the following problems:

1) optimization of the 2-dim VLC table for DCT coefficients,
2) optimization of the VLC table for Macro block addressing,
3) optimization of the VLC table for DMVs,
4) whether DMV=0 is sent as Type 3 or as data.

2. Optimization of the 2-dim VLC table for DCT coefficients

2.1 Optimization at q=1

It is desirable from the view point of hardware implementation that the maximum length of a codeword (=LWORD) is limited within 24 bits and the maximum length of the variable length part (=LVAL) within 12 bits.

Two different VLC tables (Table-A and Table-B) are designed here, with that consideration in mind, using the sequences Claire, Miss America, Salesman and Swing, all operating at q=1.

Table-A was obtained from that of RM7 (#446, Appendix B) by merely swapping some of the elements of the original 2-dim table. Therefore the code set assignment is exactly the same as that of RM7, which means LWORD=20, LVAL=9.

Table-B was designed without considering the compatibility with RM7, but we still have LWORD=19, LVAL=9.

Tables-A and -B are shown in Annex.

2.2 Performances at q=1, 6 and 24

The simulation results for the Y-SNR performance in dB are:

q=1 (10Hz)	Claire	Miss America	Salesman
Table-A	38.34	-	31.57
Table-B	38.38	-	31.64
RM7-original	38.33	-	31.56

q=6 (10Hz)	Claire	Miss America	Salesman
Table-A	44.79	-	36.83
Table-B	44.81	-	36.96
RM7-original	44.79	40.94	36.90
(Table-X)	44.93	40.98	37.00

Note: Table-X is designed for q=6 use only.

q=24 (30Hz)	Claire	Miss America	Salesman
Table-A	45.23	-	38.62
Table-B	-	-	-
RM7-original	45.23	41.40	38.62
(Table-Y)	45.23	41.42	38.70

Note: Table-Y is designed for q=24 use only.

2.3 Conclusion

Althogh the Tables-A and -B are optimized for use at q=1, no significant gain was obtained compared with the RM7-original table at this bit rate.

At higher bit rates of q=6 and q=24, it was found that the talbes optimized at a particular higher bit rate can only give slightly better performance than Tables-A, -B and RM7-original.

We conclude that the current 2-dim VLC table adopted for RM7 is a good candidate for the initial compatibility check for all the bit rates.

3. Optimization of the VLC table for Macro block addressing

Two 1-dim VLC tables, Table-C and Table-D, are designed using the sequences Claire, Miss America and Salesman.

Table-C is optimized for use at q=1, while Table-D at q=6. Both two tables and the table given in RM7 have LWORD=15, LVAL=12.

The average number of bits per frame necessary for relative macro block addressing using one of these tables is:

q=1 (10Hz)	{ Claire + Miss America + Salesman }
Table-C	280 bit/frame (96.9%)
RM7-original	289 bit/frame (100.0%)
(Absolute)	396 bit/frame (136.9%)

Note: The method "absolute" uses 33bit per GOB.

q=6 (10Hz)	{ Claire + Miss America + Salesman }
Table-D	382 bit/frame (95.6%)
RM7-original	400 bit/frame (100.0%)
(Absolute)	396 bit/frame (99.1%)

We conclude that the current VLC table for relative macro block addressing adopted for RM7 is a good candidate for the initial initial compatibility check.

4. Optimization of the VLC table for DMVs

Two 1-dim VLC tables, Table-E and Table-F, are designed using the sequences Claire, Miss America and Salesman.

Table-E is optimized for use at q=1, while Table-F at q=6. Both two tables and the table given in RM7 have LWORD=11, LVAL=11.

The average number of bits per frame necessary for differential motion vector coding using one of these tables is:

q=1 (10Hz)	{ Claire + Miss America + Salesman }
Table-E	274 bit/frame (97.4%)
RM7-original	281 bit/frame (100.0%)

q=6 (10Hz)	{ Claire + Miss America + Salesman }
Table-F	455 bit/frame (98.5%)
RM7-original	462 bit/frame (100.0%)

We conclude that the current VLC table for differential motion vector coding adopted for RM7 is a good candidate for the initial initial compatibility check.

5. Whether DMV=0 is sent as Type 3 or as data

The method in which DMV=0 is sent as Type 3 instead of as data was evaluated.

The codes employed are: MC coded DMV<>0 "10", DMV=0 "11", MC not coded DMC<>0 "010", DMC=0 "011", no MC coded "001", Intra "000".

Following is the Y-SNR performance in dB.

q=1 (10Hz)	Claire	Miss Am	Salesman	Swing
as Type 3	38.30	37.93	31.55	34.96
RM7-original	38.34	37.96	31.60	35.10

We conclude that DMV=0 can be sent either as Type 3 or as data with no significant difference in performance.

[END]

Annex

Feb. 20, 1989

Word Length of VLC for two-dimensional Coding

Run \ Level(absolute value)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	..	128
0	3	5	6	8	9	11	11	13	13	13	14	14	14	14	14	20	20	20	20	20	..	20
1	4	7	9	11	13	13	14	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
2	5	8	11	13	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
3	6	8	13	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
4	6	9	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
5	7	9	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
6	7	9	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
7	7	9	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
8	8	11	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
9	9	11	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
10	9	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
11	11	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
12	11	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
13	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
14	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
15	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
16	13	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
17	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
18	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
19	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
20	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
21	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
22	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
23	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
24	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
25	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
26	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
27	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
28	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	..	20
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Word length of EOB is 2.
Word length of all other Events (combination of Run and Level) are 20: Escape(6 bits) + Run(6 bits) + Level(8 bits).

Bit length	:	3	4	5	6	7	8	9	10	11	12	13	14
No. of codewords	:	1	1	2	3	4	4	8	-	8	-	16	16

(Bit pattern asignment is exactly same as the one described in RM7, appendix B (#446).)

Table-A

Word Length of VLC for 2-D Coding

RUN	LEVEL (absolute value) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 128
0	3	5	7	8	9	10	11	11	12	12	12	13	13	13	13
1	4	7	9	11	12	13	13	19	19	19	19	19	19	19	19
2	5	8	11	12	13	19	19	19	19	19	19	19	19	19	19
3	6	9	12	13	19	19	19	19	19	19	19	19	19	19	19
4	7	9	12	19	19	19	19	19	19	19	19	19	19	19	19
5	7	10	12	19	19	19	19	19	19	19	19	19	19	19	19
6	7	10	19	19	19	19	19	19	19	19	19	19	19	19	19
R 7	8	10	19	19	19	19	19	19	19	19	19	19	19	19	19
8	8	10	19	19	19	19	19	19	19	19	19	19	19	19	19
U 9	8	10	19	19	19	19	19	19	19	19	19	19	19	19	19
10	9	11	19	19	19	19	19	19	19	19	19	19	19	19	19
N 11	9	19	19	19	19	19	19	19	19	19	19	19	19	19	19
12	9	19	19	19	19	19	19	19	19	19	19	19	19	19	19
13	9	19	19	19	19	19	19	19	19	19	19	19	19	19	19
14	10	19	19	19	19	19	19	19	19	19	19	19	19	19	19
15	10	19	19	19	19	19	19	19	19	19	19	19	19	19	19
16	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
17	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
18	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
19	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
20	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
21	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
22	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
23	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
24	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
25	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
26	11	19	19	19	19	19	19	19	19	19	19	19	19	19	19
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** Word length of all other EVENTs (combination of RUN and LEVEL) are 19:
ESCAPE CODE (5 bits) + RUN (6bits) + LEVEL (8bits).
** Word length of EOB is 2.

Table-B