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**Datasheet for the decision  
of 8 July 2019**

**Case Number:** T 0708/14 - 3.5.04

**Application Number:** 10005839.5

**Publication Number:** 2254339

**IPC:** H04N7/26, H04N7/50

**Language of the proceedings:** EN

**Title of invention:**

Improved interpolation of compressed video frames

**Applicant:**

Dolby Laboratories Licensing Corporation

**Headword:**

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

Inventive step - (yes)

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**  
**Boards of Appeal**  
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Case Number: T 0708/14 - 3.5.04

**D E C I S I O N**  
**of Technical Board of Appeal 3.5.04**  
**of 8 July 2019**

**Appellant:** Dolby Laboratories Licensing Corporation  
(Applicant) 100 Potrero Avenue  
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**Representative:** Peterreins Schley  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted on 20 November  
2013 refusing European patent application  
No. 10005839.5 pursuant to Article 97(2) EPC.

**Composition of the Board:**

**Chairman** C. Kunzelmann  
**Members:** R. Gerdes  
T. Karamanli

## Summary of Facts and Submissions

I. The appeal is against the decision to refuse European patent application No. 10 005 839.5, published as EP 2 254 339 A2. The application is a divisional application of earlier European patent application No. 03 762 175.2 which was published as international application WO 2004/004310 A2. The present appeal is related to appeal case T 710/14, which concerns a divisional application of the present European patent application.

II. The examining division refused the present patent application on the grounds that the subject-matter of the independent claims of the then main and first auxiliary requests lacked inventive step in view of documents:

D2: ITU Study Group 16 - Video Coding Experts Group -ISO/IEC MPEG & ITU-T VCEG (ISO/IEC JTC1/SC29/WG11 and ITU-T SG16 Q6), 11th Meeting, Portland, OR, USA, 22-25 August 2000, no. q15k44, pages 1-2, XP030003136;

D3: Hannuksela, M.: "Generalized B/MH-Picture Averaging", ITU Study Group 16 - Video Coding Experts Group -ISO/IEC MPEG & ITU-T VCEG (ISO/IEC JTC1/SC29/WG11 AND ITU-T SG16 Q6), 3rd Meeting, Fairfax, VA, USA, 6-10 MAY 2002, no. JVT-C077, pages 1-8, XP030005186;

D4: Bjontegaard, G. et al.: "H.26L Test Model Long Term Number 4 (TML-4)", 10. VCEG Meeting; 16-05-2000 - 19-05-2000; Osaka, JP; (Video Coding Experts Group of ITU-T SG.16), no. q15j72d0, 16 June 2000, XP030003092, ISSN: 0000-0464.

It also referred to the following document:

D5: Kikuchi Y.: "Improved multiple frame motion compensation using frame interpolation", ITU Study Group 16 - Video Coding Experts Group -ISO/IEC MPEG & ITU-T VCEG (ISO/IEC JTC1/ SC29/WG11 and ITU-T SG16 Q6), 2nd Meeting, Geneva, CH, Jan. 29 - Feb. 1, 2002, no. JVT-B075, pages 1-8, XP030005075.

The independent claims of the then second and third auxiliary requests were found to contravene Article 123(2) EPC.

- III. The applicant filed notice of appeal against this decision, requesting that it be set aside. With the statement of grounds of appeal, the appellant requested that a patent be granted on the basis of the claims of the main request or one of the first or second auxiliary requests. The claims of the main request were those on which the decision under appeal was based. The claims of the first and second auxiliary requests were filed with the statement of grounds of appeal.
- IV. In response to the summons to oral proceedings, by a letter dated 12 February 2019, the appellant submitted amended claims according to a new main request and renumbered its previous main request and its first and second auxiliary requests to become the first to third auxiliary requests. It also filed description page 4a.
- V. By letter dated 18 March 2019, the appellant filed claims of a new main request, replacing the claims of the previous main request. It also identified the description pages and drawings for the requested grant of a patent on the basis of the new main request.

- VI. In response, the board cancelled the oral proceedings.
- VII. The requests of the appellant are therefore that the decision under appeal be set aside and that a patent be granted on the basis of the claims of the main request filed by letter of 18 March 2019, the first auxiliary request corresponding to the main request on which the decision under appeal was based, or one of the second to third auxiliary requests submitted as first and second auxiliary requests with the statement of grounds of appeal.
- VIII. Independent claims 1, 3, 5 and 6 of the main request read as follows:

"1. A method of video image compression comprising:

providing a sequence of referenceable (I, P) and bi-directional predicted (B) frames each comprising pixel values arranged in macroblocks; and

determining at least one macroblock within a bidirectional predicted frame (B) using direct mode prediction based on a motion vector between two referenceable frames (I, P) being scaled by a frame scale fraction of greater than one, wherein the two referenceable frames are previous in display order to the bidirectional predicted frame.

3. A video image compression system adapted to provide a sequence of referenceable (I, P) and bidirectional predicted (B) frames each comprising pixel values arranged in macroblocks, wherein at least one macroblock within a bidirectional predicted frame is determined using direct mode prediction based on a motion vector between two referenceable frames being

scaled by a frame scale fraction of greater than one, wherein the two referenceable frames are previous in display order to the bidirectional predicted frame.

5. A method of video image decompression comprising: receiving a sequence of referenceable (I, P) and bidirectional predicted (B) frames each comprising pixel values arranged in macroblocks; and

determining at least one macroblock within a bidirectional predicted frame (B) using direct mode prediction based on a motion vector between two referenceable frames (I, P) being scaled by a frame scale fraction of greater than one, wherein the two referenceable frames are previous in display order to the bidirectional predicted frame.

6. A video decompression system adapted to

receive a sequence of referenceable (I, P) and bidirectional predicted (B) frames each comprising pixel values arranged in macroblocks; and

determining at least one macroblock within a bidirectional predicted frame (B) using direct mode prediction based on a motion vector between two referenceable frames (I, P) being scaled by a frame scale fraction of greater than one, wherein the two referenceable frames are previous in display order to the bidirectional predicted frame."

Claims 2 and 4 are dependent on claims 1 and 3, respectively.

IX. In the decision under appeal, the examining division had held that document D2 was the closest prior art

with regard to the claimed subject-matter and that it implicitly included the disclosure of document D4 and contained an improvement of the direct mode disclosed in D4, wherein the weights of D2 were made equal to corresponding weights used for motion vector scaling.

The subject-matter of claim 1 of the then main request was distinguished from D2 by the following features:

- (a) the frame scale fraction of at least one of the motion vectors is greater than one, and
- (b) at least two of the two or more referenceable frames are previous in display order to the bidirectional prediction frame.

The problem to be solved by the present invention might therefore be regarded as increasing flexibility of coding. The claimed solution was obvious in view of D2 in combination with D3. Document D3 referenced document D2 (see page 1, paragraph "1. Summary"; pages 2 and 3, point 2.2.1) and proposed a solution aimed at increasing flexibility. On page 1, paragraph "1. Summary" and pages 3 and 4, paragraph "3. Generalized weighting of MH-Pictures", document D3 disclosed a method for interpolating a B-frame from two reference frames, where the three frames were in arbitrary order (i.e. their occurrence times T, T1 and T2 had an arbitrary order).

The syntax enabling B-frame interpolation according to the teachings of document D3, i.e. the calculation of the prediction weights for determining the B-frame predictor, was disclosed in D3, pages 4 and 5, paragraph 4.2. The particular interpolation weights for the B-frame interpolation were defined in equation (4).



With the formal definitions provided by equation (5), i.e.  $TR_B = T-T1$  and  $TR_D = T2-T1$ , equation (4) could be rewritten as equation (6).

Equation (6) referred to weighted averaging for the coding of B-frames, as disclosed in document D2, paragraph "Description", referenced in relation to said averaging in document D3, page 1, paragraph 1, first line and pages 2 and 3, paragraph 2.2.1.

Document D3 (see pages 2 and 3, paragraph 3, in particular the typographic paragraph bridging pages 2 and 3) disclosed that equation (6), with the formal definitions provided by equation (5), applied also to an arbitrary order both of the B-frame to be interpolated and of the two frames used as references for the interpolation, and disclosed further that equation (4) reduced to equation (6), equal to equation (2), adding that formula (4) was a generalised form of the weighted averaging disclosed in document D2 for B-frame coding in direct mode (with the implicit assumption of the knowledge of document D4). It also applied when the B-frame was followed or preceded by two P-frames. Therefore, the skilled person would arrive at the invention as claimed if they combined the teachings of D3 with the direct mode coding of a B-picture in document D2.

Hence, the solution proposed in claim 1 of the present application was obvious in view of D2 and D3 (see decision under appeal, Reasons, points 2.1 to 2.4).

## **Reasons for the Decision**

1. The appeal is admissible.

### *The invention*

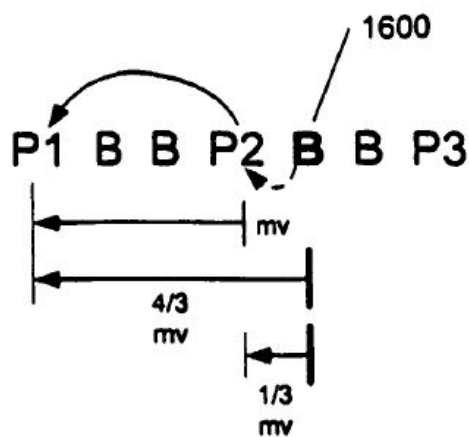
2. The invention relates to video (de-)compression, in particular to a method for improved interpolation of video frames in MPEG-encoding systems.

- 2.1 Encoding frames as bi-directionally predicted (B-)frames using bidirectional mode or direct mode was previously known.

In bidirectional mode, blocks of the bi-directionally predicted frame are encoded using forward and backward motion vectors describing the motion of a macroblock in the predicted frame with respect to macroblocks in a subsequent (forward) and a preceding (backward) (I- or P-)reference frame. The motion vectors are transmitted from the encoder to the decoder to enable reconstruction of the bi-directionally predicted frame.

In contrast, in direct mode no separate motion vectors are transmitted for a bi-directionally predicted frame. Instead, the motion vectors for the bi-directionally predicted frame are derived from the motion vector between the subsequent reference frame and the preceding reference frame using a proportional weighting corresponding to time distances from the bi-directionally predicted frame to these reference frames (called "motion vector interpolation"; see paragraphs [0011], [0013] and [0014] of the application as filed, and D4, chapter 6.4.2).

2.2 The present application proposes a direct mode extension that allows the extrapolation of a motion vector (denoted by  $mv$  in Figure 16 of the present application, which is reproduced below) of a previous reference frame (P2) which refers to an even earlier reference frame (P1). To account for the extrapolation, the motion vector has to be scaled with a factor (frame scale fraction) of greater than one ( $4/3$  of  $mv$ ), see application as filed, paragraphs [0145] and [0163] to [0168] together with Figures 16 and 17.



**FIG. 16**

*Amendments (Articles 76(1) and 123(2) EPC)*

3. Compared with claim 1 of the main request underlying the decision under appeal, claim 1 of the present main request has been restricted to relate to only two referenceable frames and a motion vector between the two referenceable frames.

3.1 A basis for these amendments can be found in Figures 16 and 17 and paragraph [0163] of the application as filed and at the same location in the earlier application as

filed. Corresponding amendments have been made to independent claims 3, 5 and 6.

- 3.2 Hence, the board finds that the claims of the appellant's main request do not contain subject-matter extending beyond the content of the application or the earlier application as filed and that they thus comply with Articles 76(1) and 123(2) EPC.

*Inventive step, Article 56 EPC*

4. It is common ground that D2 may be considered the closest prior art for the subject-matter of claim 1.
- 4.1 D2 refers to a Test Model Long Term Number (TML) simulation model which is described in detail in D4 and refers, in particular, to direct mode prediction in TML. Thus, D2 implicitly includes the motion vector interpolation features from chapter 6 of D4 and thus discloses the features of the direct mode prediction described under point 2.1 above. As an improvement over D4, D2 proposes to interpolate the pixel value of a predicted block in a B-frame based on time distances to the preceding and subsequent reference frames (see D2, chapter "Description"). Hence, D2 proposes a pixel value interpolation which is performed in a similar manner to the motion vector interpolation in D4.
- 4.2 It follows that D2 does not disclose the following features of claim 1:
- (a) the motion vector between the two referenceable frames is scaled by a frame scale fraction of greater than one, and

(b) the two referenceable frames are previous in display order to the bi-directionally predicted frame,

which is in line with the examining division's finding in the decision under appeal (see point IX above).

4.3 The distinguishing features provide further options for encoding bi-directionally predicted frames, which increase flexibility at the encoder with possible gains in compression efficiency. The board therefore agrees with the examining division's finding that the objective technical problem to be solved by the present invention is increasing the flexibility of coding.

4.4 In the decision under appeal, documents D2 and D4 were combined with documents D3 and/or D5.

4.4.1 D5 discloses a pixel value interpolation based on multiple reference frames (MH-pictures). D5, chapter 2.2, refers to "interpolative motion compensation", according to which a motion vector (see mv2 of D5, Figure 2, which is reproduced below) to reference frames other than the nearest one is not coded but instead is derived by scaling (extrapolating) the motion vector to the nearest reference frame (mv1) and adding a differential motion vector (dmv). Pixel values of the predicted area are interpolated either using equal weighting factors for the (two) reference frame pixel areas or a weighting adapted to video sequences with fading (see D5, chapters 2.2 and 4).

Hence, D5 is similar to the present application in that it involves two reference frames which precede the present frame in display order, and in that it scales a

motion vector by a frame scale fraction of greater than one (see distinguishing features (a) and (b)).

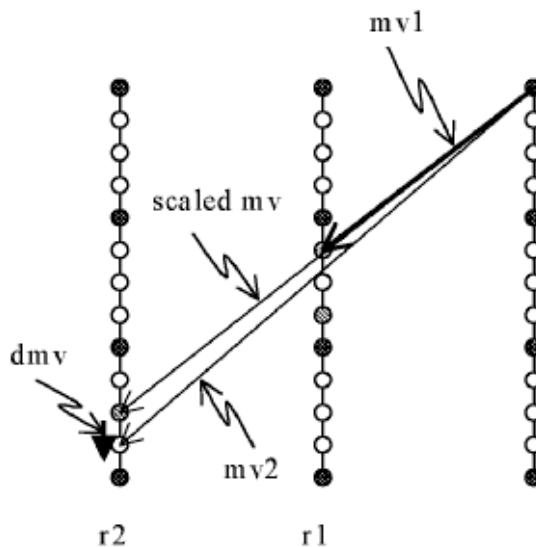


Figure 2

However, according to D5, a motion vector from the present frame to the nearest reference frame is extrapolated to a further reference frame, which is prior to the first reference frame in display order. In contrast, according to claim 1 of the present main request, a motion vector between two previous reference frames is extrapolated to the present frame (see point 2.2 above). By using the present frame as an end point of a motion vector, D5 teaches away from direct mode prediction.

4.4.2 D3 refers to D2 ("Q15-K44") and D5 ("JVT-B075") and proposes an improvement of the pixel value interpolation of D5 such that "the temporal order of the prediction frames ... is not restricted at all" (see page 3, last paragraph). On the basis of the weighting of pixel values for fades in D5, a formula for the improved pixel value interpolation is derived

which applies to "conventional B-picture coding order" and for an unrestricted order of reference frames.

D3 does not refer to direct mode prediction. Moreover, it is concerned with pixel value interpolation, and not with motion vector interpolation. In particular, equations (3) to (7) of D3, which were cited in the decision under appeal, pertain to pixel value interpolation, i.e. a pixel value P is determined as a blend of several reference frame pixel values. The evaluation of D5 in D3 focuses solely on pixel value interpolation based on macroblocks designated by two motion vectors (see points 2.2.1 and 3, first paragraph), whereas the motion vector extrapolation of D5 is not an issue in D3. In addition, as has been discussed under point 4.4.1 above, the extrapolation in D5 is different from the extrapolation in claim 1. Hence, even if D3 were considered to include the motion vector extrapolation of D5, the skilled person would not construe document D3 as suggesting an extrapolation of a motion vector between two previous reference frames to the predicted frame. Thus, the combination of D2 with D3 does not result in a direct mode frame prediction involving two reference frames previous in display order to the present frame.

4.4.3 Essentially, the invention's contribution to the technical field is considered to be the realisation that a direct mode prediction of a B-frame can be based on two reference frames which are both prior in decoding order to that B-frame. This concept is not rendered obvious by the combination of documents D2 to D5, even though equation (6) of D3 applies to an arbitrary order of frames as argued by the examining division. Equation (6) applies to pixel interpolation and not motion vector interpolation, and more

importantly, there is nothing in the available prior art to indicate that the skilled person would have considered extrapolating a motion vector in direct mode.

- 4.5 As a consequence, the subject-matter of claim 1 according to the main request involves an inventive step in view of documents D2 and D4 in combination with documents D3 and/or D5. Moreover, the board cannot see any other document or combination of documents on file by which the skilled person would have arrived at the claimed subject-matter.
- 4.6 It follows that the subject-matter of claim 1 and of independent claims 3, 5 and 6, which are restricted by features corresponding to those in claim 1, involves an inventive step (Article 56 EPC).
- 4.7 Claims 2 and 4 are dependent claims. Therefore, their subject-matter also involves an inventive step.

*Amended description*

5. The description has been amended in line with the claims of the main request and complies with the EPC.

*Conclusion*

6. In view of the above, the present case is to be remitted to the examining division with the order to grant a patent on the basis of the appellant's main request.



## Order

### For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the examining division with the order to grant a patent in the following version:

#### Description:

- pages 1 to 3, 6 to 9, 11, 12, 18, 20, 24, 33, 36 and 37 as originally filed
- pages 14, 15, 17, 23, 25 to 28, 30 to 32, 34, 35 and 38 to 40 filed with the letter of 4 August 2010
- pages 4, 5, 10, 13, 16, 19, 21, 22 and 29 filed in electronic form on 17 April 2013
- page 4a filed by letter of 12 February 2019

#### Claims:

Nos. 1 to 6 filed by letter of 18 March 2019

#### Drawings:

Sheets 1/15 to 15/15 as originally filed.

The Registrar:

The Chairman:



K. Boelicke

C. Kunzelmann

Decision electronically authenticated