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Source: I. Parke, M.E.Nilsson, BT Labs
Title: Semantics for prediction of motion vector in spatial scalability
Purpose: Proposal

This document provides additional text for sections 6.3.10 and 7.2.7 of the video working draft, version 4.2 28th April 1993, on prediction of motion vector. The purpose of this text is to define prediction of motion vectors in the case of spatial scalability. The complete original text is repeated here for clarity. Additions are highlighted by a left hand bar.

In an attempt to simplify the syntax, it is proposed that the mtype tables are extended to incorporate field/frame motion type and the prediction weight code information. Also, a column has been added to indicate which PMV's are relevant.

This document proposes an alternative, simplified, method of describing the macroblock syntax for non-scalable coding. It uses the same method to describe the syntax for spatial scalability, together with more efficient codewords for the spatial scalable macroblock type in frame pictures.

6.3.10 Macroblock layer

macroblock_intra -- Derived from macroblock_type.

|macroblock_compatible -- Derived from macroblock type.

|frame_motion_type - Derived from macroblock type.

|field_motion_type - Derived from macroblock type.

|prediction_weight_code - Derived from the macroblock type. This indicates the weighting to be used on the compatible and normal prediction. The weighting is a pair of weights for frame structured pictures and a single weight for field structured pictures.

7.2.7 Prediction of Motion Vector

The prediction of motion vectors is controlled by picture_coding_type and the macroblock type. Four motion vector predictors are used: PMV1, PMV2, PMV3 and PMV4.

PMV1 is used to predict the forward vector for frame-based and dual-prime macroblocks and field-based macroblocks in field pictures. It is also used for the first field forward vector of field-based macroblocks in frame pictures. It is also used to predict intra concealment vectors.

PMV2 is used to predict the second field forward vector of field-based macroblocks in frame pictures.

PMV3 is used to predict the backward vector for frame-based and dual-prime macroblocks and field-based macroblocks in field pictures. It is also used for the first field backward vector of field-based macroblocks in frame pictures. It is also used to predict intra concealment vectors.

PMV4 is used to predict the second field backward vector of field-based macroblocks in frame pictures.

These motion vector predictors are updated as follows.

[P-frame or field picture]

PMV1 and PMV2 are relevant. The one to use is derived from the macroblock type. If only one is used, the other reset to equal the one used. If neither is used, both are reset to zero.

[B-frame or field picture]

PMV1 and PMV2 are relevant to forward prediction. The one to use is derived from the macroblock type. If only one of these is used, the other reset to equal the one used. If neither is used, they remain the same.

PMV3 and PMV4 are relevant to backward prediction. The one to use is derived from the macroblock type. If only one of these is used, the other reset to equal the one used. If neither is used, they remain the same.

In addition to the above, all four motion vector predictors are reset to zero when

- Intra_MB without concealment vector comes in I, P and B-pictures and
- at the beginning of slices.

Table B.2-1 --- VLC's for macroblock_type in intra frame-structured pictures when picture spatial extension data is not present.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t s	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	0	0	0	1	0,0					
01	1	0	0	0	1	0,0					

Table B.2-2 --- VLC's for macroblock_type in predictive frame-structured pictures when picture spatial extension data is not present.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t s	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	1	0	1	0	0,0	field-based	2	1,2	field	0
1	0	1	0	1	0	0,0	frame-based	1	1	frame	0
1	0	1	0	1	0	0,0	Dual-Prime	1	1	field	1
01	0	0	0	1	0	0,0					
001	0	1	0	0	0	0,0	field-based	2	1,2	field	0
001	0	1	0	0	0	0,0	frame-based	1	1	frame	0
001	0	1	0	0	0	0,0	Dual-Prime	1	1	field	1
0001 1	0	0	0	0	1	0,0					
0001 0	1	1	0	1	0	0,0	field-based	2	1,2	field	0
0001 0	1	1	0	1	0	0,0	frame-based	1	1	frame	0
0001 0	1	1	0	1	0	0,0	Dual-Prime	1	1	field	1
0000 1	1	0	0	1	0	0,0					
0000 01	1	0	0	0	1	0,0					

Table B.2-3 --- VLC's for macroblock_type in interpolated frame-structured pictures when picture spatial extension data is not present.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t s	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
10 01	0	1	1	0	0	0,0	field-based	4	1,2,3,4	field	0
10 10	0	1	1	0	0	0,0	frame-based	2	1,3	frame	0
11 01	0	1	1	1	0	0,0	field-based	4	1,2,3,4	field	0
11 10	0	1	1	1	0	0,0	frame-based	2	1,3	frame	0
010 01	0	0	1	0	0	0,0	field-based	2	3,4	field	0
010 10	0	0	1	0	0	0,0	frame-based	1	3	frame	0
011 01	0	0	1	1	0	0,0	field-based	2	3,4	field	0
011 10	0	0	1	1	0	0,0	frame-based	1	3	frame	0
0010 01	0	1	0	0	0	0,0	field-based	2	1,2	field	0
0010 10	0	1	0	0	0	0,0	frame-based	1	1	frame	0
0011 01	0	1	0	1	0	0,0	field-based	2	1,2	field	0
0011 10	0	1	0	1	0	0,0	frame-based	1	1	frame	0
0001 1	0	0	0	0	1	0,0					
0001 0	1	1	1	1	0	0,0	field-based	4	1,2,3,4	field	0
0001 0	1	1	1	1	0	0,0	frame-based	2	1,3	frame	0
0000 11	1	1	0	1	0	0,0	field-based	2	1,2	field	0
0000 11	1	1	0	1	0	0,0	frame-based	1	1	frame	0
0000 10	1	0	1	1	0	0,0	field-based	2	3,4	field	0
0000 10	1	0	1	1	0	0,0	frame-based	1	3	frame	0
0000 01	1	0	0	0	1	0,0					

Table B.2-4 --- VLC's for macroblock_type in intra frame-structured pictures if spatial_scalable_mode is spatial_scalability.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t s	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	0	0	1	0	1,1					
01	1	0	0	1	0	1,1					
001	0	0	0	0	0	1,1					
00011	1	0	0	0	1	0,0					
00010	0	0	0	0	1	0,0					

Table B.2-5 --- VLC's for macroblock_type in predictive frame-structured pictures if spatial_scalable_mode is spatial_scalability.

macroblock type codes			q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t s	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
10	01		0	1	0	1	0	0,0	field-based	2	1,2	field	0
10	10		0	1	0	1	0	0,0	frame-based	1	1	frame	0
10	11		0	1	0	1	0	0,0	Dual-Prime	1	1	field	1
11	01	00	0	1	0	1	0	1,0	field-based	1	2	field	0
11	01	01	0	1	0	1	0	0,1	field-based	1	1	field	0
11	01	11	0	1	0	1	0	0.5,0.5	field-based	2	1,2	field	0
11	10	00	0	1	0	1	0	1,0	frame-based	1	1	frame	0
11	10	01	0	1	0	1	0	0,1	frame-based	1	1	frame	0
11	10	11	0	1	0	1	0	0.5,0.5	frame-based	1	1	frame	0
11	11	00	0	1	0	1	0	1,0	Dual-Prime	1	1	field	1
11	11	01	0	1	0	1	0	0,1	Dual-Prime	1	1	field	1
11	11	11	0	1	0	1	0	0.5,0.5	Dual-Prime	1	1	field	1
000110			0	0	0	1	0	0,0					
000111		00	0	0	0	1	0	1,0					
000111		01	0	0	0	1	0	0,1					
000111		10	0	0	0	1	0	1,1					
000111		11	0	0	0	1	0	0.5,0.5					
0010	01		0	1	0	0	0	0,0	field-based	2	1,2	field	0
0010	10		0	1	0	0	0	0,0	frame-based	1	1	frame	0
0010	11		0	1	0	0	0	0,0	Dual-Prime	1	1	field	1
000101			0	0	0	0	1	0,0					
0011	01	00	0	1	0	0	0	1,0	field-based	1	2	field	0
0011	01	01	0	1	0	0	0	0,1	field-based	1	1	field	0
0011	01	11	0	1	0	0	0	0.5,0.5	field-based	2	1,2	field	0
0011	10	00	0	1	0	0	0	1,0	frame-based	1	1	frame	0
0011	10	01	0	1	0	0	0	0,1	frame-based	1	1	frame	0
0011	10	11	0	1	0	0	0	0.5,0.5	frame-based	1	1	frame	0
0011	11	00	0	1	0	0	0	1,0	Dual-Prime	1	1	field	1
0011	11	01	0	1	0	0	0	0,1	Dual-Prime	1	1	field	1
0011	11	11	0	1	0	0	0	0.5,0.5	Dual-Prime	1	1	field	1
010	01		1	1	0	1	0	0,0	field-based	2	1,2	field	0
010	10		1	1	0	1	0	0,0	frame-based	1	1	frame	0
010	11		1	1	0	1	0	0,0	Dual-Prime	1	1	field	1
000100			1	0	0	1	0	0,0					
0000110			1	0	0	0	1	0,0					
011	01	00	1	1	0	1	0	1,0	field-based	1	2	field	0
011	01	01	1	1	0	1	0	0,1	field-based	1	1	field	0
011	01	11	1	1	0	1	0	0.5,0.5	field-based	2	1,2	field	0
011	10	00	1	1	0	1	0	1,0	frame-based	1	1	frame	0
011	10	01	1	1	0	1	0	0,1	frame-based	1	1	frame	0
011	10	11	1	1	0	1	0	0.5,0.5	frame-based	1	1	frame	0
011	11	00	1	1	0	1	0	1,0	Dual-Prime	1	1	field	1
011	11	01	1	1	0	1	0	0,1	Dual-Prime	1	1	field	1
011	11	11	1	1	0	1	0	0.5,0.5	Dual-Prime	1	1	field	1
0000111		00	1	0	0	1	0	1,0					
0000111		01	1	0	0	1	0	0,1					
0000111		10	1	0	0	1	0	1,1					
0000111		11	1	0	0	1	0	0.5,0.5					
0000100		00	0	0	0	0	0	1,0					
0000100		01	0	0	0	0	0	0,1					
0000100		10	0	0	0	0	0	1,1					
0000100		11	0	0	0	0	0	0.5,0.5					

Table B.2-6 — VLC's for macroblock_type in interpolated frame-structured pictures if spatial_scalable_mode is spatial_scalability.

macroblock type codes		q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t s	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
10	01	0	1	1	0	0	0,0	field-based	4	1,2,3,4	field	0
10	10	0	1	1	0	0	0,0	frame-based	2	1,3	frame	0
11	01	0	1	1	1	0	0,0	field-based	4	1,2,3,4	field	0
11	10	0	1	1	1	0	0,0	frame-based	2	1,3	frame	0
010	01	0	0	1	0	0	0,0	field-based	2	3,4	field	0
010	10	0	0	1	0	0	0,0	frame-based	1	3	frame	0
0011	01	0	0	1	1	0	0,0	field-based	2	3,4	field	0
0011	10	0	0	1	1	0	0,0	frame-based	1	3	frame	0
0010	01	0	1	0	0	0	0,0	field-based	2	1,2	field	0
0010	10	0	1	0	0	0	0,0	frame-based	1	1	frame	0
000101	01	0	1	0	1	0	0,0	field-based	2	1,2	field	0
000101	10	0	1	0	1	0	0,0	frame-based	1	1	frame	0
000110	01	00	0	1	0	0	1,0	field-based	1	4	field	0
000110	01	01	0	1	0	0	0,1	field-based	1	3	field	0
000110	01	11	0	1	0	0	0.5,0.5	field-based	2	3,4	field	0
000110	10	00	0	1	0	0	1,0	frame-based	1	3	frame	0
000110	10	01	0	1	0	0	0,1	frame-based	1	3	frame	0
000110	10	11	0	1	0	0	0.5,0.5	frame-based	1	3	frame	0
0000110	01	00	0	1	1	0	1,0	field-based	1	4	field	0
0000110	01	01	0	1	1	0	0,1	field-based	1	3	field	0
0000110	01	11	0	1	1	0	0.5,0.5	field-based	2	3,4	field	0
0000110	10	00	0	1	1	0	1,0	frame-based	1	3	frame	0
0000110	10	01	0	1	1	0	0,1	frame-based	1	3	frame	0
0000110	10	11	0	1	1	0	0.5,0.5	frame-based	1	3	frame	0
0000111	01	00	0	1	0	0	1,0	field-based	1	2	field	0
0000111	01	01	0	1	0	0	0,1	field-based	1	1	field	0
0000111	01	11	0	1	0	0	0.5,0.5	field-based	2	1,2	field	0
0000111	10	00	0	1	0	0	1,0	frame-based	1	1	frame	0
0000111	10	01	0	1	0	0	0,1	frame-based	1	1	frame	0
0000111	10	11	0	1	0	0	0.5,0.5	frame-based	1	1	frame	0
0000100	01	00	0	1	0	1	1,0	field-based	1	2	field	0
0000100	01	01	0	1	0	1	0,1	field-based	1	1	field	0
0000100	01	11	0	1	0	1	0.5,0.5	field-based	2	1,2	field	0
0000100	10	00	0	1	0	1	1,0	frame-based	1	1	frame	0
0000100	10	01	0	1	0	1	0,1	frame-based	1	1	frame	0
0000100	10	11	0	1	0	1	0.5,0.5	frame-based	1	1	frame	0
00000101		0	0	0	0	1	0,0					
011	01	1	1	1	1	0	0,0	field-based	4	1,2,3,4	field	0
011	10	1	1	1	1	0	0,0	frame-based	2	1,3	frame	0
000111	01	1	1	0	1	0	0,0	field-based	2	1,2	field	0
000111	10	1	1	0	1	0	0,0	frame-based	1	1	frame	0
000100	01	1	0	1	1	0	0,0	field-based	2	3,4	field	0
000100	10	1	0	1	1	0	0,0	frame-based	1	3	frame	0
00000100		1	0	0	0	1	0,0					
000001100	01	00	1	1	0	1	1,0	field-based	1	2	field	0
000001100	01	01	1	1	0	1	0,1	field-based	1	1	field	0
000001100	01	11	1	1	0	1	0.5,0.5	field-based	2	1,2	field	0
000001100	10	00	1	1	0	1	1,0	frame-based	1	1	frame	0
000001100	10	01	1	1	0	1	0,1	frame-based	1	1	frame	0
000001100	10	11	1	1	0	1	0.5,0.5	frame-based	1	1	frame	0
0000101	01	00	1	0	1	1	1,0	field-based	1	4	field	0
0000101	01	01	1	0	1	1	0,1	field-based	1	3	field	0
0000101	01	11	1	0	1	1	0.5,0.5	field-based	2	3,4	field	0
0000101	10	00	1	0	1	1	1,0	frame-based	1	3	frame	0
0000101	10	01	1	0	1	1	0,1	frame-based	1	3	frame	0
0000101	10	11	1	0	1	1	0.5,0.5	frame-based	1	3	frame	0
000001110	10	0	0	0	1	0	1,1					
000001111	10	1	0	0	1	0	1,1					
000001101	10	0	0	0	0	0	1,1					

Table B.2-7 --- VLC's for macroblock_type in intra, predictive and interpolated frame-structured pictures if spatial_scalable_mode is snr_scalability.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t s	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	0	0	0	0	1,1					
01	1	0	0	0	0	1,1					
001	0	0	0	1	0	1,1					
0001	1	0	0	1	0	1,1					

Table B.2-8 --- VLC's for macroblock_type in intra field-structured pictures when picture spatial extension data is not present.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	0	0	0	1	0					
01	1	0	0	0	1	0					

Table B.2-9 --- VLC's for macroblock_type in predictive field-structured pictures when picture spatial extension data is not present.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	1	0	1	0	0	field-based Dual-Prime	1	1	field	0
1	0	1	0	1	0	0		1	1	field	1
01	0	0	0	1	0	0					
001	0	1	0	0	0	0	field-based Dual-Prime	1	1	field	0
001	0	1	0	0	0	0		1	1	field	1
0001 1	0	0	0	0	1	0					
0001 0	1	1	0	1	0	0	field-based Dual-Prime	1	1	field	0
0001 0	1	1	0	1	0	0		1	1	field	1
0000 1	1	0	0	1	0	0					
0000 01	1	0	0	0	1	0					

Table B.2-10 --- VLC's for macroblock_type in interpolated field-structured pictures when picture spatial extension data is not present.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
10 01	0	1	1	0	0	0	field-based	2	1,3	field	0
11 01	0	1	1	1	0	0	field-based	2	1,3	field	0
010 01	0	0	1	0	0	0	field-based	1	3	field	0
011 01	0	0	1	1	0	0	field-based	1	3	field	0
0010 01	0	1	0	0	0	0	field-based	1	1	field	0
0011 01	0	1	0	1	0	0	field-based	1	1	field	0
0001 1	0	0	0	0	1	0					
0001 0 01	1	1	1	1	0	0	field-based	2	1,3	field	0
0000 11 01	1	1	0	1	0	0	field-based	1	1	field	0
0000 10 01	1	0	1	1	0	0	field-based	1	3	field	0
0000 01	1	0	0	0	1	0					

Table B.2-11 --- VLC's for macroblock_type in intra field-structured pictures if spatial_scalable_mode is spatial_scalability.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	0	0	1	0	1					
01	1	0	0	1	0	1					
001	0	0	0	0	0	1					
00011	1	0	0	0	1	0					
00010	0	0	0	0	1	0					

Table B.2-12 --- VLC's for macroblock_type in predictive field-structured pictures if spatial_scalable_mode is spatial_scalability.

macroblock type codes		q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
10	01	0	1	0	1	0	0	field-based	1	1	field	0
10	11	0	1	0	1	0	0	Dual-Prime	1	1	field	1
11	01	0	1	0	1	0	0.5	field-based	1	1	field	0
11	11	0	1	0	1	0	0.5	Dual-Prime	1	1	field	1
010		0	0	0	1	0	0					
011	0	0	0	0	1	0	1					
011	1	0	0	0	1	0	0.5					
0010	01	0	1	0	0	0	0	field-based	1	1	field	0
0010	11	0	1	0	0	0	0	Dual-Prime	1	1	field	1
0011		0	0	0	0	1	0					
000110	01	0	1	0	0	0	0.5	field-based	1	1	field	0
000110	11	0	1	0	0	0	0.5	Dual-Prime	1	1	field	1
000111	01	1	1	0	1	0	0	field-based	1	1	field	0
000111	11	1	1	0	1	0	0	Dual-Prime	1	1	field	1
000100		1	0	0	1	0	0					
000101		1	0	0	0	1	0					
0000110	01	1	1	0	1	0	0.5	field-based	1	1	field	0
0000110	11	1	1	0	1	0	0.5	Dual-Prime	1	1	field	1
0000111	0	1	0	0	1	0	1					
0000111	1	1	0	0	1	0	0.5					
0000100	0	0	0	0	0	0	1					
0000100	1	0	0	0	0	0	0.5					

Table B.2-13 --- VLC's for macroblock_type in interpolated field-structured pictures if spatial_scalable_mode is spatial_scalability.

macroblock type codes		q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
10	01	0	1	1	0	0	0	field-based	2	1,3	field	0
11	01	0	1	1	1	0	0	field-based	4	1,3	field	0
010	01	0	0	1	0	0	0	field-based	1	3	field	0
011	01	0	0	1	1	0	0	field-based	1	3	field	0
0010	01	0	1	0	0	0	0	field-based	1	1	field	0
0011	01	0	1	0	1	0	0	field-based	1	1	field	0
000110	01	0	0	1	0	0	0.5	field-based	1	3	field	0
000111	01	0	0	1	1	0	0.5	field-based	1	3	field	0
000100	01	0	1	0	0	0	0.5	field-based	1	1	field	0
000101	01	0	1	0	1	0	0.5	field-based	1	1	field	0
0000110		0	0	0	0	1	0					
0000111	01	1	1	1	1	0	0	field-based	2	1,3	field	0
0000100	01	1	1	0	1	0	0	field-based	1	1	field	0
0000101	01	1	0	1	1	0	0	field-based	1	3	field	0
00000100		1	0	0	0	1	0					
00000101	01	1	1	0	1	0	0.5	field-based	1	1	field	0
000001100	01	1	1	0	1	0	0.5	field-based	1	3	field	0
000001110	0	0	0	0	0	0	1					
000001101	0	1	0	0	1	0	1					
000001111	0	0	0	0	1	0	1					

Table B.2-14 --- VLC's for macroblock_type in intra, predictive and interpolated field-structured pictures if spatial_scalable_mode is snr_scalability.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	0	0	0	0	1					
01	1	0	0	0	0	1					
001	0	0	0	1	0	1					
0001	1	0	0	1	0	1					

Table B.2-15 --- VLC's for macroblock_type in D-pictures.

macroblock type codes	q u a n t	f o r w a r d	b a c k w a r d	p a t t e r n	i n t r a	w e i g h t	prediction type	n o. v e c t o r s	PMV to use	m v f o r m a t	d m v
1	0	0	0	0	1	0					

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