PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

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PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43*bis*.1)

	Date of mailing *(day/month/year)* see form PCT/ISA/210 (second sheet)
Applicant's or agent's file reference see form PCT/ISA/220	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2016/064707	24.06.2016	

International Patent Classification (IPC) or both national classification and IPC
INV. H04N19/119 H04N19/147 H04N19/176 H04N19/513 H04N19/91

Applicant
HUAWEI TECHNOLOGIES CO., LTD.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-16
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-16
Industrial applicability (IA)	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

1 **Re Item VIII**

Certain observations on the international application

The application does not meet the requirements of **Article 6 PCT**, because **claims 1, 9, 10, 15 and 2, 5, 7, 11, 12, 14** are not clear for the following reasons:

8.1. Concerning claim 1:

8.1.1. First of all, the first video coding block (400) is partitioned into a first segment (400a) and a second segment (400b), but claim 1 does not define how the second segment is further processed.

8.1.2. Secondly, claim 1 defines that "the first video coding block (400) is associated with a plurality of virtual partitions (500a-f) of the first video coding block (400), and

each virtual partition (500a-f) is associated with a respective subset of the plurality of video coding blocks of the current frame of the video signal,

> wherein each video coding block of the respective subset neighbors the first video coding block (400) and is associated with a motion vector".

8.1.2.1. It is not clear how the association between:

- a virtual partition of the first video coding block and
- a subset of video coding blocks neighboring the first video coding block,

is created or decided.

8.1.3. Thirdly, claim 1 defines "an encoding processor (102) configured to encode, for each of the virtual partitions (500a-f), the first segment motion vector on the basis of at least one motion vector of the neighboring video coding blocks associated with the selected virtual partition (500a-f) for encoding the first video coding block (400)".

It is not clear how the first segment motion vector is encoded on the basis of at least one motion vector of the neighboring video coding blocks associated with the selected virtual partition.

8.1.4. In the expression "and coding information including the encoded first segment motion vector", it is not clear how the first segment motion vector has been encoded, i.e. it is not clear to which virtual partition was associated the neighboring video coding block(s) of which the motion vector(s) served as a basis for encoding the first segment motion vector.

8.1.5. Also, it is not clear which "performance measure" is associated with the encoding of the first segment motion vector.

8.1.6. Finally, it is not clear what is done with the selected virtual partition, else than its use for encoding the first segment motion vector.

8.2. Concerning claim 9:

The above applies mutatis mutandis to independent method **claim 9**, which comprises all the technical features of apparatus **claim 1** but in terms of method steps.

8.3. Concerning claim 10:

It is not clear how the decoding of the first segment motion vector on the basis of at least one motion vector of the neighboring video coding blocks associated with the identified virtual partition (500a-f) of the first video coding block is performed.

8.4. Concerning claim 15:

The above applies mutatis mutandis to independent method **claim 15**, which comprises all the technical features of apparatus **claim 10** but in terms of method steps.

8.5. In dependent **claim 2**, it is not clear which "rate distortion measure" can be "associated with the encoding of the first segment motion vector".

8.6. In dependent **claim 5**, it is not clear how the boundary motion vector can be encoded on the basis of the first segment motion vector and/or on the basis of a second segment motion vector associated with the second segment (400b).

8.7. In dependent **claim 7**, it is not clear how the first segment motion vector is encoded on the basis of at least one motion vector of the neighboring video coding blocks associated with the selected virtual partition (500a-f) of the first video coding block (400) using motion vector merging.

8.8. In dependent **claim 11**, it is not clear how the first segment motion vector is decoded on the basis of at least one motion vector of the neighboring video coding blocks associated with the virtual partition (500a-f) of the first video coding block and at least one motion vector of a video coding block in a neighboring frame of the encoded video signal.

8.9. In dependent **claim 12**, it is not clear how the first segment motion vector is decoded on the basis of at least one motion vector of the neighboring video coding blocks associated with the virtual partition (500a-f) of the first video coding block using motion vector merging.

8.10. In dependent **claim 14**, it is not clear how a boundary motion vector associated with a boundary between the first segment and the second segment is decoded on the basis of the first segment motion vector.

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1 EP 2 597 874 A1 (NTT DOCOMO INC [JP]) 29 May 2013 (2013-05-29)

D2 WO 2013/067939 A1 (LI YINGJIN [CN]) 16 May 2013 (2013-05-16)

D3 US 2007/065025 A1 (PANICONI MARCO [US] ET AL) 22 March 2007 (2007-03-22)

5. 1. Furthermore, the above-mentioned lack of clarity notwithstanding, the subject-matter of **claim 1** does not involve an inventive step in the sense of **Article 33(3) PCT**, and the criteria of **Article 33(1) PCT** are therefore not met.

5.1.1. **D1** is regarded as being the prior art closest to the subject-matter of **claim 1**, and insofar as this claim can be understood, this document shows an apparatus for encoding a video signal, the video signal comprising a plurality of frames, each frame being dividable into a plurality of video coding blocks (`fig. 1: "image predictive encoding device" 100; par. [0053]-[0054]`), the apparatus comprising:

a partitioner (`par. [0055];fig. 1: "prediction block partitioning type selector" 113`) configured to partition a first video coding block (`par. [0055]: "target encoding block"`) of the plurality of video coding blocks of a current frame of the video signal into a first segment and a second segment (`fig. 20: (B), (C), (E), (F), (G), (H); par. [0055]: "`*For example, it selects one of (A) to (H) in Fig. 20 for each encoding block and sub-partitions the encoding block according to the selected mode. Each partitioned region is called a prediction region (prediction block) and each of the partition methods (A) to (H) in Fig. 20 is called a prediction block partition type.*"),

wherein the first segment is associated with a first segment motion vector relative to a first reference frame of the video signal (`par. [0056]: "`*The motion information estimator 114 detects motion information necessary for generation of a predicted signal of each prediction block in the target encoding block. An applicable method of generation of the predicted signal (prediction method) are* *inter-picture prediction and the intra-picture prediction [...]. In this case, the motion information contains a motion vector, an inter-picture prediction mode (forward/backward/ bidirectional prediction), a reference frame number, and so on. The detected motion information is output each via line L114 to the prediction information memory 115 and the prediction information encoder 116.*"),

wherein the first video coding block is associated with a plurality of virtual partitions of the first video coding block (fig. 12 (A): "T1a", "T1b"; par. [0117]: "*Fig. 12 shows examples in which the encoding block 400 and neighboring block 402 are similarly vertically bisected but their partition shapes are different. In these examples, the prediction block T1 (block including blocks T1a and T1b) in (A) of Fig. 12 and the prediction block T2 (block including blocks T2a and T2b) in (B) of Fig. 12 also have three neighboring blocks. For T1 in (A) of Fig. 12, the processing flow of Fig. 11 is applied to step S256 in Fig. 7, whereby it becomes feasible to execute the block merging by setting pieces of motion information of blocks Ba and Bb to respective blocks T1a and T1b resulting from virtual vertical bisection of the prediction block T1.For T2 in (B) of Fig. 12, a processing flow of Fig. 13 described below is applied to step S261 in Fig. 7, whereby it becomes feasible to execute the block merging by setting pieces of motion information of blocks Ba and Bb to respective blocks T2a and T2b resulting from virtual vertical bisection of the prediction block T2. On this occasion, it is also possible to adopt the method of transmitting second merging identification information for each virtual block and identifying either generation of the predicted signal of the virtual block based on the motion information of the neighboring block or encoding/decoding of motion information.*"), and each virtual partition is associated with a respective subset of the plurality of video coding blocks of the current frame of the video signal, wherein each video coding block of the respective subset neighbors the first video coding block (fig. 12 (A): "Ba", "Bb" for example) and is associated with a motion vector (par. [0117]: "*by setting pieces of motion information of blocks Ba and Bb to*")

an encoding processor configured to encode, for each of the virtual partitions, the first segment motion vector on the basis of at least one motion vector of the neighboring video coding blocks associated with the selected virtual partition for encoding the first video coding block (par. [0117]: "*On this occasion, it is also possible to adopt the method of transmitting second merging identification information for each virtual block and identifying either generation of the predicted signal of the virtual block based on the motion information of the neighboring block or encoding/decoding of motion information.*;")
and
a selector (115) configured

to select the ~~virtual~~ partition (500a-f) of the first video coding block (400) on the basis of a respective performance measure associated with the encoding of the first segment motion vector (par. [0055]: "*Each partitioned region is called a prediction region (prediction block) and each of the partition methods (A) to (H) in Fig. 20 is called a prediction block partition type. An available method of selecting a prediction block partitioning type is, for example, a method of carrying out each of sub-partitions of the signal of the target encoding block fed via line L102, actually carrying out below-described prediction processing and encoding processing, and selecting a partitioning type to minimize a rate-distortion value calculated from the power of an encoding error signal between the original signal of the encoding block and a reconstructed signal, and a code amount necessary for encoding of the encoding block, but is not limited thereto.*";),

and to generate a ~~virtual~~ partition identifier identifying the ~~virtual~~ partition selected by the selector and coding information including the encoded first segment motion vector (par. [0016] teaches implicitly that "previously-decoded prediction information (motion information and prediction block partitioning type) of the target coding block" is signaled).

5.1.2. The subject-matter of **claim 1** therefore differs from this known **D1** in that it is the virtual partition which is selected on the basis of a respective performance measure associated with the encoding of the first segment motion vector, not the actual partition.

5.1.3. The problem to be solved by the present invention may therefore be regarded as selecting the best virtual partition.

5.1.4. The solution proposed in **claim 1** of the present application cannot be considered to involve an inventive step (**Article 33(3) PCT**).

Indeed, **D1** teaches selecting the best actual partition, in terms of rate-distortion. Thus the skilled person, departing from said teaching, would, without exercising any inventive skills, select the best virtual partition based on rate-distortion analysis as well.

5.2. The above applies mutatis mutandis to independent method **claim 9**, which comprises all the technical features of apparatus **claim 1** but in terms of method steps, and to independent decoding apparatus **claim 10** and decoding method **claim 15**, as well as computer program **claim 16**.

Thus the subject-matter of **claims 1, 9, 10, 15** does not involve an inventive step in the sense of **Article 33(3) PCT**, and the criteria of **Article 33(1) PCT** are therefore not met.

5.3. Concerning the dependent claims:

Dependent claims 2-8, 11-14 does not appear to contain any additional features which, in combination with the features of any claim to which it refers, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

claim 2: The apparatus (100) of claim 1, wherein the selector (115) is configured to select the virtual partition of the first video coding block (400) on the basis of a respective rate distortion	This is not inventive, see **D1**, par. [0055]: "*[...] selecting a partitioning type to minimize a rate-distortion value calculated from the power of an encoding error signal between the original*

measure associated with the encoding of the first segment motion vector, in particular by minimizing the rate distortion measure.	*signal of the encoding block and a reconstructed signal, and a code amount necessary for encoding of the encoding block, but is not limited thereto*.";
claims 3, 11: The apparatus (100) of claim 1 or 2, wherein the encoding processor (105) is configured to encode the first segment motion vector on the basis of at least one motion vector of the neighboring video coding blocks associated with the selected virtual partition (500a-f) of the first video coding block (400) and at least one motion vector of a co-located video coding block in a neighboring frame of the video signal.	see **D1**, par. [0086]: "*Furthermore, the motion information contains the motion vector, the inter-picture prediction mode (forward/backward/ bidirectional prediction), the reference frame number, and so on.*"; par. [0115]: "*In cases where a block neighboring the prediction block includes an intra-picture predicted block (intra), it is also possible to apply the technique of virtually partitioning the prediction block and generating the predicted signal, [...] Based on the prediction block partitioning type of the neighboring block and the prediction mode (**inter-picture**/intra-picture prediction) in the prediction information, the intra-picture predicted block in the neighboring block is virtually integrated **with an inter-picture predicted block with motion information** (thick lines in the drawing).*

	In these examples, an intra-picture predicted block is virtually integrated with an inter-picture predicted block which is closer to the upper left corner of the neighboring block and which is closest to the intra-picture block. [...]In this manner, even in the cases where the neighboring block includes an intra-picture predicted block (intra), the generation of the predicted signal by block merging can be carried out using the motion information of the inter-picture predicted block in the neighboring block."; Inter-prediction usually makes use of co-located video coding blocks and their motion vectors;
claim 4: The apparatus (100) of any one of the preceding claims, wherein the encoding processor (102) is configured to encode the virtual partition identifier along with the first video coding block (400).	see **D1**, par. [0055]: a prediction block partition type; par. [0065]: "*the prediction information encoder 116 entropy-encodes either or both of block merging information and the motion information, along with the prediction block partitioning type.*";
claim 5: The apparatus (100) of any one of the preceding claims, wherein a **boundary**	par. [0213] of **D1**: "*When the partial regions U1, L1, U2, and L2 are set as described*

motion vector is associated with a boundary (401) between the first segment (400a) and the second segment (400b) of the first video coding block (400) and wherein the encoding processor (102) is configured to encode the boundary motion vector on the basis of the first segment motion vector and/or on the basis of a second segment motion vector associated with the second segment (400b).	*above, candidates for the motion vector predictor of each sub-partition are generated from motion vectors of previously-processed partial regions located on the same side with respect to the extension line of the boundary between sub-partitions.*"; **D3**, par. [0043]
claim 6: The apparatus (100) of claim 5, wherein the encoding processor (102) is configured to encode the boundary motion vector by rescaling a first segment motion vector of the co-located video coding block in a reference frame.	Rescaling a motion vector of a co-located video coding block in inter-frame prediction is well known to the skilled person;
claims 7, 12: The apparatus (100) of any one of the preceding claims, wherein the encoding processor (102) is configured to encode the first segment motion vector on the basis of at least one motion vector of the neighboring video coding blocks associated with the selected virtual partition (500a-f) of the first video coding block (400) **using motion vector merging.**	see **D1**, par. [0115]: "*As a consequence, the prediction block T1 is virtually partitioned according to the number of inter-picture predicted blocks in the neighboring block, as shown in (A) to (F) of Fig. 10. In this manner, even in the cases where the neighboring block includes an intra-picture predicted block (intra), the generation of*

	the predicted signal by block merging can be carried out using the motion information of the inter-picture predicted block in the neighboring block.";
claims 8, 13: The apparatus (100) of any one of the preceding claims, wherein the set of virtual partitions (500a-f) of the first video coding block (400) comprises the partitions 2NxN, Nx2N, 2NxnU, 2NxnD, nLx2N and nRx2N of the first video coding block (400).	asymmetric partitioning is known from **D2**, page 5, lines 22-30: "*The partitioning mode is one of 2NxnU, 2NxnD, nLx2N and nRx2N if the coding unit is partitioned asymmetrically.*";
claim 14: The apparatus (200) of any one of claims 10 to 13, wherein the decoding processor (205, 207, 215) is configured to decode **a boundary motion vector associated with a boundary** between the first segment and the second segment on the basis of the first segment motion vector and wherein the partitioner (221) is configured to partition the co-located first video coding block in the first reference frame of the encoded video signal into the first segment	**Boundary motion vectors** are known from **D3**, par. [0043]: "*FIG. 8 shows an example of an emerging boundary field for an object. At time t1, the identified portion of the object in target image 800 is shown at 810, and the rest of the target image is considered background region. As the boundary field evolves at time t2, the identified portion of the object grows as shown at 820. Boundary motion vectors 830 are placed along the boundary of the moving object, and values for the motion vectors are estimated. The values of the*

and the second segment on the basis of the decoded boundary motion vector.	*boundary motion vectors are determined using pixels that are identified as part of the object at the current time t2. That is, only pixels inside the identified portion of the object 820 are used to estimate the boundary motion vectors 830. Each boundary motion vector is estimated using a region inside of the identified portion of the object, within a predetermined distance from the boundary. Each boundary motion vector therefore indicates motion of a small portion of the object."*