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OF ITU

H.263

Annex V

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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

Infrastructure of audiovisual services – Coding of moving video

Video coding for low bit rate communication

Annex V: Data-partitioned slice mode

ITU-T Recommendation H.263 – Annex V

(Formerly CCITT Recommendation)

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ITU-T Recommendation H.263

Video coding for low bit rate communication

ANNEX V

Data-partitioned slice mode

Summary

This annex describes the optional *Data-Partitioned Slice* (DPS) mode capable of providing enhanced error resilience (particularly against localized corruption of bitstream contents during transmission). The DPS mode operates by separating header and motion vector data from DCT coefficient data in the bitstream and by protecting motion vector data using a reversible representation.

Source

Annex V to ITU-T Recommendation H.263 was prepared by ITU-T Study Group 16 (2001-2004) and approved under the WTSA Resolution 1 procedure on 17 November 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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Data-partitioned slice mode

V.1 Scope

This annex describes the optional data-partitioned slice (DPS) mode of H.263. The capability of this mode is signalled by external means (for example ITU-T H.245). The use of this mode shall be indicated by setting the formerly-reserved bit 17 of the optional part of the PLUSPTYPE (OPPTYPE) to "1". This mode uses the header structure defined in Annex K.

Data partitioning provides robustness in error prone environments. This is accomplished using a rearrangement of the H.263 syntax to enable early detection of and recovery from errors that have been introduced during transmission.

V.2 Structure of data partitioning

When data partitioning is used, the data is arranged as a video picture segment, as defined in R.2. The MBs in the segment are rearranged so that the header information for all the MBs in the segment are transmitted together, followed by the MVs for all the MBs in the segment, and then by the DCT coefficients for all the MBs in the segment. The segment header uses the same syntax as described in K.2. The header, MV, and DCT partitions are separated by markers, allowing for resynchronization at the end of the partition in which an error occurred. Each segment shall contain the data for an integer number of MBs. When this mode is in use, the syntax shown in Figure V.1 shall be used.

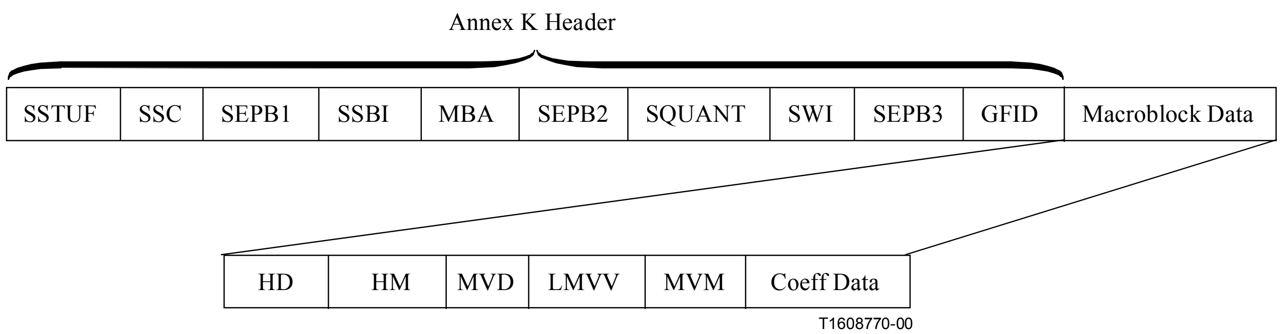

Figure V.1/H.263 – Data partitioning syntax

Note that when this annex is not active, the MV and DCT data are transmitted in an interleaved fashion for all the MBs in a video picture segment, in which case an error normally results in the loss of all information for the remaining MBs in the packet.

V.2.1 Header Data (HD) (Variable length)

The Header Data field contains the COD and MCBPC information for all the MBs in the packets, plus the MODB data in case of PB-frames or Improved PB-frames. A reversible variable length code (RVLC) is used to combine the COD and the MCBPC for all the MBs in the packet. This code is shown in Tables V.1 through V.5. If Annex O is in use, the COD is only combined with the MB TYPE to form the RVLC for B and EP pictures using Tables V.3 and V.4, and the CBPC is coded with codewords in Table O.4. If COD = 0 and Annex G or Annex M is in use, the codeword for the COD+MCBPC shall be immediately followed by the reversible variable-length encoded data corresponding to the MODB field of the macroblock. Table V.6 shall be used for PB-frames, Table V.7 shall be used for Improved PB-frames.

V.2.2 Header Marker (HM) (9 bits)

A codeword of 9 bits. Its value is 1010 0010 1. The HM terminates the header partition. When reversed decoding is used by a decoder, the decoder searches for this marker. This value cannot occur naturally in the HD field.

V.2.3 Motion vector data layer (Variable length)

V.2.3.1 Motion vector difference coding

For the motion vectors, the RVLC codewords shown in Table D.3 are used to encode the difference between the motion vector and the motion vector prediction. Note that this annex only uses the entropy coding from Annex D, but not its other aspects unless Annex D is also in use.

V.2.3.2 Prediction of motion vector values

The first motion vector in the packet is coded using a predictor value of 0 for both horizontal and vertical components, and the MVs for the subsequent coded MBs are coded predictively using the MV difference (MVD). This differs from the method otherwise used for coding the MVs in which the MVs following a skipped or INTRA MB are coded using a predictor value of 0 for both horizontal and vertical components.

Forward Direction: $MV_i = MV_{i-1} + MVD_i = MV_{i-1} + (MV_i - MV_{i-1})$

Backward Direction: $MV_{i-1} = MV_i - MVD_i = MV_i - (MV_i - MV_{i-1})$.

(MV_i and MVD_i are the *i*th MV and MV Difference in the packet respectively).

The motion vector information for the last motion vector in the packet is coded in this manner and is also coded again in the LMVV field as described below in V.2.4. This allows the decoder to independently decode the sequence of MVs using two different prediction paths:

1) in the forward direction, starting from the beginning of the motion data of the packet; and
2) in the backward direction, from the end of the motion data in a packet.

This provides robustness for better error detection and concealment.

NOTE 1 – When the DPS mode is not in use, motion vectors are predictively coded, with the prediction of the current motion vector being the median value of 3 motion vectors of neighboring locations as described in 6.1.1. Because packets in this annex are formed in a way such that the number of MBs coded in each packet is variable, using the median predictive coding method (which involves motion vectors on different rows of the frame) would prevent reversible decoding of the motion vectors in a slice. When the DPS mode is in use, a single prediction thread is formed for the MVs in the whole packet. This is shown in Figure V.2.

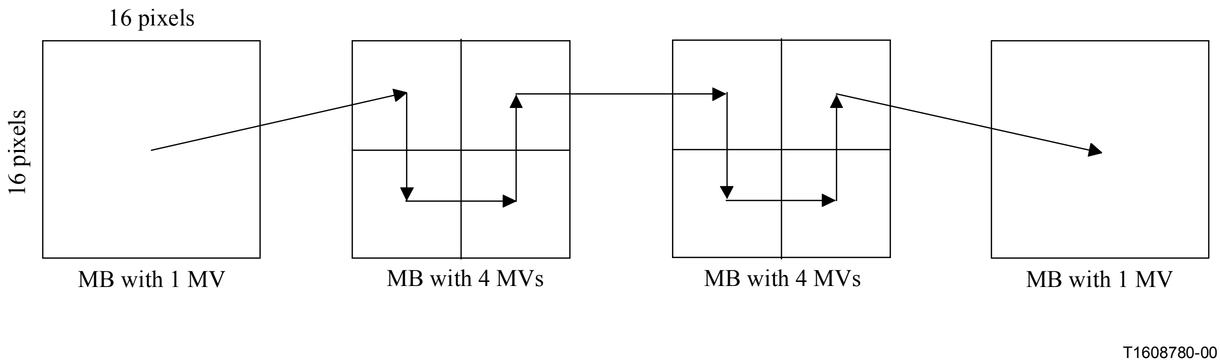

Figure V.2/H.263 – Single thread motion vector prediction

In case of B pictures or EP pictures (Annex O), MVDFW and MVDBW may be present as indicated by the MBTYPE codeword in Tables V.3 and V.4. MVDFW is predictively encoded using the same single prediction thread as described above and MVDBW (when present in B pictures) shall be encoded as specified in O.4.6. MVDFW and MVDBW shall be coded with the codewords from Table D.3.

In case of PB-frames (Annex G) and Improved PB-frames (Annex M), the MVDB data shall be encoded as specified in corresponding annexes and shall be coded using the codewords from Table D.3.

NOTE 2 – If the backward decoding mode is engaged in a B frame (Annex O) or in Improved PB-frames (Annex M), MVDB and MVDBW should be discarded by the decoder as the Motion Vector data for the backward prediction may not be recovered properly across the packet boundaries.

V.2.3.3 Start-code emulation prevention in motion vector difference coding

The MVD start-code-emulation avoidance method is changed from the method described in D.2, in order to facilitate independent parsing in the backward direction. The MV partition shall be scanned from left to right and a MVD = 0 (codeword "1") shall be inserted after any two MVDs that are both equal to 1 (codeword "000"). If a third MVD = 1 codeword follows these two MVD = 1 codewords in the original bitstream (before insertion), it shall be considered the first MVD = 1 codeword detected in the remaining codewords in the MV partition. It shall not be considered a second MVD = 1 codeword, and shall not have a MVD = 0 codeword inserted after it. This differs from Annex D, in which the bit is only inserted when two consecutive MVD = 1 (codeword "000") form a pair (i.e. when the first MVD is the horizontal component, and the second is the vertical component). If Annex D and Annex V are both in use, this Annex V method of start-code-emulation avoidance method shall be used instead of the method described in D.2.

V.2.4 Last Motion Vector Value (LMVV) (Variable length)

The LMVV field contains the last MV in the packet. It is coded using a predictor value of 0 for both the horizontal and vertical components. If there are no motion vectors or only one motion vector in the packet, LMVV shall not be present. (This use of a fixed zero-valued predictor enables the use of reversible decoding.)

V.2.5 Motion Vector Marker (MVM) (10 bits)

A codeword of 10 bits having the value "0000 0000 01". The MVM terminates the motion vector partition. When reverse decoding is used in a decoder, the decoder searches for this marker. The Motion Vector Marker (MVM) shall not be included in the packet if the packet does not contain Motion Vector Data (if all the macroblocks in the packet are intra-coded or with CODs equal to 1).

V.2.6 Coefficient Data Layer (Variable length)

The DCT data layer contains INTRA_MODE (if present), CBPB (if present), CBPC (if present), CBPY, DQUANT (if present), and DCT coefficients coded as specified in I.2, 5.3.4, O.4.3, 5.3.5, 5.3.6, and 5.4.2, respectively. The syntax diagram of DCT Data is illustrated in Figure V.3. The presence of CBPC is indicated in Tables V.3 and V.4.

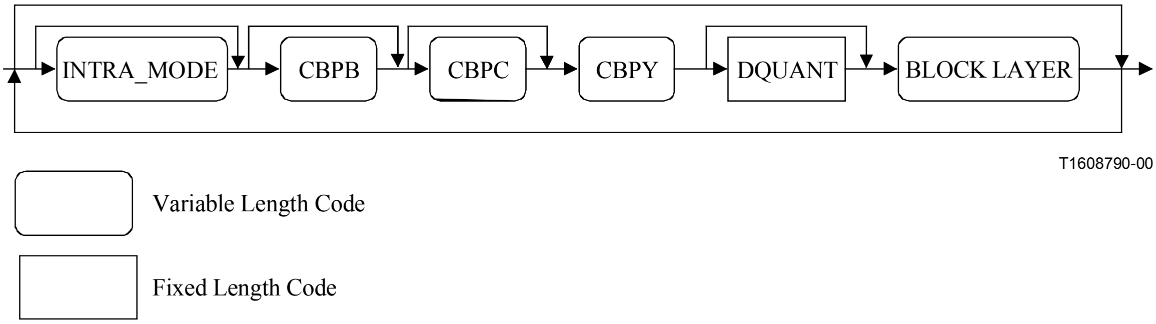

Figure V.3/H.263 – Coefficient Data syntax

V.3 Interaction with other optional modes

The DPS mode acts effectively as a sub-mode of the Slice Structured mode of Annex K, and uses its outer picture and slice header structures. The SS mode shall therefore be indicated as being in use whenever the DPS mode is in use. Both of the other sub-modes of the Slice Structured mode (the Arbitrary Slice Ordering and Rectangular Slice sub-modes) may be used in conjunction with the DPS mode.

The Syntax-Based Arithmetic Coding mode of Annex E shall not be used with this annex, as it does not allow for reversible decoding.

Annex H Forward Error Correction should not be used with this annex, as it can result in the bitstream being disrupted in undesirable places. However, the use of Annex H with the DPS mode is not forbidden, as the FEC defined in Annex H is required in some existing standard system designs.

The Temporal, SNR, and Spatial Scalability (TSSS) mode of Annex O may be used in conjunction with the DPS mode. When the TSSS and DPS modes are used together, the codewords provided in Tables V.3, V.4, and V.5 shall be used instead of those defined in Annex O.

Annex U shall not be used with this annex.

Table V.1/H.263 – COD + MCBPC RVLC table for INTRA MBs

MB type	CBPC (56)	Codeword (for combined COD+MCBPC)	Number of bits
3 (INTRA)	00	1	1
3	01	010	3
3	10	0110	4
3	11	01110	5
4 (INTRA + Q)	00	00100	5
4	01	011110	6
4	10	001100	6
4	11	0111110	7
stuffing		0011100	7

Table V.2/H.263 – COD + MCBPC RVLC table for INTER MBs

MB type	CBPC (56)	Codeword (for combined COD+MCBPC)	Number of bits
skipped		1	1
0 (INTER)	00	010	3
0	10	00100	5
0	01	011110	6
0	11	0011100	7
1 (INTER + Q)	00	01110	5
1	10	00011000	8
1	01	011111110	9
1	11	01111111110	11
2 (INTER4V)	00	0110	4
2	10	01111110	8
2	01	00111100	8
2	11	000010000	9
3 (INTRA)	00	001100	6
3	11	0001000	7
3	10	001111100	9
3	01	000111000	9
4 (INTRA + Q)	00	0111110	7
4	11	0011111100	10
4	10	0001111000	10
4	01	0000110000	10

Table V.2/H.263 – COD + MCBPC RVLC table for INTER MBs *(concluded)*

MB type	CBPC (56)	Codeword (for combined COD+MCBPC)	Number of bits
5 (INTER4V + Q)	00	00111111100	11
5	01	00011111000	11
5	10	00001110000	11
5	11	00000100000	11
stuffing		0111111110	10

Table V.3/H.263 – MBTYPE RVLC codes for B MBs

Index	Prediction type	MVDFW	MVDBW	CBPC + CBPY	DQUANT	MBTYPE	Bits
–	Direct (skipped)					1 (COD=1)	1
0	Direct			X		010	3
1	Direct + Q			X	X	001100	6
2	Forward (no texture)	X				00100	5
3	Forward	X		X		011110	6
4	Forward + Q	X		X	X	01111110	8
5	Backward (no texture)		X			0110	4
6	Backward		X	X		01110	5
7	Backward + Q		X	X	X	00111100	8
8	Bi-Dir (no texture)	X	X			0011100	7
9	Bi-Dir	X	X	X		0001000	7
10	Bi-Dir + Q	X	X	X	X	0111110	7
11	INTRA			X		00011000	8
12	INTRA + Q			X	X	011111110	9
13	Stuffing					001111100	9

Table V.4/H.263 – MBTYPE RVLC table for EP MBs

Index	Prediction type	MVDFW	MVDBW	CBPC + CBPY	DQUANT	MBTYPE	Bits
–	Forward (skipped)					1 (COD=1)	1
0	Forward	X		X		010	3
1	Forward + Q	X		X	X	0110	4
2	Upward (no texture)					01110	5
3	Upward			X		00100	5
4	Upward + Q			X	X	011110	6
5	Bi-Dir (no texture)					001100	6
6	Bi-Dir	X		X		0111110	7
7	Bi-Dir + Q	X		X	X	0011100	7
8	INTRA			X		0001000	7
9	INTRA + Q			X	X	01111110	8
10	Stuffing					00111100	8

Table V.5/H.263 – COD + MCBPC RVLC table for EI MBs

Prediction type	QCBP (56)	Codeword (for combined COD+MCBPC)	Number of bits
Upward (skipped)		1	1
0 (Upward)	00	010	3
0	01	0110	4
0	10	01110	5
0	11	00100	5
1 (Upward + Q)	00	011110	6
1	01	001100	6
1	10	0111110	7
1	11	0011100	7
2 (INTRA)	00	0001000	7
2	01	01111110	8
2	10	00111100	8
2	11	00011000	8
3 (INTRA + Q)	00	011111110	9
3	01	001111100	9
3	10	000111000	9
3	11	000010000	9
Stuffing		0111111110	10

Table V.6/H.263 – RVLC table for MODB

Index	CBPB	MVDB	Number of bits	Code
0			3	010
1		X	4	0110
2	X	X	5	01110
NOTE – "X" means that the item is present in the macroblock.				

Table V.7/H.263 – RVLC table for MODB for Improved PB-frames mode

Index	CBPB	MVDB	Number of bits	Code	Coding mode
0			3	010	Bidirectional prediction
1	X		4	0110	Bidirectional prediction
2		X	5	01110	Forward prediction
3	X	X	5	00100	Forward prediction
4			6	011110	Backward prediction
5	X		6	001100	Backward prediction
NOTE – The symbol "X" in the table above indicates that the associated syntax element is present.					

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