

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SNAP INC. and HISENSE USA CORPORATION,

Petitioners,

v.

NOKIA TECHNOLOGIES OY,

Patent Owner.

Case No. IPR2025-01263

U.S. Patent 10,536,714

DECLARATION OF CHARLES D. CREUSERE

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I, Charles D. Creusere, declare as follows:

1. My name is Charles D. Creusere. I am a Full Professor in the Klipsch School of Electrical & Computer Engineering at New Mexico State University. I have prepared this report as an expert witness retained by Hisense and Snap. In this report I give my opinions as to whether certain claims of U.S. Patent No. 10,536,714 (“the ’714 patent”) are invalid. I provide technical bases for these opinions as appropriate.

2. This declaration is based in part on prior declarations I prepared in early 2024 for Amazon.com, Inc. in IPR Case Nos. IPR2024-00604 and 605 involving the same Nokia ’714 patent. The prior Amazon IPRs were instituted but I understand the proceedings was terminated based on a settlement between Nokia and Amazon.

3. This report contains statements of my opinions formed to date and the bases and reasons for those opinions. I may offer additional opinions based on further review of materials in this case, including opinions and/or testimony of other expert witnesses. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters contained herein.

I. OVERVIEW OF THE TECHNOLOGY

A. Video Compression Basics

4. Video comprises a sequence of pictures, called frames. If you look closely at a frame, for example by putting a magnifying glass up to your monitor, you will see that a frame is comprised of pixels. Groups of pixels are referred to as blocks, for example a square of 8 pixels by 8 pixels.

5. Video encoding, also referred to as video compression, exploits redundancies in video data to reduce the size of video. Since the 1990s, major video coding standards, including MPEG, H.264 (“AVC”), and H.265 (“HEVC”), have applied the same block-based model: video frames are divided into blocks of pixels, a motion estimation and compensation front end exploits temporal patterns where a similar-looking block appears in the same frame or a nearby frame, and then a coded bitstream is produced in subsequent stages that include a transform stage and entropy encoding. Ex-1023, 000004. At the decoder, the inverse process is used to decode the video back into the original frames.¹ *Id.* A high-level conceptual diagram of encoder/decoder stages is illustrated below. *See e.g.*, Ex-1019, Fig. 2:

¹ Many of the video coding concepts, including HEVC concepts, described in this declaration still apply today.

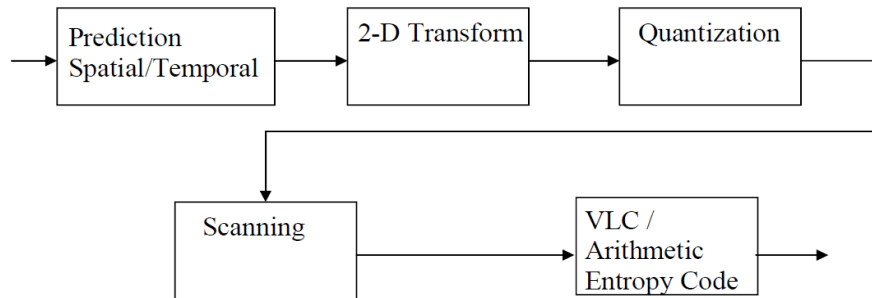


Fig. 2: Higher-level encoder block diagram

B. Motion Vectors and Inter Prediction

6. Blocks could be encoded using inter or intra-frame modes. *Intra*-frame encoding exploited redundant patterns within the same frame, with a block possibly being encoded with reference to another block in the same frame. *Inter*-frame coding allowed a block to be encoded with reference to similar blocks in other frames.

7. For example, inter-picture prediction was useful when an object moved across the screen in successive frames. In the example below, the same airplane on the bottom left of one frame appears on the top-right of the next frame.

Ex-1021, 000002 (emphasis added):

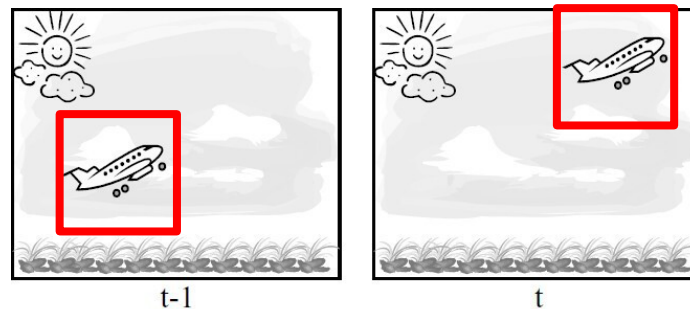
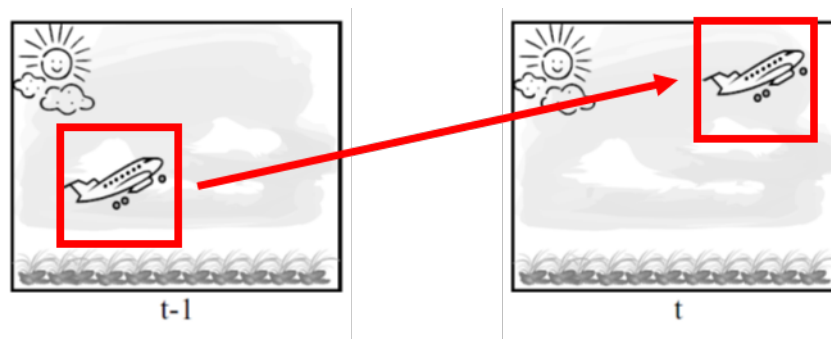


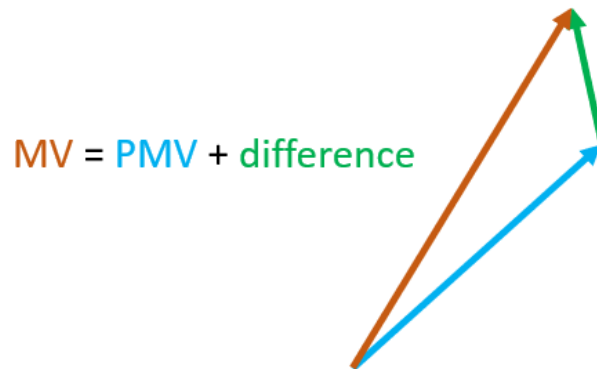
Fig. 3. Successive video frames

8. Since the block containing the airplane shifted to the right (in the X direction) and upwards (in the Y direction), a motion vector was used to describe this X-Y displacement. Ex-1017, 000002-4; Ex-1018, 000001-3. In other words, motion vectors described the motion of blocks between frames. Rather than transmit the pixels for this block twice (once for each frame), the video codecs instead transmitted the block once, for the first frame, and then signaled a motion vector, an index to a reference block in the first frame, and the residual difference between the motion compensated first frame block and the current frame block. The decoder would then use this information to reconstruct the second frame using the block from the first frame. *See e.g., Ex-1021, 000004, Fig. 3 (emphasis added):*



9. By sending a motion vector, a block index, and the residual difference, rather than an entire block of pixels, video codecs reduced the amount of data in the encoded video stream. Nonetheless, since each frame contained many thousands of blocks with frames streaming at 30 or 60 frames a second, the volume of data for transmitting motion vectors could be significant. *See Ex-1018, 000001.*

10. To reduce the amount of data used to signal motion vectors, the ITU utilized predicted motion vectors in its H.264 standard as well as in the successor



standard that became H.265. Ex-1018, 000001-2. For example, early iterations of H.264 used the median values of motion vectors from three spatially-neighboring blocks as a Predicted Motion Vector (“PMV”) or motion vector predictor (“MVP”). *Id.* Since the encoder and decoder could independently calculate this PMV, there was no need to transmit the entire vector; instead, a smaller difference vector was inserted into the video stream to indicate the difference between the predicted and actual motion vector for a block. *Id.*

11. By 2010, the idea of using neighboring blocks to find PMV candidates was well-known. For example, in 1999 this approach was discussed in connection with MPEG-4 in IEEE Transactions on Image Processing:

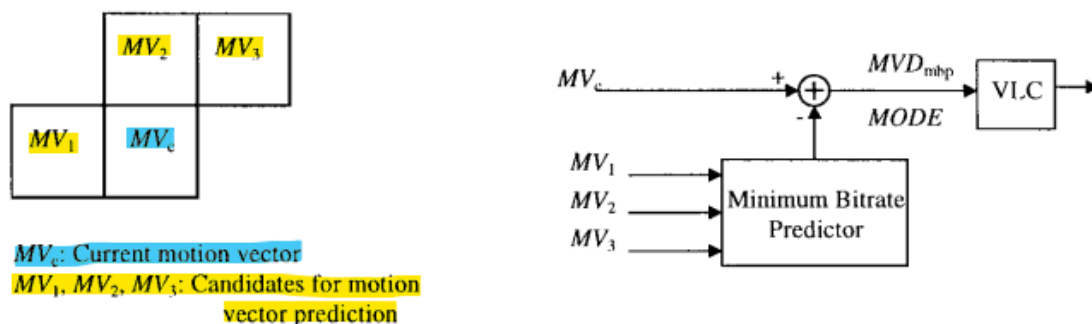
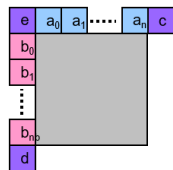


Fig. 1. Motion vector coding scheme.

Ex-1009, 1118. Ruster described a similar technique for application to H.264. Ex-1004, ¶¶2-3. Early H.265 proposals and drafts also used this approach. For example, Samsung's initial response to the H.265 call for proposals referred to this technique as "Advanced Motion Vector Prediction (AMVP)":

Motion: Advanced Motion Vector Prediction (AMVP)

- Advanced Motion Vector Prediction (**AMVP**)
 - Extension of motion vector competition techniques
- Explicit motion vector predictor signaling
 - New candidate motion vectors
(motion vector candidates = {median(a' , b' , c'), a' , b' , c' , temporal predictor})
 - **Three spatial motion vectors (a' , b' , c')**
 - The first available one for each group (inter mode & same ref. idx)
 - Groups are the above group $\{a_0, a_1, \dots, a_{na}\}$, the left group $\{b_0, b_1, \dots, b_{nb}\}$ and the corner $\{c, d, e\}$
 - Median motion vector of three spatial motion vectors
 - Temporal motion predictor using one colocated motion vector
- **Signaling overhead is minimized**
 - Candidate order is adapted according to PU splitting
 - **Unnecessary or duplicated motion vectors are removed**




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Ex-1010, 12 (highlighting added); *see also* Ex-1011, 11-12 (discussing AMVP).

12. Generally, in these approaches, since the encoder and decoder independently generated the same candidate list (using information from the same already encoded neighboring blocks), the encoder simply signaled to the decoder which candidate was chosen from the list, for example sending an index value of “2” to signal the second candidate from the list. *See, e.g.*, Ex-1009 at 1117-18 (discussing MODE bits used to signal which candidate from the set of PMV

candidates was used in coding the block). These approaches reduced the amount of motion vector data in the bitstream because the encoder did not need to transmit the candidate list or a motion vector; instead, the encoder transmitted a single, small number to signal which candidate was chosen, and the decoder referred to its independently-constructed candidate list, which was identical to that of the encoder, to look up the candidate using the index. *See e.g.*, Ex-1004, ¶37.

13. Motion vector candidates from the same frame, including those from neighboring blocks in the frame, were called spatial motion vector prediction candidates. Ex-1018, 000001-3. Neighboring blocks were often good sources of motion vector candidates because neighboring blocks tend to have the same motion. For example, when a scene pans to the right, objects in the background will tend to have similar motion towards the left across the screen. Ex-1018, 000001-2. Predicted motion vectors take advantage of such patterns to decrease the amount of data used to encode motion vectors, as explained above.

14. Redundant motion vector prediction candidates, however, can increase the size of the index needed to signal which candidate was selected as the predictor for a given block. *E.g.*, Ex-1004, ¶7, ¶107 (explaining that more bits are “needed to specify the candidate vector” as the number of vectors grows). For example, if the neighboring blocks all have the same motion vector, it would be redundant to include all of them as motion vector predictor candidates. Therefore, H.264 and H.265 both analyzed spatial motion vector prediction candidates to

remove redundant ones. In fact, it was common in the art to remove redundant motion vector candidates. For example, this was taught for H.264 and in working drafts of H.265. Ex-1004, ¶21, ¶62; Ex-1010, §8.4.2.1.1, §8.4.2.1.7.

15. For H.264, prior art that applied H.264 included methods for selecting PMV candidates from the set of all previously-coded blocks. Since “[l]imiting and/or reducing the number of candidates ... can be helpful to reduce the overhead of signaling,” it was known in the art to “avoid duplicate occurrences of the same motion vector” by “comparing the candidates already in the list with the new vector that could be added[,]” which comprised a “subset” of candidates from blocks within an allowed distance from the current block, rather than the full set of previously-coded blocks. Ex-1004, Abstract, ¶¶70-71.

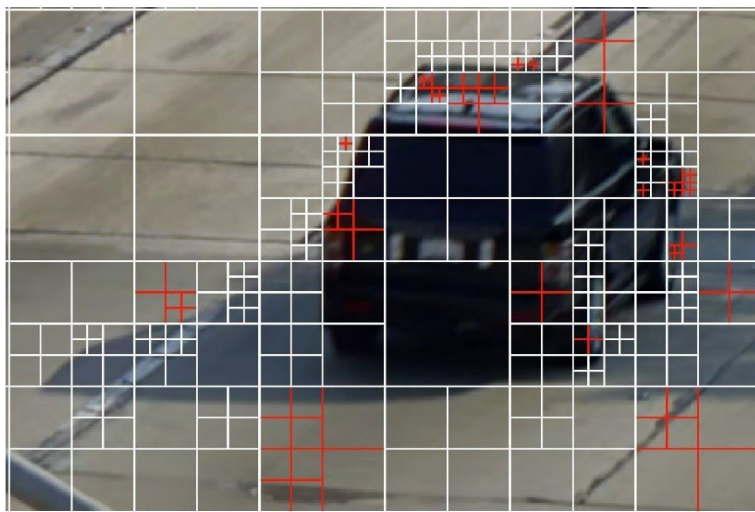
C. H.264 to H.265

16. The H.264 standard (also standardized by the ISO as MPEG Advanced Video Coding (“AVC”)) was published in 2003. H.264 was widely used for compression of video at HD (high definition) resolutions and below, and from the beginning it was popular in consumer electronics and Internet streaming. In 2010, the standardization process began for the successor video standard, which was called H.265 by the ITU and also referred to as the High Efficiency Video Coding (“HEVC”) standard by the ISO.

17. H.265 used H.264 as a starting point and incorporated many of the same concepts. Both standards followed the same overall architecture for block-

based video coding, as explained above. Both also used predicted motion vectors for motion compensation. Ex-1004, ¶¶3; Ex-1005, ¶¶3; Ex-1006, ¶¶4.

18. HEVC introduced new terminology for a type of block called a “coding unit” or “CU,” which was analogous to macroblocks in H.264. *See* Ex-1005, ¶¶32-33; Ex-1006, ¶¶4. CUs could be split into smaller CUs to fit visual patterns in the frame. “The basic partition geometry of all these elements is encoded by a scheme similar to the well-known quad-tree segmentation structure.” *See* Ex-1015, 00005; Ex-1016 at 00002 (Fig. 1):



19. Motion vectors operated on the basis of a block called a “prediction unit” or “PU.” Ex-1005, ¶¶35; Ex-1006, ¶¶25. In the simplest scenario, one CU would be covered by a PU of the same size, and a single motion vector would be assigned to the entire CU/PU. *See* Ex-1005, ¶¶35. This approach was used when the contents of an entire CU moved in the same direction, such as large blocks of road in the above image. Conversely, when different portions of a CU moved in

different directions, the CU could be divided into multiple PUs, with different motion vectors assigned to each PU. *See id.*

20. HEVC referred to an undivided CU (consisting of one PU the same size) as being $2N \times 2N$. When a CU was split horizontally into two symmetric rectangular PUs, it was referred to as a $2N \times N$ partition size. A vertically divided CU was referred to as an $N \times 2N$ partition size. Example partition modes are shown below. Ex-1006, ¶4; Ex-1014, ¶3, Fig. 2:

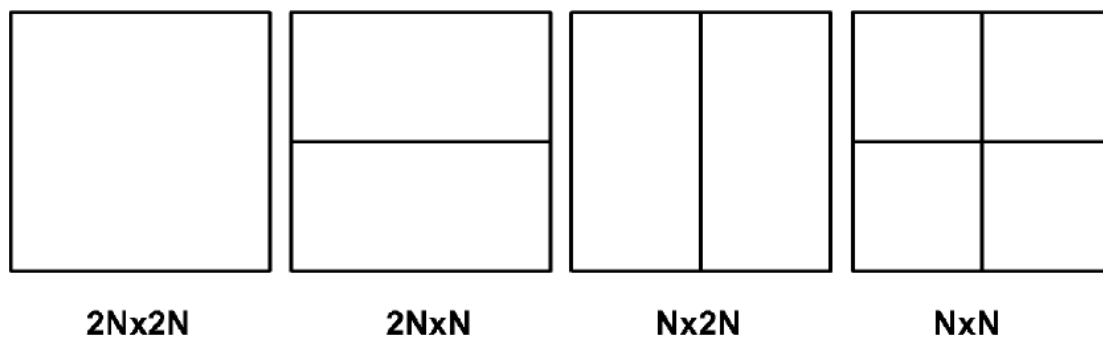


Fig. 2

See also, e.g., Ex-1010 (Samsung proposal) at 11 (showing same partition scheme).

II. THE '714 PATENT

A. Overview

21. The '714 patent is directed to video encoding and decoding in the context of H.263, H.264, and Working Draft 4 of H.265/HEVC, which the purported patent admits were pre-existing video codecs that pre-dated the '714 patent. Ex-1001, 1:40-42, 2:21-25.

22. The patent admits that prior video codecs “create[d] motion vector predictions” (“MVP”) by “generat[ing] a list or a set of candidate predictions from blocks in the current frame and/or co-located or other blocks in temporal reference pictures and signalling[sic] the chosen candidate as the motion vector prediction.” Ex-1001, 3:5-19, 3:60-66. “A spatial motion vector prediction is a prediction obtained only on the basis of information of one or more blocks of the same frame as the current frame whereas temporal motion vector prediction is a prediction obtained on the basis of information of one or more blocks of a frame different from the current frame.” *Id.* “After the list is generated, some of the motion vector prediction candidates may have the same motion information. In this case, the identical motion vector prediction candidates may be removed to reduce redundancy.” *Id.*, 3:66-4:3. To find redundant MVP candidates, the candidates in the list must be compared to each other.

23. The ’714 patent seeks to “improv[e] the prediction accuracy and hence possibly reducing information to be transmitted in video coding systems.” Ex-1001, 8:24-28. To this end, the ’714 patent purports to introduce “a method for generating a motion vector prediction list” in “a way to reduce the complexity of the implementation.” Ex-1001, 4:18-23. According to the ’714 patent, “[t]his can be achieved by performing a limited number of motion information comparisons between candidate pairs to remove redundant candidates rather than comparing every available candidate pair.” Ex-1001, 4:18-27. In particular, the ’714 patent

claims recite limitations for “determining a subset” of spatial MVP candidates and then “comparing motion information” of a selected candidate with the subset, “without making a comparison of each pair from the [full] set of spatial motion vector prediction candidates[.]” Ex-1001, claim 1.

24. However, as explained below, the prior art already included techniques for removing redundant MVP candidates without comparing each pair from the full set of candidates. *Supra* §I.

B. Priority Date

25. The ’714 patent is one of a chain of continuation applications beginning with the ’833 patent and claims priority to a provisional application filed on November 4, 2011. I have not conducted any analysis as to whether the ’714 patent is entitled to its claim of priority. For the purposes of this declaration, I have applied a November 4, 2011 priority date for my opinions without regard to whether the ’714 patent is entitled to such a priority date.

C. Challenged Claims

26. I understand that Petitioner is challenging the validity of claims 1-30 of the ’714 patent in the Petition for Inter Partes Review to which this declaration will be attached. Those claims are reproduced in Appendix 3. While this Petition and declaration are directed to the challenged claims, I have also considered portions of the ’714 patent prosecution history in forming my opinions.

III. SUMMARY OF THE PRIOR ART

27. There are a number of patents and publications that constitute prior art to the '714 patent. I have reviewed and considered the prior art discussed in this section, along with the materials listed in Appendix 2.

A. Invalidity Grounds

28. Based on my review and analysis of the materials cited herein, my opinions regarding the understanding of a POSITA in the relevant timeframe (*supra* §II.C), and my training and experience, it is my opinion that the challenged claims of the '714 patent are invalid based on the following grounds:

Ground	Claims	Statutory Basis	Prior Art
1	1-3, 5-10, 12-17, 19-24, 26-30	§103	Rusert and Karczewicz
2	1-30	§103	Rusert, Karczewicz, and Lin

29. I understand that Rusert, Karczewicz, and Lin were not cited or considered during prosecution of the '714 patent. None of these references or any related patents are listed on the face of the '714 patent. In addition, I reviewed the file history for the '714 patent and am not aware of these references being discussed in any office action or in the prosecution history generally.

B. Rusert (Ex-1004)

30. Rusert is U.S. Patent Application Publication No. 2011/0194609 to Rusert et al., entitled "Selecting Predicted Motion Vector Candidates." Rusert was

filed on February 7, 2011 and was published on August 11, 2011. I understand Rusert is prior art to the '714 patents under at least pre-AIA §102(a) and §102(e).

31. I have reviewed the Rusert reference. I understand that Rusert was not cited or considered during prosecution of the '714 patent based primarily on the fact that Rusert is not cited on the face of the '714 patent and or discussed in the prosecution history.

32. Rusert teaches a method for selecting Prediction Motion Vector candidates (“PMV candidates”) for video encoding and decoding. Ex-1004, Abstract. Rusert reduces the number of candidates using a “subset of the set of previously coded motion vectors that were used for previous blocks[,]” e.g., by limiting the candidates to those used “for previous blocks having an allowed distance from the current block.” Ex-1004, ¶11. When the list of candidates is updated, duplicates and essentially “similar” vectors are excluded. *Id.* ¶¶70-73. A candidate is selected from the list and used for motion prediction by the encoder and decoder. *Id.* ¶¶12-13, ¶¶88-99.

33. The list of PMV candidates is called “PMV_CANDS.” I note that Rusert includes some typographical errors where this name is mistyped as “PMV_SANDS.” E.g., Ex-1004, ¶6, ¶39, ¶42, ¶44, ¶88. This is clearly a typo, which would have been clear to POSITA in the context of Rusert. Several paragraphs use both “PMV_SANDS” and “PMV_CANDS” to refer to the same list. *See, e.g.*, Ex-1004, ¶39 (describing how “[u]pdate means that one or more

motion vectors are added to an existing PMV_SANDS list[]” and how “[a] PMV_CANDS list may be updated”), ¶42 (referring to “one or multiple PMV_CANDS lists” and “either a single or two different PMV_SAND”), ¶44 (describing how “[t]he PMV_CANDS list may be updated” and how “to update PMV_SANDS[]”), ¶88 (referring to “candidates in PMV_SANDS” and “candidates in the PMV_CANDS list.”). Moreover, the places where Rusert refers to “PMV_SANDS” have corresponding discussions in Rusert’s provisional application that correctly state “PMV_CANDS”. Compare Ex-1004, ¶6 with Ex-1012, 000003-4. Furthermore, this name is easily mistyped because the letter “S” is close to “C” on QWERTY keyboards and both appear in the name. Moreover, this type of typographical error is commonplace with Microsoft Word because it is all capital letters, which Microsoft Word often skips (there is a setting for the spell check to omit all-caps words).

34. Rusert discloses performing “an *outwards going scan* ... around the current block to obtain motion vectors to update PMV_[C]ANDS.” Ex-1004, ¶¶44, 58 (“spiral scan” wherein the “scan order spirals outwards”). Rusert discloses several “scan patterns” specifying the order in which PMV candidates in the vicinity of a current block are considered based on their distance (*i.e.*, Chebyshev and/or Euclidian distances) from the current block being encoded (or decoded). Ex-1004, ¶¶43-66. Various distance measurements and scan patterns are shown in Figures 3a to 3n. Ex-1004, ¶30 (“FIGS. 3a to 3n illustrate possible

scan patterns and distance measurements for a plurality of blocks surrounding a current block”).

35. To reduce the number of PMV candidates considered, the scan patterns may be restricted to blocks in “allowed positions” such as corner and middle block positions. Ex-1004, ¶¶15-16, 113. Fig. 3n, for example, depicts a scan pattern where “all blocks other than the corner blocks and the blocks directly above and to the left of the current block are excluded.” Ex-1004, ¶65. That figure is annotated below to show groupings of blocks at different distances from the current block being encoded, i.e., the ‘.’ block in the center of the figure.

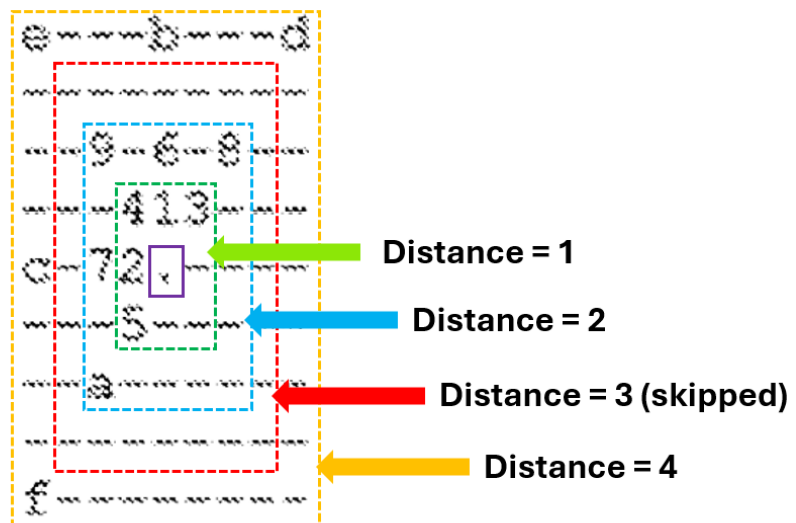


Fig. 3n

Ex-1004, Fig. 3n (color annotations added). The Fig. 3n scan pattern also skips all PMV candidates having a Chebyshev distance of 3 from the current block. Ex-1004, ¶64 (scanning may be limited to candidates at distances that are powers of 2 from the current block); Fig. 3m. The numbers and letters in the pattern signify the

order in which the blocks are evaluated from 1 through 9 and then a through f. Ex-1004, ¶53. Rusert discloses “the search pattern shown in FIG. 3n has been found to combine good compression efficiency (i.e., finding good motion vectors) with good computation performance.” Ex-1004, ¶66

36. Because the scan starts with PMV candidates closest to the current block and progresses to candidates that are further away, the candidate list (PMV_CANDS) is naturally sorted by distance and no explicit sorting by distance needs to be performed. Ex-1004, ¶¶50, 73, 53 (“We then select blocks in an order that took the closest ones first, with some tie-breaking rule for blocks at the same distance. A possible order for the blocks shown in FIG. 3a is shown in FIG. 3b, where the order is shown according to: 1, 2, 3, . . . , 9, a, b, . . .”).

37. Rusert explains that “[l]imiting and/or reducing the number of candidates in PMV_CANDS can be helpful to reduce the overhead of signaling which PMV is used for motion vector prediction, since shorter lists require shorter code words.” Ex-1004, ¶84. To that end, a given PMV candidate in the scan pattern may be excluded from the candidate list (PMV_CANDS) if “the PMV candidate is a duplicate of another PMV candidate in the set; the PMV candidate is determined to be within a threshold distance of an existing PMV candidate; [or] the PMV candidate would never be used because at least one alternative PMV candidate will allow motion vectors to be coded using fewer bits.” Ex-1004, ¶21. Additionally, a maximum size of the candidate list may be specified and such that

scanning for additional PMV candidates is halted when the maximum allowed number of candidates has been reached. Ex-1004, ¶¶73, 107 (exemplary limits of 4 and 7 PMV candidates).

38. Rusert is analogous art in the same field as the '714 patent (video encoding and decoding, *infra* §IV). For example, Rusert teaches a method for a video encoding and decoding apparatus (Ex-1004, ¶1), with motion vector teachings used to encode and decode video (*id.*, ¶¶23-25).

C. Karczewicz (Ex-1005)

39. Karczewicz is U.S. Patent Application Publication No. 2011/0249721 to Karczewicz, entitled “Variable Length Coding of Coded Block Pattern (CBP) in Video Compression.” Karczewicz was filed on April 11, 2011 and was published on October 13, 2011. I understand Karczewicz is prior art to the '714 patent under at least pre-AIA §102(a) and §102(e).

40. I have reviewed the Karczewicz reference. I understand that Karczewicz was not cited or considered during prosecution of the '714 patent based primarily on the fact that Karczewicz is not cited on the face of the patent or discussed in the prosecution history.

41. Karczewicz provides video encoding/decoding teachings related to the High Efficiency Video Coding (“HEVC”) video standard, also referred to as H.265. Ex-1005, Abstract. Karczewicz teaches that H.265 is a new video coding

standard. Ex-1005, ¶32. For example, Karczewicz teaches block types in H.265, e.g., coding units and prediction units. Ex-1005, ¶¶33-35.

42. Karczewicz is analogous art in the same field as the '714 patent (video encoding and decoding, *infra* §IV). For example, Karczewicz teaches that its techniques relate to “coding video data.” Ex-1005, Abstract.

D. Lin (Ex-1006)

43. Lin is U.S. Patent Application Publication No. 2014/0092981, entitled “Method and Apparatus for Removing Redundancy in Motion Vector Predictors.” Lin was filed on June 12, 2012 and claims priority to provisional application 61/500,903, which was filed on June 24, 2011. I understand Lin is prior art to the '714 patent under at least pre-AIA §102(e).

44. It is my understanding that a prior art patent application publication is entitled to its provisional application date if the subject matter relied upon in the reference published application is described in the provisional application, and at least one of the claims of the published application is supported by the written description of the provisional application. It is my opinion that Lin is entitled to its priority date of June 24, 2011 (the filing date of its provisional application), which is before the earliest possible priority date of November 4, 2011 of the '714 patent. First, Lin's provisional application provides support for all subject matter relied-upon by this Declaration. Second, as set forth in the following table, the Lin

Provisional provides sufficient details to enable one reasonably skilled in the art to make or use the invention claimed by Lin, including as stated in Lin's claim 1.

Lin's Claim 1	Lin's Provisional
1. A method of deriving a motion vector predictor (MVP) for a current block in an Inter, Merge, or Skip mode, the method comprising:	Ex-1013, 000007, 000009, 000012
determining neighboring blocks of the current block, wherein an MVP candidate set is derived from MVP candidates associated with the neighboring blocks;	Ex-1013, 000016 (Fig. 6)
determining at least one redundant MVP candidate according to a non- MV-value based criterion;	Ex-1013, 000009-11
removing said at least one redundant MVP candidate from the MVP candidate set; and	Ex-1013, 000009-11
providing a modified MVP candidate set, wherein the modified MVP candidate set corresponds to the MVP candidate set with said at least one redundant MVP candidate removed.	Ex-1013, 000008-11

45. I have reviewed the Lin reference. I understand that Lin was not cited or considered during prosecution of the '714 patent, based primarily on the fact that Lin is not cited on the face of the patent or discussed in the prosecution history. A different reference authored by Lin, directed to different teachings, is cited on the face of the '714 patent.

46. Lin provides teachings related to removing redundant motion vector predictors (MVPs). Lin teaches that, under the HEVC standard, each coding unit (CU) contains one or multiple prediction units (PUs). Ex-1006, ¶4; Ex-1013,

000007. When a CU is divided into two PUs, Lin teaches that the MVP candidate from the second PU can be removed because it is redundant. Ex-1006, ¶44, ¶25, Fig. 7A-7D; Ex-1013, 000010, 000017.

47. Lin is analogous art in the same field as the '714 patent (video encoding and decoding, *infra* §IV). For example, Lin teaches that its disclosures relate to video coding, in particular, “coding techniques associated with derivation of motion vector predictors for motion vector coding.” Ex-1006, ¶2; *see also* Ex-1013, 000007.

IV. LEVEL OF ORDINARY SKILL IN THE ART

48. I have analyzed the '714 patent and determined that the field of the patent is video encoding and decoding. For example, the '714 patent characterizes its alleged invention as “a method for encoding, a method for decoding,” and “an encoder and a decoder.” Ex-1001, 1:18-20. More specifically, the '714 states “[t]he present invention introduces a method for generating a motion vector prediction list for an image block.” Ex-1001, 4:18-19.

49. In determining the characteristics of a hypothetical person of ordinary skill in the art (“POSITA”) of the '714 patent at the time of the claimed invention, I considered several things, including various prior art techniques relating to video encoding and decoding, the type of problems that such techniques gave rise to, and the rapidity with which innovations were made. I also considered the sophistication of the technologies involved, and the educational background and

experience of those actively working in the field at the time. I also considered the level of education that would be necessary to understand the '714 patent. Finally, I placed myself back in the relevant period of time and considered the engineers and programmers that I have worked with and managed in the field of video encoding and video decoding.

50. I came to the conclusion that a person of ordinary skill in the field of art of the '714 patent would have been a person with (1) a bachelor's degree in electrical engineering, computer engineering, computer science, or a comparable field of study such as physics, and (2) approximately two to three years of practical experience with video encoding/decoding. Additional experience can substitute for the level of education, and vice-versa. I at least qualify under the definition of a POSITA because I had a BS degree in electrical and computer engineering by 1985, with many years of experience in video encoding and decoding (more than three) by 2011, as explained in my qualifications section. *Infra* §VII.

V. CLAIM CONSTRUCTION

51. For purposes of this inter partes review, I have considered the claim language, specification, and portions of the prosecution history to determine the meaning of the claim language as it would have been understood by a person of ordinary skill in the art at the time of the invention. The “plain and ordinary meaning” or Phillips standard has traditionally been applied in district court

litigation, where a claim term is given its plain and ordinary meaning in view of the specification from the viewpoint of a person of ordinary skill in the art.

52. I have applied the *Phillips* standard in my analysis. Unless otherwise stated, I have applied the plain and ordinary meaning to claim terms.

A. “spatial motion vector prediction candidate”

53. Based on my review of the claims and specification of the ’714 patent, it is my opinion that a POSITA would have understood a “spatial motion vector prediction candidate” to mean a candidate motion vector obtained from one or more previously-encoded blocks in the current frame.

54. The specification of the ’714 patent states that “a spatial motion vector *prediction* is a prediction obtained only on the basis of information of one or more blocks of the same frame than the current frame.” Ex-1001, 3:9-14.

Furthermore, the specification “defines candidate motion vectors for the current frame by using... one or more neighbour blocks and/or other blocks of the current block *in the same frame*...” Ex-1001, 12:51-56. Therefore, a spatial motion vector prediction *candidate* would be a candidate motion vector obtained only on the basis of information of one or more blocks of the current frame. *See* Ex-1001, 3:9-14, 12:51-56. The specification further states that spatial motion vector prediction candidates are obtained from “one or more already encoded block.” Ex-1001, 12:58-59. That is, because spatial motion vector prediction candidates are “define[d]... by using one or more of the motion vectors of one or more neighbour

blocks and/or other blocks of the current block in the same frame[,]" each spatial motion vector prediction candidate "represents the motion vector of one or more already encoded block." Ex-1001, 12:51-59.

B. "temporal motion vector prediction candidate"

55. Based on my review of the claims and specification of the '714 patent, it is my opinion that a POSITA would have understood a "temporal motion vector prediction candidate" to mean a candidate motion vector obtained from a previously-encoded frame.

56. The specification of the '714 patent states that a "temporal motion vector *prediction* is a prediction obtained on the basis of information of one or more blocks of a frame different from the current frame." Ex-1001, 3:12-14. Furthermore, the specification states that "for temporal prediction... motion vectors of a co-located block or other blocks in a previously encoded frame can be selected as candidate predictors for the current block." Ex-1001, 12:63-13:3.

C. "the block"

57. In the prior IPR cases, the PTAB construed "the block" to mean "the block associated with the first spatial motion vector prediction candidate." Ex-1007, 16-18; Ex-1008, 15-17. This Declaration applies this prior construction of the PTAB.

D. “a subset of ... candidates”

58. Limitation [1b] recites “a subset of ... candidates,” which means a subset of one or more candidates. The claims confirm that the subset may comprise one candidate. Limitation [1c] compares motion information of a potential candidate with motion information of “candidates in the determined subset” of limitation [1b]; dependent claim 3 further specifies that the potential candidate is compared with “at most one other” candidate. The specification includes embodiments where the subset is a single candidate. Ex-1001, 15:50-16:39 (e.g., block A1 is compared with block B1, block B0 is compared with block B1, block A0 is compared with block A1), Fig. 8b.

VI. INVALIDITY

59. Based on my review and analysis of the materials cited herein, my opinions regarding the understanding of a POSITA in the 2011 timeframe, and my training and experience, it is my opinion that a POSITA would have found the challenged claims 1-30 of the '714 patent obvious in view of the invalidity grounds. The reasons for my conclusions are explained more fully below.

60. It is my opinion that a POSITA would have found the Challenged Claims obvious based on Ground 1, i.e., the teachings of Rusert alone or in combination with Karczewicz. Rusert teaches and suggests the limitations of the challenged claims. Karczewicz provides additional teachings that update Rusert's terminology and teachings in accordance with the H.265 standard.

61. It is my opinion that a POSITA would have found the Challenged Claims obvious based on Ground 2, i.e., the teachings of Rusert, Karczewicz, and Lin. In addition to the teachings provided by Rusert and Karczewicz for Ground 1, Lin provides further teachings regarding excluding redundant motion vector candidates.

A. Motivation to Combine and Reasonable Expectation of Success

62. **Rusert and Karczewicz.** Rusert provides various teachings for selecting motion vector predictor candidates for video encoding and decoding. Ex-1004, ¶¶1-4, ¶¶11-15, ¶¶24-26, ¶¶34-44. Rusert uses H.264 to explain its teachings but explains that it is not limited to any particular video standard: “while examples have been given in the context of particular coding standards, these examples are not intended to be the limit of the coding standards to which the disclosed method and apparatus may be applied.” Ex-1004, ¶116. While Rusert’s teachings and embodiments were “given in the context of H.264/AVC, *the principles disclosed herein can also be applied to ... other coding standard[s], and indeed any coding system which uses predicted motion vectors.*” *Id.*

63. The successor video standard to H.264 was called H.265. Ex-1005, ¶32. As Karczewicz teaches, by 2011, it had been widely known that H.265 was emerging as the successor video standard. *Id.* (“[t]he emerging HEVC standard... referred to as ITU-T H.265[.]”). Both H.264 and H.265 standards were drafted by

ITU-T, the Telecommunication Standardization Sector of the International Telecommunication Union.

64. H.265 used H.264 as a baseline starting point and used the same concepts of block-based video encoding with predicted motion vectors for those blocks. Ex-1005, ¶35 (“[T]he PU may include data defining a motion vector for the PU.”), ¶37 (“Each of the blocks may be predictively encoded based on blocks of previously coded pixels[.]”), ¶66, ¶71; Ex-1006, ¶5 (“[I]n HEVC, the motion vector competition (MVC) based scheme is applied to select one motion vector predictor (MVP) among a given MVP candidate set which includes spatial and temporal MVPs.”). Therefore, H.265 is a coding standard that uses predicted motion vectors—precisely the type of coding standard for which Ruser provides express motivation to combine.

65. In short, given Ruser’s express teachings to apply its teachings to other video coding standards, and the fact that the successor H.265 standard was well known in the art and taught by Karczewicz, a POSITA would have been motivated to combine the teachings of Ruser and Karczewicz. This express teaching, suggestion, or motivation in the art was sufficient, on its own, to motivate a POSITA to combine Ruser and Karczewicz. Nonetheless, a POSITA would have been motivated to make this combination for a number of additional reasons, explained below.

66. A POSITA would have been motivated to make this combination because it would have combined prior art elements according to known methods to yield predictable results. For example, the combination would have combined Rusert's motion vector teachings, including for the selection of PMV candidates for blocks, with H.265 concepts (e.g., prediction units and related information for motion vectors), according to known methods (e.g., as taught by Karczewicz and known throughout the industry based on the widespread knowledge of H.265). Rusert explains its teachings in terms of blocks, with motion vectors assigned to or obtained from blocks. Ex-1004, ¶¶2-5, ¶36, ¶43. As Karczewicz explains, H.265 introduced new terminology for a type of block called a "prediction unit" ("PU"), with motion vectors being assigned to PUs and PUs comprising the blocks that are used for motion prediction. Ex-1005, ¶¶33-36, ¶¶64-66. Karczewicz also provides related teachings on the types of information conveyed by motion vectors. Ex-1005, ¶35. Therefore, it would have been obvious to apply Rusert's motion-vector teachings to PUs in the H.265 context as a combination of prior art elements according to known methods, with predictable results as explained further below.

67. The combination would also have used Rusert's known techniques (e.g., for efficiently selecting PMV candidates) to improve similar devices and methods (e.g., for H.264 and H.265) in the same way. Rusert provides block-based motion vector teachings that were explained using H.264 as an example but were applicable to a variety of video coding standards. Ex-1004, ¶2, ¶116. This would

have included the H.265 standard, which was similar to and, in fact, derived from H.264. Ex-1005, ¶3, ¶32 (“[T]he HEVC Test Model... presumes several capabilities of video coding devices over devices according to, e.g., ITU-T H.264/AVC.”); *supra* §II.D. Karczewicz teaches aspects of the H.265 standard. Therefore, it would have been natural to apply Rusert’s teachings regarding blocks to the H.265 context, including by applying Rusert’s teachings to PUs as taught by Karczewicz, to improve the similar H.265 standard in the same way that Rusert explained for H.264. This would have applied a known technique to a known device/method that was ready for improvement, to yield predictable results as further explained below.

68. Furthermore, the combination of Rusert and Karczewicz was a simple substitution of a known element (e.g., Karczewicz’s prediction unit teachings) into Rusert’s teachings. Rusert explains its teachings in terms of the blocks that form the basis for motion vector operations, and Karczewicz explains that, for H.265 video, those blocks (whose sizes are now allowed to vary) were called “PUs.” Ex-1005, ¶6, ¶¶32-33, ¶64. Therefore, a POSITA would have been motivated to combine Rusert and Karczewicz by applying Karczewicz’s teachings regarding PUs into Rusert’s teachings for selecting PMV candidates for blocks in video frames.

69. Additionally, a POSITA would have found motivation in the similarity of the references. Both Rusert and Karczewicz are directed to video

coding. Ex-1004, ¶1 (“The present application relates to ... a video encoding apparatus, a video decoding apparatus ...”); Ex-1005, Abstract (“This disclosure describes techniques for coding video data.”). Both are discussed in the context of ITU standards, including H.264 and H.265. Ex-1004, ¶¶3-4, ¶67, ¶116 (“specific examples have been given in the context of H.264/AVC”); Ex-1005, ¶3, ¶5, ¶38, ¶¶32-33, ¶73. And while H.265 included new terminology for coding units (“CU”) and prediction units (“PU”), Karczewicz explains that all of these are blocks of image pixels (Ex-1005, ¶64 (“block” generally “may refer to one or more of a macroblock, LCU, CU, sub-CU, TU, or PU.”)), and “[i]n general, a CU” of H.265 “has a similar purpose to a macroblock of H.264[.]” Ex-1005, ¶33. In its simplest case, a CU was a PU, with the flexibility where a CU can be divided into multiple PUs. Ex-1005, ¶35 (“A CU... may include one or more prediction units (PUs).”).

70. A POSITA would also have been motivated because the combination of Rusert and Karczewicz would have yielded several advantages. For example, Rusert provides for “an improved method and apparatus for selecting PMV candidates” “to improve video coding efficiency[.]” Ex-1004, ¶7. Karczewicz provides teachings “used to improve efficiency in coding (e.g., encoding or decoding) video data.” Ex-1005, ¶6.

71. Additionally, a POSITA would have been motivated to combine Rusert’s teachings from its embodiments with Rusert’s teachings regarding the operation of H.264 in its background section. Rusert explains that its teachings are

given with examples in H.264 and therefore provides express teaching, suggestion, and motivation to combine the teachings of its embodiments with known concepts of the H.264 video standard. *See, e.g.*, Ex-1004, ¶¶3-4, ¶67, ¶77, ¶116.

72. Rusert teaches two options for initializing and updating PMV_CANDS: (1) PMV_CANDS is “dynamically generated specifically for the current motion compensation block” and (2) PMV_CANDS is “initialized once” and “updated according to a sliding window approach.” Ex-1004, ¶41. A POSITA would have been motivated to use the first option in which PMV_CANDS is dynamically generated specifically for each block because Rusert presents it as the first option. Furthermore, the first option is one of only two options, and a POSITA would have been motivated to apply at least the first option as one of a finite number of options that Rusert teaches.

73. Karczewicz discusses H.264 and H.265 and applies its teachings to both. Therefore, Karczewicz’s teachings regarding other features of H.265 would not have dissuaded a POSITA from combining with Rusert. For example, Karczewicz’s coded block pattern teachings are applicable to both H.264 and H.265. Ex-1005, ¶5, ¶38. Furthermore, Rusert’s teachings and Karczewicz’s teachings are applicable to coding and decoding blocks of pixels, regardless of the nomenclature used to label them. In my opinion, A POSITA would have understood the features introduced by H.265 do not prevent teachings with respect to H.264 from being applied to H.265, and vice-versa.

74. Moreover, the combination would have had predictable results. Rusert already applies its teachings to block-based video encoding/decoding—i.e., where the operation of motion vectors is based on blocks. *See, e.g.*, Ex-1004, ¶¶2, ¶11. Karczewicz explains that a PU is a type of block, and that the operation of motion vectors in H.265 is based on PUs. Ex-1005, ¶35. Therefore, the concepts taught in Rusert were readily applicable to PUs, and the combination would have had the predictable result of selecting PMV candidates (as Rusert teaches) for PUs (as Karczewicz teaches). *See, e.g.*, Ex-1004, ¶116.

75. Furthermore, the combination would not have changed the principle of operation for any of the teachings of the references relied upon in the combination. The combination applies teachings from Rusert and Karczewicz in the manner taught by each reference: Rusert's teachings are still applied to the selected PMV candidates for block-based video encoding/decoding using predicted motion vectors, and Karczewicz's teachings are still used with motion vectors assigned to PUs, as explained above. Applying H.265 teachings to Rusert, and vice versa, would have been consistent with Rusert's statement that its principles are applicable to other video standards. *Id.*

76. A POSITA would have had a reasonable expectation of success when combining Rusert and Karczewicz. As explained above, the combination applies teachings from each reference according to their known purposes, in a conventional manner as taught by Rusert and Karczewicz, without changing their

principle of operation. Furthermore, the teachings from Rusert and Karczewicz are complementary because both teach aspects of block-based video encoding from H.264 and H.265, respectively. Rusert provides examples using H.264, explaining it was not limited to that standard and its teachings apply to other coding standards, which naturally would have included the successor standard H.265. *Id.* Therefore, Karczewicz's teachings complement Rusert by teaching terminology and concepts from H.265. Ex-1005, ¶32.

77. Additionally, the combination had predictable results, as explained above, and Ground 1 does not modify Rusert or Karczewicz in a way that would render either reference inoperative. To the contrary, the similarities of the architectures and video standards—which both use block-based video encoding/decoding with predicted motion vectors assigned to blocks—would have given a POSITA a reasonable expectation of success in combining their teachings. *See, e.g.*, Ex-1004, ¶11 (discussing motion vectors used for coding blocks); Ex-1005, ¶2 (“[t]his disclosure relates to block-based video coding techniques...”).

78. Given the education and experience of a POSITA (*supra* §IV), a POSITA would have been more than capable of applying Karczewicz's teachings to Rusert, and vice versa, because it would simply have applied Rusert's teachings from H.264 to the successor standard H.265. Additionally, motion estimation and compensation were commonplace, having been introduced by MPEG standards in the 1990s, and H.264 had introduced the use of predicted motion vectors by the

early-mid 2000s. *Supra* §I. These were basic aspects of video encoding/decoding that a POSITA would have been knowledgeable about.

79. **Rusert, Karczewicz, and Lin.** The motivation to combine Rusert and Karczewicz was explained above. A POSITA would have been further motivated to apply Lin’s teachings for removing redundant PMV candidates, for the reasons explained below.

80. Lin teaches a way to reduce the number of motion vectors that must be considered—particularly for the scenario where a block has been divided into two PUs. Ex-1006, ¶4, ¶25, ¶44. Applying these teachings would have furthered a stated goal of Lin and Rusert by reducing the number of motion vector candidates. Rusert seeks to “reduce[] the number of previous motion vectors that must be considered” so “that less computation is needed, improving the processor efficiency of the coding.” Ex-1004, ¶12; *see also* Ex-1004, ¶7, ¶13, ¶21, ¶70, ¶84. Lin likewise seeks to reduce the number of motion vector candidates. Ex-1006, ¶¶39-40 (teaching removing redundant MVP candidates to reduce complexity), ¶47; Ex-1013, 000009 (discussing removing redundant MVPs).

81. Additionally, Karczewicz provides motivation to combine with Lin. As explained above, the combination applies Karczewicz’s PU teachings to Rusert. Karczewicz explains that CUs do not have to be divided—in the simplest case, if the block has uniform motion, the same motion vector can be assigned to the entire block. Thus, the entire CU block is a PU since there would be no reason to divide

it into multiple PUs. Conversely, if different parts of the block are moving in different directions, the CU can be divided into multiple PUs so that each can have a different motion vector. Ex-1005, ¶35; Ex-1006, ¶35; Ex-1013, 000007. In other words, the block is divided into two PUs when each half of the block has different motion. If a block is divided into two PUs because its two portions have differing motion vectors, then there is no way that the motion vector corresponding to one of these PUs can be a good predictor to the motion of the other PU. Therefore, when analyzing potential motion vectors for half of a block (that has been divided into two PUs), Lin explains that the motion vector from the other half can be removed from consideration. Ex-1006, ¶25, ¶44; Ex-1013, 000010. Lin explains that assigning the same motion vector to both halves of a divided block is redundant to the scenario where the block was not divided at all and the same motion vector was applied to the entire block comprising one PU. *See id.* Since Karczewicz already teaches that CUs can—but do not have to be—divided into PUs, a POSITA would have been motivated to reduce redundancy as Lin teaches.

82. A POSITA would have been motivated to combine Lin with Rusert and Karczewicz because it would have used Lin's known technique of reducing PMV candidates to improve similar devices/methods in the same way. After all, the combination already applied Karczewicz's PU teachings to Rusert. Adding Lin's further optimization of reducing candidates for this PU splitting scenario would have improved similar H.265 PU-based methods. A POSITA would have

applied Lin's known technique to the known devices/methods as taught by Rusert and Karczewicz, which was ready for improvement to reduce the number of previous motion vectors that must be considered. Ex-1004, ¶12. Moreover, this would have been a combination of prior art elements according to known methods to yield predictable results.

83. Furthermore, a POSITA would have been motivated by the similarity of the references. The coding units and prediction units taught by Lin are the same as those taught by Karczewicz—both refer to H.265 nomenclature. Ex-1006, ¶4 (“The basic unit for compression, termed Coding Unit (CU)... contains one or multiple Prediction Units (PUs).”); Ex-1005, ¶35 (“A CU... may include one or more prediction units (PUs). In general, a PU represents all or a portion of the corresponding CU[.]”). Both Lin and Karczewicz apply their teachings to H.265.

84. While Lin provides teachings in the context of merge mode, its teachings—e.g., for excluding redundant candidates when a block has been divided into multiple PUs—likewise apply to the combination of Rusert and Karczewicz, which seeks to efficiently select PMV candidates for a given block (as taught by Rusert) applied to PUs that can come from divided blocks (as taught by Karczewicz). The same underlying reasoning therefore applies because, even without merge mode, blocks are divided into multiple PUs to assign them different motion vectors, and it would not make sense to divide a block into separate PUs only to assign the same motion vector to both PUs. Ex-1005, ¶35; Ex-1006, ¶4;

Ex-1013, 000007. Doing so would be less efficient than keeping the entire block as a single PU and be contrary to the reason why the block was divided to begin with.

85. The combination would have had predictable results: when a block is divided into two PUs, the PMV candidate from one PU is excluded as a candidate for the other PU. Excluding the candidate would have been a predictable result consistent with the reason why a block is divided into PUs to begin with, as explained above.

86. Furthermore, the combination would not have changed the principle of operation for any of the teachings of the references. The combination applies teachings in the manner taught by each reference: Rusert and Karczewicz were explained above, and Lin's teachings are used to exclude candidates when a block is divided into two symmetric PUs, as taught and illustrated by Lin. Ex-1006, ¶44; Ex-1013, 000016. Since Ground 1 already applies H.265 PU concepts to Rusert, the application of Lin's PU teachings to this combination would have been entirely compatible with it and would not have changed its principle of operation. Ground 2 simply applies Lin's exclusion of PUs in certain scenarios.

87. A POSITA would have had a reasonable expectation of success when combining Lin with Rusert and Karczewicz. As explained above, the combination applies teachings from each reference according to their known purposes, in a conventional manner as taught by Rusert, Karczewicz, and Lin, without changing

their principle of operation. Furthermore, the teachings are complementary because all three references teach aspects of block-based video encoding from H.264 and H.265. *E.g.* Ex-1004, ¶25, ¶39; Ex-1005, ¶3, ¶5, ¶38; Ex-1006, ¶4, ¶25; Ex-1013, 000009-11. Lin's teachings apply a basic concept to further Rusert's stated goal of reducing the number of PMV candidates, by eliminating redundant ones as explained above. *E.g.*, Ex-1004, ¶25, ¶39, ¶¶42-44; Ex-1013, 000009-11.

88. Additionally, the combination would have had predictable results, as explained above, and Ground 2 does not modify Rusert, Karczewicz, or Lin in a way that would render any reference inoperative. To the contrary, the similarities of the architectures and video standards would have given a POSITA a reasonable expectation of success in combining their teachings. Ex-1004, ¶67, ¶116; Ex-1005, ¶32; Ex-1006, ¶¶4-5, ¶44; Ex-1013, 000007.

89. Given the education and experience of a POSITA (*supra* §IV), a POSITA would have been more than capable of applying Lin's teachings to Rusert and Karczewicz because it would simply have applied the concept of excluding candidates in a particular scenario as taught by Lin. Motion estimation and predicted motion vectors had been widespread for many years. *Supra* §I. These were basic aspects of video encoding/decoding that a POSITA would have been knowledgeable about.

B. Encoder Claims

90. The '714 patent includes claims that are directed to encoders and encoder-side processing as well as claims directed to decoders and decoder-side processing. I will address the encoder-side claims first and then turn to the decoder-side claims in Section VI.B.

1. Independent Claim 1

[1pre] A method comprising:

91. To the extent that the preamble is limiting, Ground 1 teaches limitation [1pre], as explained below.

92. Rusert teaches a **method**. For example, Rusert teaches “a *method* of selecting PMV candidates, wherein each PMV candidate corresponds to a motion vector used for coding of a previous block, said previous block having a distance from a current block.” Ex-1004, Abstract, ¶1, ¶11. The method further comprises the steps and elements explained below. *Infra* §§VI.B.1[1a]-[1e].

[1a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for a block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates and is utilized to identify motion vector prediction candidates of which one spatial motion vector prediction candidate from the motion vector prediction list is signaled as the motion information for the prediction unit;

93. Ground 1 teaches limitation [1a], as explained below.

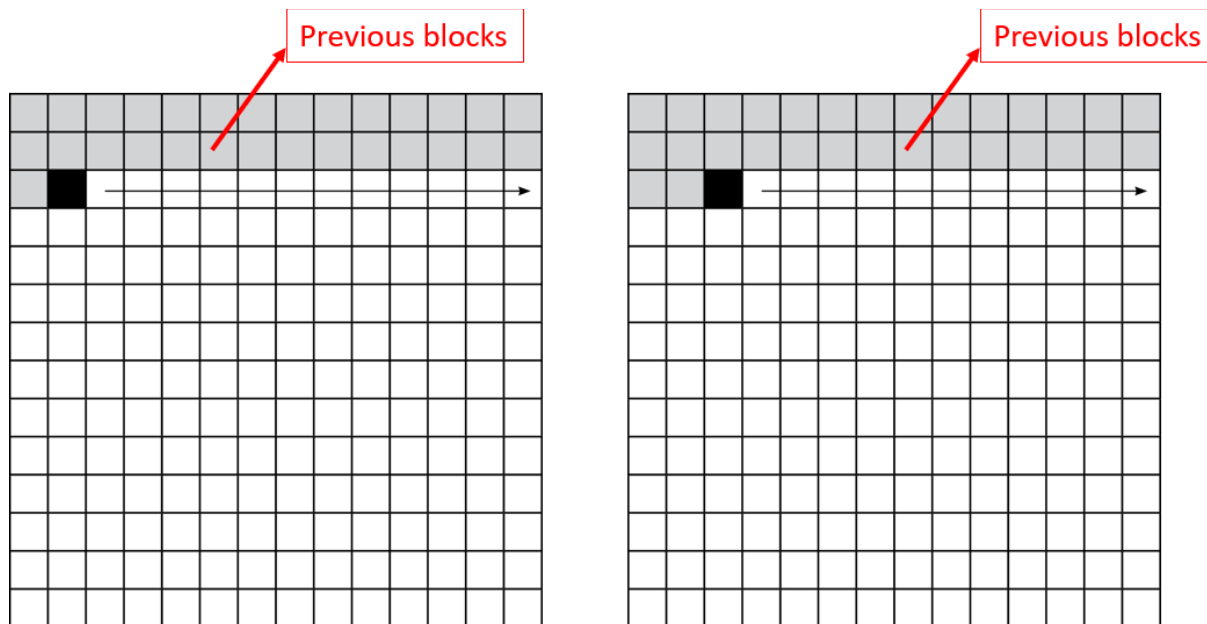
94. Ground 1 teaches **selecting a first spatial motion vector prediction candidate** (e.g., a PMV candidate) **from a set of spatial motion vector**

prediction candidates (e.g., set of previously-coded motion vectors or set of PMV candidates in Rusert's scan pattern) **for a block of pixels**. For example, Rusert refers to a predicted motion vector as a "PMV" (Ex-1004, ¶3) and teaches "selecting ... PMV candidates" from a "set of previously coded motion vectors that were used for previous blocks[.]" Ex-1004, ¶11, ¶12, ¶15, ¶24, ¶25, ¶39, ¶113, Fig. 6. Rusert's "set of previously coded motion vectors that were used for previous blocks" is "a set of spatial motion vector prediction candidates" as claimed. PMV_CANDS is a list of predicted motion vectors and is therefore a motion vector prediction list. *Id.*

95. Rusert's PMV candidates comprise spatial motion vector prediction candidates that are obtained from one or more previously-encoded blocks in the current frame. *Supra* §V.A. Rusert teaches that the PMV candidates include "*spatially* neighboring motion vectors" (Ex-1004, ¶6) with one of the PMV candidates being selected as a "*motion vector predictor*... for [a] vector to be coded" (Ex-1004, ¶3). *See also* Ex-1004, ¶¶4-5. Furthermore, Rusert teaches that PMV candidates are evaluated for inclusion in a PMV_CANDS list, which includes spatial and temporal motion vector prediction candidates, e.g., "[m]otion vectors" that "comprise *spatial* or temporal *neighbors of the current block*[.]" Ex-1004, ¶67. Since neighboring blocks are next to the current block in the current frame, Rusert's spatially neighboring motion vectors from those neighboring

blocks are obtained only on the basis of information of one or more blocks of the current frame. Ex-1004, ¶¶4-6.

96. The PMV candidates are selected from a “set of previously coded motion vectors that were used for previous blocks[,]” which is a set of spatial motion vector prediction candidates for a block of pixels. *E.g.*, Ex-1004, ¶¶11-12. As Rusert iterates through pixel blocks in a frame (e.g., PUs in the terminology of H.265), each block will have its own “dynamically generated” set of previously-coded motion vectors, specific for that block and different from those of all other blocks. As pixel blocks in the video frame are encoded, the number of blocks previous to the current block increases; therefore, the set of previously-coded motion vectors that were used for previous blocks expands with each encoded pixel block. *See id.* Ex-1004, ¶59. Blocks are encoded/decoded in sequence, with a common approach being a raster scanning order (from top left to bottom right). *See, e.g.*, Ex-1004, ¶59 (teaching that “the blocks to the right and below the current block position have not been visited yet, and do not yet have motion vectors known for them”), Fig. 3g. I have illustrated this concept below where the current block is indicated in black. Each time the current block advances, the set of spatial motion vector prediction candidates increases by one.

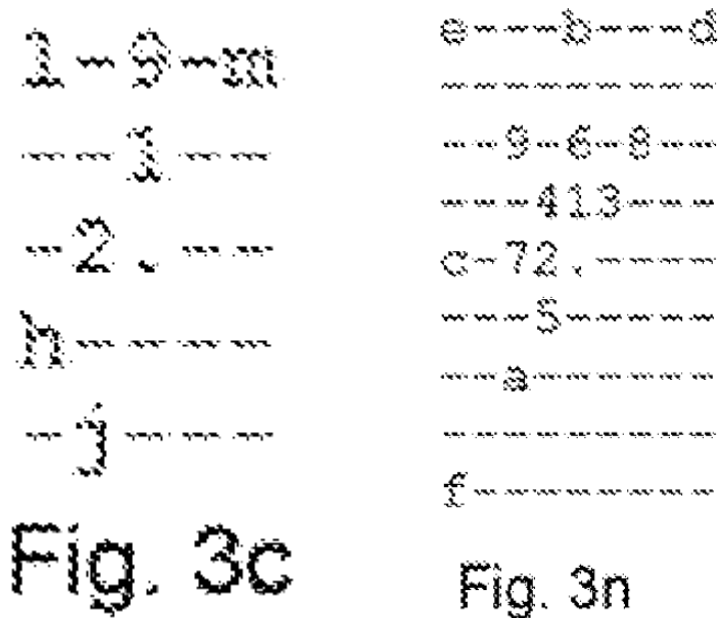


Regardless of the scan pattern used, the sets of spatial motion vector prediction candidates are different for different blocks of pixels. Rusert's teachings are applied to "pixel blocks" or blocks of pixels, as further described below. Ex-1004, ¶2, ¶36.

97. Additionally, and in the alternative, the set of PMV candidates in the scan pattern is also "a set of spatial motion vector prediction candidates" as claimed. In Rusert's method, only PMV candidates associated with blocks within the scan pattern are evaluated and used to construct the PMV_CANDS candidate list. Ex-1004, ¶¶53-54, 58, 64-66.

98. Accordingly, the claimed "first spatial motion vector prediction candidate" is selected from (1) the set of motion vectors associated with the previously coded blocks in the frame, and (2) the set of PMV candidates associated with the blocks in the scan pattern. Both of these sets satisfy the claimed "set of spatial motion vector prediction candidates."

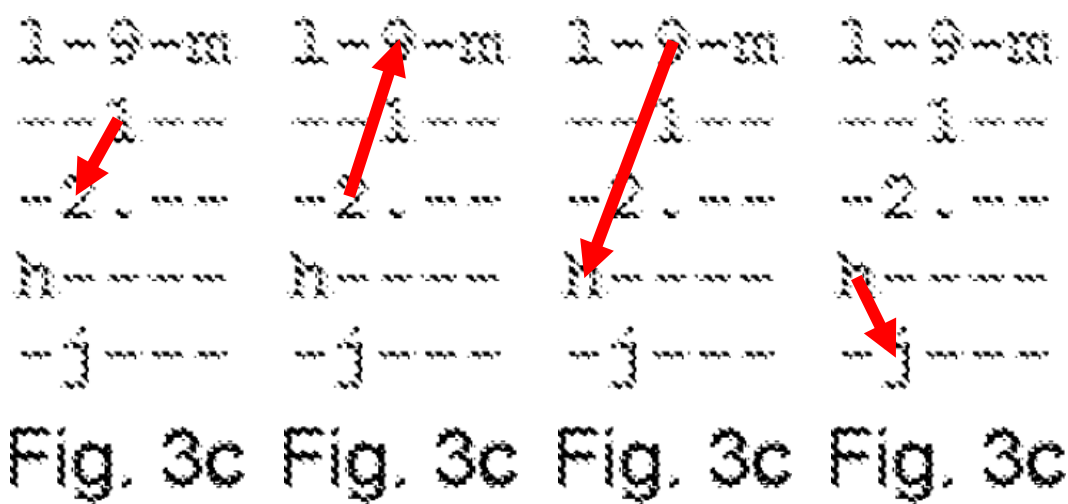
99. Ground 1 further teaches **selecting a first... candidate... as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list** (e.g., PMV_CANDS). For example, Rusert teaches selecting candidate motion prediction vectors in “an outwards going scan... around the current block” for PMV candidates to potentially be included in a PMV_CANDS list. Ex-1004, ¶¶44, 51-66. Rusert teaches numerous examples of “first...candidate” selection process (see Ex-1004, Figs. 3a-n), including Fig. 3c and the “search pattern shown in FIG. 3n” that “has been found to combine good compression efficiency (i.e., finding good motion vectors) with good computation performance.” Ex-1004, ¶66, Figs. 3a-3n:



100. I note that Fig. 3c illustrates a scan pattern “in the following order: 1, 2, 9, h, j, l, m[]” with “1” (one) being the block located directly above the current block “.” and “l” (lowercase l) being the block located in the upper left corner. Ex-1004, ¶54. Fig. 3n illustrates a scan pattern with “an ordering as shown”: 1, 2, 3, 4,

5, 6, 7, 8, 9, a, b, c, d, e, f with “a” being hexadecimal for 10, “b” being hexadecimal for 11, and so on. Ex-1004, ¶65.

101. Rusert selects PMV candidates in the sequences taught by its search patterns, starting with a first candidate labelled “1” in its figures. Ex-1004, ¶¶51-66, Figs. 3a-n. Each candidate is selected from the set of previously-coded motion vectors that were used for previous blocks as well as from the set of blocks in the scan pattern. Ex-1004, ¶¶11, ¶12, ¶15, ¶24, ¶25, ¶39, ¶44, ¶¶51-66. Rusert teaches visiting (in order) each block in the scan pattern and evaluating the motion vector for that block as a candidate for potential inclusion in PMV_CANDS. Ex-1004, ¶44, ¶¶51-66; *infra* §§VI.B.1[1c]-[1d] (explaining how the selected candidate is compared with candidates in PMV_CANDS for potential inclusion in PMV_CANDS). In the figures below, I have illustrated how the scan would proceed using the search pattern in Fig. 3c (horizontally):



and for Fig. 3n (horizontally):

e---b---d	e---b---d	e---b---d
-----	-----	-----
---9-6-8---	---9-6-8---	---9-6-8---
---413---	---413---	---413---
c-72,-----	c-72,-----	c-72,-----
---5-----	---5-----	---5-----
---a-----	---a-----	---a-----
-----	-----	-----
f-----	f-----	f-----

Fig. 3n

Fig. 3n

Fig. 3n

e---b---d	e---b---d	e---b---d
-----	-----	-----
---9-6-8---	---9-6-8---	---9-6-8---
---413---	---413---	---413---
c-71,-----	c-72,-----	c-72,-----
---5-----	---5-----	---5-----
---a-----	---a-----	---a-----
-----	-----	-----
f-----	f-----	f-----

Fig. 3n

Fig. 3n

Fig. 3n

and for Fig. 3n again with directional annotation added:



Fig. 3n

Any given PMV candidate in the scan pattern could be the claimed “first spatial motion vector prediction candidate.”

102. PMV_CANDS is a **motion vector prediction list for a prediction unit of the block of pixels**. Ruser teaches that “[t]he PMV_CANDS list [is] used for coding a motion vector associated with a current motion compensation block[.]” Ex-1004, ¶41; *see also* Ex-1004, ¶4, ¶39, ¶42. PMV_CANDS is “dynamically generated specifically for the current motion compensation block[.]” Ex-1004, ¶41. “In that case, before a block is processed, a PMV_CANDS list is initialized and then updated with a number of previously coded or pre-defined motion vectors.” *Id.* When Ruser’s PMV_CANDS list is updated (Ex-1004, ¶39 (“Update means that one or more motion vectors are added to an existing [PMV_CANDS] list”)), it comprises a list of motion vectors for potential use in coding the current block, the motion vectors being sourced from the PMV candidates in Ruser’s scan pattern. Ex- 1004, ¶¶43-44, ¶¶51-66, ¶¶4-5, ¶¶36-39 (“A

PMV_CANDS list may be updated to include previously coded motion vectors (MV.”). When Ruser’s PMV_CANDS list is complete, a “predicted motion vector (PMV)” that “is used to predict a [motion vector]... is signaled” using PMV_CANDS and an index “to select a particular PMV candidate... from... PMV_CANDS[.]” Ex-1004, ¶36.

103. Ruser explains its teachings with references to blocks to which motion vectors are assigned. Ex-1004, ¶¶2-5, ¶36, ¶43. Therefore, in the context of Ruser’s nomenclature, the prediction unit of Ruser’s block of pixels is the block itself because Ruser’s block is the unit for which a motion vector is assigned for motion prediction. Ex-1004, ¶2 (“Each motion compensation block is assigned one motion vector (for uni-predictive temporal prediction, such as in P frames) or two motion vectors (for bi-predictive temporal prediction, such as in B frames).”), ¶3 (“in recent video coding standards such as H.264/AVC where *small motion compensation block sizes* are used”), ¶4, ¶36, ¶43 (“Before a motion vector associated with a current motion compensation block is processed, the PMV_CANDS list used for coding the current motion vector may be updated by using motion vectors associated with surrounding blocks.”). For Ruser’s teachings, a motion vector is provided for each “8x8 pixel block,” also called a “sub-block” because it is a portion of a “macroblock.” Ex-1004, ¶36. When Ruser looks for neighboring motion vectors, it scans nearby blocks where motion

vectors have been assigned to those blocks. Ex-1004, ¶¶50-67, Figs. 3a-3n. Those blocks are therefore the prediction units in the context of Rusert’s teachings.

104. Additionally, the combination of Ground 1 applies Rusert’s teachings regarding “blocks” (in the H.264 context) to prediction units (following nomenclature in the H.265 context). *Supra* §VI.A (explaining how and why Rusert and Karczewicz’s teachings would have been combined). Rusert uses H.264 terminology, and a POSITA would have found it obvious and been motivated to apply Rusert’s teachings to the successor standard H.265. *Id.* Rusert provides express motivation to do so. Ex-1004, ¶116.

105. Rusert’s motion-vector teachings are explained on the basis of “blocks” because Rusert applies H.264 terminology, where motion vectors are assigned to “blocks.” Ex-1004, ¶¶2-5, ¶36, ¶43. However, Rusert also explains that its teachings “can also be applied to... *any coding system which uses predicted motion vectors.*” Ex-1004, ¶116. As Karczewicz explains, the successor video standard H.265 introduced new terminology for a type of block called a “prediction unit” (“PU”), with motion vectors being assigned to PUs. Ex-1005, ¶¶33-36; *see also supra* §I. For H.265, “[i]n general, a CU has a similar purpose to a macroblock of H.264[.]” Ex-1005, ¶33. “A CU... may include one or more prediction units (PUs); “[i]n general, a PU represents all or a portion of the corresponding CU[.]” Ex-1005, ¶35. In its simplest case, a CU is commensurate with a PU. *Id.* “[T]he PU may include data defining a motion vector for the

PU[.]” and “the motion vector may describe, for example, a horizontal component” and “a vertical component[.]” *Id.* This motion information is used for “prediction using a PU[.]” Ex-1005, ¶36; ¶66.

106. In short, Ruser explains its teachings in terms of blocks, with motion vectors assigned to or obtained from blocks in the H.264 context. Ex-1004, ¶¶2-5, ¶36, ¶43. Karczewicz explains that, for H.265, a PU is a type of block, and motion vectors are assigned to PUs. Ex-1005, ¶64 (“[T]he phrase ‘block’ refers to any size or type of video block” and “may refer to one or more of a macroblock, LCU, CU, sub-CU, TU, or PU.”), ¶¶33-36. Therefore, based on these combined teachings, it would have been obvious to apply Ruser’s motion vector teachings to PUs in the H.265 context, with PMV_CANDS being a motion vector prediction list for a prediction unit of the block of pixels. Ex-1005, ¶¶33-36, ¶66.

107. **Where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates.** Ruser’s PMV_CANDS list comprises motion information of the spatial motion vector prediction candidates. PMV_CANDS is a “list of PMV candidates[.]” Ex- 1004, ¶37. Furthermore, “each PMV candidate corresponds to a motion vector used for coding of a previous block.” Ex-1004, ¶11; *see also* Ex-1004, ¶¶24-25, ¶39, ¶41. The motion vectors of the PMV candidate include, for example, “x and y components.” Ex-1004, ¶106, ¶36, ¶¶91-94, ¶100. Therefore, Ruser’s PMV_CANDS list includes motion information, including motion vectors and

their x and y components, of the PMV candidates. *See* Ex-1004, ¶¶2-3 (discussing motion vectors used for prediction of pixel blocks across frames); *see also* Ex-1001, 2:59-3:4 (“motion information is indicated by motion vectors associated with each motion compensated image block”). In short, Rusert teaches this limitation.

108. Additionally, Karczewicz teaches “the PU may include data defining a motion vector for the PU.” Ex-1005, ¶35. The motion vector for the PU includes “a horizontal component” (e.g., x-component), “a vertical component” (e.g., y-component), “a resolution..., a reference frame... and/or a reference list[.]” *Id.* Therefore, Karczewicz confirms that the motion vectors of Rusert’s PMV candidates include “x and y components” (Ex-1004, ¶¶106, 36, 91-94, 100) because Karczewicz teaches motion vectors include “a horizontal component” and “a vertical component[.]” Ex-1005, ¶35. Moreover, based on the combined teachings of Karczewicz and Rusert, it would have been obvious to include the PU information described by Karczewicz (e.g., “a resolution..., a reference frame... and/or a reference list”) in PMV_CANDS because the combination relies on Karczewicz’s PU teachings and applies them to Rusert. *Supra* §VI.A (explaining how the references would have been combined). Therefore, the combination of Ground 1 teaches the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates.

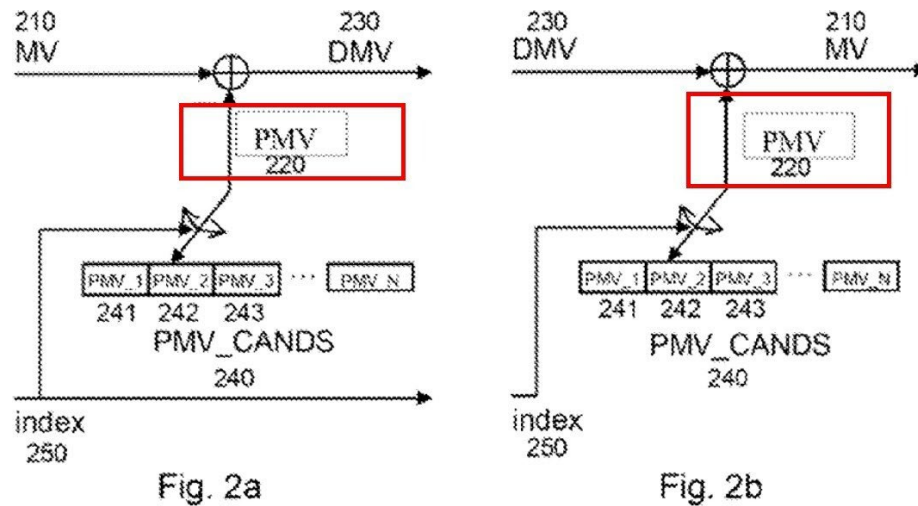
109. The PMV_CANDS list **is utilized to identify motion vector prediction candidates of which one spatial motion vector prediction candidate**

from the motion vector prediction list is signaled as the motion information for the prediction unit.² For example, Ruser teaches using an index to signal “a particular PMV candidate... from [the] list of PMV candidates, PMV_CANDS” as the “predicted motion vector (PMV)... to predict a [motion vector]” for a block. Ex-1004, ¶36; *see also* Ex-1004, ¶4 (discussing approaches to “explicitly *signal a PMV* to be used out of a set of PMV candidates, PMV_CANDS”), ¶35 (“the generation of the *signaling bits* is done in the encoder”), ¶37 (“Using the transmitted index, the decoder 150 can determine the PMV 220 as used in the encoder[.]”), ¶75 (“... use of one of the candidates in PMV_CANDS for prediction...”), ¶88, Table 1. This index is transmitted to a decoder, and the decoder uses this “transmitted index” to “determine the PMV... as used in the encoder” from PMV_CANDS to “reconstruct [a motion vector].” Ex-1004, ¶37. For example, Ruser teaches an example of using an index “3” or “0010” to signal “[PMV] candidate 3” in a PMV_CANDS list with seven PMV candidates. Ex-1004, ¶¶91-92. The index is transmitted to the decoder as the motion information for the block. Ex-1004, ¶¶35-37; *infra* §VI.B.1[1e] (providing further explanation). Therefore, Ground 1 teaches that PMV_CANDS is used to identify candidates, of which one is signaled as the motion information for the PU. As explained above, Ground 1 applies Ruser’s teachings to PUs.

² The ’714 patent admits that it was known for “video codecs” to “generate a list of motion vector prediction[.]” candidates, and that it was known for “[t]o]ne of the candidate motion vectors in the list” to be “signalled[sic] to be used as the motion vector prediction of the current block.” Ex-1001, 3:60-66.

110. Ruser teaches exemplary codes used to signal which candidate from PMV_CANDS is used for the motion information for the current block. E.g., Ex-1004, ¶¶88-102 (exemplary codes for index values shown in various tables); *infra* §VI.B.1[1e].

111. Furthermore, Ruser illustrates in Figs. 2a and 2b below that a PMV candidate, PMV 220 (PMV_2 242 in the set), is signaled as the motion information for the block:



Figs. 2a-2b teach examples of how a candidate from PMV_CANDS is signaled from encoder to decoder as the motion information for the current block; the decoder utilizes the index with PMV_CANDS to identify the motion vector prediction candidate. In these examples, the index 250 signals one PMV candidate (PMV_2 242) from PMV_CANDS, which includes a list of PMV candidates (PMV_1 241, PMV_2 242, PMV_3 243, PMV_N). Ex-1004, ¶36. The decoder uses the index 250 to identify PMV 220 as the PMV candidate to be used for the current block.

112. Ground 1 further applies Rusert’s block-based teachings to PUs. *Supra* §VI.A (explaining how and why the references would be combined). Based on the foregoing explanations, Ground 1 teaches limitation [1a].

[1b] determining a subset of spatial motion vector prediction candidates based on a location of the block associated with the first spatial motion vector prediction candidate;
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113. Ground 1 teaches limitation [1b], as explained below.

114. Rusert teaches **determining a subset of spatial motion vector prediction candidates**. Rusert teaches for each PMV candidate determining a subset of spatial motion vector prediction candidates. In particular, Rusert teaches that the evaluation of each PMV candidate includes a redundancy check whereby the PMV candidate is compared to the PMV candidates already in the PMV_CANDS list. Ex-1004, ¶71 (duplications can be avoided “when updating the list, by comparing the candidates already in the list with the new vector that could be added”). Thus, Rusert teaches or suggests using the PMV_CANDS list to determine a subset of PMV candidates for comparing with the current PMV candidate (“first spatial motion vector prediction candidate”).

115. The set of PMV candidates ascertained from the PMV_CANDS list is “a subset of spatial motion vector prediction candidates” as claimed. Ex-1004, ¶12 (“A PMV candidate list is created by selecting a subset of the motion vectors previously used for previous blocks.”). As I discussed in §III.B and in §VI.B.1[1a], Rusert discloses constructing the PMV_CANDS list using scan

patterns that exclude candidates at certain positions relative to the current block and at certain distances from the current block.³ The scan pattern thus defines a subset of the larger set of motion vector prediction candidates in the frame and the PMV candidates in the PMV_CANDS list is a subset of the PMV candidates in the scan pattern (since, *e.g.*, PMV candidates in the scan pattern may be excluded as unnecessary). Thus, the PMV candidates in the PMV_CANDS list is a subset of both larger sets.

116. Ruser improves coding efficiency by using this subset of spatial motion vector prediction candidates instead of all of previously-coded motion vectors. Ex-1004, ¶13 (“The size of the PMV candidate list is limited because a very large list would require long code words to identify which PMV candidate to use.... This allows a candidate list to be produced using motion vectors from a wide range of previous blocks, but that is not excessively long.”), ¶12 (“*Restricting the previous blocks* that are considered reduces the number of previous motion vectors that must be considered *meaning that less computation is needed, improving the processor efficiency of the coding.*”).

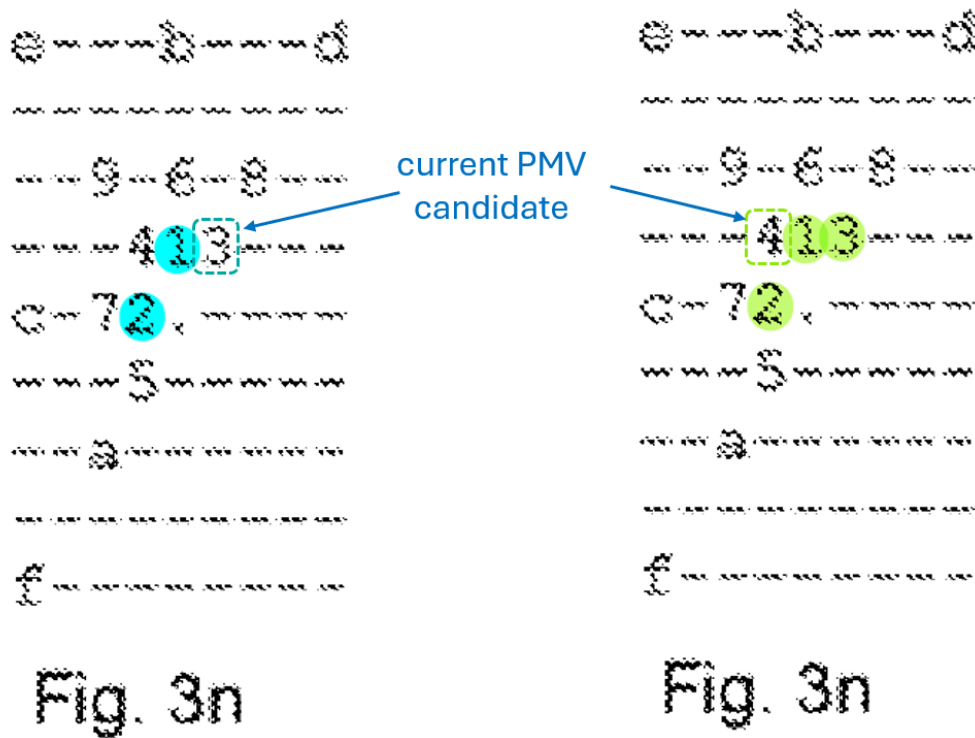
³ Additionally, Ruser teaches terminating a scan “as soon as a pre-defined number of unique PMV candidates have been found[.]” Ex-1004, ¶48. Therefore, not all PMV candidates are considered. Even PMV candidates that are within “a certain distance” and part of “a predetermined scan pattern” are not considered if the “pre-defined number of unique PMV candidates have been found.” Ex-1004, ¶¶44-49. For example, while Fig. 3n includes a scan of up to 15 blocks, Ruser terminates the scan with a subset of candidates from those blocks once a pre-determined number of candidates has been added to the PMV_CANDS list (*e.g.*, 7), without using the remaining candidates in the scan sequence. Ex-1004, ¶48, ¶107.

117. The PMV candidates in the PMV_CANDS list is **a subset ... based on a location of the block associated with the first spatial motion vector prediction candidate**. The subset of PMV candidates ascertained from the PMV_CANDS list is also “based on a location of the block associated with the first spatial motion vector prediction candidate” as claimed. As I discussed in §III.B.1, Ruser’s scan patterns progress through a sequence of PMV candidates in a manner that spirals outward from the current block and each PMV candidate is added to the PMV_CANDS list unless it is excluded as unnecessary. In this approach, the subset of PMV candidates in the PMV_CANDS list grows as the scan progresses through the PMV candidates in the pattern.

118. For instance, if the scanning pattern in Fig. 3n of Ruser is used and “the first spatial motion vector prediction candidate” is selected as the one labeled as “4” (i.e., above and to the left of the current block), then the “subset” consists of motion vectors corresponding to spatial blocks “1” (above), “2” (left), and “3” (above, right). The PMV_CANDS list may, at this point, contain motion vectors corresponding to all three of these spatial blocks or it may contain only some of them, depending on the availability of motion vectors for specific blocks and the uniqueness of these vectors. Ex-1004, ¶¶43-44, ¶¶51-66, ¶¶4-5, ¶¶36-39 (“A PMV_CANDS list may be updated to include previously coded motion vectors MV.”). As the scan progresses outwards (i.e., the “first motion vector prediction candidate” increments to “5”, “6”, “7”, etc.), the subset includes the PMV

candidates obtained from blocks in previous locations of Ruser's scan order. Ex-1004, ¶44, ¶¶51-66, Figs. 3a-3n.

119. For example, following the scan order of Fig. 3n, when block "3" is selected, the subset is the PMV candidates obtained from blocks located at positions 1 and 2. *Id.* When block "4" is selected, the subset is the PMV candidates obtained from blocks located at positions 1, 2, and 3. The figure below uses colored dots to show the PMV candidates in the PMV_CANDS list when blocks 3 and 4 are evaluated, respectively:



Ex-1001, Fig. 3n (annotations added)

120. Thus, the subset of PMV candidates in the PMV_CANDS list when a given PMV candidate is evaluated includes the previously evaluated PMV candidates in the scan pattern that were not excluded as unnecessary. Moreover,

because the scan patterns are sequenced based on increasing distance from the current block (e.g., Ex-1004, ¶53), that PMV_CANDS subset only includes PMV candidates *as close as or closer*⁴ to the block currently being encoded (i.e., the ‘.’ block in Ruser’s Fig. 3 patterns). Conversely, the PMV_CANDS list cannot include a candidate that is further away from the current block than the PMV candidate being evaluated. Accordingly, the subset of PMV candidates in PMV_CANDS (to which the current PMV candidate is compared) is “based on a location of the block associated with the” current PMV candidate (“first spatial motion vector prediction candidate”).

121. To see this more clearly, consider again Fig. 3n of Ruser. The “.” represents Ruser’s “current block.” If the “block associated with the first spatial motion vector prediction candidate” is labeled “4” in the figure, then the subset as determined by the allowed distance and position would be motion vectors corresponding to spatial blocks “1”, “2”, and “3”. Blocks “1” and “2” have Euclidean distances of 1 from the current block “.” While block “3” has a Euclidean distance of $\sqrt{1 + 1} = \sqrt{2}$. Relative to the “block associated with the first spatial motion vector prediction candidate,” the Euclidean distance is 1 to block “1”, 1 to block “2”, and 2 to block “3”. In raster scan fashion, once we finish processing the current block in Fig. 3n, the “.” along with all of the numbers

⁴ Successive PMV candidates in the scan order may have the same distance from the current block in which case a tie-breaking rule is used to determine the sequence as to these candidates. Ex-1004, ¶¶ 53, 59.

indicating the block scanning order move one position to the right. With respect to this new “current block,” the Euclidean distances between it and blocks “1”, “2”, and “3” will be exactly the same as they were above. Critically, the Euclidean distances between block “4” and blocks “1”, “2”, and “3” will also be exactly the same as they were above. Since the motion vectors corresponding to blocks “1”, “2”, and “3” are the ones in the subset of limitation [1b] when the “first candidate” corresponds to block “4”, the fact that the relative Euclidean distance between block “4” and blocks “1”, “2”, and “3” doesn’t change when we move forward to process a new “current block” proves that the “subset” is “based on the location associated with the first spatial motion vector prediction candidate.

122. In the prior IPR cases, I understand that Nokia argued that the PMV candidates in Rusert’s PMV_CANDS list are not determined based on the location of current PMV candidate because PMV_CANDS is already populated based on the processing of the previous PMV candidates in the scan pattern. In my opinion, this argument should be rejected because a POSITA would not interpret the claim language to preclude determining the claimed subset by referencing a list such as PMV_CANDS that already identifies a subset of PMV candidates based on the location of the current PMV candidate. A cashier can “determine” a customer’s date of birth by looking at the customer’s driver’s license, for example. The ’714 patent specification suggests an encoder can “determine” the maximum number of spatial motion prediction candidates by simply reading a stored value from

memory. *See* Ex-1001 at 14:53-59 (“A maximum number of spatial motion prediction candidates to be included in the merge list may be defined. This maximum number may have been stored, for example, to the memory 58 of the apparatus 50, or to another appropriate place. It is also possible to *determine* the maximum number by using other means, or it may be determined in the software of the encoder of the apparatus 50.”).

123. In the prior IPR cases, I also understand that Nokia argued that the subset of PMV candidates in the PMV_CANDS list is not determined based on the location of the current PMV candidate because the makeup of the list is also impacted by other factors (*e.g.*, whether previous candidates in scan pattern are intra-coded and thus have no motion vector, whether previous candidates were themselves excluded as the same or too similar to other candidates in the list). I disagree with this argument for two reasons. First, the claim language—in particular the “based on ...” phrase— does not require the claimed subset to be based ***only*** on the location of the first spatial motion vector prediction candidate. Second, in my opinion a POSITA would have readily understood that in many instances—especially early in the scan pattern—none of the previously considered PMV candidates would have been excluded from the PMV_CANDS list and the list would include all the PMV candidates in the scan pattern that are closer than the current PMV candidate to the current block being encoded. I understand from

counsel that combinations of prior art that sometimes meet the claim elements are sufficient to show obviousness.

124. In summary, in my opinion Rusert teaches determining a subset of spatial motion vector prediction candidates based on a location of the block associated with the first spatial motion vector prediction candidate (i.e., the current PMV candidate being evaluated). In Rusert, the subset is ascertained using the PMV_CANDS list which includes a subset of PMV candidates that are as close or closer than the current PMV candidate to the block currently being encoded.

[1c]	comparing motion information of the first spatial motion vector prediction candidate with motion information of spatial motion vector prediction candidates in the determined subset of spatial motion vector prediction candidates without making a comparison of each pair from the set of spatial motion vector prediction candidates;
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125. Ground 1 teaches limitation [1c], as explained below.

126. Rusert teaches **comparing motion information of the first spatial motion vector prediction candidate with motion information of spatial motion vector prediction candidates in the determined subset of spatial motion vector prediction candidates** (e.g., subset of PMV candidates). For example, when updating its PMV_CANDS list, Rusert teaches at least three comparisons for determining whether to include or skip a PMV candidate (Ex-1004, ¶¶71-72; *supra* §VI.B.1[1b]), any one of which is sufficient on its own to satisfy this limitation. When considering “the first spatial motion vector prediction candidate” for inclusion in PMV_CANDS, the “PMV candidate may be determined to be unnecessary if it at least one of the following conditions is fulfilled: [1] the PMV

candidate is a duplicate of another PMV candidate in the set; [2] the PMV candidate is determined to be within a threshold distance of an existing PMV candidate; and [3] the PMV candidate would never be used because at least one alternative PMV candidate will allow motion vectors to be coded using fewer bits.” Ex-1004, ¶21.

127. First, Rusert teaches comparing whether “the PMV candidate is a duplicate of another PMV candidate” taken from the subset of PMV candidates. *Id.*, ¶71. “This ca[n] be done, when updating the list, by comparing the candidates already in the list with the new vector that could be added, and if a duplicate is found... [i]t is preferable to skip the new vector[.]” Ex-1004, ¶71. Skipping (thus excluding) duplicates is “[o]ne measure for reducing the number of candidates[.]” *Id.*; *see also* Ex-1004, ¶62 (“It has been identified as advantageous to discard such duplicates”). When “the first spatial motion vector prediction candidate” is selected and Rusert evaluates whether to add it to the PMV_CANDS list, the motion information of this first candidate is compared to the motion information of candidates already in the list—which were themselves selected from the “subset” of candidates identified for limitation [1b]. If it is a duplicate, then the first candidate is skipped and excluded. For example, two motion vectors are duplicates when their vector values (e.g., their x values and y values) are the same.

128. Second, Rusert teaches comparing whether “the PMV candidate is... within a threshold distance of an existing PMV candidate” in the subset of PMV

candidates. Ex-1004, ¶21. This is accomplished using “a similarity measure” such as “Euclidian distance... or absolute distance.” Ex-1004, ¶72, ¶87. For example, Euclidian distance is measured by “ $(x_0-x_1)^2+(y_0-y_1)^2$ ” and absolute distance is measured by “ $|x_0-x_1|+|y_0-y_1|$, with (x_0, y_0) and (x_1, y_1) being the pair of motion vectors under consideration.” Ex-1004, ¶72. Here, the x and y components of the motion vector for the first candidate are compared to the same components for each of the PMV candidates in PMV_CANDS to determine whether the distance between them is less than a threshold distance.⁵ If the “similarity measure [is] smaller than a pre-defined threshold,” then the PMV candidate is “[r]emov[ed] or skipp[ed][.]” Ex-1004, ¶72, ¶87.

129. Third, Rusert teaches comparing whether “at least one alternative PMV candidate will allow motion vectors to be coded using fewer bits.” Ex-1004, ¶21. This is accomplished by “removing PMV candidates” that “will never be used” because another PMV candidate in the PMV_CANDS list facilitates “a bit sequence that is shorter or of the same length compared for all possible motion vectors.” Ex-1004, ¶90. For example, Rusert teaches that “[i]f we want to encode a motion vector, such as $MV=(0,2)$,” then “we can [] encode it using...” a first candidate “ $PMV=(0,2)$, plus a difference $DMV=(0,0)$ ” or a second candidate “ $PMV=(-1,2)$, plus a difference $DMV=(1,0)$ [.]” Ex-1004, ¶¶91-94. In this example, the first candidate uses a “total number of... 6 bits” to code the motion

⁵ If the two PMV candidates are duplicates, the distance (such as the Euclidean distance and the absolute distance) between the two PMV candidates is zero.

vector because of its index costs (4 bits) and the difference cost to code the difference between the motion vector and the first candidate (1 bit for the x component difference and 1 bit for the y component difference). Ex-1004, ¶93. The second candidate only uses “5 bits in total” because of its index costs (1 bit) and the difference cost (3 bits for the x component difference and 1 bit for the y component difference). From this example, Ruser teaches that “it will never be beneficial to use” the first candidate because the second candidate “will always be one [b]it cheaper or better.” Ex-1004, ¶95. Therefore, when evaluating whether the subset of PMV candidates should be updated to include the “first candidate”, Ruser teaches comparing the motion information of the first candidate with that of each PMV candidate that is already in PMV_CANDS to determine if one will allow motion vectors to be encoded using fewer bits.

130. All three teachings compare a potential candidate with at least one other candidate from the subset of preceding candidates in Ruser’s scan sequence. Since preceding candidates have smaller index values, they would be signaled more efficiently than later duplicates, and Ruser improves efficiency by determining this subset and comparing potential new candidates to the subset. Ex-1004, ¶¶88-98. For all three comparisons, the x and y components of Ruser’s candidates are compared; this is motion information of the PMV candidates because the x and y components of the vector values describe the “motion of pixel blocks across frames.” Ex-1004, ¶2. For example, “coding of a motion vector

consists of... a motion vector predictor... and ... the difference... between the motion vector and the motion vector predictor.” Ex-1004, ¶3, ¶¶36-37; *supra* §VI.B.1[1a] (explaining that the motion information is represented by vector values). Therefore, making any of the three comparisons is comparing the motion information of a PMV candidate with the motion information of another PMV candidate from the set of previously-coded motion vectors—in particular, the selected first candidate to candidates from the subset of limitation [1b].

131. Additionally, for all three comparisons, Rusert teaches or at least suggests performing these comparisons when evaluating whether to update PMV_CANDS, which stores PMV candidates from the current subset of candidates, by adding a new PMV candidate to it. Ex-1004, ¶71, ¶75, ¶¶84-87, ¶90. Furthermore, this would have been obvious because Rusert teaches the advantages of reducing the number of candidates in PMV_CANDS, including with the use of these comparisons (Ex- 1004, ¶12, ¶21, ¶70, ¶84, ¶90), and the natural time to perform these comparisons would have been when evaluating whether or not to add a PMV candidate to PMV_CANDS. As Rusert teaches, performing this check when PMV_CANDS is updated will prevent “unnecessary” candidates from being added, “because it may happen that some candidates... will never be used, since choosing a candidate with a shorter codeword and encoding the distance will give a bit sequence that is shorter or of the same length compared for all possible motion vectors.” Ex-1004, ¶90.

132. Rusert teaches **comparing ... without making a comparison of each pair from the set of spatial motion vector prediction candidates**. As I discussed for limitation [1a], the claimed “a set of spatial motion vector prediction candidates” could be (1) the set of motion vectors used for all previous coded blocks in the frame or (2) the set of motion vectors for the blocks in the scan pattern. Each of the three comparisons I discussed above compares motion information from a selected first candidate with the candidates chosen from the subset of PMV candidates, without making a comparison of each pair from either of the larger set of motion vectors. Ex-1004, ¶¶11-13, ¶¶15-16, ¶113.

133. As to the first mapping, where the larger “set” is the set of motion vectors used for all previous coded blocks in the frame, Rusert teaches that the subset of PMV candidates is itself a “subset of the motion vectors previously used for previous blocks.” Ex-1004, ¶¶11-12, ¶¶24-25. Since a given PMV candidate is only compared against the PMV candidates in the PMV_CANDS list and that list can only include PMV candidates within the scan pattern, no PMV candidate in the scan pattern will be compared to any spatial motion vector prediction candidates that fall outside the scan pattern. For example, in the Fig. 3n pattern, blocks with a Chebyshev distance of 3 from the current block are excluded. Ex-1004, ¶64; Fig. 3m; *see also id.*, ¶13 (discussing “allowed distance values”) Additionally, “all blocks other than the corner blocks and the blocks directly above and to the left of the current block are excluded.” *Id.*, ¶65; *see also id.*, ¶¶14-15 (discussing

“allowed positions”). In the annotated figure below, the dotted orange blocks are excluded from the scan pattern because they are not in an “allowed position” and the dotted pink blocks are excluded based on their distance from the current block (i.e., a Chebyshev distance of 3 which is not a power of 2).



Fig. 3n

Ex-1004, Fig. 3n (annotations added). Because these dotted orange and pink blocks are not within the scan pattern, they cannot contribute PMV candidates to the PMV_CANDS list, and no PMV candidate in the scan pattern would be compared to them.

134. Turning to the second mapping, where the claimed “set of spatial motion vector prediction candidates” is the set of PMV candidates in Rusert’s scan patterns, Rusert discloses multiple reasons that would prevent every pair of candidates within the scan pattern from being compared. First, as I discussed above for [1b], when a given PMV candidate in the scan pattern is considered, the PMV candidates in the PMV_CANDS list are limited to PMV candidates that are *as close or closer* to the current block being encoded. Using the scan pattern in Fig. 3n as an example, when block 3 is evaluated, it would be compared to blocks 1 and 2, but not to most of the other blocks in the pattern which are further away from the current block (e.g., blocks 6-9 and a-f). Second, Rusert teaches that a “scan may be terminated... as soon as a pre-defined number of unique PMV candidates have been found[.]” Ex-1004, ¶48. For example, Rusert teaches “us[ing] a maximum of four candidates in the [PMV_CANDS] list” or “us[ing] seven” as the maximum. Ex-1004, ¶107. Again, using the Fig. 3n pattern as an example, if PMV candidates 1, 2, 3, and 4 were all added and the list was limited to four PMV candidates, there would never be a comparison involving blocks 5 or 6 even though those blocks are within the scan pattern.

135. Therefore, Rusert discloses not comparing each possible pair of candidates from the set of all previously-coded blocks, or even each possible pair of blocks within the scan pattern. Rusert thus teaches Claim 1 with the recited “set” being either (a) the previously-coded motion vectors for that frame, or (b) the full

set of candidates from Rusert's scan order, because in both cases Rusert compares the selected candidate with a subset of candidates, without comparing each pair from the set of previously-coded motion vectors or the entire scan order.

136. Based on the foregoing explanations, Ground 1 teaches limitation [1c].

[1d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

137. Ground 1 teaches limitation [1d], as explained below.

138. Rusert teaches **determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list** (e.g., PMV_CANDS) **based on the comparing**. As I explained above, Rusert teaches at least three ways for comparing motion information of a PMV candidate with motion information of PMV candidates in the PMV_CANDS list, which stores the subset of PMV candidates. *Supra* §VI.B.1[1c]. Rusert performs all three comparisons to determine whether to include or exclude the selected PMV candidate in the PMV_CANDS list. Ex-1004, ¶¶20-21.

139. Rusert teaches removing “unnecessary PMV candidates from the set of PMV candidates.” Ex-1004, ¶20. “This ensures the length of the [PMV_CANDS] list is not unnecessarily long, which would reduce coding efficiency.” Ex-1004, ¶21. “*A PMV candidate may be determined to be unnecessary* if it at least one of the following conditions is fulfilled: [1] the PMV candidate is a duplicate of another PMV candidate in the set; [2] the PMV candidate is determined to be within a threshold distance of an existing PMV

candidate; and [3] the PMV candidate would never be used because at least one alternative PMV candidate will allow motion vectors to be coded using fewer bits.”

Ex-1004, ¶21. “Unnecessary PMV candidates are removed... because it may happen that some candidates in the list will never be used.” Ex-1004, ¶90. A shorter PMV_CANDS list “allows the remaining PMV candidates to be signaled using shorter codes and so fewer bits[.]” Ex-1004, ¶¶22, 90 (“thereby making the list shorter and the average bit length of each index shorter.”).

140. Rusert excludes unnecessary candidates, including the three categories explained above (duplicate PMV candidates, PMV candidates within a threshold distance of PMV candidates in the PMV_CANDS list, and PMV candidates that have at least one alternative PMV candidate that will allow motion vectors to be coded using fewer bits), when deciding whether to add a new candidate to PMV_CANDS. Ex-1004, ¶21, ¶¶71-72; *supra* §VI.B.1[1c]. As Rusert explains, the “PMV_CANDS list may be updated to include” PMV candidates. Ex-1004, ¶39, ¶44, ¶71, ¶87; *supra* §VI.B.1[1c]. Here, “[u]pdate means that one or more motion vectors are added to an existing PMV_[C]ANDS list.” Ex-1004, ¶39. For example, PMV candidates with “unique vectors” are inserted in the PMV_CANDS list based on an “outwards going scan[.]” Ex-1004, ¶50. As part of the “update” process whereby new candidates are added to PMV_CANDS, Rusert determines whether a selected PMV candidate should be included or skipped, meaning it is excluded because it is a duplicate, it is within a threshold distance of another PMV

candidate in PMV_CANDS, or there is an alternative PMV candidate that will allow motion vectors to be coded using fewer bits. Ex-1004, ¶¶71-72; *supra* §§VI.B.1[1b]-[1c].

141. Additionally, this would have been obvious because Rusert teaches the advantages of reducing the number of candidates in PMV_CANDS using the three comparisons from [1c] (Ex-1004, ¶12, ¶21, ¶70, ¶84, ¶90), and the natural time to perform the comparisons would have been when evaluating whether or not to add a candidate to the subset of PMV candidates stored in PMV_CANDS. As Rusert teaches, performing this check when PMV_CANDS is updated prevents “unnecessary” candidates from being added, “because it may happen that some candidates... will never be used[.]” Ex-1004, ¶90. Thus, Rusert teaches determining to include or exclude a PMV candidate in the PMV_CANDS list.

142. Based on the foregoing explanations, Ground 1 teaches limitation [1d].

[1e] causing information identifying the one spatial motion vector prediction candidate from the motion vector prediction list to be transmitted to a decoder or to be stored.
--

143. Ground 1 teaches limitation [1e], as explained below.

144. Rusert teaches **causing information identifying the one spatial motion vector prediction candidate from the motion vector prediction list (e.g., PMV_CANDS) to be transmitted to a decoder or to be stored.** For example, Rusert teaches sending an index “to select a particular PMV candidate... from a list of PMV candidates, PMV_CANDS[.]” Ex-1004, ¶35. The index is

stored in the video stream and transmitted “from the encoder... to the decoder[.]”
Id.

145. As I explained above for limitation [1a], Rusert identifies and signals, using an “index,” one PMV candidate from PMV_CANDS as the motion information for the current block. Ex-1004, ¶¶35-37, ¶75, ¶¶91-92, Figs. 2a-2b; *supra* §VI.B.1[1a]. Rusert teaches transmitting the index to a decoder. Ex-1004, ¶¶35-37, Fig. 1:

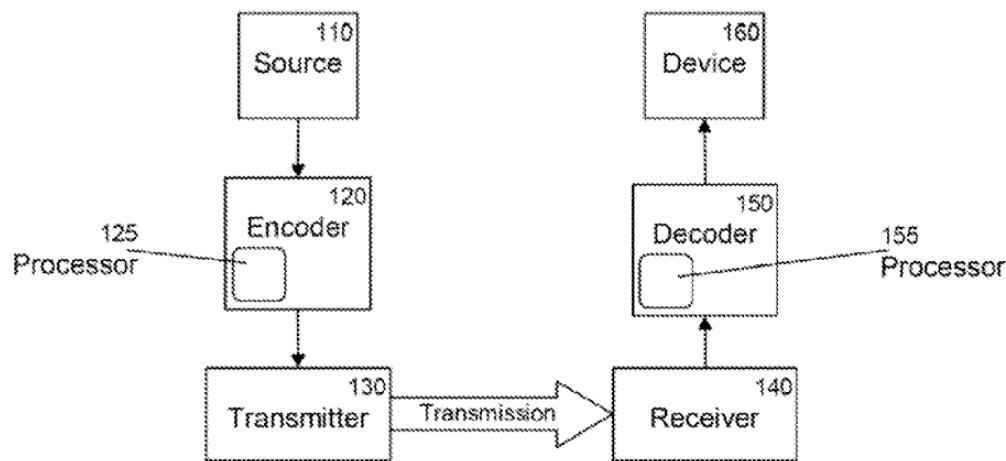


Fig. 1

For example, in Fig. 1, an “encoded video stream is sent to a transmitter... prior to transmission[.]” and “[a] receiver... receives the transmitted encoded video stream and passes this to a decoder[.]” Ex-1004, ¶34. In the encoded video stream, an “index... may be sent once together with each transmitted motion vector[.]” Ex-1004, ¶36, ¶34, Fig. 1. The decoder, “[u]sing the transmitted index,... can determine the PMV... as used in the encoder[.]” Ex-1004, ¶37.

146. Rusert teaches exemplary binary codes for the index used to identify a spatial motion vector prediction candidate from PMV_CANDS. E.g., Ex-1004, ¶¶88-102 (exemplary codes for index values shown in various tables):

Value	Index	Code
(-1,2)	0	1
(13, 4)	1	010
(12, 3)	2	011
(0, 2)	3	0010
(3, 4)	4	0011
(-4, 1)	5	0000
(4, 8)	6	0001

Table 1, for example, includes exemplary VLC codes depending on the maximum size of the PMV_CANDS list. *Id.* These types of binary codes were commonly used in video encoding to encode a value for storage in the video stream and transmission to the decoder because a video stream was a binary sequence of 1s and 0s. Therefore, index values needed to be converted from their numerical representations (e.g., 0, 1, 2, 3, 4, 5, 6) into binary codes. That is why Rusert teaches binary codes for its index values—it is information identifying a candidate from PMV_CANDS that is stored in the video stream and transmitted to the decoder. *Id.*, ¶¶91-102.

147. Furthermore, Rusert teaches “the respective lists of PMV candidates” are “stored in the encoder and decoder[.]” Ex-1004, ¶35. Corresponding indices that identify candidates from those lists would have obviously been stored as well. Representing bits in a computer fundamentally requires storage of the information in volatile or non-volatile memory, and Rusert’s binary code in Table 1 above is an

example of the manner in which those indices could be stored in such memory.⁶

That is how computers have operated for many decades.

148. The combination of Ground 1 applies Rusert's teachings from "blocks" (in the H.264 context) to PUs (following nomenclature in the H.265 context). *Supra* §VI.A (explaining how and why Rusert and Karczewicz's teachings would have been combined).

149. Based on the foregoing explanations, Ground 1 teaches limitation [1e].

2. Dependent Claim 2

2. The method according to claim 1 further comprising selecting spatial motion vector prediction candidates from the set of spatial motion vector prediction candidates as the potential spatial motion vector prediction candidate in a predetermined order.
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150. Ground 1 teaches claim 2, as explained below.

151. As I have explained above, the combination of Rusert and Karczewicz teaches claim 1.

152. Rusert teaches selecting spatial motion vector prediction candidates from the set of spatial motion vector prediction candidates as the potential spatial motion vector prediction candidate. As I explained above for limitation [1a], Rusert teaches selecting a first spatial motion vector prediction candidate from the set of spatial motion vector prediction candidates for a block of pixels as a potential spatial motion vector prediction candidate. *Supra* §VI.B.1[1a]. Rusert also teaches

⁶ For example, to convert a digit to a binary code, the computer takes the input of a digit and stores it in the memory. After the digit is converted to a binary code, the binary code is also stored in the memory for transmission or further processing.

selecting a sequence of spatial motion vector prediction candidates from the set of spatial motion vector prediction candidates by scanning “a plurality of blocks surrounding a current block.” Ex-1004, ¶30, ¶40 (“an outwards going scan may be performed around the current block to obtain motion vectors to update PMV_[C]ANDS.”), ¶¶51-66 (describing various scan patterns).

153. Rusert further teaches **selecting ... in a predetermined order**. For example, Rusert teaches “a simple procedure to scan the candidates in order[.]” Ex-1004, ¶58. In particular, Rusert teaches “scan patterns... for a plurality of blocks surrounding a current block[.]” Ex-1004, ¶30, ¶40, ¶¶51-66. Rusert provides example scan patterns in Fig. 3a through Fig. 3n, with Fig. 3n shown below:

```

e---b---d
~::~~::~~
--9--6--8--
--413--
c-72.-
--5-
--a-
~::~~::~~
f-~::~~::~~

```

Fig. 3n

154. For example, for the scan pattern illustrated in Fig. 3c, Rusert teaches scanning “blocks in the following order: 1, 2, 9, h, j, l, m.” Ex-1004, ¶54, Fig. 3c:

Fig. 3c

Rusert teaches this scan pattern “select[s] blocks in an order that took the closest ones first” with “considerations... that only a subset of blocks have valid motion vectors.” Ex-1004, ¶¶53-54. As another example, Rusert teaches a search pattern with “an ordering as shown in FIG. 3n” which goes 1, 2, 3, 4, 5, 6, 7, 8, 9, a, b, c, d, e, f. Ex-1004, ¶¶65-66, Fig. 3n. Rusert teaches this search pattern “has been found to combine good compression efficiency (i.e., finding good motion vectors) with good computation performance.” Ex-1004, ¶66.

155. When discussing the scan patterns illustrated in Figs. 3a-3n, Rusert discusses the various known tradeoffs associated with these scan patterns. *See* Ex-1004, ¶¶51-65. In the end, Rusert teaches using its exemplary scan patterns, despite potential drawbacks, and a POSITA would have understood that each scan pattern was known and available to use as a predetermined scan pattern for scanning blocks. That Rusert teaches the approaches in view of known drawbacks is evidence that their benefit outweighs such drawbacks, and that various patterns were known and used in different scenarios. Thus, Figs. 3a-3n illustrate predetermined orders by which to scan “blocks surrounding a current block[.]” Ex-1004, ¶30.

156. Based on the foregoing explanation, Rusert teaches claim 2.

3. Dependent Claim 3

3. **The method according to claim 1, further comprising comparing motion information of the potential spatial motion vector prediction candidate with motion information of at most one other spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates.**

157. Ground 1 teaches claim 3, as explained below.

158. As I have explained above, the combination of Rusert and Karczewicz teaches claim 1, including [1c]: comparing motion information of the first spatial motion vector prediction candidate with motion information of spatial motion vector prediction candidates in the determined subset of spatial motion vector prediction candidates without making a comparison of each pair from the set of spatial motion vector prediction candidates. *Supra* §VI.B.1[1c]. Rusert teaches at least three comparisons: (1) whether “the PMV candidate is a duplicate of another PMV candidate” in the PMV_CANDS list; (2) whether “the PMV candidate is... within a threshold distance of an existing PMV candidate[]”; and (3) whether “at least one alternative PMV candidate will allow motion vectors to be coded using fewer bits.” *Id.*; e.g., Ex-1004, ¶21.

159. Rusert further teaches comparing motion information of the candidate with **at most one other spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates**. For example, Rusert teaches a scan sequence for evaluating whether to include or exclude spatial motion vector

prediction candidates from neighboring blocks in PMV_CANDS. *Supra* §VI.B.1[1a]; Ex-1004, ¶44, ¶¶51-66, Figs. 3a-3n. Rusert teaches that the “PMV_CANDS list may be initialized e.g. as an empty list (zero entries)[.]” Ex-1004, ¶39. PMV_CANDS is then “updated to include previously coded motion vectors[.]” *Id.* This update is based on “an outwards going scan... around the current block to obtain motion vectors to update PMV_[C]ANDS.” Ex-1004, ¶44. Rusert performs its comparisons, e.g., checking for duplicates, “when updating the list[.]” Ex-1004, ¶71; *supra* §VI.B.1[1c].

160. Thus, Rusert begins the scan with a first PMV candidate, e.g., labelled “1” in Figs. 3a-3n, and considers whether to update PMV_CANDS with the first candidate. Ex-1004, ¶39. The scan then moves to the second PMV candidate, which is “compar[ed with] the candidates already in the list[.]” Ex-1004, ¶71. Here, for the second candidate, the PMV_CANDS list includes at most one other spatial motion vector prediction candidate: the first candidate. *See id.* Therefore, the motion information of the second PMV candidate in the sequence is compared with the motion information of at most one other PMV candidate (the first PMV candidate). Ex-1004, ¶21, ¶¶38-40, ¶44. Furthermore, Rusert teaches “the number of candidates in PMV_CANDS may be limited to a pre-defined or dynamically obtained number.” Ex-1004, ¶73, ¶¶84-90. With a maximum number of two candidates, the scan would end once two PMV candidates are added to PMV_CANDS, so any potential PMV candidate would be compared with at most

one other PMV candidate, the PMV candidate already in PMV_CANDS. It would have been obvious to a POSITA to choose two as a maximum number because it would allow the selection of the PMV candidate for use with the current block to be signaled with one bit (e.g., “0” or “1”). *See* Ex-1004, ¶77.

161. Based on the foregoing explanations, Ground 1 teaches claim 3.

4. Dependent Claim 4

4. **The method according to claim 1 further comprising examining whether the block of pixels is divided into a first prediction unit and a second prediction unit; and if so, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the prediction unit is the second prediction unit.**

162. As I have explained above, Ground 1 teaches claim 1. Ground 2 further teaches claim 4. *Supra* §VI.A (explaining how and why Lin’s teachings would have been applied to the combination of Rusert and Karczewicz).

163. Ground 2 teaches **examining whether the block of pixels is divided into a first prediction unit and a second prediction unit**. For example, Lin teaches that, in H.265/HEVC, “[t]he basic unit for compression, termed Coding Unit (CU), is a 2N×2N square block, and... [e]ach CU contains one or multiple Prediction Units (PUs)” with divisions “correspond[ing] to horizontal and vertical partition[s.]” Ex-1006, ¶4; Ex-1013, 000007. When a CU is not divided, the CU corresponds to a single PU. When a CU is divided horizontally, the 2N×2N square is divided in half into two symmetric PU rectangles having dimensions of 2N×N. Likewise, when a CU is divided vertically, the 2N×2N square is divided into two symmetric PU rectangles of N×2N size. *Id.*; Ex-1013, 000016. Lin teaches both

examples, where the block of pixels is divided into two prediction units: a first PU (“PU1”) and a second PU (“PU2”). *Id.*; Ex-1006, ¶25, ¶44, Figs. 7A-7D; Ex-1013, 000010, 000017. This limitation is also satisfied the other way around, where the claimed “first” PU is PU2 and the claimed “second” PU is PU1.

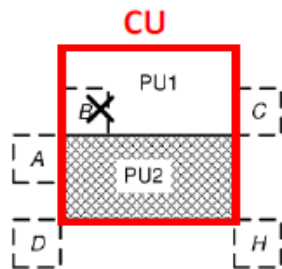


Fig. 7A

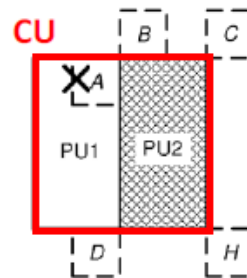


Fig. 7B

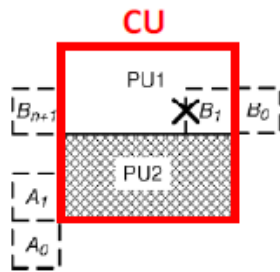


Fig. 7C

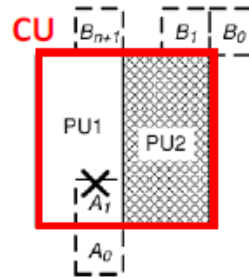


Fig. 7D

164. Lin “*identifies and removes redundant MVP candidates*” by examining the CU for “scenario[s] that multiple partitioned PUs... may cause the current PU to be... considered redundant and can be removed without comparing the [motion vector] values.” Ex-1006, ¶44; Ex-1013, 000010, 000017. These scenarios include a CU divided horizontally into two prediction units (“2NxN”) or

vertically into two prediction units (“Nx2N”) where, “for the second 2NxN,... Nx2N... PU, one or more of the MVP candidates are redundant and removed if said one or more of the MVP candidates located within the previous (first) 2NxN,... Nx2N... PU.” Ex-1006, ¶25; Ex-1013, 000009-11. Lin teaches examining whether a block of pixels is divided horizontally or vertically into two prediction units to exclude redundant motion vector predictor candidates, as further explained below.

165. Ground 2 teaches **and if so, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the prediction unit is the second prediction unit.** For example, Lin examines whether (i) the current block is divided into two PUs and (ii) the spatial motion vector prediction candidate is from the other PU; if so, Lin teaches excluding the candidate from the motion vector prediction list. As illustrated in Figs. 7A-7D below, “the second PU of 2NxN [and] Nx2N... can be removed without comparing the values of MVs[]” because “the MVP candidates of a current PU that may cause the current PU to be merged with other PUs... is considered redundant and can be removed without comparing the MV values.” Ex-1006, ¶44, ¶25, Fig. 7A-7D; Ex-1013, 000010, 000017.

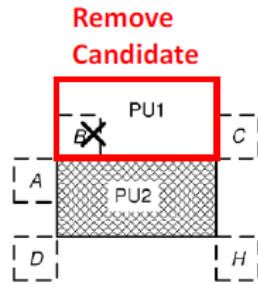


Fig. 7A

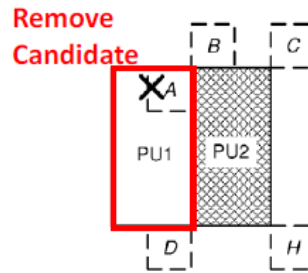


Fig. 7B

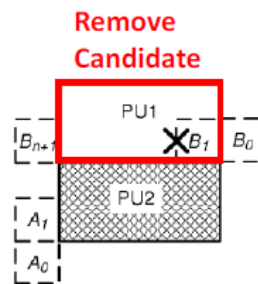


Fig. 7C

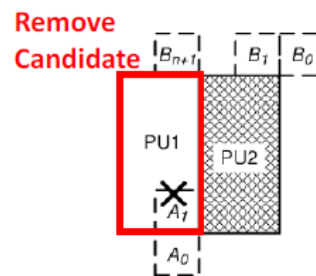


Fig. 7D

166. In particular, Lin teaches that, for “FIG. 7A, MVP B for the second 2NxN PU in the 2NxN... can be removed to avoid the duplication.” Ex-1006, ¶44; Ex-1013, 000010. Likewise, “[i]n FIG. 7C, MVP B₁ for 2NxN PU2... is determined to be redundant and is removed from the MVP candidate set.” *Id.*; Ex-1013, 000017. Similarly, MVP A for PU2 in the Nx2N in Fig. 7B and “MVP A₁ in FIG. 7D... are determined to be redundant and are removed from the MVP candidate set, respectively.” *Id.* Therefore, Lin teaches examining whether the block is divided into two PUs (e.g., 2NxN and Nx2N), and if so, removing the MVP candidate of the second PU from the MVP candidate set because it is redundant.

167. This concept was obvious in view of the reason why a CU is divided to begin with. CUs do not have to be divided—in the simplest case, one CU comprises one PU (they are commensurate in size). Ex-1006, ¶4 (“Each CU contains one or multiple Prediction Units (PUs).”); Ex-1013, 000007; Ex-1005, ¶35 (“A CU... may include one or more prediction units (PUs).”). If the block has uniform motion, there is no reason to divide it into multiple PUs. Conversely, if different parts of the block are moving in different directions, the CU can be divided into multiple PUs so that each can have a different motion vector. Ex-1006, ¶4. In other words, the block is divided into two PUs when each half of the block has different motion. If a block is divided into two PUs because its two portions have differing motion vectors, there is no way that the motion vector corresponding to one of these PUs can be a good predictor for the motion of the other PU. Therefore, when analyzing potential motion vectors for half of a block (that has been divided into two PUs), Lin explains that the motion vector from the other half can be removed. Ex-1006, ¶25, ¶44; Ex-1013, 000010. Lin explains that assigning the same motion vector to both halves of a divided block is redundant to the scenario where the block was not divided at all and the same motion vector was applied to the entire block comprising one PU. That is why Lin teaches “remov[ing] redundant [motion vector predictor] candidates.” Ex-1006, ¶44; Ex-1013, 000010.

168. In the combination of Ground 2, it would have been obvious to a POSITA to combine Lin's teachings with Rusert and Karczewicz to remove redundant PMV candidates from PMV_CANDS. *Supra* §VI.A (explaining how and why the teachings of the references would have been combined). In particular, a POSITA would have been motivated to apply Lin's teachings of excluding candidates from the other PU when a block is divided into two PUs, as explained above, to Ground 1's process for selecting PMV candidates. *See id.*

169. Based on the foregoing explanations, Ground 2 teaches claim 4.

5. Dependent Claim 5

5[pre]. The method according to claim 1, further comprising
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170. Ground 1 teaches claim 5, as explained below.

171. As I explained above, the combination of Rusert and Karczewicz teaches the method of claim 1. *Supra* §VI.B.1. Therefore, the combination teaches the preamble of claim 5.

[5a] determining a maximum number of spatial motion vector prediction candidates to be included in the motion vector prediction list; and
--

172. Ground 1 teaches limitation [5a], as explained below. The spatial motion vector prediction candidates (e.g., PMV candidates) and motion vector prediction list (e.g., PMV_CANDS) were explained for claim 1. *Supra* §VI.A.2[1a], §VI.A.3.

173. Ruser teaches **determining a maximum number of spatial motion vector prediction candidates to be included in the motion vector prediction list** (e.g., PMV_CANDS). For example, Ruser teaches “the number of candidates in PMV_CANDS *may be limited* to a pre-defined or dynamically obtained number.” Ex-1004, ¶73, ¶¶84-90. As some examples, Ruser teaches “a maximum of four candidates in the list” and “us[ing] seven” for a maximum. Ex-1004, ¶107. Ruser also teaches that “it is possible that PMV_CANDS list size is set to one, such that no bits need to be sent for index signaling.” Ex-1004, ¶77.

174. Ruser teaches several benefits to determining a maximum number of candidates for PMV_CANDS. For example, “[l]imiting and/or reducing the number of candidates in PMV_CANDS can be helpful to reduce the overhead of signaling which PMV is used for motion vector prediction, since shorter lists require shorter code words.” Ex-1004, ¶84, ¶70, ¶13 (“The size of the PMV candidate list is limited because a very large list would require long code words to identify which PMV candidate to use[.]”). With “a bigger maximum,... the number of bits needed to specify the candidate vector also increases” and “many vectors can be represented using several candidates, which is unnecessary.” Ex-1004, ¶107. By determining a maximum number of candidates, Ruser balances between “chances increas[ing] that a suitable vector can be found” and “redundant representation” that “grows the more vectors are added.” Ex-1004, ¶107. In short, Ruser teaches determining a maximum number of candidates for PMV_CANDS,

e.g., 4 candidates, to balance the increased chance of a suitable match with the increased cost of using longer code words. *Id.*

175. Ruser teaches variable-length coding (“VLC”) examples for index values which vary based on the “Maximum list size C” of PMV_CANDS. Ex-1004, ¶88 (Table 1). “The VLC table used can depend on the maximum number of candidates in PMV_[C]ANDS (the list size), as e.g. dynamically adapted according to the methods above.” Ex-1004, ¶88. “Table 1 below presents some examples for VLC codes for different maximum list sizes. The left column shows the maximum list size, also denoted as C. In the right column, the VLC codes are shown along with indexes to address candidates in the PMV_CANDS list.” *Id.* Therefore, Ruser teaches determining a maximum number of candidates to be included in PMV_CANDS, e.g. as denoted by “C,” which dictates the encoding table for index values and controls the maximum number of candidates in the PMV_CANDS list. *Id.*

176. Based on the foregoing explanations, Ruser teaches limitation [5a].

[5b]	limiting the number of spatial motion vector prediction candidates in the motion vector prediction list smaller or equal to the maximum number.
-------------	--

177. Ground 1 teaches limitation [5b], as explained below.

178. Ruser teaches **limiting the number of spatial motion vector prediction candidates in the motion vector prediction list smaller or equal to the maximum number**. For example, Ruser teaches “an outwards going scan...

to obtain motion vectors to update PMV_[C]ANDS... may be terminated... as soon as a pre-defined number of unique PMV candidates have been found[.]” Ex-1004, ¶¶44-48. By terminating the scan “as soon as a pre-defined number of unique PMV candidates have been found,” the number of PMV candidates in PMV_CANDS is limited to the pre-defined number, which is the maximum number, because no additional PMV candidates are considered for inclusion in PMV_CANDS. *Id.*

179. In addition, Rusert teaches that “the candidate at the end of the PMV_CANDS list may be removed” in order to limit “the number of candidates in PMV_CANDS... to a pre-defined... number[.]” Ex-1004, ¶73. Thus, the number of PMV candidates in PMV_CANDS is smaller or equal to the maximum number because candidates are removed in order to limit the number of PMV candidates to the maximum number. Moreover, by teaching a “maximum” number of candidates in the PMV_CANDS list, Rusert teaches a limit (the maximum) to the number of candidates in the list.

180. Rusert further teaches VLC examples based on the “Maximum list size C” of PMV_CANDS. Ex-1004, ¶88 (Table 1). “The VLC table used can depend on the maximum number of candidates in PMV_[C]ANDS (the list size), as e.g. dynamically adapted according to the methods above.” Ex-1004, ¶88. “Table 1 below presents some examples for VLC codes for different maximum list sizes. The left column shows the maximum list size, also denoted as C. In the right

column, the VLC codes are shown along with indexes to address candidates in the PMV_CANDS list.” *Id.* Therefore, Rusert teaches limiting the number of candidates in PMV_CANDS to be smaller or equal to the maximum number, e.g. as denoted by “C,” in accordance with the encoding tables in Table 1. *Id.* For example, when the maximum list size C is 4, Table 1 lists encodings for four index values to encode up to four values in PMV_CANDS. None of the encodings exceed the maximum list size C.

181. Based on the foregoing explanations, Rusert teaches limitation [5b].

6. Dependent Claim 6

6[pre]. The method according to claim 5 comprising:

182. Ground 1 teaches claim 6, as explained below.

183. As I explained above, the combination of Rusert and Karczewicz teaches the method of claim 5. *Supra* §VI.A.6. Therefore, the combination of Rusert and Karczewicz teaches the preamble of claim 6.

[6a] examining, if the number of spatial motion vector prediction candidates in the motion vector prediction list smaller than the maximum number;

184. Ground 1 teaches limitation [6a], as explained below.

185. Rusert teaches **examining, if the number of spatial motion vector prediction candidates in the motion vector prediction list [is] smaller than the maximum number**. As I explained above with respect to claim 5, Rusert teaches determining a maximum number of PMV candidates for PMV_CANDS and

limiting the number of PMV candidates in PMV_CANDS to the maximum number. Ex-1004, ¶13, ¶¶44-48, ¶70, ¶73, ¶77, ¶¶84-90, ¶107; *supra* §VI.A.6 (claim 5). For example, Rusert examines if the number of candidates in PMV_CANDS is smaller than the maximum number when determining whether to continue its scan for additional PMV candidates. Rusert teaches “terminat[ing]” a scan for new candidates “as soon as a pre-defined number of unique PMV candidates have been found[.]” Ex-1004, ¶¶44-48. Here, “an outwards going scan... around the current block” is performed to obtain PMV candidates “to update PMV_[C]ANDS[.]” and the number of PMV candidates in PMV_CANDS is examined to determine whether to continue or terminate the scan. *Id.* If the number of PMV candidates is less than the maximum number, or the “pre-defined number of unique PMV candidates[.]” then the scan continues; but if the number of PMV candidates is equal to the maximum number, then the scan is “terminated[.]” *Id.*

186. In addition, Rusert teaches that “the candidate at the end of the PMV_CANDS list may be removed” in order to limit “the number of candidates in PMV_CANDS... to a pre-defined... number.” Ex-1004, ¶73. Thus, Rusert teaches examining if the number of PMV candidates in PMV_CANDS is smaller than the maximum number to determine whether to remove a PMV candidate for another PMV candidate or to add the other PMV candidate.

187. Based on the foregoing explanations, Ground 1 teaches limitation [6a].

[6b]	if so, examining whether the prediction unit to which the potential spatial motion vector prediction candidate belongs is available for motion prediction;
-------------	---

188. Ground 1 teaches limitation [6b], as explained below.

189. Ground 1 teaches **examining whether the prediction unit to which the potential spatial motion vector prediction candidate belongs is available for motion prediction**. While scanning blocks for new candidates, Rusert examines whether the block to which a potential candidate belongs is available for motion prediction because motion vectors are not available for some blocks. For example, Rusert teaches three exemplary reasons why a block would be unavailable for motion prediction, any one of those teachings satisfies this limitation.

190. First, Rusert teaches that blocks “coded after the present block[.]” “would never be available[.]” Ex-1004, ¶54. For example, blocks below and to the right of the current block would be coded after the present block. *Id.* Quite simply, these blocks are never available because they have not been coded yet and therefore do not have any motion information for motion prediction. No motion vector has been assigned to those blocks yet and therefore the blocks cannot provide a motion vector candidate.

191. Second, blocks are “sometimes... available depending upon the traversal pattern used[.]” Ex-1004, ¶54. Depending on the pattern used to reach the current block, some blocks would not be coded yet, and similar to the first

condition explained above, these blocks do not have any motion information for motion prediction.

192. Third, Rusert teaches that blocks that have “no motion vector present” or have “the same [motion vector] as a block earlier in the sequence” are not available. Ex-1004, ¶54. Blocks that have no motion vector present do not have motion information for motion prediction and cannot provide a motion vector candidate. Since Rusert seeks to avoid duplicates, blocks that have the same motion vector as a block earlier in the sequence are not available for motion prediction.

193. Thus, with any of these considerations, Rusert teaches examining whether a block is available for motion prediction.

194. In the context of Rusert’s nomenclature, Rusert’s block is a prediction unit because it is the unit for which a motion vector is assigned for motion prediction. Ex-1004, ¶¶2-5, ¶36, ¶43; *supra* §VI.A.2[1a] (explaining PUs and Rusert’s blocks). Therefore, Rusert teaches this limitation.

195. Additionally, the combination of Ground 1 applies Rusert’s motion vector teachings to Prediction Units. *Supra* §VI.A.1 (explaining how and why Rusert and Karczewicz’s teachings would have been combined), §VI.A.2[1a] (explaining application of block and PU teachings); Ex-1004, ¶¶3-4, ¶36; Ex-1005, ¶¶33-36, ¶¶64-66. As Karczewicz explains, H.265 introduced terminology for a “prediction unit,” which was a type of block, and motion vectors were assigned to

PU. Ex-1005, ¶¶33-36; *supra* §I. Therefore, it would have been obvious to apply Rusert's motion vector teachings to PUs, and the combination of Ground 1 teaches examining whether the prediction unit, to which the potential spatial motion vector prediction candidate belongs, is available for motion prediction.

196. Furthermore, this would have been obvious based on the teachings of Rusert and Karczewicz. As explained above, Rusert teaches three reasons for examining whether a block is available for motion prediction as part of its process for finding and evaluating potential spatial motion vector prediction candidates, and Karczewicz teaches that, in H.265, the block for which motion vectors are assigned is called a PU. Ex-1005, ¶¶33-36, ¶¶64-66. Therefore, when scanning for potential spatial motion vector prediction candidates as Rusert teaches, it would have been obvious to scan PUs in the H.265 context, and it would have been obvious to examine whether the PU is available for motion prediction, using the various criteria Rusert teaches.

197. Based on the foregoing explanations, Ground 1 teaches limitation [6b].

[6c] if so, performing at least one of the following:

...

[6k] for a potential spatial motion vector prediction candidate, which is below the potential spatial motion vector prediction candidate on the left side of the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;

...

198. Limitation [6c] requires “performing at least one of the following.” Therefore, I understand that this limitation is satisfied if limitation [6k] (which is “one of the following”) is satisfied.

199. Ground 1 teaches this limitation, as explained below. As an initial matter, in the context of Rusert’s nomenclature, Rusert’s block is a prediction unit because it is the unit for which a motion vector is assigned for motion prediction. Ex-1004, ¶¶2-5, ¶36, ¶43. Additionally, the combination of Ground 1 applies Rusert’s motion vector teachings to Prediction Units. *Supra* §VI.A.1 (explaining how and why Rusert and Karczewicz’s teachings would have been combined), §VI.A.2[1a] (explaining application of block and PU teachings); Ex-1004, ¶¶3-4, ¶36; Ex-1005, ¶¶33-36, ¶¶64-66. As Karczewicz explains, H.265 introduced terminology for a “Prediction Unit,” which was a type of block, and motion vectors were assigned to PUs. Ex-1005, ¶¶33-36; *supra* §I. Therefore, when Rusert teaches its scanning and analysis process for motion vectors from various blocks, it would have been obvious to apply those teachings to PUs in the H.265 context because motion vectors were assigned on a PU basis in H.265. *Id.*

200. If Rusert’s scan continues (the number of candidates in PMV_CANDS is less than a pre-defined number), Ground 1 applies the below-explained teachings **for a potential spatial motion vector prediction candidate, which is below the potential spatial motion vector prediction candidate on the left side of the prediction unit.** For example, Rusert teaches a scan pattern in Fig.

3n, illustrated below, that “has been found to combine good compression efficiency (i.e., finding good motion vectors) with good computation performance.” Ex-1004, ¶¶66. As illustrated in Fig. 3n, the current block is “.” (highlighted red below); the scan starts with a PMV candidate above the current block (e.g., block “1”), then scans a PMV candidate left of the current block (e.g., block “2”) second, and so on, progressing through blocks “3,” “4,” and then “5.” Ex-1004, ¶¶65-66, Fig. 3n. The PMV candidate for block “5” (highlighted green below) is below the PMV candidate for block “2” (highlighted blue below), which is on the left side of the current block (in red). *Id.*:

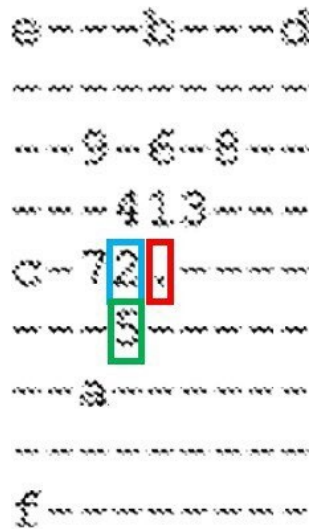


Fig. 3n

201. Therefore, Rusert analyzes a potential spatial motion vector prediction candidate (e.g., the PMV candidate from block “5” highlighted in green) which is below the potential PMV candidate on the left (e.g., from block “2” highlighted in blue) of the current block (e.g., block “.” highlighted in red) for which candidates

are being evaluated. Ex-1004, ¶66, Fig. 3n. As explained above, these blocks are prediction units, and Ground 1 applies these teachings to PUs in the H.265 context.

202. Ground 1 teaches excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit. For example, when analyzing a new PMV candidate, Rusert teaches “comparing the [PMV] candidates already in [PMV_CANDS] with the new [PMV candidate] that could be added, and if a duplicate is found,... skipping the new [PMV candidate].” Ex-1004, ¶¶71-72, ¶21, ¶62 (“It has been identified as advantageous to discard such duplicates.”).

203. Rusert analyzes new PMV candidates following a scan order of nearby blocks, including the pattern of Fig. 3n illustrated below. Block 1 is analyzed first, then blocks 2, 3, and 4 in that order, adding candidates from those blocks to PMV_CANDS. When the 5th block is analyzed (highlighted green), Rusert will already have analyzed blocks 1, 2, 3, and 4. Ex-1004, ¶44, ¶¶65-66, Fig. 3n. Therefore, when Rusert evaluates whether to update PMV_CANDS with the spatial motion vector prediction candidate from block 5, Rusert compares the new candidate with the candidates already in PMV_CANDS, e.g., the candidates from blocks 1, 2, 3, and 4, to determine if it is a duplicate or within a threshold distance (meaning it is within a similarity measure) of an existing candidate in

PMV_CANDS. Ex-1004, ¶¶71-72. This comparison includes a comparison of the PMV candidate from block 5 with the PMV candidate from block 2, and Rusert excludes the potential spatial motion vector prediction candidate for block 5 from PMV_CANDS if it is a duplicate or within a similarity threshold as compared to the candidate on the left side of the PU (block 2). *Id.* In short, for the scan pattern of Fig. 3n, Rusert teaches excluding the PMV candidate below the PMV candidate to the left of the current block from PMV_CANDS if it is essentially similar (e.g., a duplicate or within a threshold distance) compared to the PMV candidate to the left. Ex-1004, Fig. 3n:

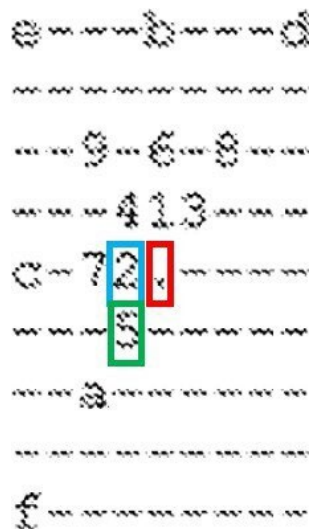


Fig. 3n

204. Rusert looks to whether the candidates are essentially similar by looking at whether they are duplicates or within a threshold distance. Indeed, Rusert uses its threshold comparison to “skip[] new motion vectors ... that are similar but not equal, such as pairs of motion vectors *that have a similarity*

measure smaller than a pre-defined threshold...” Ex-1004, ¶72. Therefore Rusert looks to whether candidates are essentially similar. *Id.*

205. Based on the foregoing explanations, Ground 1 teaches claim 6.

7. Dependent Claim 7

7. **The method according to claim 1 further comprising including a temporal motion prediction candidate into the motion vector prediction list.**

206. Ground 1 teaches claim 7, as explained below.

207. As I explained above, the combination of Rusert and Karczewicz teaches claim 1.

208. Rusert further teaches **including a temporal motion prediction candidate into the motion vector prediction list**. For example, Rusert teaches that “[m]otion vectors to be added to a PMV_CANDS list may comprise spatial or *temporal neighbors of the current block*, or combinations of spatial and/or temporal neighbors[.]” Ex-1004, ¶67. These teachings are consistent with “[e]xisting approaches” to motion prediction that “typically use motion vectors from spatially surrounding blocks or *temporally neighboring blocks* (co-located blocks in neighboring frames).” Ex-1004, ¶5. By including candidates from temporally-neighboring blocks in neighboring frames, e.g., frames that are close in time before and after the current frame, Rusert includes temporal candidates including candidate motion vectors obtained from a previously-encoded frame.

Supra §V.B.

209. Based on the foregoing explanations, Ground 1 teaches claim 7.

8. Dependent Claim 8

8. The method according to claim 1 further comprising selecting one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the block of pixels.

210. Ground 1 teaches claim 8, as explained below.

211. As I have explained above, the combination of Rusert and Karczewicz teaches claim 1.

212. Rusert further teaches **selecting one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the block of pixels**. For example, Rusert teaches “signaling which PMV [candidate] is used for motion vector prediction[.]” Ex-1004, ¶84; *supra* §§VI.A.2[1a], [1e]. “[A] code ‘index’... is sent to *select* a particular PMV candidate... from a list of PMV candidates, PMV_CANDS” and the particular PMV candidate is used to “reconstruct $MV=DMV+PMV$ ” for the current block of pixels. Ex-1004, ¶¶36-37. Therefore, a PMV candidate is selected from PMV_CANDS using an index, and the selected PMV candidate represents the “predicted motion vector (PMV)” used to reconstruct the motion vector for a block. *Id.*, ¶36. Therefore, Rusert teaches selecting one motion vector prediction candidate from PMV_CANDS to represent a motion vector prediction for the block of pixels.

213. Additionally, Rusert teaches exemplary codes to signal the index of the selected candidate from PMV_CANDS. Ex-1004, ¶¶88-102 (exemplary codes

for index values to signal which candidate from PMV_CANDS is used for motion information). For example, Table 1 includes codes for lists of various sizes including codes to indicate the first, second or third candidate in a list size of 3 candidates. *Id.*, ¶88.

214. Based on the foregoing explanations, Ground 1 teaches claim 8.

9. Independent Claim 15

[15pre] An apparatus comprising a processor and a memory including computer program code, the memory and the computer program code configured to, with the processor, cause the apparatus to:

215. To the extent that the preamble is limiting, Ground 1 teaches limitation [15pre], as explained below.

216. Rusert teaches an **apparatus comprising a processor and a memory including computer program code, the memory and computer program code is configured to, with the processor, cause the apparatus to**. For example, Rusert teaches “[t]he present application relates to ... a video encoding apparatus, a video decoding apparatus, and a computer-readable medium.” Ex-1004, ¶1; *see also* Ex-1004, ¶¶24-27, ¶114, ¶116, claim 17, claim 18. The “video encoding apparatus compris[es] a processor” and that the “video decoding apparatus compris[es] a processor[.]” Ex-1004, ¶¶24-25. Rusert further teaches “a computer-readable medium, carrying instructions, which, when executed by computer logic,” such as a processor, “causes said computer logic to carry out any of the methods disclosed herein.” Ex-1004, ¶26. Therefore, Rusert teaches an “apparatus comprising a processor” and memory “carrying instructions” that cause the

apparatus to “carry out any of the methods disclosed herein.” Ex-1004, ¶¶24-26.

At the very least, it would have been obvious to a POSITA for a video encoder and a video decoder to include a processor and a memory, such as a hard drive, to execute software because conventional computers have included processors and memory for this purpose for decades.

217. Based on the foregoing explanations, Ground 1 teaches the preamble of claim 15.

[15a] select a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for a block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates and is utilized to identify motion vector prediction candidates of which one spatial motion vector prediction candidate from the motion vector prediction list is signaled as the motion information for the prediction unit;

218. Ground 1 teaches limitation [15a]. Limitation [15a] is identical to limitation [1a], except that limitation [15a] recites “select” while limitation [1a] recites “selecting.” For the same reasons I have discussed for limitation [1a], Ground 1 teaches limitation [15a]. *Supra* §VI.B.1[1a].

[15b] determine a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

219. Ground 1 teaches limitation [15b], as explained below.

220. Limitation [15b] is substantially similar to limitation [1b]. Their differences are shown below:

15[b]

determine a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

1[b]

determining a subset of spatial motion vector prediction candidates based on a location of the block associated with the first spatial motion vector prediction candidate;

221. Limitation [15b] recites “*the* location of the block,” which lacks an antecedent basis and refers to the only location of the block. This limitation is taught for the same reasons that “*a* location of the block” of limitation [1b] is taught, because both limitations reference the location of the block of pixels and neither claim requires a second location of the block.

222. At the very least, Ground 1 teaches limitation [15b] for the reasons I explained for limitation [1b]. *Supra* §VI.B.1[1b].

[15c] compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

223. Ground 1 teaches limitation [15c], as explained below.

224. Limitation [15c] is substantially similar to limitation [1c]. Their differences are shown below:

15[c]

compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

1[c]

comparing motion information of the first spatial motion vector prediction candidate with motion information of spatial motion vector prediction candidates in the determined subset of spatial motion vector prediction candidates without making a comparison of each pair from the set of spatial motion vector prediction candidates;

225. As an initial matter, “*the spatial motion vector prediction candidate*” of limitation [15c] lacks antecedent basis. “[*T*]*he spatial motion vector prediction candidate*” is rendered obvious for the same reasons that “spatial motion vector prediction candidates” is rendered obvious, since both limitations reference a spatial motion vector prediction candidate in the determined subset of candidates.

226. As I explained above, the subset of spatial motion vector prediction candidates determined in limitation [1b]/[15b] is satisfied by a subset of one or more spatial motion vector prediction candidates. *Supra* §V.D. Ground 1 teaches limitation [15c] for the same reasons limitation [1c] is taught. *Supra* §VI.B.1[1c].

227. Furthermore, “each *possible candidate* pair” is taught by Rusert for the same reasons that “each pair” is taught by Rusert, because a comparison of each pair from the full set is a comparison of each possible candidate pair from that set. In any event, the overarching goal of Rusert’s teachings is to ensure that comparisons are *not* made between all possible candidate pairs in order to reduce

the computational complexity as much as possible while still achieving good compression performance.

228. At the very least, it would be obvious that Ground 1 teaches limitation [15c], for the same reasons I explained for limitation [1c]. *See* §VI.B.1[1c].

[15d] determine to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on comparison of the motion information of the first spatial motion vector candidate with motion information of the spatial motion vector prediction candidate; and

229. Ground 1 teaches limitation [15d], as explained below.

230. Limitation [15d] is substantially similar to limitation [1d]. Their differences are shown below:

15[d]
determine to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on comparison of the motion information of the first spatial motion vector candidate with motion information of the spatial motion vector prediction candidate; and

1[d]
determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

231. Limitation [1d] refers back to “the comparing” of limitation [1c]. Limitation [15d] is nearly identical to [1d], but instead of referring back to [15c], it simply repeats the language from [15c], which recites a step to “compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate.”

232. Therefore, limitation [15d] is nearly identical to limitation [1d]. The minor differences, shown above, do not affect my analysis that Grounds 1 and 2 teach limitation [15d].

233. Therefore, for the same reasons I have discussed for limitation [1d], Ground 1 teaches limitation [15d]. *Supra* §VI.B.1[1d].

[15e] cause information identifying the one spatial motion vector prediction candidate from the motion vector prediction list to be transmitted to a decoder or to be stored.

234. Ground 1 teaches limitation [15e]. Limitation [15e] is identical to limitation [1e], except that limitation [15e] recites “cause” while limitation [1e] recites “causing.” For the same reason I have discussed for limitation [1e], Ground 1 teaches limitation [15e]. *Supra* §VI.B.1[1e].

10. Dependent Claim 16

235. Ground 1 teaches claim 16. Claim 16 is identical to claim 2, except that claim 2 recites “the method according to claim 1 further comprising selecting...,” while claim 16 recites “the apparatus according to claim 15 wherein the apparatus is further caused to select...” I addressed the apparatus of claim 15 above. *Supra* §VI.A.10. The rest of claim 16 is satisfied for the same reasons I explained for claim 2. *Supra* §VI.B.2.

11. Dependent Claim 17

236. Ground 1 teaches claim 17. Claim 17 is identical to claim 3, except that claim 3 recites “the method according to claim 1 further comprising

comparing ...,” while claim 17 recites “the apparatus according to claim 15 wherein the apparatus is further caused to compare...” I addressed the apparatus of claim 15 above. *Supra* §VI.A.10. The rest of claim 17 is satisfied for the same reasons I explained for claim 3. *Supra* §VI.B.3.

12. Dependent Claim 18

237. Ground 1 teaches claim 18. Claim 18 is identical to claim 4, except that claim 4 recites “the method according to claim 1 further comprising examining...” and “excluding,” whereas claim 18 recites “the apparatus according to claim 15 wherein the apparatus is further caused to examine...” and “exclude.” I addressed the apparatus of claim 15 above (*supra* §VI.A.10), and the rest of claim 18 is satisfied for the same reasons I explained for claim 4. *Supra* §VI.B.4.

13. Dependent Claim 19

238. Ground 1 teaches claim 19. Claim 19 is identical to claim 5, except that claim 5 recites “the method according to claim 1 further comprising determining ...” and “limiting,” whereas claim 19 recites “the apparatus according to claim 15 wherein the apparatus is further caused to determine...” and “limit.” I addressed the apparatus of claim 15 above. *Supra* §VI.A.10. The rest of claim 19 is satisfied for the same reasons I explained for claim 5. *Supra* §VI.B.5.

14. Dependent Claim 20

239. Ground 1 teaches claim 20. Claim 20 is identical to claim 6, except that claim 6 recites “the method according to claim 1 further comprising

examining...,” followed by limitations using verbs in their gerund form, whereas claim 20 recites “the apparatus according to claim 15 wherein the apparatus is further caused to examine...,” followed by the same limitations with the verbs in their base form. I addressed the apparatus of claim 15 above. *Supra* §VI.B.9. The rest of claim 20 is satisfied for the same reasons I explained for claim 6. *Supra* §VI.B.6.

15. Dependent Claim 21

240. Ground 1 teaches claim 21. Claim 21 is identical to claim 7, except that claim 7 recites “the method according to claim 1 further comprising including...,” while claim 21 recites “the apparatus according to claim 15 wherein the apparatus is further caused to include...” I addressed the apparatus of claim 15 above. *Supra* §VI.B.9. The rest of claim 21 is satisfied for the same reasons I explained for claim 7. *Supra* §VI.B.7.

16. Dependent Claim 22

241. Ground 1 teaches claim 22. Claim 22 is identical to claim 8, except that claim 8 recites “the method according to claim 1 further comprising comparing ...,” while claim 22 recites “the apparatus according to claim 15 wherein the apparatus is further caused to compare...” I addressed the apparatus of claim 15 above. *Supra* §VI.B.9. The rest of claim 22 is satisfied for the same reasons I explained for claim 8. *Supra* §VI.B.8.

17. Independent Claim 29

[29pre]. A non-transitory computer readable medium having stored thereon a computer executable program code for use by an encoder, said program codes comprising instructions for:

242. To the extent that the preamble is limiting, Ground 1 teaches limitation [29pre], as explained below.

243. Rusert teaches **a non-transitory computer readable medium having stored thereon a computer executable program code for use by an encoder, said program codes comprising instructions for.** For example, Rusert teaches “a computer-readable medium, carrying instructions, which, when executed by computer logic, causes said computer logic to carry out any of the methods disclosed herein.” Ex-1004, ¶26, ¶1 (“The present application relates to... a computer-readable medium.”), claim 19. The computer-readable medium is used, for example, by “a video encoding apparatus[.]” Ex-1004, ¶24. At the very least, it would have been obvious to a POSITA for a video encoder to include a non-transitory computer-readable medium, such as a hard drive, that stores computer executable program code, such as software, because conventional computers have included hard drives storing software for decades.

244. Based on the foregoing explanations, Ground 1 teaches the preamble of claim 29.

[29a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for a block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates and is utilized to identify motion vector prediction candidates of which one spatial motion vector prediction candidate from the motion vector prediction list is signaled as the motion information for the prediction unit;

245. Ground 1 teaches limitation [29a]. Limitation [29a] is identical to limitation [1a]. For the same reasons I have discussed for limitation [1a], Ground 1 teaches limitation [29a]. *Supra* §VI.B.1[1a].

[29b] determining a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

246. Ground 1 teaches limitation [29b], as explained below.

247. Limitation [29b] is nearly identical to limitation [1b]. As shown below, limitation [29b] recites “the location of the block,” while limitation [1b] recites “a location of the block.” This difference is identical to the difference between limitation [15b] and limitation [1b]. For the same reasons I have discussed for limitation [15b], which references to limitation [1b], Ground 1 teaches limitation [29b]. *Supra* §VI.B.9[15b], §VI.B.1[1b].

29[b]

determining a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

1[b]

determining a subset of spatial motion vector prediction candidates based on a location of the block associated with the first spatial motion vector prediction candidate;

[29c] comparing motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

248. Ground 1 teaches limitation [29c], as explained below.

249. Limitation [29c] is nearly identical to limitation [1c]. As shown below, the minor differences between limitation [29c] and limitation [1c] are identical to the differences between limitation [15c] and limitation [1c]. For the same reasons I have discussed for limitation [15c], which references to limitation [1c], Ground 1 teaches limitation [29c]. *Supra* §VI.B.9[15c], §VI.B.1[1c].

29[c]

comparing motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

1[c]

comparing motion information of the first spatial motion vector prediction candidate with motion information of spatial motion vector prediction candidates in the determined subset of spatial motion vector prediction candidates without making a comparison of each pair from the set of spatial motion vector prediction candidates;

[29d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

250. Ground 1 teaches limitation [29d]. Limitation [29d] is identical to limitation [1d]. For the same reasons I have discussed for limitation [1d], Ground 1 teaches limitation [29d]. *Supra* §VI.B.1[1d].

[29e] causing information identifying the one spatial motion vector prediction candidate from the motion vector prediction list to be transmitted to a decoder or to be stored.

251. Ground 1 teaches limitation [29e]. Limitation [29e] is identical to limitation [1e]. For the same reasons I have discussed for limitation [1e], Ground 1 teaches limitation [29e]. *Supra* §VI.B.1[1e]

C. Decoder Claims

252. The decoder-side claims of the '714 patent largely include substantially the same limitations as the encoder claims I discussed above. Moreover, Rusert discloses that the decoder “follow[s] the same steps” as the encoder “for creating and modifying the set of PMV candidates” Exj-1004, ¶35. Accordingly, my discussion of the decoder-side claims below references back to my detailed discussion above for the encoder-side claims such as claim 1.

1. Independent Claim 9

[9pre] A method comprising:

253. To the extent that the preamble is limiting, Ground 1 teaches limitation [9pre].

254. Rusert teaches a **method**. For example, Rusert teaches “a *method* of selecting PMV candidates, wherein each PMV candidate corresponds to a motion vector used for coding of a previous block, said previous block having a distance from a current block.” Ex-1004, Abstract, ¶1, ¶11. The method further comprises the steps and elements explained below. *Infra* §§VI.A.2[9a]-[9e].

[9a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for an encoded block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the encoded block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates;

255. Ground 1 teaches limitation [9a].

256. Step [9a] is substantially similar to step [1a] except it omits the last portion of 1[a] which recites that the motion vector prediction list is used to select the motion vector prediction candidate which gets signaled as the motion information for the prediction unit. As I noted above, Rusert teaches that the decoder “follow[s] the same steps” as the encoder “for creating and modifying the set of PMV candidates” Ex-1004, ¶¶35, 39 (“the decoder can derive the PMV_CANDS in the same way as the encoder”). Karczewicz similarly teaches that the encoder and decoder use “reciprocal ... techniques.” Ex1005, ¶50.

257. Because Rusert discloses that the decoder receives the encoded video data generated by the encoder and uses the signaled PMV candidate to *decode* a corresponding block, a POSITA would have understood that, on the decoder side, the PMV candidates would be determined for “encoded block[s]” of pixels as claimed. Accordingly, Rusert discloses decoding step [9a] for the same reasons it discloses substantially similar encoding step [1a]. *See supra* § VI.B.1[1a].

[9b] determining a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

258. Ground 1 teaches limitation [9b].

259. Step [9b] is almost identical to step [1b]. The only distinction is that [1b] refers to “a location of the block” whereas [9b] refers to “the location of the block.” As I discussed, Rusert teaches that the decoder performs the same steps to derive the set of motion vector prediction candidates. Ex-1004, ¶¶35, 39.

Accordingly, in my opinion, Rusert discloses decoding step [9b] for the same reasons it discloses substantially identical encoding step [1b]. *See supra* § VI.B.1[1b].

[9c] comparing motion information of the first spatial motion vector prediction candidate with motion information of another spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;
--

260. Ground 1 teaches limitation [9c].

261. Step [9c] is almost identical to step [1c] except that 9[c] requires (i) comparing the motion information of the first spatial motion vector prediction candidate with that of another spatial motion vector prediction candidate “of the set” (as opposed to “the determined subset”) and (ii) avoiding comparison of each “possible candidate” pair (as opposed to “each pair”) from the set.

262. As I discussed, Rusert teaches that the decoder performs the same steps to derive the set of motion vector prediction candidates. Ex-1004, ¶¶35, 39. Accordingly, in my opinion, Rusert discloses decoding step [9c] for the same reasons it discloses substantially similar encoding step [1c]. *See supra* § VI.B.1[1c].

263. Moreover, as I discussed for [1c], Rusert’s method compares the motion information of the first spatial motion vector prediction candidate with the PMV candidates in the PMV_CANDS list. While the candidates in the PMV_CANDS list are the claimed “determined subset” (*see supra* § VI.B.1[1b]), they are also a subset of the broader claimed set (*i.e.*, the claimed “a set”) of motion vector prediction candidates which, as I discussed for [1a], can be either (1) the set of motion vectors used for all previous coded blocks in the frame or (2) the set of motion vectors for the blocks in the scan pattern. Accordingly, the comparisons to the PMV candidates in the PMV_CANDS list I discussed for limitation [1c] satisfies the *broader* limitation of [9c] as well.

264. As I discussed for limitation [1c], Rusert’s method avoids comparing each candidate pair from the set of spatial motion vector prediction candidates. *See supra* § VI.B.1[1c]. For the same reasons, Rusert avoids “a comparison of each *possible candidate* pair from the set ...” as recited by [9c].

[9d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and
--

265. Ground 1 teaches limitation [9d].

266. Step [9d] is identical to step [1a]. As I discussed, Rusert teaches that the decoder performs the same steps to derive the set of motion vector prediction candidates. Ex-1004, ¶¶35, 39. Accordingly, in my opinion Rusert discloses

decoding step [9d] for the same reasons it discloses substantially identical encoding step [1d]. *See supra* § VI.B.1[1d].

[9e]	selecting a spatial motion vector prediction candidate from the motion vector prediction list for use in decoding the encoded block of pixels, wherein the spatial motion vector prediction candidate is selected from the motion vector prediction list using information that was received identifying a respective spatial motion vector prediction candidate from the motion vector prediction list constructed by an encoder.
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267. Ground 1 teaches limitation [9e], as explained below.

268. Rusert teaches **selecting a spatial motion vector prediction candidate from the motion vector prediction list for use in decoding the encoded block of pixels**. For example, Rusert teaches “a code ‘index’... to select a particular PMV candidate ... from a list of PMV candidates, PMV_CANDS[.]” Ex-1004, ¶36. Then, “[u]sing the transmitted index, the decoder ... can determine the PMV ... and thus may reconstruct [the motion vector].” Ex-1004, ¶37. These techniques are “for video decoding, wherein the current block is the block being ... decoded[.]” Ex-1004, ¶23, ¶35 (“The methods disclosed herein are performed ... in the decoder during decoding.”). The current block is part of an “encoded video stream” that is “passe[d] to a decoder ... employed in decoding the encoded video stream.” Ex-1004, ¶34. Therefore, Rusert teaches a decoder using an index to select a PMV candidate from the PMV_CANDS list for use in decoding an encoded block.

269. Rusert teaches **the spatial motion vector prediction candidate is selected from the motion vector prediction list using information that was**

received identifying a respective spatial motion vector prediction candidate from the motion vector prediction list constructed by an encoder. For example, Rusert teaches “a particular PMV candidate” is selected “from a list of PMV candidates, PMV_CANDS[,]” using “a code ‘index’” sent “from the encoder... to the decoder[.]” Ex-1004, ¶¶36, ¶37 (“Using the transmitted index, the decoder... can determine the PMV... as used in the encoder... and thus may reconstruct $MV=DMV+PMV$.”), Fig. 1:

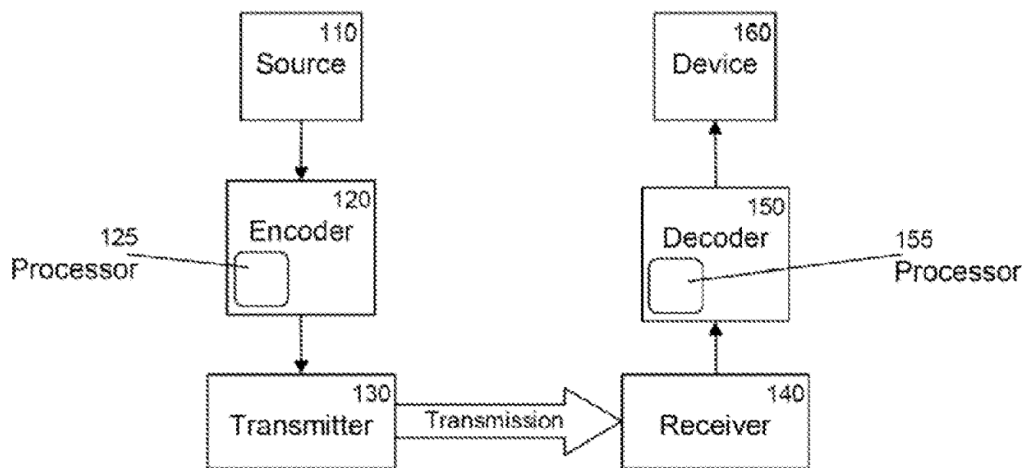


Fig. 1

270. The index is information received by Rusert’s decoder to “select a particular PMV candidate... from a list of PMV candidates, PMV_CANDS” and the selected PMV candidate is used to reconstruct the motion vector for the current block. Ex-1004, ¶¶36-37. In this way, the received index is an index into the list by pointing to a particular candidate based on its position in the list. Rusert teaches zero-based indexing examples, starting with zero for the first candidate and ending with n-1 for a list of n candidates. Ex-1004, ¶¶88-95. PMV_CANDS is constructed by an encoder, and the decoder “mimics the encoder” to construct the

same PMV_CANDS list. Ex-1004, ¶35, ¶37, ¶39. From PMV_CANDS, the decoder uses the index “signaled from the encoder” to “select a particular PMV candidate[.]” Ex-1004, ¶36. “Using the transmitted index, the decoder... can determine the PMV 220” to “reconstruct [the motion vector.]” Ex-1004, ¶27.

271. Ruser teaches that PMV_CANDS is constructed by an encoder. Ruser’s decoder “mimics the encoder” and “follow[s] the same rules for creating and modifying the set of PMV candidates” so “the respective lists of PMV candidates stored in the encoder and decoder maintain synchronization.” Ex-1004, ¶35, ¶37 (“The list PMV_CANDS 240 is identically available at both the encoder 120 and the decoder 150”), ¶39 (“[T]he decoder can derive the list PMV_CANDS in the same way as the encoder.”). Therefore, the list of PMV candidates, PMV_CANDS, used by Ruser’s decoder is the PMV_CANDS constructed by the encoder. Ex-1004, ¶35, ¶37, ¶39. From PMV_CANDS, Ruser’s decoder uses the index “signaled from the encoder ... to the decoder” to “select a particular PMV candidate[.]” Ex-1004, ¶36.

272. Ruser illustrates this process in Figs. 2a and 2b, reproduced below, where Fig. 2a shows the encoding process and Fig. 2b shows the decoding process:

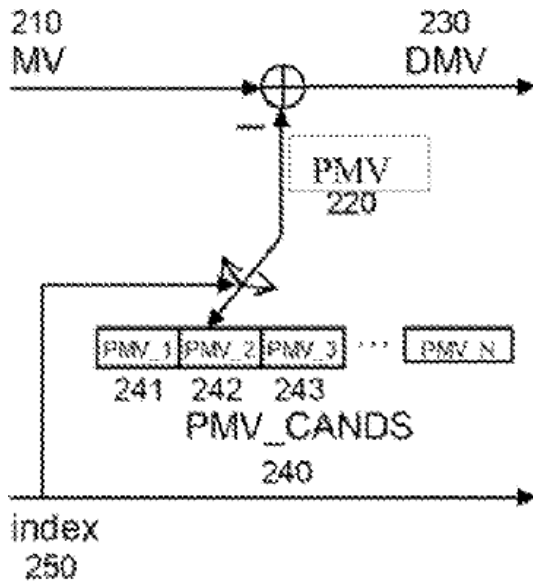


Fig. 2a

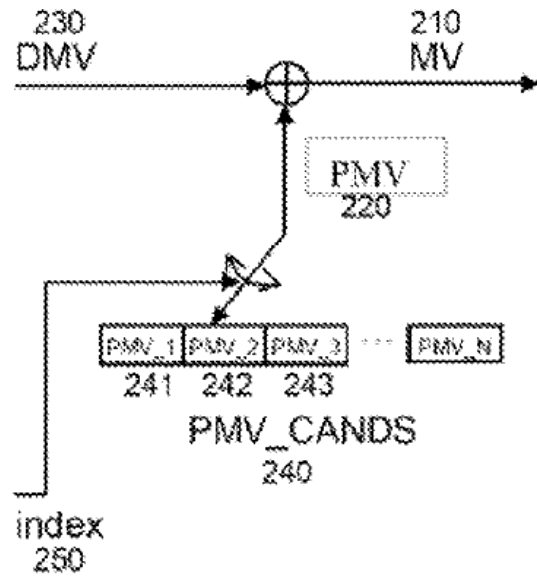


Fig. 2b

This example shows how “a code ‘index’ 250 is sent to select a particular PMV candidate, in this case 242 from a list of PMV candidates, PMV_CANDS 240[.]”

Ex-1004, ¶36. Here, “PMV_CANDS 240 is identically available at both the encoder... and the decoder[.]” and “[u]sing the transmitted index, the decoder... can determine the PMV 220” to “reconstruct [the motion vector.]” Ex-1004, ¶37.

273. Based on the foregoing explanations, Ground 1 teaches limitation [9e].

2. Dependent Claim 10

- 10. The method according to claim 9 further comprising comparing motion information of the potential spatial motion vector prediction candidate with motion information of at most one other spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates.**

274. Ground 1 teaches claim 10.

275. Claim 10 adds the same limitation as claim 3 and is rendered obvious for the same reasons I discussed for claim 3. *Supra* § VI.B.3.

3. Dependent Claim 11

- | | |
|------------|---|
| 11. | The method according to claim 9 further comprising examining whether the received encoded block of pixels is divided into a first prediction unit and a second prediction unit; and if so, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the prediction unit is the second prediction unit. |
|------------|---|

276. Ground 2 teaches claim 11.

277. Claim 11 adds substantially the same limitation as claim 4 discussed above. Accordingly, Rusert, Karczewicz, and Lin render obvious claim 11 for the same reasons I discussed for claim 4. *Supra* §VI.B.4.

4. Dependent Claim 12

- | | |
|----------------|--|
| [12pre] | The method according to claim 9 further comprising |
| 12[a] | determining a maximum number of spatial motion vector prediction candidates to be included in the motion vector prediction list; and |
| 12[b] | limiting the number of spatial motion vector prediction candidates in the motion vector prediction list smaller or equal to the maximum number. |

278. Ground 1 teaches claim 12.

279. Claim 12 adds substantially the same limitations as claim 5 discussed above. As I noted, Rusert teaches that the decoder “follow[s] the same steps” as the encoder “for creating and modifying the set of PMV candidates” Ex-1004, ¶¶35, 39 (“the decoder can derive the PMV_CANDS in the same way as the encoder”). Karczewicz similarly teaches that the encoder and decoder use “reciprocal ... techniques.” Ex1005, ¶50.

280. Accordingly, Ground 1 renders obvious claim 12 for the same reasons I discussed for claim 5. *Supra* §VI.B.5.

5. Dependent Claim 13

[13pre]	The method according to claim 12 further comprising:
[13a]	examining, if the number of spatial motion vector prediction candidates in the motion vector prediction list smaller than the maximum number;
[13b]	if so, examining whether the prediction unit to which the potential spatial motion vector prediction candidate belongs is available for motion prediction;
[13c]	if so, performing at least one of the following:
...	
[13k]	for a potential spatial motion vector prediction candidate, which is below the potential spatial motion vector prediction candidate on the left side of the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;
...	

281. Ground 1 teaches claim 13.

282. Claim 13 adds substantially the same limitations as claim 6 including the limitations above which are substantially identical to [6pre], [6a], [6b], [6c], and [6k].

283. Accordingly, Rusert and Karcewicz render obvious claim 13 for the same reasons I discussed for claim 6. *Supra* §VI.B.6.

6. Dependent Claim 14

14. The method according to claim 9 further comprising selecting one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the encoded block of pixels.

284. Ground 1 teaches claim 14, as explained below.

285. As I have explained above, the combination of Rusert and Karczewicz teaches claim 1.

286. Rusert further teaches **selecting one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the encoded block of pixels**. For example, Rusert teaches “signaling which PMV [candidate] is used for motion vector prediction[.]” Ex-1004, ¶84; *supra* §§VI.B.1[1a], [1e]. “[A] code ‘index’... is sent to *select* a particular PMV candidate... from a list of PMV candidates, PMV_CANDS” and the particular PMV candidate is used to “reconstruct $MV=DMV+PMV$ ” for the current block of pixels. Ex-1004, ¶¶36-37. Therefore, a PMV candidate is selected from PMV_CANDS using an index, and the selected PMV candidate represents the “predicted motion vector (PMV)” used to reconstruct the motion vector for a block. *Id.*, ¶36. Therefore, Rusert teaches selecting one motion vector prediction candidate from PMV_CANDS to represent a motion vector prediction for the encoded block of pixels.

287. Additionally, Rusert teaches exemplary codes to signal the index of the selected candidate from PMV_CANDS. Ex-1004, ¶¶88-102 (exemplary codes

for index values to signal which candidate from PMV_CANDS is used for motion information). For example, Table 1 includes codes for lists of various sizes including codes to indicate the first, second or third candidate in a list size of 3 candidates. *Id.*, ¶88.

288. Rusert teaches that the techniques of selecting a PMV candidate using an index are used for decoding an encoded block of pixels. For example, Rusert teaches that its teachings apply to “video decoding, wherein the current block is the block being... decoded[.]” Ex-1004, ¶23, ¶35 (“The methods disclosed herein are performed... in the decoder during decoding.”). The current block is part of an “encoded video stream” that is “passe[d] to a decoder... employed in decoding the encoded video stream.” Ex-1004, ¶34. The index that identifies a particular PMV candidate is also transmitted to the decoder as the motion information for the encoded block. The decoder thus selects a PMV candidate from PMV_CANDS using the transmitted index, and the selected PMV candidate represents the “predicted motion vector (PMV)” used to reconstruct the motion vector for the encoded block. Ex-1004, ¶36. Therefore, Rusert teaches a decoder using an index to select a PMV candidate from PMV_CANDS to represent a motion vector prediction for the encoded block of pixels. *See supra* §VI.C.1[9e].

289. Based on the foregoing explanations, Ground 1 teaches claim 14.

7. Independent Claim 23

[23pre] An apparatus comprising a processor and a memory including computer program code, the memory and the computer program code configured to, with the processor, cause the apparatus to:
--

290. To the extent that the preamble is limiting, Ground 1 teaches limitation [23pre], as explained below.

291. Rusert teaches an **apparatus comprising a processor and a memory including computer program code, the memory and computer program code is configured to, with the processor, cause the apparatus to**. For example, Rusert teaches “[t]he present application relates to ... a video encoding apparatus, a video decoding apparatus, and a computer-readable medium.” Ex-1006, ¶1; *see also* Ex-1006, ¶24, ¶26, ¶27, ¶114, ¶116, claim 17, claim 18. The “video encoding apparatus compris[es] a processor” and that the “video decoding apparatus compris[es] a processor[.]” Ex-1006, ¶¶24-25. Rusert further teaches “a computer-readable medium, carrying instructions, which when executed by computer logic,” such as a processor, “causes said computer logic to carry out any of the methods disclosed herein.” Ex-1006, ¶26. Therefore, Rusert teaches an “apparatus comprising a processor” and memory “carrying instructions” that cause the apparatus to “carry out any of the methods disclosed herein.” Ex-1006, ¶¶24-26. At the very least, it would have been obvious to a POSITA for a video encoder and a video decoder to include a processor and a memory, such as a hard drive, to execute software because conventional computers have included processors and memory for this purpose for decades.

292. Based on the foregoing explanations, Ground 1 teaches the preamble of claim 23.

[23a] select a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for an encoded block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the encoded block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates;

293. Ground 1 teaches limitation [23a]. Limitation [23a] is identical to limitation [9a], except that limitation [23a] recites “select” while limitation [9a] recites “selecting.” For the same reasons I have discussed for limitations [1a] and [9a], Ground 1 teaches limitation [23a]. *Supra* §§VI.B.1[1a]; VI.C.1[9a].

[23b] determine a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

294. Ground 1 teaches limitation [23b]. Limitation [23b] is identical to limitation [9b], except that limitation [23b] recites “determine” while limitation [9b] recites “determining.” Limitation 23[b] is also nearly identical to limitation [1b]. For the same reasons I have discussed for limitations [1b] and [9b], Ground 1 teaches limitation [23b]. *Supra* §VI.B.1[1b]; VI.C.1[9b].

[23c] compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

295. Grounds 1 and 2 teach limitation [23c].

296. Limitation [23c] is substantially similar to limitation [1c]. Their minor differences are shown below:

23[c]

compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

1[c]

comparing motion information of the first spatial motion vector prediction candidate with motion information of spatial motion vector prediction candidates in the determined subset of spatial motion vector prediction candidates without making a comparison of each pair from the set of spatial motion vector prediction candidates;

297. As an initial matter, “*the* spatial motion vector prediction candidate” of limitation [23c] lacks antecedent basis. In my opinion, a POSITA would interpret “*the* spatial motion vector prediction candidate” as referring to any of the candidates in the determined subset because nothing in the claim language indicates which of the candidates in the determined subset is used for the comparison. Additionally, dependent claim 24 (discussed next) recites “compar[ing] motion information of the potential spatial motion vector prediction candidate with motion information of *at most one other* spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates.”

298. As I discussed for limitation [1c], Rusert discloses different comparisons of the selected PMV candidate against the PMV candidates in the PMV_CANDS list. *Supra* §§VI.B.1[1c]. Additionally, as I discussed for limitation [9c], Rusert discloses avoiding comparisons of each “possible candidate” pair for

the same reasons it discloses avoiding comparisons of each pair of candidates as recited by limitation [1c].

299. Accordingly, for the reasons I explained for limitation [1c] and [9c], Ground 1 teaches limitation [23c]. *Supra* §§VI.B.1[1c], VI.C.1[9c].

[23d] determine to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on comparison of the motion information of the first spatial motion vector candidate with motion information of the spatial motion vector prediction candidate; and

300. Grounds 1 and 2 teaches limitation [23d], as explained below.

301. Limitation [23d] is substantially similar to limitations [9d] and [1d] (which are identical to one another). The differences are shown below:

[23d]	[1d] / [9d]
determine to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on comparison of the motion information of the first spatial motion vector candidate with motion information of the spatial motion vector prediction candidate; and	determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

302. Limitations [1d] and [9d] refer back to “the comparing” of limitation [9c]. Limitation [23d] is nearly identical but instead of referring back to [23c], it simply repeats the language from [23c], which recites a step to “compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate.”

303. Therefore, limitation [23d] is nearly identical to limitations [1d] and [9d]. The minor differences, shown above, do not affect my analysis that Grounds 1 and 2 teach limitation [23d].

304. Therefore, for the same reasons I have discussed for limitation [1d] and [9d], Ground 1 teaches limitation [23d]. *Supra* §§VI.B.1[1d], VI.C.1[9d].

[23e] select a spatial motion vector prediction candidate from the motion vector prediction list for use in decoding the encoded block of pixels, wherein the spatial motion vector prediction candidate is selected from the motion vector prediction list using information that was received identifying a respective spatial motion vector prediction candidate from the motion vector prediction list constructed by an encoder.

305. Ground 1 teaches limitation [23e]. Limitation [23e] is identical to limitation [9e], except that limitation [23e] recites “select” while limitation [9a] recites “selecting.” For the same reason I have discussed for limitation [9e], Ground 1 teaches limitation [23e]. *Supra* §VI.C.1[9e].

8. Dependent Claim 24

306. Ground 1 teaches claim 24. Claim 24 is identical to claim 10, except that claim 10 recites “the method according to claim 9 further comprising comparing ...,” while claim 24 recites “the apparatus according to claim 23 wherein the apparatus is further caused to compare...” I addressed the apparatus of claim 23 above. *Supra* §VI.A.8. The rest of claim 24 is satisfied for the same reasons I explained for claims 3 and 10. *Supra* §§ VI.B.3 and VI.C.2.

9. Dependent Claim 25

307. Ground 2 teaches claim 25. Claim 25 is identical to claim 11, except that claim 11 recites “the method according to claim 9 further comprising comparing ...” and “excluding,” whereas claim 25 recites “the apparatus according to claim 23 wherein the apparatus is further caused to compare...” and “exclude.” I addressed the apparatus of claim 23 above. *Supra* §VI.C.7. The rest of claim 25 is satisfied for the same reasons I explained for claims 4 and 11. *Supra* §§ VI.B.4 and VI.C.3.

10. Dependent Claim 26

308. Ground 1 teaches claim 26. Claim 26 is identical to claim 12, except that claim 12 recites “the method according to claim 1 further comprising determining ...” and “limiting,” whereas claim 19 recites “the apparatus according to claim 23 wherein the apparatus is further caused to determine...” and “limit.” I addressed the apparatus of claim 23 above. *Supra* §VI.C.7. The rest of claim 26 is satisfied for the same reasons I explained for claims 5 and 12. *Supra* §§ VI.B.5 and VI.C.4.

11. Dependent Claim 27

309. Ground 1 teaches claim 27. Claim 27 is identical to claim 13, except that claim 13 recites “the method according to claim 12 further comprising examining ...,” followed by limitations using verbs in their gerund form, whereas claim 27 recites “the apparatus according to claim 26 wherein the apparatus is

further caused to examine...,” followed by the same limitations with the verbs in their base form. I addressed the apparatus of claim 23 above. *Supra* §VI.C.7. The rest of claim 27 is satisfied for the same reasons I explained for claims 6 and 13. *Supra* §§ VI.B.6 and VI.C.5.

12. Dependent Claim 28

310. Ground 1 teaches claim 28, as explained below.

28. The apparatus according to claim 23 wherein the apparatus is further caused to select one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the received encoded block of pixels.

311. Claim 28 is substantially similar to claim 14. Their differences are shown below:

[28]

The apparatus according to claim 23 wherein the apparatus is further caused to select one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the received encoded block of pixels.

[14]

The method according to claim 9 further comprising selecting one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the encoded block of pixels.

312. Claim 28 requires the apparatus to select one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the received encoded block of pixels. This is substantially the same as claim 14. As I have explained above for claim 14, the encoded block of pixels is transmitted from the encoder and received by the decoder. *See supra* §VI.C.6. For the reasons I explained for claim 14, Ground 1 teaches claim 28. *See id.*

13. Independent Claim 30

[30pre]. A non-transitory computer readable medium having stored thereon a computer executable program code for use by an encoder, said program codes comprising instructions for:

313. To the extent that the preamble is limiting, Ground 1 teaches limitation [30pre], as explained below.

314. [30pre] recites “an encoder” while the body of the claim generally tracks the steps of the decoder-side claims. By the time of the alleged invention, a POSITA would have known that the same computer systems (e.g., PCs) could be used both to encode and to decode compressed video. Karczewicz expressly references a “combined encoder/decoder (codec).” Ex-1005, ¶¶50, 129. Additionally, in my opinion a POSITA would have been well-aware that encoders often included decoding capabilities so the encoders could use locally decoded image data during the encoding process. Karczewicz discloses this as well. Ex-1005, ¶68. Accordingly, it would have been obvious to a POSITA in my opinion for Rusert’s encoder to include program instructions for performing the claimed decoding steps. As I noted above, the decoder-side steps are very similar to the encoder-side steps anyway. Ex-1004, ¶35 (“The methods disclosed herein are performed in the encoder during encoding, and also in the decoder during decoding.”).

315. Additionally, if the reference to “an encoder” in [30pre] is taken to be a typo that should read “a decoder,” the claim would still be obvious because Rusert discloses a video decoding “apparatus” comprising “a processor” and

“computer-readable medium, carrying instructions, which when executed[,]... causes [the processor] to carry out any of the methods disclosed herein.” Ex-1004, ¶1, ¶¶24-27.

316. Rusert teaches **a non-transitory computer readable medium having stored thereon a computer executable program code for use by an encoder [or decoder], said program codes comprising instructions for.** For example, Rusert teaches “a computer-readable medium, carrying instructions, which, when executed by computer logic, causes said computer logic to carry out any of the methods disclosed herein.” Ex-1004, ¶26, ¶1 (“The present application relates to... a video encoding apparatus, a video decoding apparatus, and a computer-readable medium.”), claim 19. The computer-readable medium is used, for example, by “a video encoding apparatus” and “a video decoding apparatus[.]” Ex-1004, ¶¶24-25. At the very least, it would have been obvious to a POSITA for a video encoder and a video decoder to include a non-transitory computer-readable medium, such as a hard drive, that stores computer executable program code, such as software, because conventional computers have included computer readable media (e.g., hard drives) storing executable software for decades.

317. Based on the foregoing explanations, Ground 1 teaches the preamble of claim 30.

[30a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for an encoded block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the encoded block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates;

318. Ground 1 teaches limitation [30a]. Limitation [30a] is identical to limitation [9a]. For the same reasons I have discussed for limitations 1[a] and [9a], Ground 1 teaches limitation [30a]. *Supra* §§VI.B.1[1a], VI.C.1[9a].

[30b] determining a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

319. Ground 1 teaches limitation [30b]. Limitation [30b] is identical to limitation [9b]. For the same reasons I have discussed for limitations [1b] and [9b], Ground 1 teaches limitation [30b]. *Supra* §§VI.B.1[1b], VI.C.1[9b].

[30c] comparing motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

320. Ground 1 teaches limitation [30c].

321. Limitation [30c] is nearly identical to limitation [9c]. As shown below, the minor differences between limitation [30c] and limitation [9c] are identical to the differences between limitation [23c] and limitation [9c]. For the same reasons I have discussed for limitation [23c], which references to limitations

[1c] and [9c], Ground 1 teaches limitation [30c]. *Supra* §VI.A.7[23c], §VI.C.1[9c], §VI.B.1[1c].

[30c]

comparing motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

[9c]

comparing motion information of the first spatial motion vector prediction candidate with motion information of another spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

[30d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

322. Ground 1 teaches limitation [30d]. Limitation [30d] is identical to limitation [9d]. For the same reasons I have discussed for limitation [9d], Ground 1 teaches limitation [30d]. *Supra* §§ VI.B.1[1d], VI.C.1[9d].

[30e] selecting a spatial motion vector prediction candidate from the motion vector prediction list for use in decoding the encoded block of pixels, wherein the spatial motion vector prediction candidate is selected from the motion vector prediction list using information that was received identifying a respective spatial motion vector prediction candidate from the motion vector prediction list constructed by an encoder.

323. Ground 1 teaches limitation [30e]. Limitation [30e] is identical to limitation [9e]. For the same reasons I have discussed for limitation [9d], Ground 1 teaches limitation [30e]. *Supra* §VI.C.1[9e].

VII. BACKGROUND AND QUALIFICATIONS

324. This section contains a summary of my educational background, career history, publications, and other relevant qualifications. My full curriculum vitae is attached as Appendix 1 to this declaration.

325. I received a bachelor of science degree in Electrical and Computer Engineering from the University of California at Davis in 1985. I received a Master of Science degree in electrical and Computer Engineering from the University of California at Santa Barbara in 1990, and I received my PhD. in Electrical and Computer Engineering, also from the University of California at Santa Barbara in 1993.

326. I have more than 30 years of experience with data compression, decompression, and data storage.

327. I am currently a Full Professor in the Klipsch School of Electrical & Computer Engineering at New Mexico State University. I was an Assistant Professor at New Mexico State from January 2000 until I became an Associate Professor in 2004. I have been a Full Professor since August 2010. My research and coursework at New Mexico State have focused on digital signal and image and

video processing. Much of the research I have done over the course of my career is in the area of image and video compression.

328. My first exposure to the field of signal compression came in the fall of 1989, when I took a course entitled Vector Quantization and Signal Compression at UCSB from Prof. Allen Gersho—an internationally renowned researcher in the area of speech compression. As my Ph.D. research progressed, I began to focus on transform-based compression as my main application area. My first paper dealing with image compression was published in 1991. I have since written 24 other journal and conference papers directly related to compression, and I am the named inventor on two issued United States patents related to compression.

329. Since joining the faculty of New Mexico State University in 2000, I have taught numerous classes at both the graduate and undergraduate levels. At the graduate level, I have taught the following: Signal Compression (EE573), Image Processing (EE596), Digital Signal Processing (EE545), Pattern Recognition (EE565), Advanced Linear Systems (EE555), Telemetry Systems (EE585), Information Theory (EE586), Adaptive Signal Processing (EE594), Multirate Signal Processing and Wavelets (EE595), and Neural Signal Processing (EE590). At the undergraduate level, I have taught the following courses: Linear Algebra & Probability (EE200), Signals and Systems I (EE312), Image Processing (EE446), Introduction to Digital Signal Processing (EE395), and Digital Communications (EE497).

330. From 1993 through 1999, I was a Researcher and Team Leader, at the Naval Air Warfare Center, China Lake. At China Lake, my research efforts focused on high speed image and video compression technologies including embedded wavelet video compression. I also developed a real-time video streaming system that efficiently operated over TCP/IP networks while retaining the highest possible fidelity.

331. From 1990 through 1993, I worked as a Research Assistant in the Department of Electrical and Computer Engineering at the University of California, Santa Barbara. In this position, I worked on subband coding (compression) and multirate filter bank theory. I also implemented real-time filter banks on a digital signal processor. In the summer of 1992, I worked at AT&T Bell labs where I developed and simulated new methods of extremely low bit rate video coding for video telephone applications.

332. From 1985 through 1989, I worked as a Design Engineer at the Naval Weapons Center, China Lake. In this role, I built and tested the guidance electronics for various laser guided munitions. This project included mixed analog and digital circuit design as well as the programming of an embedded digital signal processor. I also developed software for an advanced video processor and studied ground target tracking.

333. A full listing of my publications is found in my curriculum vitae. *See* Appendix 1.

334. I have published 17 peer-reviewed journal articles and 94 conference papers, including 9 journal articles and 30 conference papers directly related to data compression; the following are representative:

- C.D. Creusere, “A new method of robust image compression based on the embedded zerotree wavelet algorithm,” IEEE Trans. on Image Processing, Vol 6, No. 10, Oct. 1997, pp. 1436-1442.
- C.D. Creusere, “Fast embedded compression for video,” IEEE Trans. on Image Processing, Vol. 8, No. 12, pp. 1811-16, December 1999.
- C.D. Creusere, “Motion compensated video compression with reduced complexity encoding for remote transmission,” Signal Processing: Image Communications, Vol. 16, pp. 627-42, April 2000.

335. I am a named co-inventor on two issued patents, both relating specifically to image and video compression. I am the listed inventor on U.S. Patent No. 6,148,111 entitled “Parallel digital image compression system which exploits zerotree redundancies in wavelet coefficients” and U.S. Patent No. 6,466,698 entitled “Efficient embedded image and video compression using lifted wavelets.”

336. In addition to the experience and publications listed above, I have also received the following awards and distinctions that are relevant to the subject matter of this declaration. I am currently deputy Editor-in-Chief for IEEE Transactions on Image Processing as well as an Area Editor for IEEE Open Journal on Signal Processing. I have previously served as an Associate Editor for IEEE Transactions on Image Processing from 2010 through 2014. I have also served in this capacity from 2002 through 2005. From 2008-2013, I served as an Associate Editor for IEEE Transactions on Multimedia. I also served as a Senior Area Editor for IEEE Transactions on Image Processing from 2016-2022.

337. In 2004, I served as the co-general chair for the IEEE Digital Signal Processing Workshop in Taos, New Mexico. In 2012 and 2014, I served as the co-technical chair for the Southwest Symposium on Image Analysis and Interpretation held in Santa Fe, New Mexico and San Diego, CA, respectively. In addition, I served as the technical chair for the 2015 and 2021 International Telemetering Conference held in Las Vegas, NV in October. I am also a member of the technical program committees for the IEEE Data Compression Conference, IEEE International Conference on Image Processing and the IEEE Acoustics, Speech, and Signal Processing Conference.

A. Compensation

338. For my efforts in connection with the preparation of this declaration I have been compensated at my standard rate for this type of consulting activity. My

compensation is in no way contingent on the results of these or any other proceedings relating to the above-captioned patent.

B. Materials and Other Information Considered

339. I have considered information from various sources in forming my opinions. I have reviewed and considered each of the exhibits listed in the attached Appendix 2 (Materials Considered in the Preparation of This Declaration) in forming my opinions.

VIII. UNDERSTANDING OF THE LAW

340. I am not an attorney. In forming my opinions in this Declaration, I applied the relevant legal principles provided to me by counsel, which are summarized in Appendix 4.

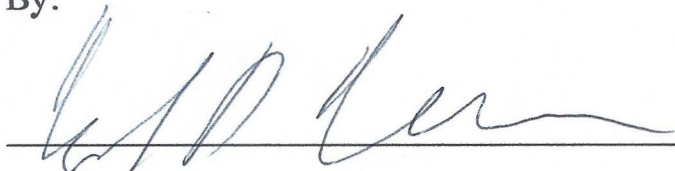
IX. RESERVATION OF RIGHTS

341. My opinions are based upon the information that I have considered to date. I am unaware of any evidence of secondary considerations with respect to the '714 patent that would render any of the challenged claims non-obvious. I reserve the right, however, to supplement my opinions in the future to respond to any arguments raised by the owner of the '714 patent and to take into account new information that becomes available to me.

342. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on July 23, 2025.

By:

A handwritten signature in blue ink, appearing to read 'Charles D. Creusere', is written over a horizontal line.

Charles D. Creusere

APPENDIX 1: CURRICULUM VITAE OF CHARLES D. CREUSERE

VITA

CHARLES D. CREUSERE

Klipsch School of Electrical & Computer Engineering

Mailing Address:

MSC 3-0

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Las Cruces, NM 88003-8001

Phone: 575-646-3919

Fax: 575-646-1435

email: ccreuser@nmsu.edu

DISSERTATION TITLE

"Perfect Reconstruction Modulated Polyphase Filter Banks Using Reverse-Time Subfilters."

ACADEMIC TRAINING

- 1980-1985:** University of California at Davis, B.S. in Electrical and Computer Engineering.
- 1989-1990:** University of California at Santa Barbara, M.S. in Electrical and Computer Engineering.
- 1990-1993:** University of California at Santa Barbara, Ph.D. in Electrical and Computer Engineering.

PROFESSIONAL EXPERIENCE

2010-current Holder of the Frank Carden Endowed Chair in Telemetry & Telecommunications (2010-2024) and Full Professor (current). Current research interests include compressive sensing/sparse reconstruction for LIDAR and streaming sensor data as well as EEG brain analysis for audiovisual perceptual quality assessment and modeling.

October 2008 Selected for the International Foundation for Telemetry Endowed Professorship.

Jan. 2000-2008 Assistant/Associate professor in the Klipsch School of Electrical & Computer Engineering. My teaching areas include digital signal processing, image processing, pattern classification, and source coding (signal compression). I have done past research in areas of image, video, and audio compression as well as feature vector extraction for pattern classification. Currently, my research interests include distributed compression, polarimetric image processing for scene analysis, and nonstationary signal denoising.

1993-1999: Researcher & Team Leader, Naval Air Warfare Center, China Lake. My research efforts have focused on high speed image and video compression technologies which offer unique capabilities such as robustness to transmission errors and regional localization. My team (2 other people) and I have implemented a real-time (3 to 15 frames/second with 240x512 frames)

320C80-based system which uses a wavelet transform along with embedded coding techniques to compress a video input and stream it through the Internet via TCP/IP protocols. Our recent research focus has been to add more intelligence to the encoder so that the space-frequency information in the image that is most useful for image analysis is received with the highest fidelity. While most of my recent research has been in the area of embedded compression, I am still very much interested in other applications of time/space-frequency decompositions and of multirate digital signal processing concepts in general.

1999, Spring Quarter: Instructor at the University of California at Santa Barbara. Taught graduate class in Multirate Digital Signal Processing, ECE 258B.

1990-1993: Research Assistant, Department of Electrical and Computer Engineering, University of California, Santa Barbara. Worked under Prof. S.K. Mitra on subband coding and multirate filter bank theory. Also implemented real-time filter banks on a Motorola 56001 digital signal processor.

1992: Summer Employee, AT&T Bell labs, Murray Hill, NJ. Developed and simulated new methods of extremely low bit rate video coding for video telephone applications.

1985-1989: Design Engineer, Naval Weapons Center, China Lake. Designed, built, and tested the guidance electronics for the Laser Guided Training Round. This project included mixed analog and digital circuit design as well as the programming of an embedded DSP. Also developed software for an advanced video processor and studied ground target tracking.

FUNDED RESEARCH

- (2000) Office of Naval Research, *Compression of Digital Elevation Maps Using Non-linear Wavelets*, 2000-2003, \$94K
- (2001) Sandia National Labs, *Intelligent Compression for Remote Sensing*, 2001-2003, \$70K.
- (2002) National Science Foundation (Early Career Grant), *Efficient Audio Compression with Perceptually Embedded Scalability*, 2002-2007, \$350K.
- (2004) National Geospatial-Intelligence Agency, *Passive Polarimetric Imagery Classification Study*, 2004-2006, \$160K (joint with Dr. David Voelz).
- (2005) Los Alamos National Laboratories, *Signal Detection via Adapted Filter Banks and Geometric Dimensionality Reduction*, 2005-2006, \$15K (unburdened).
- (2006) Los Alamos National Laboratories, *Signal Detection via Adapted Filter Banks and Geometric Dimensionality Reduction*, 2006-2007, \$50K (unburdened).
- (2006) National Geospatial-Intelligence Agency, *Exploiting Polarization in Imaging Systems*, 2006-2009, \$304K (joint with Dr. David Voelz).
- (2006) Army Research Office, *Distributed Source Coding Using Bitstream-based Detection and Classification*, 2006-2009, \$326K.
- (2006) DARPA (Subcontract from LANL), *ADAM Project*, 2006-2007, \$104K (joint with Dr. Joe Lakey and Dr. Jaime Ramirez)

- (2009) NMSU IRG, *Perceptual audio quality evaluation by direct measurement of human brain responses*, 2009-2010, \$39K (joint with Dr. Jim Kroger, Psychology)
- (2011) National Science Foundation, *CIF:Medium:Assessment and modeling of temporal variation in perceived audio and video quality using direct brainwave measurement*, 2011-2015, \$917K (lead PI with Dr. Jim Kroger and Dr. Joerg Kliewer as co-PIs)
- (2011) NASA EPSCOR, *Proximity Operations for Near Earth Asteroid Exploration*, 2011-2014, \$750K (co-PI, with Dr. Eric Butcher (lead), others)
- (2012) National Geospatial Intelligence Agency (NGA), *Pulse Complexity Based LIDAR Scene Modeling for Sparse Reconstruction and Super-Resolution*, 2012-2013 (plus 3 1 year options), \$150K (\$75K/option year), co-PI Dr. David Voelz.
- (2018) Airforce Research Lab (AFRL), *Software Radio Design in LabView FPGA*, 2018-2019, \$140K.

PATENTS

- Patent titled "Parallel digital image compression system which exploits zerotree redundancies in wavelet coefficients," Patent Number 6,148,111.
- Patent titled "Efficient embedded image and video compression using lifted wavelets," Number: 6,466,698, granted October 15, 2002.

OTHER DISTINCTIONS

- Awarded the International Foundation for Telemetering Professorship, October 2008.
- Received an educational fellowship from the Department of Defense, 1989-1992.
- Certificate of Merit for the outstanding technical paper awarded at the AIAA Missile Sciences Conference for the paper "Automatic target recognition directed image compression," Nov. 1998.
- Patent (classified) "Notice of Allowability" titled, "Microcontroller-Based Laser Pulse Decoder," granted October 7, 1991.
- Associate editor for IEEE Trans. on Image Processing, 2002-2005, 2010-2014
- Associate editor for IEEE Trans. on Multimedia, 2008-2013.
- Guest Editor, "Issue on Advances in Hyperspectral Data Processing and Analysis", IEEE Journal of Selected Topics in Signal Processing, Vol. 5, Numbers: 5 & 6, August-September 2015,
- Co-general chair, IEEE Digital Signal Processing Workshop, August 2004, Taos, NM.
- Co-technical chair for the 2012 and 2014 Southwest Symposium on Image Analysis and Interpretation.
- Student Paper Contest Chair, 40th Asilomar Conf. on Signals, Systems, and Computers, October 2006.

- Organized special session entitled "Applications of Multirate DSP" at the 40th Asilomar Conf. on Signals, Systems, and Computers, October 2006.
- Member of technical program committees for the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP), the IEEE International Conference on Image Processing (ICIP), and the IEEE Data Compression Conference (DCC).
- Senior Area Editor, IEEE Transactions on Image Processing, March 2016 to May 2022.
- Area Editor for IEEE Access, June 2022-Present.
- Deputy Editor-in-Chief, IEEE Transactions on Image processing, May 2023-June 2024.

CONSULTING ACTIVITIES

- Video compression systems (technology consultant), Abba Tech, Albuquerque, NM, 2000.
- Expert witness in laser rangefinding technology, Asia Optical Inc. (through NY law firm of Osterlenk, Faber, Gerb & Soffen), Case: LTI versus Nikon/AOI, July 2001-2003. Case went to trial/ testified in court.
- Technical expert for defense; Case: Real-Time v. AT&T (byte.mobile), 2011-2012, case settled June 2012.
- Technical expert for defense; Case: Princeton Digital v. Dell, 2014-2015, case dismissed June 2015.
- Technical expert for defense; Noninfringement & IPR (6,597,812), Real-time v. SAP, 1/2016-6/2016.
- Technical expert for defense; IPRs (7,378,992 & 8,643,513), Real-time v. Riverbed, et al., 2/2016-2017
- Technical expert for defense; IPRs (7,415,530, 9,116,908, 7,161,506, & 9,054,728), Real-time v. Dell, et al., 2/2016-2017
- Technical expert for defense; Noninfringement, Real-time v. HP Enterprises, 4/2016-2018.
- Technical expert for defense; IPR (7,358,867, 7,161,506, & 9,054,728), Real-time v. Teradata 11/2016-2017
- Technical expert for defense; IPRs (7,415,530, 8,643,513 & 7,378,992), Real-time v. Veritas 12/2016-2017.
- Technical expert for defense; IPRs (7,075,917 & 6,304,612), UNILOC v. Apple 9/2018-2019.
- Technical expert for defense; IPR (7,558,730), Advanced Voice Recognition Systems v. Apple 7/2019-2020.
- Technical expert for defense; District Court; Noninfringement, Realtime Adaptive Systems v. YouTube/Google, 2018-2020.
- Technical expert for defense; ITC case; Nokia v. Lenovo, Oct. 2020-2021.
- Technical expert for defense; IPR (10,176,848), Maxell v. Apple, 2019-2021.

- Technical expert for plaintiff (rebutting invalidity); East Texas District Court; USAA v. PNC Bank, 2021-present. Deposed in Case 1 and Case 2; Attended trial in May 2022 for Case 1 and September 2022 for Case 2 but was not called to testify (USAA won on all counts, patents upheld as valid); I have also opined as an expert in 3 related IPRs (deposed in one of those cases, so far).
- Technical expert for defense; District Court; Gesture Tech Partners v. Apple/Lenovo&Motorola, 2021.

JOURNAL PUBLICATIONS

1. **C.D. Creusere and S.K. Mitra**, "A simple method for designing high-quality prototype filters for M-band pseudo-QMF banks," *IEEE Trans. on Signal Processing*, Vol. 43, No. 4, April 1995, pp. 1005-1007.
2. **C.D. Creusere and S.K. Mitra**, "Efficient audio coding using perfect reconstruction noncausal IIR filter banks," *IEEE Trans. on Speech and Audio Processing*, Vol. 4, No. 2, March 1996, pp. 115-123.
3. **C.D. Creusere and S.K. Mitra**, "Image coding using wavelets based on perfect reconstruction IIR filter banks," *IEEE Trans. on Circuits and Systems for Video Technology*, Vol. 6, No. 5, Oct. 1996, pp. 447-458.
4. **C.D. Creusere**, "A new method of robust image compression based on the embedded zerotree wavelet algorithm," *IEEE Trans. on Image Processing*, Vol 6, No. 10, Oct. 1997, pp. 1436-1442.
5. **C.D. Creusere and A. Van Nevel**, "ATR-directed image and video compression," *Journal of Aircraft*, Vol. 36, No. 4, pp. 626-31, July-August 1999.
6. **C.D. Creusere**, "Fast embedded compression for video," *IEEE Trans. on Image Processing*, Vol. 8, No. 12, pp. 1811-16, December 1999.
7. **C.D. Creusere**, "Motion compensated video compression with reduced complexity encoding for remote transmission," *Signal Processing: Image Communications*, Vol. 16, pp. 627-42, April 2000.
8. **C.D. Creusere**, "Understanding perceptual distortion in MPEG scalable audio coding," *IEEE Trans. on Speech and Audio Processing*, Vol. 13, No. 3, pp. 422-431, May 2005.
9. **L. E. Boucheron and C.D. Creusere**, "Lossless wavelet-based compression of digital elevation maps for fast and efficient search and retrieval," *IEEE Trans. on Geoscience and Remote Sensing*, Vol. 43, No. 5, pp. 1210-1214, May 2005.
10. **V. Thilak, D. Voelz, and C.D. Creusere**, "Polarization-based index of refraction and reflection angle estimation for remote sensing applications," *Applied Optics*, Vol. 46, Bo. 30, pp. 7427-7536, Oct. 2007.
11. **C.D. Creusere, K. Kallakuri, and R. Vanam**, "An Objective Metric of Human Subjective Audio Quality Optimized for a Wide Range of Audio Fidelities," *Audio, Speech, and Language Processing, IEEE Transactions on [see also Speech and Audio Processing, IEEE Transactions on]*, vol.16, no.1, pp.129-136, Jan. 2008
12. **S. Kandadai and C.D. Creusere**, "Scalable Audio Compression at Low Bitrates," *Audio, Speech, and Language Processing, IEEE Transactions on [see also Speech and Audio Processing, IEEE Transactions on]*, vol.16, no.5, pp.969-979, July 2008
13. **S. Kandadai and C.D. Creusere**, "Reverse engineering and repartitioning vector quantizers using training set synthesis," *Signal Processing*, August 2008.
14. **V. Thilak, C.D. Creusere, and D. Voelz**, "Passive Polarimetric Imagery-Based Material Classification Robust to Illumination Source Position and Viewpoint," *Image Processing, IEEE Transactions on*, vol.20, no.1, pp.288-292, Jan. 2011.
15. **C.D. Creusere and J. Hardin**, "Assessing the Quality of Audio Containing Temporally Varying Distortions," *Audio, Speech, and Language Processing, IEEE Transactions on*, vol.19, no.4, pp.711-720, May 2011.

16. **Castorena, J.; Creusere, C.D.**, "The Restricted Isometry Property for Banded Random Matrices," *Signal Processing, IEEE Transactions on* , vol.62, no.19, pp.5073-5084, Oct.1, 2014
doi: 10.1109/TSP.2014.2345350.
17. **Castorena, J.; Creusere, C.D.**, "Sampling of Time-Resolved Full-Waveform LIDAR Signals at Sub-Nyquist Rates," *Geoscience and Remote Sensing, IEEE Transactions on* , vol.53, no.7, pp.3791-3802, July 2015. doi: 10.1109/TGRS.2014.2383839.

REFEREED CONFERENCE PUBLICATIONS

1. **H. Babic, S.K. Mitra, C.D. Creusere, and A. Das**, "Perfect reconstruction recursive QMF banks for image subband coding," *Proc. Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, Nov. 1991, pp. 746-750.
2. **S.K. Mitra, C.D. Creusere, and H. Babic**, "A novel implementation of perfect reconstruction QMF banks using IIR filters," *Proc. IEEE Int. Symposium on Circuits and Systems*, San Diego, CA, May 1992, pp. 2312-2315.
3. **S.K. Mitra, C.D. Creusere, and H. Babic**, "Design of transmultiplexers using IIR filter banks," *Signal Processing VI: Theories and Applications*, Elsevier Science Publishers, 1992, pp. 223-226.
4. **C.D. Creusere and S.K. Mitra**, "Efficient image scrambling using polyphase filter banks," *Proc. International Conference on Image Processing*, Austin, TX, Nov. 1994, pp. 81-85.
5. **C.D. Creusere and G. Hewer**, "Wavelet-based nearest neighbor pattern classification using scale sequential matching," *Proc. Asilomar Conf. Signals, Systems and Computers*, Pacific Grove, CA, Nov. 1994, pp. 1123-1127.
6. **C.D. Creusere**, "Embedded zerotree image coding using low complexity IIR filter banks," *Proc. Int. Conf. on Acoustics, Speech, and Signal Processing*, Detroit, MI, May 1995, pp. 2213-16.
7. **C.D. Creusere and Gary Hewer**, "Digital video compression for weapons control and bomb damage indication," *AGARD Conference Proceedings 576*, Chapter 16, Sept. 1995.
8. **C.D. Creusere**, "Image coding using parallel implementations of the embedded zerotree wavelet algorithm," *Proc. of the Digital Video Compression Conference (Algorithms and Technologies 1996)*, San Jose, CA, Jan. 28-Feb. 2, 1996, pp. 82-93.
9. **C.D. Creusere**, "A family of image compression algorithms which are robust to transmission errors," *Proceedings of the SPIE*, Vol. 2825, Denver, CO, August, 1996, pp. 890-900.
10. **C.D. Creusere**, "Perfect reconstruction time-varying IIR filter banks," *Conf. Rec. Asilomar Conf. Signals, Systems, and Computers*, Pacific Grove, CA, Nov. 1996, pp. 1319-23.
11. **C.D. Creusere**, "Out-of-loop motion compensation for reduced complexity video encoding," *Proc. of the Data Compression Conf.* (pp. 428) & *Data Compression Industry Workshop* (pp.28-37), March 1997, Snowbird, UT.
12. **C.D. Creusere**, "Periodic pan compensation for reduced complexity video compression," *Proc. Int. Conf. on Acoustics, Speech, and Signal Processing*, Vol IV, pp. 2889-92, April 1997, Munich, Germany.
13. **C.D. Creusere**, "A new approach to global motion compensation which reduces video encoding complexity," *Proc. Int. Conf. on Image Processing*, Vol. III, pp. 634-7, October 1997, Santa Barbara, CA.
14. **C.D. Creusere**, "Spatially partitioned lossless image compression in an embedded framework," *Conf. Rec. 31st Asilomar Conf. on Signals, Systems, and Computers*, Nov. 1997, Pacific Grove, CA.
15. **C.D. Creusere**, "Adaptive embedding for reduced complexity image and video compression," *Proc.*

- of the SPIE, Vol 3309 (Visual Communications and Image Processing), pp. 48-57, Jan. 1998, San Jose, CA.
16. **C.D. Creusere**, "Successive coefficient refinement for embedded lossless image compression," *Proc. of the Data Compression Conf.*, pp. 539, March 1998, Snowbird, UT.
 17. **C.D. Creusere**, "Subband coding of speech and audio," *Proc. of the European Signal Processing Conf.* (invited paper), Sept. 1998, Isle of Rhodes, Greece.
 18. **C.D. Creusere**, "Fast embedded video compression using cache-based processing," *Proc. of the European Signal Processing Conf.*, Sept. 1998, Isle of Rhodes, Greece.
 19. **C.D. Creusere**, "Successive coefficient refinement for embedded lossless image compression," *Proc. Int. Conf. on Image Processing*, Oct. 1998, Chicago, IL.
 20. **C.D. Creusere** and A. Van Nevel, "Autonomous target recognition directed image compression," *Proc. of the AIAA*, Nov. 1998.
 21. **C.D. Creusere**, "Improved successive refinement for wavelet-based embedded image compression," *Proc. of the SPIE*, Denver, CO, July 1999.
 22. A. Van Nevel and **C.D. Creusere**, "Intelligent Bandwidth Compression," *Proc. of the SPIE*, Denver, CO, July 1999.
 23. **C.D. Creusere**, "Optimal refinement/significance map tradeoffs in SPIHT-based image compression," *Conf. Rec., 34th Asilomar Conf. on Signals, Systems, & Computers*, pp. 1026-30, Oct. 2000.
 24. **C.D. Creusere**, "Compression of digital elevation maps using nonlinear wavelets," *Proc. Int. Conf. on Image Processing*, pp. 824-7, October 2001.
 25. **C.D. Creusere and G. Dahman**, "Object detection and localization in compressed video," *Conf. Rec. 35th Asilomar Conf. on Signals, Systems, and Computers*, Nov. 2001, Pacific Grove, CA.
 26. **C.D. Creusere**, "An analysis of perceptual artifacts in MPEG scalable audio coding," *Proceedings of the Data Compression Conference*, pp. 152-161, April 2002, Snowbird, UT.
 27. **C.D. Creusere and N. Tolk**, "Combining wavelets and GLICBAWLS to achieve resolution-progressive lossless compression," *Proc. of the International Conference on Image Processing*, pp. III-229-32, October 2002.
 28. **L. Boucheron and C.D. Creusere**, "Compression of digital elevation maps for fast and efficient search and retrieval," *Proc. of the International Conference on Image Processing*, pp. 629-32, September 2003.
 29. **S. Kandadai and C.D. Creusere**, "An experimental study of object detection in the wavelet domain," *Conf. Rec. 37th Asilomar Conf. on Signals, Systems, and Computers*, pp. 1620-4, Nov. 2003, Pacific Grove, CA.
 30. **C.D. Creusere**, "Quantifying perceptual distortion in scalably compressed MPEG audio," *Conf. Rec. 37th Asilomar Conf. on Signals, Systems, and Computers*, pp. 265-9, Nov. 2003, Pacific Grove, CA.
 31. **C.D. Creusere and L. Zhou**, "Spatial object detection and classification in JPEG bitstreams," *Proceedings 11th Digital Signal Processing Workshop*, pp. 115-9, August 2004, Taos Ski Valley, NM.
 32. **L. Zhou and C.D. Creusere**, "Spatial object detection in JPEG bitstreams," *Proceedings European Conference on Signal Processing*, pp. 949-52, September 2004, Vienna, Austria.
 33. **V. Thilak and C.D. Creusere**, "Tracking of extended size targets in H.264 compressed video using the probabilistic data association filter," *Proceedings European Conference on Signal Processing*, pp. 281-4, September 2004, Vienna, Austria.
 34. **S. Kandadai and C.D. Creusere**, "Reverse engineering vector quantizers by training set synthesis," *Proceedings European Conference on Signal Processing*, pp. 789-92, September 2004, Vienna, Austria.

35. **V. Thilak, J. Saini, D. G. Voelz, C. D. Creusere** , "Pattern recognition for passive polarimetric data using nonparametric classifiers," *Proc. of the SPIE Vol. 5888*, p. 337-344, Polarization Science and Remote Sensing II; Joseph A. Shaw, J. Scott Tyo; Eds.
36. **R. Vanam and C.D. Creusere**, "Evaluating low bitrate scalable audio quality using advanced version of PEAQ and energy equalization approach ," *Proc. IEEE Int. Conf. on Acoustics, Speech, and Signal Processing*, Vol. III, pp. 189-92, March 2005.
37. **S. Kandadai and C.D. Creusere**, "Reverse engineering vector quantizers for repartitioned signal spaces," *Proc. 39th Asilomar Conference on Signals, Systems, and Computers*, pp. 1208-12, Pacific Grove, CA, Nov. 2005.
38. **R. Vanam and C.D. Creusere**, "Scalable perceptual metric for evaluating audio quality," *Proc. 39th Asilomar Conference on Signals, Systems, and Computers*, pp. 319-23, Pacific Grove, CA, Nov. 2005.
39. **S. Kandadai and C.D. Creusere**, "Perceptually-weighted audio coding that scales to extremely low bitrates," *Proc. IEEE Data Compression Conference*, pp. 382-391, Snowbird, UT, March 2006.
40. **V. Thilak, D. Voelz, C. Creusere, S. Damarla**, "Estimating the refractive index and reflected zenith angle of a target using multiple polarization measurements," *Proc. SPIE Vol. 6240, 624004*, Polarization: Measurement, Analysis, and Remote Sensing VII; Dennis H. Goldstein, David B. Chenault; Eds., May 2006.
41. **V.M. Prasad and C.D. Creusere**, "Analyzing reversible lapped transformations using Reng probing," *Proc. 40th Asilomar Conference on Signals, Systems, and Computers*, pp. 873-877, Oct. 2006.
42. **N. Balachandran and C.D. Creusere**, "Chirp classification using hidden Markov models," *Proc. 40th Asilomar Conference on Signals, Systems, and Computers*, pp. 545-549, Oct. 2006.
43. **V. Thilak and C.D. Creusere**, "Estimating the complex index of refraction and view angle of an object using multiple polarization measurements," *Proc. 40th Asilomar Conference on Signals, Systems, and Computers*, pp. 1067-1071, Oct. 2006.
44. **V. Thilak, C.D. Creusere, and D.G. Voelz**, "Material classification using passive polarimetric imagery," *Proc. IEEE Int. Conf. on Image Proc.*, Vol. 4, pp. IV-121-124, Sept., 2007.
45. **A. Pamba, V. Thilak, D. G. Voelz, C. D. Creusere** "Estimation of incidence and reflection angles from passive polarimetric imagery: extension to out-of-plane scattering," *Proc. SPIE Vol 6682, 66820O*, Polarization Science and Remote Sensing III, Joseph A. Shaw; J. Scott Tyo, Editors, September 2007.
46. **V. Thilak, D. G. Voelz, C. D. Creusere**, "Image segmentation from multi-look passive polarimetric imagery, *Proc. SPIE 6682, 668206*, Polarization Science and Remote Sensing III, Joseph A. Shaw; J. Scott Tyo, Editors, October 2007.
47. **S. Kandadai and C.D. Creusere**, "Optimal Bit Layering for Scalable Audio Compression Using Objective Audio Quality Metrics," *Signals, Systems and Computers, 2007. ACSSC 2007. Conference Record of the Forty-First Asilomar Conference on* , pp.560-564, 4-7 Nov. 2007.
48. **C.D. Creusere and I. Mecimore**, "Bitstream-based overlap analysis for multi-view distributed video coding," *Proc. IEEE Southwest Symposium on Image Analysis and Interpretation*, pp. 93-96, March 2008.
49. **V. Thilak, C.D. Creusere, and D.G. Voelz**, "Passive Polarimetric Imagery Based Material Classification For Remote Sensing Applications," *Proc. IEEE Southwest Symposium on Image Analysis and Interpretation*, pp. 153-156 March 2008.
50. **V. Thilak, Q. Wang, D. G. Voelz, C. D. Creusere**, "Estimation of target geometry from Mueller matrix imagery," *Proc. SPIE 6972*, March 2008.
51. **C.D. Creusere and I. Mecimore**, "Bitstream-based correlation detector for multi-view distributed video coding applications," *Proc. Int. Conf. on Acoustics, Speech, and Signal Processing*, pp.

1001-1004, April 2008, Las Vegas, NV.

52. **S. Kandadai, J. Hardin, and C.D. Creusere**, "Audio quality assessment using the mean structural similarity measure," *Proc. Int. Conf. on Acoustics, Speech, and Signal Processing*, pp. 221-224, April 2008, Las Vegas, NV.
53. **S. Matta and C.D. Creusere**, "Efficient correlation extraction for distributed audio coding," *Signals, Systems and Computers, 2008 42nd Asilomar Conference on*, vol., no., pp.1272-1276, 26-29 Oct. 2008.
54. **J.C. Hardin and C.D. Creusere**, "Objective analysis of temporally varying audio quality metrics," *Signals, Systems and Computers, 2008 42nd Asilomar Conference on*, vol., no., pp.1245-1249, 26-29 Oct. 2008.
55. **S. Matta and C.D. Creusere**, "Distributed audio coding with efficient source correlation extraction," *Proceedings 13th Digital Signal Processing Workshop*, pp. 16-20, January 2009, Marco Island, FL.
56. **I. Mecimore and C.D. Creusere**, "Unsupervised bitstream based segmentation of images," *Proceedings 13th Digital Signal Processing Workshop*, pp. 642-647, January 2009, Marco Island, FL.
57. **Q. Wang, C.D. Creusere, V. Thilak, and D.G. Voeltz**, "Active polarimetric imaging for estimation of scene geometry," *Proceedings 13th Digital Signal Processing Workshop*, pp. 659-663, January 2009, Marco Island, FL.
58. **J.C. Hardin and C.D. Creusere**, "A temporally varying objective audio quality metric," *Proceedings 13th Digital Signal Processing Workshop*, pp. 21-25, January 2009, Marco Island, FL.
59. **I. Mecimore, W. Fahrenkrog, and C.D. Creusere**, "On bitstream based edge detection techniques," ITEA Conference, January 2009, El Paso, TX (best graduate student paper award).
60. **Mecimore, Ivan; Creusere, Charles D.**, "Low complexity multi-view distributed video coding based on JPEG," *Image Analysis & Interpretation (SSIAI), 2010 IEEE Southwest Symposium on*, vol., no., pp.165-168, 23-25 May 2010.
61. **Creusere, C.D.; Mehta, K.; Voelz, D.G.**, "Model-based estimation of surface geometry using passive polarimetric imaging," *Geoscience and Remote Sensing Symposium (IGARSS), 2010 IEEE International*, vol., no., pp.4557-4560, 25-30 July 2010.
62. **Castorena, J.; Creusere, C.D.; Voelz, D.**, "Modeling lidar scene sparsity using compressive sensing," *Geoscience and Remote Sensing Symposium (IGARSS), 2010 IEEE International*, vol., no., pp.2186-2189, 25-30 July 2010.
63. **Castorena, J.; Creusere, C.D.; Voelz, D.**, "Using finite moment rate of innovation for LIDAR waveform complexity estimation," *Signals, Systems and Computers (ASILOMAR), 2010 Conference Record of the Forty Fourth Asilomar Conference on*, vol., no., pp.608-612, 7-10 Nov. 2010.
64. **Creusere, C.D.; Siddenki, S.; Hardin, J.; Kroger, J.**, "Early investigations into subjective audio quality assessment using brainwave responses," *Signals, Systems and Computers (ASILOMAR), 2011 Conference Record of the Forty Fifth Asilomar Conference on*, vol., no., pp., Nov. 2011.
65. **Castorena, J.E.; Creusere, C.**, "Remote-sensed LIDAR using random sampling and sparse reconstruction," *Proc. International Telemetering Conference*, Las Vegas, NV, October 2011.
66. **Davis, P; Creusere, C.**, "Quantifying the gains of compressive sensing for telemetering application," *Proc. International Telemetering Conference*, Las Vegas, NV, October 2011.
67. **Creusere, C.D.; Kroger, J.; Siddenki, S.R.; Davis, P.; Hardin, J.**, "Assessment of subjective audio quality from EEG brain responses using time-space-frequency analysis," *Signal Processing Conference (EUSIPCO), 2012 Proceedings of the 20th European*, vol., no., pp.2704-2708, 27-31 Aug. 2012.
68. **Castorena, J.; Creusere, C.D.**, "Compressive sampling of LIDAR: Full-waveforms as signals

of finite rate of innovation," *Signal Processing Conference (EUSIPCO), 2012 Proceedings of the 20th European* , vol., no., pp.984-988, 27-31 Aug. 2012.

69. **Castorena, J.; Creusere, C.D.**; "Random impulsive scan for LIDAR sampling," *Proc. IEEE Int. Conf. on Image Proc.*, October 2012.

70. **Creusere, C., Nelson, E., Critz, T., Butcher, E.**; "Analysis of communication interconnectedness in the proximity of near-earth asteroids," *Proc. International Telemetering Conference*, San Diego, CA, October 2012.

71. **Castorena, J.E.; Creusere, C.**; "Remote-sensed LIDAR using random impulsive scans," *Proc. International Telemetering Conference*, San Diego, CA, October 2012.

72. **Castorena, J.; Creusere, C.D.**, "Sub-spot localization for spatial super-resolved LIDAR," *Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on* , vol., no., pp.2227,2231, 26-31 May 2013.

73. **Charles D. Creusere ; Juan Castorena**, "A unified framework for 3rd generation lidar pulse processing based on finite rate of innovations," *Proc. SPIE 8858, Wavelets and Sparsity XV*, 88580T (September 26, 2013); doi:10.1117/12.2022447.

74. **Nelson, E., Creusere, C., Critz, T., Butcher, E.**; "Analysis of communication rates in the proximity of near-earth asteroids," *Proc. International Telemetering Conference*, Las Vegas, NV, October 2013.

75. **Castorena, J.E.; Creusere, C.**; "Full-waveform LIDAR recovery at sub-Nyquist rates," *Proc. International Telemetering Conference*, Las Vegas, NV, October 2013.

76. **Davis, P.; Creusere, C.D.; Kroger, J.**, "EEG and the human perception of video quality: Impact of channel selection on discrimination," *Global Conference on Signal and Information Processing (GlobalSIP), 2013 IEEE* , vol., no., pp.9,12, 3-5 Dec. 2013, doi: 10.1109/GlobalSIP.2013.6736798.

77. **Creusere, C.D.; McRae, N.; Davis, P.**, "Sample-based cross-frequency coupling analysis with CFAR detection," *Signals, Systems and Computers, 2014 48th Asilomar Conference on* , vol., no., pp.179,183, 2-5 Nov. 2014; doi: 10.1109/ACSSC.2014.7094423.

78. **Davis, P.; Creusere, C.D.; Kroger, J.**, "Classification of human viewers using high-resolution EEG with SVM," *Signals, Systems and Computers, 2014 48th Asilomar Conference on* , vol., no., pp.184,188, 2-5 Nov. 2014; doi: 10.1109/ACSSC.2014.7094424.

79. **Davis, P.; Creusere, C. D.; Tang, W.**, "ASIC implementation of the cross frequency coupling algorithm for EEG signal processing," *2014 14th International Symposium on Integrated Circuits (ISIC)*, pp.248-251, Dec. 2014 doi: 10.1109/ISICIR.2014.7029468

80. **Nelson, Evan; Creusere, Charles D.; Butcher, Eric**, "Determining position around an asteroid using communication relays and trilateration," *Aerospace Conference, 2015 IEEE* , vol., no., pp.1,6, 7-14 March 2015; doi: 10.1109/AERO.2015.7118955.

81. **Davis, Philip; Creusere, Charles D.; Tang, Wei**, "Window length effect on cross frequency coupling in an EEG processing circuit," in *Circuits and Systems (MWSCAS), 2015 IEEE 58th International Midwest Symposium on* , vol., no., pp.1-4, 2-5 Aug. 2015 doi: 10.1109/MWSCAS.2015.7282125.

82. **Davis, Philip; Creusere, Charles D.; Kroger, Jim**, "Subject Identification Based on EEG Response to Video Stimuli," *Proceedings International Conference on Image Processing, 2015 IEEE*, September 2015.

83. **Newtonson, Kathy; Creusere, Charles D.**, "Histogram oriented gradients and map seeking circuits pattern recognition with compressed imagery," *Proc. Southwest Symposium on Image Analysis and Interpretation*, Santa Fe, NM, March 2016.

84. **Davis, Philip; Creusere, Charles D.; Kroger, Jim**, " Assessing Cross Frequency Coupling in EEG Collected from Subjects Viewing Video using a Modified Metric ," *Proc. Southwest Symposium on Image Analysis and Interpretation*, Santa Fe, NM, March 2016.

85. **Davis, Philip; Creusere, Charles D.; Kroger, Jim**, "The Effect of Perceptual Video Quality on EEG Power Distribution," *Proceedings International Conference on Image Processing, 2016 IEEE*, Phoenix, AZ, September 2016.
86. **Creusere, Charles D.; Castorena, J.; Dragulin, I.; Voelz, D.**, "Quantifying the Accuracy of FRI based LIDAR Waveform Analysis," *Proceedings International Conference on Image Processing, 2016 IEEE*, Phoenix, AZ, September 2016.
87. **Kathy A. Newton, Charles D. Creusere**, "Compressed imagery detection rate through map seeking circuit, and histogram of oriented gradient pattern recognition", *Proc. SPIE 10203, Pattern Recognition and Tracking XXVIII*, 102030F (1 May 2017); doi:10.1117/12.2262919; <https://doi.org/10.1117/12.2262919>
88. **Erandi Wijerathna, Charles D. Creusere, David Voelz, Juan Castorena**, "Polarimetric LIDAR with FRI sampling for target characterization", *Proc. SPIE 10407, Polarization Science and Remote Sensing VIII*, 104070R (7 September 2017); doi: 10.1117/12.2272587; <https://doi.org/10.1117/12.2272587>
89. **Andrew J. Phillips, Charles D. Creusere**, "The effects of lossy EEG compression on ERP analysis," *International Telemetering Conference Proceedings*, November 2018, <http://hdl.handle.net/10150/631654>.
90. **Andrew J. Phillips, Charles D. Creusere**, "The effects of lossy frequency-domain EEG compression on cross-frequency coupling analysis," *International Telemetering Conference Proceedings*, October 2019.
91. **Sergio Lara, Charles D. Creusere**, "Software Defined Radio for Carrier and Symbol Timing Extraction," *International Telemetering Conference Proceedings*, October 2021.
92. **Sergio Lara, Charles D. Creusere**, "LabView for Software Defined Radio Development," *International Telemetering Conference Proceedings*, October 2021.
93. **Ayatelrahman Elsayed, Charles D. Creusere**, "The Feedback Dynamics of Brain-Computer Interfaces in a Distributed Processing Environment," *Proceedings of HICSS-55*, January 2022; <http://hdl.handle.net/10125/79821>.
94. **Joshua Tellez, Charles D. Creusere**, "Evaluation of JPEG-2000 Image Compression as Applied to Electroencephalography," *International Telemetering Conference Proceedings*, Glendale, AZ, October 2022, <https://repository.arizona.edu/handle/10150/666964>.

PRESENTATIONS & OTHER PUBLICATIONS

1. **C.D. Creusere**, "Generic Tracking Laboratory Study," *NWC Technical Paper 7018*, Nov. 1989, Naval Weapons Center, China Lake, CA.
2. **C.D. Creusere**, "Robust image coding using the embedded zerotree wavelet algorithm," presented at the Digital Compression Conference, Snowbird, UT, April 1996.
3. **C.D. Creusere**, "Creating a compressed and embedded image representation which is robust to transmission errors," presented at the Office of Naval Research Workshop on Error Resilient Compression, San Diego, CA, February, 1996.
4. **C.D. Creusere**, "Data Compression Project Final Report," NAWCWD Technical Paper, TP 8442.
5. **C.D. Creusere**: "Applications of multirate digital signal processing to communications systems," NATO/RTA lecture series 216 on *Applications of Mathematical Signal Processing Techniques to Mission Systems*, presented in Paris, France; Cologne, Germany; and Monterey, CA,

November 1999.

6. **C.D. Creusere**, "Object detection and recognition in compressed video," invited presentation and white paper for the Motion Imagery Workshop, sponsored by the National Imagery and Mapping Agency (NIMA) and the National Science Foundation (NSF).

7. **C.D. Creusere**, "Application specific compression: digital elevation map browsing, video surveillance, and scalable audio," invited seminar at the University of Arizona, Tucson, AZ, March 2003.

8. **C.D. Creusere**, "Compressing Digital Elevation Maps for Efficient Search and Retrieval," presented at the Office of Naval Research Workshop on Image Processing, Minneapolis, MN, May 2003.

APPENDIX 2: MATERIALS CONSIDERED IN THE PREPARATION OF THIS DECLARATION

Exhibit No.	Description
1001	U.S. Patent No. 10,536,714 to Bici, et al. (“the ’714 patent”)
1002	Prosecution File History for the ’714 patent (“Prosecution History”)
1004	U.S. Patent Application Publication No. 2011/0194609 to Rusert et al (“Rusert”)
1005	U.S. Patent Application Publication No. 2011/0249721 to Karczewicz et al (“Karczewicz”)
1006	U.S. Patent Application Publication No. 2014/0092981 to Lin et al (“Lin”)
1007	IPR2024-00604, Paper 11: Decision Granting Institution of Inter Partes Review
1008	IPR2024-00605, Paper 11: Decision Granting Institution of Inter Partes Review
1009	Sung Deuk Kim and Jong Beom Ra, An Efficient Motion Vector Coding Scheme Based on Minimum Bitrate Prediction, IEEE Transactions on Image Processing, Vol. 8, No. 8 (Aug. 1999)
1010	Ken McCann and Thomas Davies, Samsung and BBC Response to Call for Proposals on Video Compression Technology (2010)
1011	JCTVC-A124, Samsung’s Response to the Call for Proposals on Video Compression Technology, Joint Collaborative Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 and ISO/IEC JTC1/SC29/WG11, 1 st Meeting, Dresden, DE, 15-23 April, 2010.
1012	U.S. Provisional Application 61/301,649 (“Rusert Provisional”)
1013	U.S. Provisional Application 61/500,903 (“Lin Provisional”)
1014	U.S. Patent Application Publication No. 2012/0128067 to Liu (“Liu”)
1015	Gary J. Sullivan, Recent Developments in Standardization of High Efficiency Video Coding (HEVC) (“Sullivan”)
1016	Frank Bossen, HEVC Complexity and Implementation Analysis (“Bossen”)
1017	Jian-Wei Chen et al, Introduction to H.264 advanced video coding. In: Proceedings of the 2006 Asia and South Pacific Design Automation Conference vol. 2006, PP. 736-741 (2006)

Exhibit No.	Description
1018	Won, Kwanghyun et al, Motion vector coding using decoder-side estimation of motion vector. In 2009 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB). IEEE, 2009.
1019	Gary J. Sullivan et al, The H.264/AVC Advanced Video Coding Standard: Overview and Introduction to the Fidelity Range Extensions, SPIE Conference on Applications of Digital Image Processing XXVII, 2004.

APPENDIX 3: LANGUAGE OF CHALLENGED CLAIMS

Encoder Claims

[1pre] 1. A method comprising:

[1a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for a block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates and is utilized to identify motion vector prediction candidates of which one spatial motion vector prediction candidate from the motion vector prediction list is signaled as the motion information for the prediction unit;

[1b] determining a subset of spatial motion vector prediction candidates based on a location of the block associated with the first spatial motion vector prediction candidate;

[1c] comparing motion information of the first spatial motion vector prediction candidate with motion information of spatial motion vector prediction candidates in the determined subset of spatial motion vector prediction candidates without making a comparison of each pair from the set of spatial motion vector prediction candidates;

[1d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

[1e] causing information identifying the one spatial motion vector prediction candidate from the motion vector prediction list to be transmitted to a decoder or to be stored.

2. The method according to claim 1 further comprising selecting spatial motion vector prediction candidates from the set of spatial motion vector prediction candidates as the potential spatial motion vector prediction candidate in a predetermined order.

3. The method according to claim 1, further comprising comparing motion information of the potential spatial motion vector prediction candidate with motion information of at most one other spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates.

4. The method according to claim 1 further comprising examining whether the block of pixels is divided into a first prediction unit and a second prediction unit; and if so, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the prediction unit is the second prediction unit.

[5pre]. The method according to claim 1, further comprising

[5a] determining a maximum number of spatial motion vector prediction candidates to be included in the motion vector prediction list; and

[5b] limiting the number of spatial motion vector prediction candidates in the motion vector prediction list smaller or equal to the maximum number.

[6pre] The method according to claim 5 comprising:

[6a] examining, if the number of spatial motion vector prediction candidates in the motion vector prediction list smaller than the maximum number;

[6b] if so, examining whether the prediction unit to which the potential spatial motion vector prediction candidate belongs is available for motion prediction;

[6c] if so, performing at least one of the following:

[6d] for a potential spatial motion vector prediction candidate on a left side of the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[6e] the received block of pixels is vertically divided into a first prediction unit and a second prediction unit;

[6f] the received block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and if the prediction unit is the second prediction unit, and the potential spatial motion vector prediction candidate has essentially

similar motion information than a spatial motion vector prediction candidate above the prediction unit;

[6g] for a potential spatial motion vector prediction candidate above the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[6h] the received block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and the prediction unit is the second prediction unit;

[6i] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;

[6j] for a potential spatial motion vector prediction candidate, which is on a right side of the potential spatial motion vector prediction candidate above the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate above the prediction unit;

[6k] for a potential spatial motion vector prediction candidate, which is below the potential spatial motion vector prediction candidate on the left side of

the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;

[6l] for a potential spatial motion vector prediction candidate cornerwise neighbouring the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[6m] all the other potential spatial motion vector prediction candidates have been included in the motion vector prediction list;

[6n] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate above the prediction unit;

[6o] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit.

7. The method according to claim 1 further comprising including a temporal motion prediction candidate into the motion vector prediction list.

8. The method according to claim 1 further comprising selecting one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the block of pixels.

[15pre] An apparatus comprising a processor and a memory including computer program code, the memory and the computer program code configured to, with the processor, cause the apparatus to:

[15a] select a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for a block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates and is utilized to identify motion vector prediction candidates of which one spatial motion vector prediction candidate from the motion vector prediction list is signaled as the motion information for the prediction unit;

[15b] determine a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

[15c] compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction

candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

[15d] determine to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on comparison of the motion information of the first spatial motion vector candidate with motion information of the spatial motion vector prediction candidate; and

[15e] cause information identifying the one spatial motion vector prediction candidate from the motion vector prediction list to be transmitted to a decoder or to be stored.

16. The apparatus according to claim 15 wherein the apparatus is further caused to select spatial motion vector prediction candidates from the set of spatial motion vector prediction candidates as the potential spatial motion vector prediction candidate in a predetermined order.

17. The apparatus according to claim 15, wherein the apparatus is further caused to compare motion information of the potential spatial motion vector prediction candidate with motion information of at most one other spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates.

18. The apparatus according to claim 15 wherein the apparatus is further caused to examine whether the block of pixels is divided into a first prediction unit

and a second prediction unit; and if so, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if the prediction unit is the second prediction unit.

19. The apparatus according to claim 15, wherein the apparatus is further caused to:

determine a maximum number of spatial motion vector prediction candidates to be included in the motion vector prediction list; and

limit the number of spatial motion vector prediction candidates in the motion vector prediction list smaller or equal to the maximum number.

[20pre] The apparatus according to claim 19 wherein the apparatus is further caused to:

[20a] examine, if the number of spatial motion vector prediction candidates in the motion vector prediction list smaller than the maximum number;

[20b] if so, examine whether the prediction unit to which the potential spatial motion vector prediction candidate belongs is available for motion prediction;

[20c] if so, perform at least one of the following:

[20d] for a potential spatial motion vector prediction candidate on a left side of the prediction unit, exclude the potential spatial motion vector prediction

candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[20e] the received block of pixels is vertically divided into a first prediction unit and a second prediction unit;

[20f] the received block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and if the prediction unit is the second prediction unit, and the potential spatial motion vector prediction candidate has essentially similar motion information than a spatial motion vector prediction candidate above the prediction unit;

[20g] for a potential spatial motion vector prediction candidate above the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[20h] the received block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and the prediction unit is the second prediction unit;

[20i] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;

[20j] for a potential spatial motion vector prediction candidate, which is on a right side of the potential spatial motion vector prediction candidate above the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate above the prediction unit;

[20k] for a potential spatial motion vector prediction candidate, which is below the potential spatial motion vector prediction candidate on the left side of the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;

[20l] for a potential spatial motion vector prediction candidate cornerwise neighbouring the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[20m] all the other potential spatial motion vector prediction candidates have been included in the motion vector prediction list;

[20n] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate above the prediction unit;

[20o] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit.

21. The apparatus according to claim 15 wherein the apparatus is further caused to include a temporal motion prediction candidate into the motion vector prediction list.

22. The apparatus according to claim 15 wherein the apparatus is further caused to select one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the block of pixels.

[29pre] A non-transitory computer readable medium having stored thereon a computer executable program code for use by an encoder, said program codes comprising instructions for:

[29a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for a block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector

prediction candidates and is utilized to identify motion vector prediction candidates of which one spatial motion vector prediction candidate from the motion vector prediction list is signaled as the motion information for the prediction unit;

[29b] determining a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

[29c] comparing motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

[29d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

[29e] causing information identifying the one spatial motion vector prediction candidate from the motion vector prediction list to be transmitted to a decoder or to be stored.

Decoder Claims

[9pre] A method comprising:

[9a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for an encoded block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the encoded block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates;

[9b] determining a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

[9c] comparing motion information of the first spatial motion vector prediction candidate with motion information of another spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

[9d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing;
and

[9e] selecting a spatial motion vector prediction candidate from the motion vector prediction list for use in decoding the encoded block of pixels, wherein the spatial motion vector prediction candidate is selected from the motion vector prediction list using information that was received identifying a respective spatial motion vector prediction candidate from the motion vector prediction list constructed by an encoder.

10. The method according to claim 9 further comprising comparing motion information of the potential spatial motion vector prediction candidate with motion information of at most one other spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates.

11. The method according to claim 9 further comprising examining whether the received encoded block of pixels is divided into a first prediction unit and a second prediction unit; and if so, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the prediction unit is the second prediction unit.

[12pre] The method according to claim 9 further comprising

[12a] determining a maximum number of spatial motion vector prediction candidates to be included in the motion vector prediction list; and

[12b] limiting the number of spatial motion vector prediction candidates in the motion vector prediction list smaller or equal to the maximum number.

[13pre]. The method according to claim 12 further comprising:

[13a] examining, if the number of spatial motion vector prediction candidates in the motion vector prediction list smaller than the maximum number;

[13b] if so, examining whether the prediction unit to which the potential spatial motion vector prediction candidate belongs is available for motion prediction;

[13c] if so, performing at least one of the following:

[13d] for a potential spatial motion vector prediction candidate on a left side of the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[13e] the received encoded block of pixels is vertically divided into a first prediction unit and a second prediction unit;

[13f] the received encoded block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and if the prediction unit is the second prediction unit, and the potential spatial motion vector prediction candidate has essentially similar motion information than a spatial motion vector prediction candidate above the prediction unit;

[13g] for a potential spatial motion vector prediction candidate above the prediction unit, excluding the potential spatial motion vector prediction candidate

from the motion vector prediction list if any of the following conditions are fulfilled:

[13h] the received encoded block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and the prediction unit is the second prediction unit;

[13i] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;

[13j] for a potential spatial motion vector prediction candidate, which is on a right side of the potential spatial motion vector prediction candidate above the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate above the prediction unit;

[13k] for a potential spatial motion vector prediction candidate, which is below the potential spatial motion vector prediction candidate on the left side of the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the

spatial motion vector prediction candidate on the left side of the prediction unit;
and

[13l] for a potential spatial motion vector prediction candidate cornerwise neighbouring the prediction unit, excluding the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[13m] all the other potential spatial motion vector prediction candidates have been included in the motion vector prediction list;

[13n] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate above the prediction unit;

[13o] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit.

14. The method according to claim 9 further comprising selecting one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the encoded block of pixels.

[23pre]. An apparatus comprising a processor and a memory including computer program code, the memory and the computer program code configured to, with the processor, cause the apparatus to:

[23b] determine a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

[23c] compare motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

[23d] determine to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on comparison of the motion information of the first spatial motion vector candidate with motion information of the spatial motion vector prediction candidate; and

[23e] select a spatial motion vector prediction candidate from the motion vector prediction list for use in decoding the encoded block of pixels, wherein the spatial motion vector prediction candidate is selected from the motion vector prediction list using information that was received identifying a respective spatial motion vector prediction candidate from the motion vector prediction list constructed by an encoder.

24. The apparatus according to claim 23 wherein the apparatus is further caused to compare motion information of the potential spatial motion vector

prediction candidate with motion information of at most one other spatial motion vector prediction candidate of the set of spatial motion vector prediction candidates.

25. The apparatus according to claim 23 wherein the apparatus is further caused to examine whether the received encoded block of pixels is divided into a first prediction unit and a second prediction unit; and if so, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if the prediction unit is the second prediction unit.

[26pre] The apparatus according to claim 23 wherein the apparatus is further caused to:

[26a] determine a maximum number of spatial motion vector prediction candidates to be included in the motion vector prediction list; and

[26b] limit the number of spatial motion vector prediction candidates in the motion vector prediction list smaller or equal to the maximum number.

[27pre] The apparatus according to claim 26 wherein the apparatus is further caused to:

[27a] examine if the number of spatial motion vector prediction candidates in the motion vector prediction list smaller than the maximum number;

[27b] if so, examine whether the prediction unit to which the potential spatial motion vector prediction candidate belongs is available for motion prediction;

[27c] if so, perform at least one of the following:

[27d] for a potential spatial motion vector prediction candidate on a left side of the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[27e] the received encoded block of pixels is vertically divided into a first prediction unit and a second prediction unit;

[27f] the received encoded block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and if the prediction unit is the second prediction unit, and the potential spatial motion vector prediction candidate has essentially similar motion information than a spatial motion vector prediction candidate above the prediction unit;

[27g] for a potential spatial motion vector prediction candidate above the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[27h] the received encoded block of pixels is horizontally divided into a first prediction unit and a second prediction unit, and the prediction unit is the second prediction unit;

[27i] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit;

[27k] for a potential spatial motion vector prediction candidate, which is below the potential spatial motion vector prediction candidate on the left side of the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit; and

[27l] for a potential spatial motion vector prediction candidate cornerwise neighbouring the prediction unit, exclude the potential spatial motion vector prediction candidate from the motion vector prediction list if any of the following conditions are fulfilled:

[27m] all the other potential spatial motion vector prediction candidates have been included in the motion vector prediction list;

[27n] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate above the prediction unit;

[27o] the potential spatial motion vector prediction candidate has essentially similar motion information than the spatial motion vector prediction candidate on the left side of the prediction unit.

28. The apparatus according to claim 23 wherein the apparatus is further caused to select one motion vector prediction candidate from the motion vector prediction list to represent a motion vector prediction for the received encoded block of pixels.

[30pre] A non-transitory computer readable medium having stored thereon a computer executable program code for use by an encoder, said program codes comprising instructions for:

[30a] selecting a first spatial motion vector prediction candidate from a set of spatial motion vector prediction candidates for an encoded block of pixels as a potential spatial motion vector prediction candidate to be included in a motion vector prediction list for a prediction unit of the encoded block of pixels, where the motion vector prediction list comprises motion information of the spatial motion vector prediction candidates;

[30b] determining a subset of spatial motion vector prediction candidates based on the location of the block associated with the first spatial motion vector prediction candidate;

[30c] comparing motion information of the first spatial motion vector prediction candidate with motion information of the spatial motion vector prediction candidate in the determined subset of spatial motion vector prediction candidates without making a comparison of each possible candidate pair from the set of spatial motion vector prediction candidates;

[30d] determining to include or exclude the first spatial motion vector prediction candidate in the motion vector prediction list based on the comparing; and

[30e] selecting a spatial motion vector prediction candidate from the motion vector prediction list for use in decoding the encoded block of pixels, wherein the spatial motion vector prediction candidate is selected from the motion vector prediction list using information that was received identifying a respective spatial motion vector prediction candidate from the motion vector prediction list constructed by an encoder.

APPENDIX 4: UNDERSTANDING OF THE LAW

I have applied the following legal principles provided to me by counsel in arriving at the opinions set forth in this report.

Legal Standard for Prior Art

I am not an attorney. I have been informed by attorneys of the relevant legal principles and have applied them to arrive at the opinions set forth in this declaration.

I understand that the petitioner for inter partes review may request the cancelation of one or more claims of a patent based on grounds available under 35 U.S.C. § 102 and 35 U.S.C. § 103 using prior art that consists of patents and printed publications.

Anticipation and Prior Art

I understand that § 102 specifies when a challenged claim is invalid for lacking novelty over the prior art, and that this concept is also known as “anticipation.” I understand that a prior art reference anticipates a challenged claim, and thus renders it invalid by anticipation, if all elements of the challenged claim are disclosed in the prior art reference. I understand the disclosure in the prior art reference can be either explicit or inherent, meaning it is necessarily present or implied. I understand that the prior art reference does not have to use

the same words as the challenged claim, but all of the requirements of the claim must be disclosed so that a person of ordinary skill in the art could make and use the claimed subject-matter.

In addition, I understand that § 102 also defines what is available for use as a prior art reference to a challenged claim.

Under § 102(a), a challenged claim is anticipated if it was patented or described in a printed publication in the United States or a foreign country before the challenged claim's date of invention.

Under § 102(b), a challenged claim is anticipated if it was patented or described in a printed publication in the United States or a foreign country more than one year prior to the challenged patent's filing date.

Under § 102(e), a challenged claim is anticipated if it was described in a published patent application that was filed by another in the United States before the challenged claim's date of invention, or was described in a patent granted to another that was filed in the United States before the challenged claim's date of invention.

I understand that a challenged claim's date of invention is presumed to be the challenged patent's filing date. I also understand that the patent owner may establish an earlier invention date and "swear behind" prior art defined by § 102(a) or § 102(e) by proving (with corroborated evidence) the actual date on which the

named inventors conceived of the subject matter of the challenged claim and proving that the inventors were diligent in reducing the subject matter to practice.

I understand that the filing date of a patent is generally the filing date of the application filed in the United States that issued as the patent. However, I understand that a patent may be granted an earlier effective filing date if the patent owner properly claimed priority to an earlier patent application.

I understand that when a challenged claim covers several structures, either generically or as alternatives, the claim is deemed anticipated if any of the structures within the scope of the claim is found in the prior art reference.

I understand that when a challenged claim requires selection of an element from a list of alternatives, the prior art teaches the element if one of the alternatives is taught by the prior art.

Legal Standard for Obviousness

I understand that even if a challenged claim is not anticipated, it is still invalid if the differences between the claimed subject matter and the prior art are such that the claimed subject matter would have been obvious to a person of ordinary skill in the pertinent art at the time the alleged invention.

I understand that obviousness must be determined with respect to the challenged claim as a whole.

I understand that one cannot rely on hindsight in deciding whether a claim is obvious.

I also understand that an obviousness analysis includes the consideration of factors such as (1) the scope and content of the prior art, (2) the differences between the prior art and the challenged claim, (3) the level of ordinary skill in the pertinent art, and (4) “secondary” or “objective” evidence of non-obviousness.

Secondary or objective evidence of non-obviousness includes evidence of: (1) a long felt but unmet need in the prior art that was satisfied by the claimed invention; (2) commercial success or the lack of commercial success of the claimed invention; (3) unexpected results achieved by the claimed invention; (4) praise of the claimed invention by others skilled in the art; (5) taking of licenses under the patent by others; (6) deliberate copying of the claimed invention; and (7) contemporaneous and independent invention by others. However, I understand that there must be a relationship between any secondary evidence of non-obviousness and the claimed invention.

I understand that a challenged claim can be invalid for obviousness over a combination of prior art references if a reason existed (at the time of the alleged invention) that would have prompted a person of ordinary skill in the art to combine elements of the prior art in the manner required by the challenged claim. I understand that this requirement is also referred to as a “motivation to combine,”

“suggestion to combine,” or “reason to combine,” and that there are several rationales that meet this requirement.

I understand that the prior art references themselves may provide a motivation to combine, but other times simple common sense can link two or more prior art references. I further understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a motivation to combine references may come from market forces.

I understand obviousness to include, for instance, scenarios where known techniques are simply applied to other devices, systems, or processes to improve them in an expected or known way. I also understand that practical and common-sense considerations should be applied in a proper obviousness analysis. For instance, familiar items may have obvious uses beyond their primary purposes.

I understand that the combination of familiar elements according to known methods is obvious when it yields predictable results. For instance, obviousness bars patentability of a predictable variation of a technique even if the technique originated in another field of endeavor. This is because design incentives and other market forces can prompt variations of it, and predictable variations are not the product of innovation, but rather ordinary skill and common sense.

I understand that a particular combination may be obvious if it was obvious to try the combination. For example, when there is a design need or market

pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. This would result in something obvious because the result is the product not of innovation but of ordinary skill and common sense. However, I understand that it may not be obvious to try a combination when it involves unpredictable technologies.

It is further my understanding that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, I understand that any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

It is my understanding that the Manual of Patent Examining Procedure §2143 sets forth the following as exemplary rationales that support a conclusion of obviousness:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of known technique to improve similar devices (methods, or products) in the same way;

- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

A person of ordinary skill in the art looking to overcome a problem will often use the teachings of multiple publications together like pieces of a puzzle, even though the prior art does not necessarily fit perfectly together. Therefore, I understand that references for obviousness need not fit perfectly together like puzzle pieces. Instead, I understand that obviousness analysis takes into account inferences, creative steps, common sense, and practical logic and applications that a person of ordinary skill in the art would employ under the circumstances.

I understand that a claim can be obvious in light of a single reference, if the elements of the challenged claim that are not explicitly or inherently disclosed in the reference can be supplied by the common sense of one of skill in the art.

I understand that obviousness also bars the patentability of applying known or obvious design choices to the prior art. One cannot patent merely substituting one prior art element for another if the substitution can be made with predictable results. Likewise, combining prior art techniques that are interoperable with respect to one another is generally obvious and not patentable.

In order for a claim to be found invalid based upon a modification or combination of the prior art, there must be reasonable expectation that a person of ordinary skill would have successfully modified or combined the prior art to arrive at the claimed arrangement. This does not mean that it must be certain that a person of ordinary skill would have been successful – the law only requires that the person of ordinary skill in the art would have perceived a reasonable expectation of success in modifying or combining the prior art to arrive at the claimed invention.

In sum, my understanding is that obviousness invalidates claims that merely recite combinations of, or obvious variations of, prior art teachings using understanding and knowledge of one of skill in the art at the time and motivated by the general problem facing the inventor at the time. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor

at the time of the invention, can provide a reason for combining the elements of or attempting obvious variations on prior art references in the claimed manner.

Legal Standard for Claim Construction

I understand that before any invalidity analysis can be properly performed, the scope and meaning of the challenged claims must be determined by claim construction.

I understand that a patent may include two types of claims, independent claims and dependent claims. I understand that an independent claim stands alone and includes only the limitations it recites. I understand that a dependent claim depends from an independent claim or another dependent claim. I understand that a dependent claim includes all the limitations that it recites in addition to the limitations recited in the claim (or claims) from which it depends.

In comparing the challenged claims to the prior art, I have carefully considered the patent and its file history in light of the understanding of a person of skill at the time of the alleged invention.

I understand that to determine how a person of ordinary skill would have understood a claim term, one should look to sources available at the time of the alleged invention that show what a person of skill in the art would have understood disputed claim language to mean. It is my understanding that this may include what is called “intrinsic” evidence as well as “extrinsic” evidence.

I understand that, in construing a claim term, one should primarily rely on intrinsic patent evidence, which includes the words of the claims themselves, the remainder of the patent specification, and the prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient. I understand that extrinsic evidence may include principles, concepts, terms, and other resources available to those of skill in the art at the time of the invention.

I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else or something more specific. I understand that to determine whether a term has special meaning, the claims, the patent specification, and the prosecution history are particularly important, and may show that the inventor gave a term a particular definition or intentionally disclaimed, disavowed, or surrendered claim scope.

I understand that the claims of a patent define the scope of the rights conferred by the patent. I understand that because the claims point out and distinctly claim the subject matter which the inventors regard as their invention, claim construction analysis must begin with and is focused on the claim language itself. I understand that the context of the term within the claim as well as other claims of the patent can inform the meaning of a claim term. For example, because

claim terms are normally used consistently throughout the patent, how a term is used in one claim can often inform the meaning of the same term in other claims. Differences among claims or claim terms can also be a useful guide in understanding the meaning of particular claim terms.

I understand that a claim term should be construed not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the entire specification. I understand that because the specification is a primary basis for construing the claims, a correct construction must align with the specification.

I understand that the prosecution history of the patent as well as art incorporated by reference or otherwise cited during the prosecution history are also highly relevant in construing claim terms. For instance, art cited by or incorporated by reference may indicate how the inventor and others of skill in the art at the time of the invention understood certain terms and concepts. Additionally, the prosecution history may show that the inventors disclaimed or disavowed claim scope, or further explained the meaning of a claim term.

With regard to extrinsic evidence, I understand that all evidence external to the patent and prosecution history, including expert and inventor testimony, dictionaries, and learned treatises, can also be considered. For example, technical dictionaries may indicate how one of skill in the art used or understood the claim

terms. However, I understand that extrinsic evidence is considered to be less reliable than intrinsic evidence, and for that reason is generally given less weight than intrinsic evidence.

I understand that in general, a term or phrase found in the introductory words or preamble of the claim, should be construed as a limitation if it recites essential structure or steps, or is necessary to give meaning to the claim. For instance, I understand preamble language may limit claim scope: (i) if dependence on a preamble phrase for antecedent basis indicates a reliance on both the preamble and claim body to define the claimed invention; (ii) if reference to the preamble is necessary to understand limitations or terms in the claim body; or (iii) if the preamble recites additional structure or steps that the specification identifies as important.

On the other hand, I understand that a preamble term or phrase is not limiting where a challenged claim defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention. I understand that to make this determination, one should review the entire patent to gain an understanding of what the inventors claim they invented and intended to encompass in the claims.

I understand that 35 U.S.C. § 112 ¶ 6 created an exception to the general rule of claim construction called a “means plus function” limitation. These types of

terms and limitations should be interpreted to cover only the corresponding structure described in the specification, and equivalents thereof. I also understand that a limitation is presumed to be a means plus function limitation if (a) the claim limitation uses the phrase “means for”; (b) the “means for” is modified by functional language; and (c) the phrase “means for” is not modified by sufficient structure for achieving the specified function.

I understand that a structure is considered structurally equivalent to the corresponding structure identified in the specification only if the differences between them are insubstantial. For instance, if the structure performs the same function in substantially the same way to achieve substantially the same result. I further understand that a structural equivalent must have been available at the time of the issuance of the claim.