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

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SOURCE: NTT, KDD, NEC and FUJITSU
TITLE : CODING OF BLOCK TYPE

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1. Introduction

As an achievement of the previous meeting, a coding method of the block type (TYPE3) has been defined in the Flexible Hardware specification (see Section 2.2.3/Doc. #182), based on the attribute method. There are 12 block types (Type 1 to 6d) in luminance blocks and 4 block types (Type 1 to 4) in chrominance blocks. In addition to these, the fixed block is defined as inter-mode coded with no coded prediction error, no motion vector, and no filter in predictor.

This document describes the block type statistics in the data of RM3 and proposes provisional code sets for TYPE3.

2. Block type statistics

According to the block attribute values of the RM3 coded pictures, a block type (TYPE3) as in the Flexible Hardware specification is determined for each block.

Table 1 shows the number of occurrence of each type in the 147 coded pictures excluding scene cuts: Miss America (73 pictures), Checked Jacket (28 pictures) and Split-Trevor (46 pictures).

The table also shows conditional statistics based on the value of TYPE2, from which the number of GOBs in each TYPE2 is summarized in Table 2. It is found that 87% of all the GOBs belong to TYPE2=011 (MC, Filter).

3. Comparison of TYPE3 coding schemes

The following four schemes are compared in terms of the necessary bits per picture to encode TYPE3 with code sets designed according to the Huffman algorithm.

A: 1 VLC for Y/C integrated (/1/ in Table 3)
B: 1 VLC for Y/C integrated (Annex 3/Doc. 181R)
C: 2 VLCs for Y and C (/2/ and /3/ in Table 3)
D: 2 VLCs for, one for luminance blocks of TYPE2=01x, the other for luminance blocks of TYPE2=00x and chrominance blocks (/4/ and /5/ in Table 3)

The number of bits required to encode TYPE3 with each scheme is shown in Table 4. Scheme C is proposed considering efficiency and simplicity. This means that the same code set is applied for encoding TYPE3 with TYPE2=0xx when motion compensation is used.

4. Code set

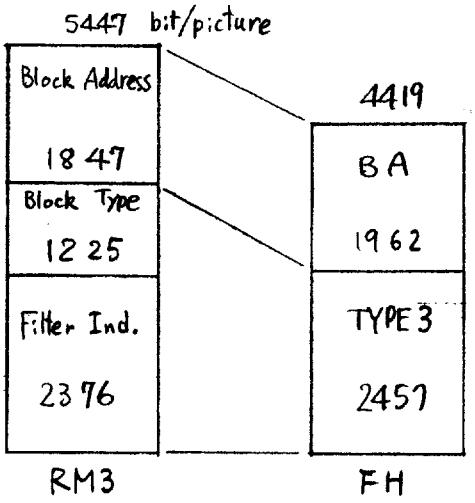
The following two code sets, one for luminance and the other for chrominance, are proposed for the initial compatibility check.

Table 5 VLC code sets for TYPE3

TYPE3	Luminance	Chrominance
1	00010	0001
2	01	1
3	100	001
4	1101	01
5a	0000001	
5b	1100	
5c	000001	
5d	001	
6a	00011	
6b	101	
6c	00001	
6d	111	
7	00000001	

5. Comparison with RM3 bit count method

In RM3, the attribute information is counted as a total of block address, block type and filtering indication (see Doc. #183). If we encode the block type and filtering indication together using Table 4, about 1000 bits/picture can be saved as shown in Figure 1. Block address bits increase a little compared with RM3, because Type 3 blocks are also counted as fixed in RM3.



Average of 147 coded pictures
- 911 blocks: Type 1-6d
- 1465 blocks: Fixed

Figure 1 Coding efficiency for block attributes compared with RM3

6. Conclusion

Block type statistics have been presented according to the TYPE3 definition in the Flexible Hardware specification. Based on these statistics, two code sets (Table 4) are proposed for the initial compatibility check. They may be further optimized through hardware experiments.

Table Block type statistics

TYPE 3	Y	C	total
0	141844	73474	215318
1	2109	537	2646
2	21911	17438	39349
3	10632	9251	19883
4	7420	15724	23144
5a	697	0	697
5b	6804	0	6804
5c	747	0	747
5d	8082	0	8082
6a	2459	0	2459
6b	12860	0	12860
6c	1738	0	1738
6d	15545	0	15545
7	0	0	0
total	232848	116424	349272

fixed

Number of blocks in

MA: 73 pic
CJ: 28
SP: 18
TR: 28

147

● TYPE 2 = 1xx (Intra)

0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5a	0	0	0
5b	0	0	0
5c	0	0	0
5d	0	0	0
6a	0	0	0
6b	0	0	0
6c	0	0	0
6d	0	0	0
7	0	0	0
total	0	0	0

● TYPE 2 = 010 (MC, No Fil)

0	3102	730	3832
1	0	0	0
2	347	1250	1597
3	0	0	0
4	0	0	0
5a	15	0	15
5b	354	0	354
5c	0	0	0
5d	0	0	0
6a	8	0	8
6b	134	0	134
6c	0	0	0
6d	0	0	0
7	0	0	0
total	3960	1980	5940

● TYPE 2 = 000 (No MC, No Filter)

0	4819	2034	6853
1	0	0	0
2	285	518	803
3	0	0	0
4	0	0	0
5a	0	0	0
5b	0	0	0
5c	0	0	0
5d	0	0	0
6a	0	0	0
6b	0	0	0
6c	0	0	0
6d	0	0	0
7	0	0	0
total	5104	2552	7656

● TYPE 2 = 011 (MC, Fil)

0	115338	61929	177267
1	2109	537	2646
2	19769	14497	34266
3	9932	9009	18941
4	7183	15404	22587
5a	682	0	682
5b	6450	0	6450
5c	747	0	747
5d	8082	0	8082
6a	2451	0	2451
6b	12726	0	12726
6c	1738	0	1738
6d	15545	0	15545
7	0	0	0
total	202752	101376	304128

● TYPE 2 = 001 (No MC, Fil)

0	16913	7945	24858
1	0	0	0
2	1510	1173	2683
3	700	242	942
4	237	320	557
5a	0	0	0
5b	0	0	0
5c	0	0	0
5d	0	0	0
6a	0	0	0
6b	0	0	0
6c	0	0	0
6d	0	0	0
7	[illegible]	0	0
total	19360	9680	29040

● All blocks in a GOB = Fixed

0	1672	836	2508
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5a	0	0	0
5b	0	0	0
5c	0	0	0
5d	0	0	0
6a	0	0	0
6b	0	0	0
6c	0	0	0
6d	0	0	0
7	0	0	0
total	1672	836	2508

Table 2 Number of GOBs belonging to each TYPE2

TYPE2	GOB	%
1xx(Intra)	0	0
000(No MC, No Filter)	58	2.19
001(No MC, Filter)	220	8.31
010(MC, No Filter)	45	1.70
011(MC, Filter)	2304	87.07
Fixed	19	0.72
Total	2646	100

Table 3 VLC code sets for TYPE 3 coding

TYPE2 bits 1 to 3	Types of Luminance block	Types of Chrominance block
1xx (Intra)	1	1
000 (No MC, no filter)	1, 2	1, 2
001 (No MC, filter)	1, 2, 3, 4	1, 2, 3, 4
010 (MC, no filter)	1, 2, 5a, 5b, 6a, 6b	1, 2
011 (MC, filter)	1, 2, 3, 4, 7, 5a, 5b, 5c, 5d, 6a, 6b, 6c, 6d	1, 2, 3, 4

/1/ /2/ /3/ /4/ /5/

Table 4 Coding efficiency

Scheme	bits/picture*	
A	2681	(1.098)
B	2839	(1.163)
C	2457	(1.006)
D	2442	(1)

* (Reletive value to D)