ITU - Telecommunications Standardization Sector
STUDY GROUP 16 Question 6
Video Coding Experts Group (VCEG)

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Title: Use of run-length coding to identify coded macroblocks

Purpose: Proposal

1 Introduction

In TML 5.9 information of which macroblocks are coded or not is signalled by MB_type. For inter pictures there is a one bit code to signal "skip" if no other information is sent for that macroblock. For some sequences and at high QP this has turned out to be very wasteful. This document describes a different method to signal coded MBs.

2 IPR

"The contributor are not aware of any issued, pending, or planned patents associated with the technical content of this proposal."

3 Use of run-length coding

For inter frames a new codeword is added at the beginning of each macroblock telling how many MBs are skipped since the last coded MB. If the last MB of the frame is not coded an additional codeword is added which points to a MB outside the picture. (This last code is not strictly necessary but has been included to simplify the decoded structure and to be in line with the input from Ericsson).

At the same time the "Skip" is not needed in the code table. The new code table is shown below.

Nokia Exhibit 2027, p. 1
Amazon.com v. Nokia
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Code_number	RUN	MB_Type		Intra_pred_mode[1]		MVD	CBP		Tcoeff_chroma_DC[2]		Tcoeff_chroma_AC[2] Tcoeff_luma[2] Simple scan		Tcoeff_luma[2] Double scan	
		Intra	Inter	Prob0	Prob1		Intra	Inter	Level	Run	Level	Run	Level	Run
0	0	Intra4x4	16x16	0	0	0	47	0	EOB	-	EOB	-	EOB	-
1	1	0,0,0[3]	8x8	1	0	1	31	16	1	0	1	0	1	0
2	2	1,0,0	16x8	0	1	-1	15	1	-1	0	-1	0	-1	0
3	3	2,0,0	8x16	0	2	2	0	2	2	0	1	1	1	1
4	4	3,0,0	8x4	1	1	-2	23	4	-2	0	-1	1	-1	1
5	5	0,1,0	4x8	2	0	3	27	8	1	1	1	2	2	0
6	6	1,1,0	4x4	3	0	-3	29	32	-1	1	-1	2	-2	0
7	7	2,1,0	Intra4x4	2	1	4	30	3	3	0	2	0	1	2
8	8	3,1,0	0,0,0[3]	1	2	-4	7	5	-3	0	-2	0	-1	2
9	9	0,2,0	1,0,0	0	3	5	11	10	2	1	1	3	3	0
10	10	1,2,0	2,0,0	0	4	-5	13	12	-2	1	-1	3	-3	0
11	11	2,2,0	3,0,0	1	3	6	14	15	1	2	1	4	4	0
12	12	3,2,0	0,1,0	2	2	-6	39	47	-1	2	-1	4	-4	0
13	13	0,0,1	1,1,0	3	1	7	43	7	1	3	1	5	5	0
14	14	1,0,1	2,1,0	4	0	-7	45	11	-1	3	-1	5	-5	0
15	15	2,0,1	3,1,0	5	0	8	46	13	4	0	3	0	1	3
16	16	3,0,1	0,2,0	4	1	-8	16	14	-4	0	-3	0	-1	3
17	17	0,1,1	1,2,0	3	2	9	3	6	3	1	2	1	1	4
18	18	1,1,1	2,2,0	2	3	-9	51	9	-3	1	-2	1	-1	4
19	19	2,1,1	3,2,0	1	4	10	10	31	2	2	2	2	2	1
20	20	3,1,1	0,0,1	0	5	-10	12	35	-2	2	-2	2	-2	1
21	21	0,2,1	1,0,1	1	5	11	19	37	2	3	1	6	3	1
22	22	1,2,1	2,0,1	2	4	-11	21	42	-2	3	-1	6	-3	1
23	23	2,2,1	3,0,1	3	3	12	26	44	5	0	1	7	6	0
24	24	3,2,1	0,1,1	4	2	-12	28	33	-5	0	-1	7	-6	0
25	25		1,1,1	5	1	13	35	34	4	1	1	8	7	0
26	26		2,1,1	5	2	-13	37	36	-4	1	-1	8	-7	0
27	27		3,1,1	4	3	14	42	40	3	2	1	9	8	0
28	28		0,2,1	3	4	-14	44	39	-3	2	-1	9	-8	0
29	29		1,2,1	2	5	15	1	43	3	3	4	0	9	0
30	30		2,2,1	3	5	-15	2	45	-3	3	-4	0	-9	0
31	31		3,2,1	4	4	16	4	46	6	0	5	0	10	0
32	32			5	3	-16	8	17	-6	0	-5	0	-10	0
33	33			5	4	17	17	18	5	1	3	1	4	1
34	34			4	5	-17	18	20	-5	1	-3	1	-4	1
35	35			5	5	18	20	24	4	2	3	2	2	2
36	36					-18	24	19	-4	2	-3	2	-2	2
37	37					19	6	21	4	3	2	3	2	3
38	38					-19	9	26	-4	3	-2	3	-2	3
39	39					20	22	28	7	0	2	4	2	4
40	40					-20	25	23	-7	0	-2	4	-2	4
41	41					21	32	27	6	1	2	5	2	5
42	42					-21	33	29	-6	1	-2	5	-2	5
43	43					22	34	30	5	2	2	6	2	6
44	44					-22	36	22	-5	2	-2	6	-2	6
45	45					23	40	25	5	3	2	7	2	7
46	46					-23	38	38	-5	3	-2	7	-2	7
47	47					24	41	41	8	0	2	8	11	0
	..					..			..	..	..	..	..	..

4 Simulation results

Compared to TML 5.9 the proposed changes influences bitrate only. The overall results are shown in VCEG-M34 where there is a gain for practically all sequences. The figure below show gains in % as function of QP for some sequences. It is seen that significant gain is obtained for some "simple" sequences especially for for high QP values.

Nokia Exhibit 2027, p. 2
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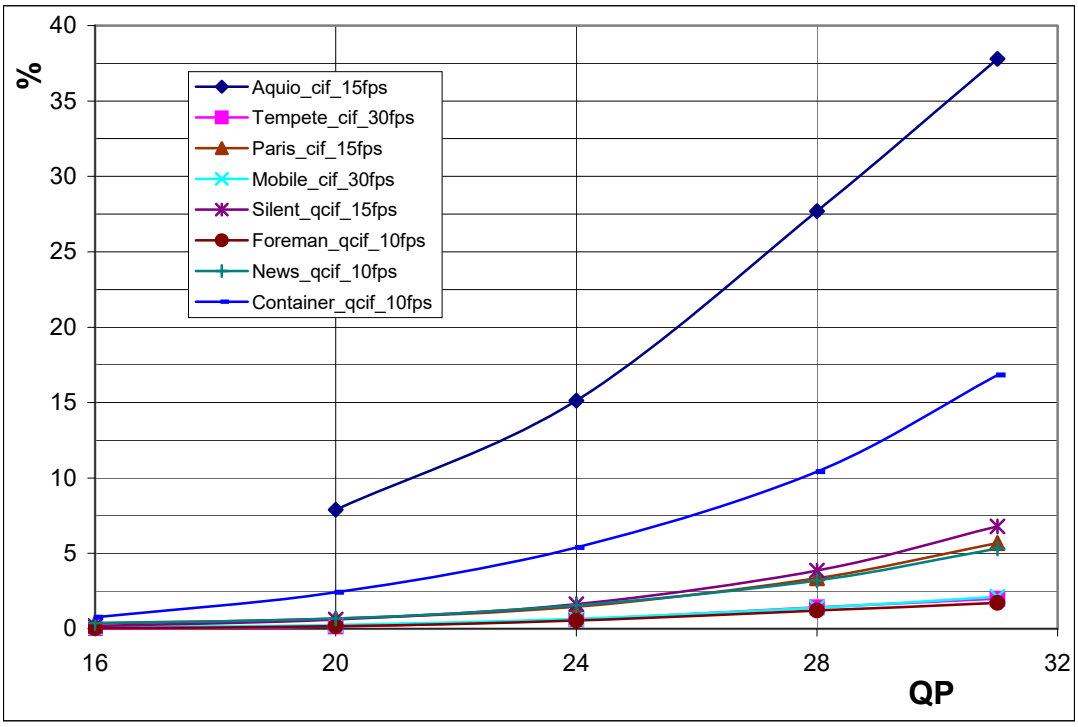

Figure. Additional bitrate used with TML 5.9 compared with the described method with run-length coding.