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Datasheet for the decision of 28 October 2025

Case Number: T 0756/24 - 3.5.04

Application Number: 18887638.7

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Language of the proceedings: EN

Title of invention:
IMAGE CODING METHOD ON BASIS OF TRANSFORMATION AND DEVICE THEREFOR

Applicant:
LG Electronics Inc.

Relevant legal provisions:
RPBA 2020 Art. 13(2)
EPC Art. 56

Keyword:
Main request and first to third auxiliary requests - admittance - exceptional circumstances (no)
Fourth to sixth auxiliary requests - inventive step (no)

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Case Number: T 0756/24 - 3.5.04

D E C I S I O N
of Technical Board of Appeal 3.5.04
of 28 October 2025

Appellant: (Applicant)	LG Electronics Inc. 128, Yeoui-daero, Yeongdeungpo-gu Seoul 07336 (KR)
Representative:	Mooser, Sebastian Thomas Wuesthoff & Wuesthoff Patentanwälte und Rechtsanwalt PartG mbB Schweigerstraße 2 81541 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 6 February 2024 refusing European patent application No. 18887638.7 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair	B. Willems
Members:	B. Le Guen
	G. Decker

Summary of Facts and Submissions

I. The appeal is against the decision to refuse European patent application No. 18 887 638.7.

II. The prior-art documents cited in the decision under appeal included the following:

D3: US 2017/0094313 A1

D6: Jianle Chen et al., "*Algorithm Description of Joint Exploration Test Model 7 (JEM 7)*", Joint Video Exploration Team (JVET) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11, 7th Meeting, Torino, IT, 13-21 July 2017, JVET-G1001-v1, server date: 19 August 2017, XP030150980

III. The decision under appeal was based on the grounds that the subject-matter of the claims of the main request and of the first and second auxiliary requests then on file did not involve an inventive step (Articles 52(1), 56 EPC).

IV. The applicant (appellant) filed notice of appeal. With the statement setting out the grounds of appeal, the appellant re-filed the claims of the main request and of the first and second auxiliary requests on which the decision under appeal was based, and explained why in its view the claimed subject-matter involved an inventive step.

V. The appellant was summoned to oral proceedings. In a communication under Article 15(1) RPBA, the board gave its preliminary opinion that the subject-matter of the

claims of the main request and of the first and second auxiliary requests lacked an inventive step (Articles 52(1), 56 EPC).

VI. By letter dated 23 September 2025, the appellant filed amended claims of a main request and first to third auxiliary requests.

VII. The oral proceedings before the board were held on 28 October 2025.

The appellant's final requests were that the decision under appeal be set aside and that a European patent be granted on the basis of the claims of the **main request** filed by letter dated 23 September 2025 or, alternatively, one of the **first to third auxiliary requests** filed by letter dated 23 September 2025 or any of the **fourth to sixth auxiliary requests** filed with the statement of grounds of appeal as the main request and the first and second auxiliary requests.

At the end of the oral proceedings, the chair announced the board's decision.

VIII. **Claim 2** of the requests at hand reads as follows:

Main request

"An image encoding method performed by an encoding apparatus, the method comprising:
deriving (S1100) residual samples for a target block;
deriving (S1110) transform coefficients for the target block by performing a secondary transform for primary transform coefficients obtained based on the residual samples;

deriving (S1120) quantized transform coefficients by applying quantization based on the transform coefficients for the target block; and
encoding (S1130) information about the quantized transform coefficients to output a bitstream,
wherein the secondary transform is based on a non-separable transform and is performed based on a matrix operation using a transform matrix, wherein the transform matrix is a non-square matrix,
wherein a number of the primary transform coefficients to which the secondary transform based on the non-separable transform is applied is N,
characterized in that
a size of the transform matrix is RxN, wherein R is equal to a number of the transform coefficients derived by the secondary transform based on the non-separable transform, R is less than N, and each of N and R is a positive integer,
wherein the R transform coefficients are derived as an output of the matrix operation by performing the matrix operation on all of the N primary transform coefficients, and
wherein based on a size of the target block being larger than 8x8, R is equal to 16."

First auxiliary request

As claim 2 of the main request, except for the following differences (additions are shown by underlining and deletions by ~~strikethrough~~):

"An image encoding method performed by an encoding apparatus, the method comprising:
[...]
wherein the R transform coefficients are derived as an output of the matrix operation by performing the matrix

operation on all of the N primary transform coefficients, ~~and~~
wherein based on a size of the target block being larger than 8x8, R is equal to 16, and
wherein for the target block of which size is 64x64, the secondary transform based on the non-separable transform is applied to the N primary transform coefficients constituting 64 primary transform coefficients arranged in a top-left 8x8 area of the target block, R is equal to 16 and 16<N<=64."

Second auxiliary request

As claim 2 of the first auxiliary request, except for the following differences (additions are shown by underlining and deletions by ~~strikethrough~~):

"An image encoding method performed by an encoding apparatus, the method comprising:
[...]
wherein the R transform coefficients are derived as an output of the matrix operation by performing the matrix operation on all of the N primary transform coefficients,
wherein based on a size of the target block being larger than 8x8, R is equal to 16, and
wherein for the target block of which size is 64x64, the secondary transform based on the non-separable transform is applied to the N primary transform coefficients constituting 64 primary transform coefficients arranged only in a top-left 8x8 area of the target block, R is equal to 16 and 16<N<=64."

Third auxiliary request

As claim 2 of the main request, except for the following differences (additions are shown by underlining and deletions by ~~strikethrough~~):

"An image encoding method performed by an encoding apparatus, the method comprising:
deriving (S1100) residual samples for a target block;
deriving a transform coefficient block for the target block by performing primary transform for the residual samples for the target block, the transform coefficient block with a width W and a height H comprising W x H primary transform coefficients, W and H being larger than 8;
deriving (S1110) transform coefficients ~~for the target block~~ by performing a secondary transform for primary transform coefficients ~~obtained based on the residual samples~~ in a top-left 8x8 area of the transform coefficient block;
deriving (S1120) quantized transform coefficients by applying quantization based on the transform coefficients for the target block; and
encoding (S1130) information about the quantized transform coefficients to output a bitstream,
[...]
wherein the R transform coefficients are derived as an output of the matrix operation by performing the matrix operation on all of the N primary transform coefficients, ~~and~~
wherein for the target block of which size is 64x64, the secondary transform based on the non-separable transform is applied to the N primary transform coefficients constituting 64 primary transform coefficients arranged in 8x8 block, and R is predetermined to be 16,

wherein based on a size of the target block being larger than 8x8, R is equal to 16."

Fourth auxiliary request

"An image encoding method performed by an encoding apparatus, the method comprising:
deriving (S1100) residual samples for a target block;
deriving (S1110) transform coefficients for the target block by performing a secondary transform for primary transform coefficients obtained based on the residual samples;
deriving (S1120) quantized transform coefficients by applying quantization based on the transform coefficients for the target block; and
encoding (S1130) information about the quantized transform coefficients to output a bitstream,
wherein the secondary transform is based on a non-separable transform and is performed based on a matrix operation using a transform matrix, wherein the transform matrix is a non-square matrix,
wherein a number of the primary transform coefficients to which the secondary transform based on the non-separable transform is applied is N,
characterized in that
a size of the transform matrix is RxN, wherein R is equal to a number of the transform coefficients derived by the secondary transform based on the non-separable transform, R is less than N, and each of N and R is a positive integer, and
wherein the R transform coefficients are derived as an output of the matrix operation by performing the matrix operation on all of the N primary transform coefficients."

Fifth and sixth auxiliary requests

As claim 2 of the fourth auxiliary request, except for the following differences (additions are shown by underlining and deletions by ~~strikethrough~~):

"An image encoding method performed by an encoding apparatus, the method comprising:
[...]
characterized in that
a size of the transform matrix is RxN, wherein R is equal to a number of the transform coefficients derived by the secondary transform based on the non-separable transform, R is less than N, and each of N and R is a positive integer, ~~and~~
wherein the R transform coefficients are derived as an output of the matrix operation by performing the matrix operation on all of the N primary transform coefficients, and
wherein for the target block of which size is 64x64, the secondary transform based on the non-separable transform is applied to the N primary transform coefficients constituting 64 primary transform coefficients arranged in 8x8 block, and R is predetermined to be 16."

Reasons for the Decision

1. The appeal is admissible.

Technical background

2. In video coding standards, a video block is typically predicted using intra or inter prediction. A prediction residual ("X") of size NxN is then transformed in the

frequency domain and the transformed coefficients are quantised and entropy coded. The spatial-to-frequency transform is typically implemented as the matrix operation C*X*R, wherein the N rows of matrix C and the N columns of matrix R contain N basis vectors (sinusoidal functions) spanning the frequency domain. A significant number of horizontal and vertical basis vectors may be required to represent a feature that is neither horizontal nor vertical. Thus such transform operating separately on rows and columns ("separable transform") may not be optimal.

3. A non-separable frequency-to-frequency ("secondary") transform ("NSST") may be applied on the result of the spatial-to-frequency ("primary") transform to reduce the number of non-zero transform coefficients. For a transformed block X of size NxN, an NSST is typically implemented as the matrix operation T*vector(X), wherein T is an N^2*N^2 matrix and vector(X) is a one-dimensional column vector containing the N^2 coefficients of X. T is typically derived using off-line training using blocks of the same class as X, e.g. blocks obtained using the same intra prediction mode.

4. To reduce computational complexity, the application at hand proposes to reduce the number of rows of the matrix T, i.e. to use only a reduced set of basis vectors to represent vector(X).

Main request and first to third auxiliary requests - admittance (Article 13(2) RPBA)

5. The **main request** and the **first to third auxiliary requests** were filed after notification of the board's communication under Article 15(1) RPBA. Pursuant to

Article 13(2) RPBA, these requests "*shall, in principle, not be taken into account unless there are exceptional circumstances, which have been justified with cogent reasons by the party concerned*".

6. Compared with the claims of the requests filed with the statement of grounds of appeal (fourth to sixth auxiliary requests at hand), the claims of the main request and the first to third auxiliary requests recite additional features allegedly taken from paragraphs [0091], [0138] to [0144] and [0150] of the application as filed (see points II.1, III.1, IV.1 and V.I of the appellant's reply dated 23 September 2025).

7. At the oral proceedings before the board, the appellant argued that these features had been added to attempt to overcome the inventive-step objection raised in the board's communication pursuant to Article 15(1) RPBA. Moreover, the board's reasoning in point 10 of that communication deviated from the reasoning set out in point II.1.4.2 of the decision under appeal.

8. The board finds that there are no "*exceptional circumstances, which have been justified with cogent reasons by the appellant*" within the meaning of Article 13(2) RPBA. In its communication pursuant to Article 15(1) RPBA, the board confirmed the examining division's finding that the subject-matter of the claims of the then-main request (fourth auxiliary request at hand) did not involve an inventive step in view of the disclosure of document D3, and that the subject-matter of the then-first and second auxiliary requests (fifth and sixth auxiliary requests at hand) did not involve an inventive step in view of the combined disclosures of documents D3 and D6 (see sections II.1, II.3 and II.5 of the decision under

appeal). In point 10 of its communication, the board, addressing in its reasoning the arguments submitted by the appellant in its statement of grounds of appeal, confirmed the examining division's interpretation of paragraph [0191] of document D3 set out in points II.2.1.1 and II.2.4.1 of the decision under appeal. Therefore the appellant's arguments do not convince the board that the main request and the first to third auxiliary requests represent a reaction to unexpected developments in the proceedings.

9. In view of the above, the board, exercising its discretion under Article 13(2) RPBA, decided not to take into account the main request and the first to third auxiliary requests.

Fourth auxiliary request - inventive step

10. An invention must not be obvious to the person skilled in the art having regard to the state of the art (Articles 52(1), 56 EPC).

11. Using the wording of **claim 2** of the **fourth auxiliary request** at hand, document **D3** discloses:

An image encoding method performed by an encoding apparatus (see D3, Figure 8), the method comprising:

- deriving residual samples for a target block (see D3, Figure 8, "*RESID BLOCKS*"; Figure 5: "*Residual block 101*");
- deriving transform coefficients for the target block by performing a secondary transform for primary transform coefficients obtained based on the residual samples (see D3, Figure 8: "*TRANSFORM PROCESSING UNIT 252*"; Figure 10A: "*PRIMARY*

TRANSFORM UNIT 802", "*SECONDARY TRANSFORM UNIT 804*"; Figure 5: 100, 106; paragraph [0134]);

- deriving quantized transform coefficients by applying quantization based on the transform coefficients for the target block (see D3, Figures 8 and 10A: "*QUANTIZATION UNIT 254*"; Figure 5: 114); and
- encoding information about the quantized transform coefficients to output a bitstream (see D3, Figure 8: "*ENTROPY ENCODING UNIT 256*"),
- wherein the secondary transform is based on a non-separable transform (see D3, paragraph [0044]: "*the use of a non-separable transform as the secondary transform may provide improved transform efficiency*"; Figure 5: 106; paragraphs [0131] and [0134]) and is performed based on a matrix operation using a transform matrix (see D3, paragraph [0091]: "*a non-separable 2-D transform may first reorganize all elements of X into a single vector, namely X', by applying the following mathematical mapping:* $X'_{(i*N+j)}=X_{i,j}$ *Then, a 1-D transform T' may be applied for X' as below:* $Y=T'X'$ *In the equation above, T' is an (M*N)x(M*N) transform matrix.*").

12. In addition to the above features, claim 2 of the fourth auxiliary request essentially specifies that the transform matrix has R rows and N columns, with $R < N$, and is applied to N primary transform coefficients to derive R secondary transform coefficients.

13. Paragraph [0191] of D3 reads as follows:

"*In an example of the eighth technique, for an NxN block, a zero-out NSST may be applied such that only the first M coefficients are calculated, and the*

remaining N-M coefficient may be considered to be zero. For instance, for a 1-dimensional coefficient vector that includes N number of coefficients, video encoder 20 may apply an NSST that calculates only the first M of the N coefficients of the 1-dimensional coefficient vector and sets the remaining (i.e., N-M) coefficients of the 1-dimensional coefficient vector to zero."

On pages 4 to 6 and 10 of its statement of grounds of appeal, the appellant submitted that paragraph [0191], when read in the context set out in paragraphs [0185], [0186], [0189] and [0190] of D3, taught applying an RxR NSST to the first R coefficients of the input area, the remaining N-R coefficients being considered to be zero. Setting the remaining N-R coefficients of the input coefficients to zero caused some data loss (see page 7 of the statement of grounds of appeal, first full paragraph).

The board does not share the appellant's view. The natural understanding of paragraph [0191] of D3 is that only M of the N coefficients that would normally have been calculated are calculated, i.e. instead of multiplying an NxN NSST by an Nx1 input vector of primary transform coefficients, only the first M rows of that NxN NSST are multiplied by that Nx1 input vector. The skilled person would have understood that this corresponds to an approximation of the input vector using a subset of the basis vectors. Moreover, the skilled person would have understood from the term "only" that the remaining N-M rows of the NxN NSST are **not** multiplied by the input vector. Instead, the N-M remaining coefficients are set to 0.

14. The value R specified in claim 2 of the fourth auxiliary request cannot be distinguished from the

value M of paragraph [0191] of document D3. Therefore it is not apparent that fewer coefficients are derived by the secondary transform in the method of claim 2 than in the method of paragraph [0191] of D3. Moreover, contrary to the appellant's submissions (see statement of grounds of appeal, page 8, last paragraph and page 9, first paragraph), the fact that N-R zeroes are appended to the R transform coefficients derived by the second transform to obtain an output vector having the same size (N) as the input vector is not ruled out by claim 2. It may be necessary to obtain an output vector having the same size as the input vector to rearrange the coefficients in a two-dimensional block before quantisation and entropy coding. Therefore no difference can be identified between the secondary transform coefficients that are signalled to the decoder by applying the methods of claim 2 of the fourth auxiliary request and paragraph [0191] of D3.

For these reasons, the board finds that the subject-matter of claim 2 neither reduces complexity nor has higher coding performance when compared with the disclosure of document D3 (see statement of grounds of appeal, page 6, second paragraph and page 10, fourth full paragraph).

15. Extracting an MxN sub-matrix consisting of the first M rows of the original NxN NSST matrix and multiplying that sub-matrix by the Nx1 vector of primary transform coefficients would have been an obvious way of calculating the first M coefficients. In applying that obvious solution, the skilled person would have arrived at an encoding method falling within the ambit of claim 2 of the fourth auxiliary request.

16. In view of the above, the board agrees with the examining division that the subject-matter of claim 2 of the fourth auxiliary request (main request filed with the statement of grounds of appeal) does not involve an inventive step.

Fifth and sixth auxiliary requests - inventive step

17. Claim 2 of the **fifth and sixth auxiliary requests** differs from claim 2 of the fourth auxiliary request in that it specifies that i) the size of the target block is 64x64, ii) the N primary transform coefficients constitute 64 primary transform coefficients arranged in an 8x8 block, and iii) R is predetermined to be 16.

18. According to the method disclosed in paragraph [0191] of D3, the size of the target block is NxN and N also constitutes the number of primary transform coefficients which would normally be calculated if all the rows of the NxN NSST were applied.

19. It can be derived from paragraph [0134] and Figure 5 of D3, *inter alia*, that the primary transform coefficients undergoing the NSST are obtained at the encoder by reorganising a two-dimensional block of primary transform coefficients as a one-dimensional vector according to a scanning order. Paragraph [0137] of D3 teaches that the one-dimensional vector may be obtained by scanning a square 4x4 coefficient group using a zig-zag scanning order. This operation is reversed at the decoder (see paragraph [0135] and Figure 6). In view of this, it would have been obvious to obtain the Nx1 vector of primary transform coefficients specified in paragraph [0191] of D3 by scanning a square coefficient group using a zig-zag

scanning order. This would have implied a coefficient group of size $N^{1/2}$ by $N^{1/2}$.

20. At the oral proceedings, the appellant argued that paragraph [0134] and Figure 5 of document D3 related to the "*third technique*", whereas paragraph [0191] of D3 was part of the "*eighth technique*". The combination of these techniques was not hinted at in the document.

21. These submissions are not convincing. Paragraph [0191] specifies *inter alia* that an NSST is applied to a one-dimensional vector that includes N coefficients. Paragraph [0191] does not specify how the one-dimensional vector is obtained from the two-dimensional block of primary transform coefficients. The determination of a one-dimensional vector to be given as input to an NSST is the focus of the third technique disclosed in paragraphs [0131] to [0147]. Thus the skilled person implementing the embodiment disclosed in paragraph [0191] would have relied on that third technique.

22. In view of the above, the features identified in point 17. above merely differentiate the claimed subject-matter from an obvious implementation of the embodiment disclosed in paragraph [0191] of D3 in that $N = 64$ (i.e. $N^{1/2} = 8$) and $R = 16$.

23. On page 15 of the statement of grounds of appeal, the appellant submitted that the features identified in point 17. above enhanced transmission efficiency as allegedly disclosed in paragraphs [138] to [144] of the application as filed.

24. However, paragraphs [138] to [144] of the application as filed do not attribute any effect to the values 64 and 16. It is clear that these values merely represent exemplary values among several, the feature enhancing transmission efficiency being that R is smaller than N.

25. As indicated by the examining division in point II.3.4.4 of the decision under appeal, document D6 teaches using transform blocks of sizes larger than or equal to 64 by 64 for high-resolution videos. Thus, for such videos, the skilled person would have modified the encoder disclosed in D3 to include the possibility of obtaining transform blocks of size 64 by 64. Moreover, the skilled person would have chosen (or would have designed the encoder so that it selects) the values of N and M specified in paragraph [0191] of D3 to minimise a given rate-distortion cost. The case N = 64 and R = 16 is merely one among several that would have been arrived at depending on the input content and the target bitrate.

26. In view of the above, the board agrees with the examining division that the subject-matter of claim 2 of the fifth and sixth auxiliary requests (first and second auxiliary requests filed with the statement of grounds of appeal) does not involve an inventive step.

Conclusion

27. Since the main request and the first to third auxiliary requests were not taken into account under Article 13(2) RPBA and the fourth to sixth auxiliary requests are not allowable, the appeal must be dismissed.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chair:

K. Boelicke B. Willems

Decision electronically authenticated