

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM, INC. and AMAZON.COM SERVICES LLC,

PETITIONER

v.

NOKIA TECHNOLOGIES OY,

PATENT OWNER.

IPR2024-00847, IPR2024-00848

U.S. Patent No. 7,532,808

DECLARATION OF DR. JOSEPH P. HAVLICEK

REGARDING U.S. PATENT NO. 7,532,808

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XI. CONCLUSION 241

I, Joseph P. Havlicek, hereby declare as follows:

I. INTRODUCTION

1. I have been retained on behalf of Amazon.com, Inc. and Amazon.com Services LLC (“Amazon” or “Petitioner”) to offer technical opinions related to U.S. Patent No. 7,532,808 (“the ’808 Patent”) (EX-1001). I understand that Amazon is requesting that the Patent Trial and Appeal Board (“PTAB” or “Board”) institute an inter partes review (“IPR”) proceeding of the ’808 Patent. Specifically, I have been asked to consider the validity of claims 1-2, 6-7, 9-11, 15-16, 20-25, 28-30, 32, 34, 36, 39-41, 43-44, 47-49, 51-54, 58-60, and 62-65 of the ’808 Patent (the “Challenged Claims”) in view of prior art and obviousness considerations from the perspective of a person of ordinary skill in the art at the time of the invention (“POSITA”) as it relates to the ’808 Patent.

2. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my opinions, or the outcome of any proceeding involving the Challenged Claims. I have no financial interest in the outcome of this matter or on the pending litigation between Petitioner and Patent Owner.

3. My analysis here is based on my years of education, research, and experience, as well as my investigation and study of relevant materials, including those cited herein.

4. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

5. My analysis of the materials in this proceeding is ongoing, and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

II. BACKGROUND AND QUALIFICATIONS

6. I am over the age of 18 and am competent to write this declaration. I have personal knowledge, or have developed knowledge of these technologies, based upon education, training, or experience, of the matters set forth herein.

7. My qualifications are set forth in my curriculum vitae, a copy of which is filed as Exhibit EX-1004. The following is a brief summary of my relevant qualifications and professional experience.

A. Educational Background

8. I received a Bachelor of Science Degree in electrical engineering with minors in mathematics and computer science from Virginia Tech in 1986. I also received a Master of Science degree in electrical engineering from Virginia Tech in 1988. I received a Ph.D. degree in Electrical and Computer Engineering from the

University of Texas at Austin in 1996. My Ph.D. research was in the field of image processing.

B. Professional Experience

9. From December 1984 to May 1987, I was a software engineer at Management Systems Laboratories, Blacksburg, VA. My main job responsibilities included developing software for nuclear materials management under contract with the United States Department of Energy.

10. From June 1987 to January 1997, I was an electrical engineer at the United States Naval Research Laboratory. For the period of June 1987 through August 1989, I was an on-site contractor affiliated with SFA, Inc, Landover, Maryland. From August 1989 through January 1997, I was a regular government employee. I was on leave without pay from August 1987 through July 1988 while completing my Master of Science Degree. I was also on leave without pay for much of the period from August 1990 through January 1997 while I completed my Ph.D. degree. My main job responsibilities at the United States Naval Research Laboratory included designing digital and analog circuits to process real-time video signals and designing and implementing target detection, tracking, and identification algorithms. I developed missile warning receivers for Navy aircraft including the Navy's first two-color infrared system. I was a recipient of the 1990 Department of the Navy Award of Merit for Group Achievement for this work. The production version of this system was deployed on Navy helicopters and saw combat in Afghanistan and Iraq.

11. From January 1993 through December 1993, I was an on-site contractor at International Business Machines (IBM) Corporation, Austin, TX. My main job responsibilities included designing and implementing image compression and decompression algorithms (CODECs) for IBM products.

12. Since January 1997, I have been a regular faculty member in the School of Electrical and Computer Engineering at the University of Oklahoma, Norman, OK. I was an Assistant Professor from January 1997 through June 2002. I was promoted to the rank of Associate Professor and granted tenure in July 2002. I was promoted to the rank of Professor in July 2007. I was appointed to the Williams Companies Foundation Presidential Professorship in April 2009. In April 2017 I was appointed to the Gerald Tuma Presidential Professorship. My main job responsibilities at the University of Oklahoma include conducting academic research in electrical and computer engineering, teaching graduate and undergraduate courses in electrical and computer engineering, and performing professional and institutional service.

13. I am a member of several professional societies and organizations, including the Institute of Electrical and Electronics Engineers (IEEE), the IEEE Signal Processing Society, the IEEE Computer Society, and the IEEE Intelligent Transportation Society. I am a Senior Member of the IEEE. From November 2015 through February 2018, I served as a Senior Area Editor for the IEEE Transactions on Image Processing. I was formerly an Associate Editor for the IEEE Transactions on

Image Processing from December 2010 through October 2015. I served as a Technical Area Chair for the IEEE International Conference on Image Processing in the area of Image & Video Analysis, Synthesis, and Retrieval (2012, 2013) and have served on the organizing committee of that conference (2007). I have also served as a Technical Area Chair for the IEEE International Conference on Acoustics, Speech, and Signal Processing in the area of Image, Video, and Multidimensional Signal Processing (2012-2014).

14. For over 35 years, I have conducted research and taught classes in the field of image processing and image analysis. My main scholarly contributions have been in the areas of modulation domain image models and image processing (AM-FM image models), video target tracking, and distributed control of video networks for intelligent transportation systems. I have supervised or co-supervised 11 Ph.D. students to completion and I am currently supervising two Ph.D. students. I have supervised 27 M.S. students to completion and I am currently supervising two additional M.S. students. I have served as a committee member on 67 additional doctoral committees and 68 additional M.S. committees.

15. I teach a variety of courses at the University of Oklahoma, including the required junior-level Signals and Systems course ECE 3793 (taught 21 times), the graduate level Digital Image Processing course ECE 5273 (taught 25 times), and the graduate level Digital Signal Processing course ECE 5213 (taught 18 times). I have

received a number of teaching awards, including the University of Oklahoma College of Engineering Outstanding Faculty Advisor Award (2005-2006) and the University of Texas Engineering Foundation Award for Exemplary Engineering Teaching while Pursuing a Graduate Degree (1992).

16. Since joining the University of Oklahoma in January 1997, I have been Principal Investigator or Co-Principal Investigator on over 110 externally funded grants and contracts with a total value of \$27,061,653. My main research contributions have been in the areas of signal, image, and video processing, video target tracking, and intelligent transportation systems. I have been author or coauthor on over 130 scholarly publications in these areas. I was a recipient of the 1990 Department of the Navy Award of Merit for Group Achievement for my work in video target tracking. My research group at the University of Oklahoma originated the Virtual Traffic Management Center concept featured in a December 2014 FHWA technical report (Guidelines for Virtual Transportation Management Center Development) and a November 2014 FHWA national webinar with the same title. I am co-founder and director of the University of Oklahoma Center for Intelligent Transportation Systems. Under my supervision, the Center has collaborated with the Oklahoma Department of Transportation since 1998 to design and implement the Oklahoma Statewide Intelligent Transportation System, including a geographically distributed video network that is currently deployed on major highways and interstates across the entire State of Oklahoma.

C. Publications

17. A complete listing of my publications is found in my curriculum vitae (EX-1004). I highlight some of the publications relevant to the subject matter of the '808 patent below.

18. J.P. Havlicek, T.N. Arian, H. Soltani, T. Przebinda, and M. Özaydın, “A preliminary case for Hirschman transform video coding,” in Proc. IEEE Southwest Symp. Image Anal. & Interp., Santa Fe, NM, Mar. 29-31, 2020, pp. 104-07.

19. E. Vorakitolan, J.P. Havlicek, R.D. Barnes, and A.R. Stevenson, “Simple, Effective Rate Control for Video Distribution in Heterogeneous Intelligent Transportation System Networks,” in Proc. IEEE Southwest Symp. Image Anal. & Interp., San Diego, CA, Apr. 6-8, 2014, pp. 37-40.

20. V. DeBrunner, J.P. Havlicek, T. Przebinda, and M. Özaydın, “Entropy-Based Uncertainty Measures for $L^2(\mathbb{R}^n)$, $l_2(\mathbb{Z})$, and $l_2(\mathbb{Z}/N\mathbb{Z})$ with a Hirschman Optimal Transform for $l_2(\mathbb{Z}/N\mathbb{Z})$,” IEEE Trans. Signal Process., Aug. 2005, vol. 53, no. 8, pp. 2690-99.

21. O. Alkhoul, V. DeBrunner, and J. Havlicek, “Hirschman Optimal Transform (HOT) DFT Block LMS Algorithm,” in Adaptive Filtering, L. Garcia, ed., ISBN: 978-953-307-158-9, InTech, Sep. 2011, pp. 135-52.

22. V. DeBrunner, M. Özaydın, T. Przebinda, and J. Havlicek, “The optimal solutions to the continuous- and discrete-time versions of the Hirschman uncertainty principle,” in Proc. IEEE Int'l. Conf. Acoust., Speech, Signal Process., Istanbul,

Turkey, Jun. 5-9, 2000, vol. 1, pp. 81-84.

III. LEVEL OF ORDINARY SKILL IN THE ART

23. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a POSITA at the time of the alleged invention. I understand there is a dispute whether the Challenged Claims are entitled to the priority date of the '808 provisional—March 15, 2002—or the filing date of its non-provisional application—March 14, 2003. My opinions herein would not change regardless of which of these dates applies. I understand that the factors considered in determining the ordinary level of skill in a field of art include the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art; and the sophistication of the technology at the time of the alleged invention. I understand that a POSITA is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a POSITA would also have knowledge from the teachings of the prior art, including the art cited below.

24. Taking these factors into consideration, in my opinion, at the relevant time, a POSITA relating to the technology of the '808 Patent would have had (1) 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. In my opinion, more education could substitute for experience and vice versa.

25. Before March 15, 2002 (and thus also March 14, 2003), my level of skill in the art was at least that of a POSITA. I am qualified to provide opinions concerning what a POSITA would have known and understood at that time, and my analysis and conclusions herein are from the perspective of a POSITA as of that date. My opinions would not change regardless of which of the two possible priority dates the Challenged Claims are entitled to.

IV. MATERIALS CONSIDERED AND RELIED UPON

26. In forming my opinions expressed herein, in addition to relying on my education and experience, I considered the totality of the following materials:

Exhibit	Reference
1001	U.S. Patent No. 7,532,808 (“the ’808 Patent”)
1002	File History of the ’808 Patent (“’808FH”)
1005	U.S. Patent Provisional Application No. 60/365,072
1006	International Patent Publication No. WO 01/11891 A1 (“Karczewicz”)
1007	U.S. Patent Publication No. 2003/0123738 (“Frojdih”)
1008	U.S. Patent Provisional Application No. 60/334,979 (“Frojdih Provisional”)
1009	ITU-T Recommendation H.263 (February 1998) (“H.263”)
1010	Martyn J. Riley and Iain E.G. Richardson, <i>Digital Video Communications</i> , Artech House, Inc. (1997) (“Riley”)
1011	Gary J. Sullivan and Thomas Wiegand, <i>Rate-Distortion Optimization for Video Compression</i> , IEEE Signal Processing Magazine, pp. 74-90 (November 1998) (“Sullivan”)

Exhibit	Reference
1012	JVT of ISO/IEC and ITU-T VCEG – JVT-A003r1, Joint Model Number 1, Revision 1 (JM-1r1), Pattaya, Thailand, 3-7 December 2001
1013	Ismaeil et al., “Efficient Motion Estimation Using Spatial and Temporal Motion Vector Prediction.” In <i>Proceedings 1999 International Conference on Image Processing</i> (Cat. 99CH36348), vol. 1, pp. 70-74. IEEE, 1999.
1014	Wang et al., <i>Video Processing and Communications</i> (Prentice Hall, 2002) (“Wang”)
1015	Bhaskaran, Vasudev, Konstantinides, Konstantinos, <i>Image and Video Compression Standards, Algorithms and Architectures</i> , (Kluwer Academic Publishers, 1995) (“Bhaskaran”)
1016	Respondents’ Opening Claim Construction Brief, Investigation No. 337-TA-1379 (ITC)
1017	Complainant’s Opening Claim Construction Brief, Investigation No. 337-TA-1379 (ITC)
1018	Staff’s Opening Claim Construction Brief, Investigation No. 337-TA-1379 (ITC)
1019	Respondents’ Responsive Claim Construction Brief, Investigation No. 337-TA-1379 (ITC)
1020	Complainant’s Responsive Claim Construction Brief, Investigation No. 337-TA-1379 (ITC)
1021	Staff’s Responsive Claim Construction Brief, Investigation No. 337-TA-1379 (ITC)
1022	Order Construing Claims, Investigation No. 337-TA-1379 (ITC), Order No. 38
1026	Declaration of June Ann Munford

I have also considered any materials cited in this declaration even if not included in

the list above.

V. LEGAL STANDARDS

27. I am not an attorney and offer no legal opinions, but in the course of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a POSITA. For the purposes of this Declaration, I have been informed about certain aspects of the law that are relevant to my analysis, as summarized below.

28. I understand that a nonprovisional patent application publication is prior art as of the earlier filing date of a provisional application if the disclosure of the provisional provides written description support for at least one claim in the publication, and the provisional describes the subject matter relied upon as prior art in the publication. As I describe below (in Section X.B.1.a (Ground 2A, Priority Analysis)), Frojdh is entitled to its priority date based on the filing of Frojdh Provisional because Frojdh Provisional provides written description support for at least one Frojdh claim (claim 15), and because Frojdh Provisional discloses the subject matter relied upon for prior art in Frojdh in my discussions below (Section X.B (Ground 2A) and Section X.C (Ground 2B)).

A. Priority Date

29. I understand that, to gain benefit of the filing date of an earlier patent application, each application in the chain leading back to the earlier application must comply with the statutory written description requirement.

30. I understand that, to satisfy the written description requirement, a patent's

specification must reasonably convey to a POSITA that the inventor had possession of the claimed subject matter when the patent application was filed. I understand that, to show “possession” of the invention, the disclosure must describe the invention, including all of its claimed limitations. It is not enough that a claimed invention is an obvious variant of that which is disclosed in the specification.

31. I further understand that entitlement to a filing date extends only to subject matter that is disclosed and not to subject matter that is not disclosed but would be obvious over what is expressly disclosed. Thus, a prior application itself must describe an invention, and do so in sufficient detail that a POSITA can clearly conclude that the inventor invented the claimed invention as of the filing date sought.

32. I also understand that a patent’s priority date is a legal determination based on underlying factual issues. For that reason, I am not rendering a legal opinion on the ultimate legal question of priority date. Rather, my testimony addresses the underlying facts and factual analysis that would support a legal determination of the priority date.

B. Claim Interpretation

33. I understand from Counsel that during an IPR proceeding, claims are to be construed in light of the specification as would be read by a POSITA at the time the application was filed. I understand that claim terms are given their ordinary and customary meaning as would be understood by a POSITA in the context of the entire disclosure. A claim term, however, will not receive its ordinary meaning if the patentee acted as his or her own lexicographer and clearly set forth a definition of the claim term

in the specification. In that case, the claim term will receive the definition set forth in the patent.

C. Prior Art

34. I understand from Counsel that certain patents and printed publications can be considered prior art in an IPR proceeding. I understand that prior art must predate the effective filing date of the claims of the patent-at-issue.

D. Obviousness

35. I understand that a claim is unpatentable if the claim limitations, as arranged in a claim, would have been obvious to a person of ordinary skill in the art as of the date of invention. For example, a combination of familiar elements according to known methods is likely to be obvious if the combination does no more than produce predictable results.

36. In determining obviousness, I understand that the analysis may take into account multiple prior art references, as well as the common knowledge possessed by a POSITA (as discussed above). I further understand that the POSITA is not an automaton but one having common sense and ordinary creativity. I also understand that a claim is not obvious simply because a combination of prior art references discloses each claim element collectively.

37. In determining obviousness, I understand that one should consider the following.

- The scope and content of the prior art;

- The differences between the claimed invention and the prior art;
- The level of ordinary skill in the pertinent art; and
- Secondary considerations of obviousness.

38. I understand that a POSITA is assumed to have knowledge of all prior art references. I also understand that when considering the obviousness of a patent claim, one should consider whether a teaching, suggestion, or motivation to combine the references exists so as to avoid impermissibly applying hindsight when considering the prior art. I understand this test should not be rigidly applied, but that the test can be important to avoiding such hindsight.

39. I understand that a POSITA can combine various prior art references based on the teachings of those prior art references, the general knowledge present in the art, or common sense. I understand that a motivation to combine the references may be implicit in the prior art, and there is no requirement that there be an actual or explicit teaching to combine two references. Thus, one may take into account the inferences and creative steps that a POSITA would employ to combine the known elements in the prior art in the manner claimed by the patent-at-issue. I understand that one should avoid “hindsight bias” and ex post reasoning in performing an obviousness analysis. This does not mean, however, that a POSITA, for purposes of the obviousness inquiry, does not have recourse to common sense.

40. I understand that the following are examples of approaches and rationales

that may be considered in determining whether a prior art reference could have been combined with other prior art or with other information within the knowledge of a POSITA:

- 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 techniques 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;
- That it was “obvious to try”—i.e., that it was one choice 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; and
- Some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify the prior art reference or to combine multiple prior art reference teachings to arrive at the claimed invention.

41. I also understand that obviousness is a legal conclusion based on the underlying factual issues of the scope and content of the prior art, the differences between the claimed invention and the prior art, the level of ordinary skill in the art, and any objective indicia of non-obviousness. For that reason, I am not rendering a legal opinion on the ultimate legal question of obviousness. Rather, my testimony addresses the underlying facts and factual analysis that would support a legal conclusion of obviousness, and when I use the term obvious, I am referring to the perspective of a POSITA at the time of invention.

VI. SUMMARY OF OPINIONS

42. For the reasons I discuss below, it is my opinion that claims 1-2, 6-7, 9-11, 15-16, 20-25, 28-30, 32, 34, 36, 39-41, 43-44, 47-49, 51-54, 58-60, and 62-65 of the '808 Patent are disclosed in the prior art, and are rendered obvious by the prior art.

VII. TECHNOLOGY OVERVIEW

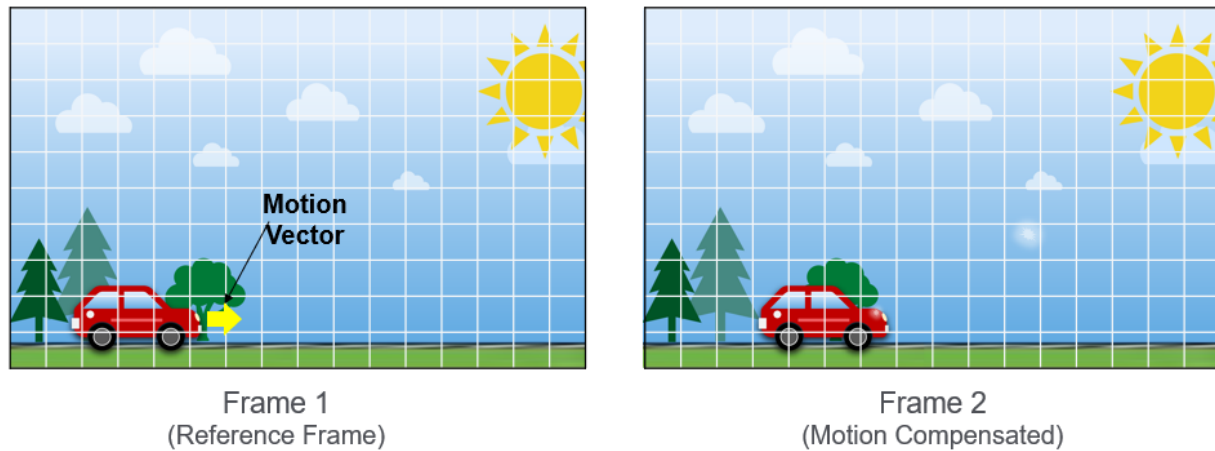
43. Digital video, like analog video (and film) comprises a rapid, time-ordered sequence of image frames. Sullivan, 74. Digital video in its raw format is highly redundant. Each video frame comprises a regular, rectangular array of pixels. Transmission or storage of raw digital video data requires huge volumes of data and very fast data rates. Sullivan, 74-76. Compression and decompression refer to techniques to take one form of data and convert it into another form that takes up less space, i.e., a fewer number of bits, in a memory. Compression is the process of taking data and making it occupy less space in memory, and decompression is the process of

restoring the data to its original form. An encoder compresses data, and a decoder reverses the process for display. Riley, 15, 18-19 (“[D]igital video information must be compressed (encoded) prior to transmission and decompressed (decoded) before displaying it at the receiver.”).

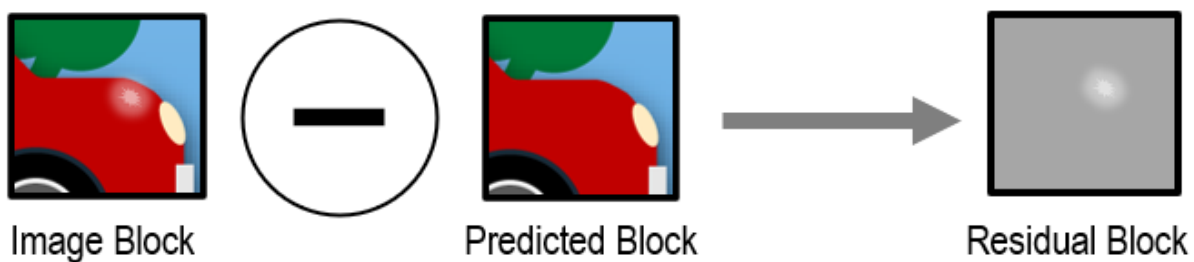
44. Image frames in a video sequence may depend on information from other frames. This dependency arises from the use of a compression technique called “temporal prediction,” which takes advantage of “temporal redundancy” across image frames. “The term ‘temporal redundancy’ expresses the fact that objects appearing in one frame of a sequence are likely to appear in subsequent frames.” ’808 Patent, 2:42-44. Because image frames in a video sequence are typically captured in quick succession, many aspects of the scene being captured do not change, or change in predictable ways, from one image frame to the next. These aspects are considered to be temporally redundant.

45. A technique called motion compensated prediction is often used “to reduce the temporal redundancy in [a] sequence [of frames].” ’808 Patent, 3:11-15. Using motion compensated prediction, image content of frames, typically on a macroblock by macroblock basis, is “‘predicted’ from one or more frames in the sequence, known as ‘reference’ frames ... by tracking the motion of objects or regions of an image between the frame to be coded [] and the reference frame(s) using ‘motion vectors.’” *Id.*, 3:15-21.

46. The figure below illustrates the concept of motion compensated prediction, where a macroblock in a current frame (“Frame 2”) is predicted using a motion vector that characterizes the motion of a macroblock in a reference frame (“Frame 1”):

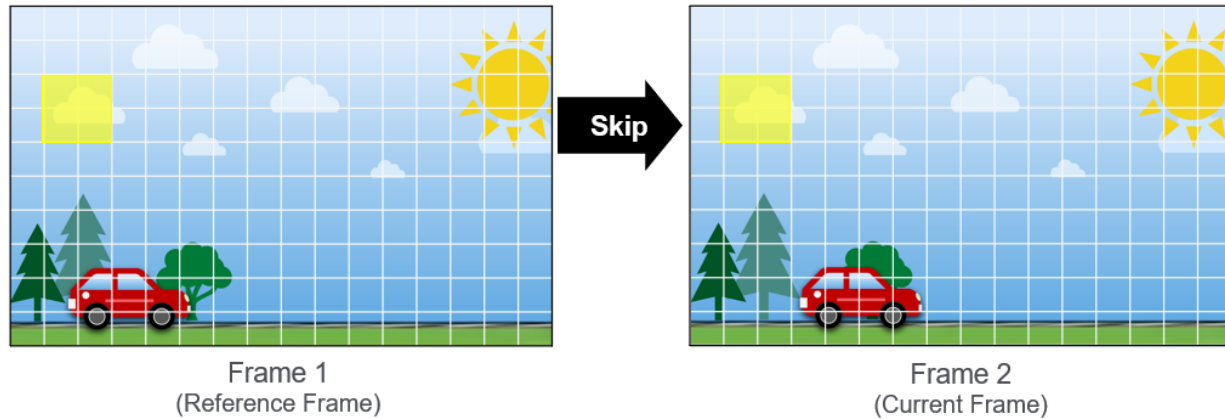


47. Motion compensated prediction alone may create unacceptable levels of distortion, so it is typically necessary to provide a prediction error frame, which represents the difference between a decoded version of the predicted frame and the image content of the frame. ’808 Patent, 3:28-35; Karczewicz, 9:14-27. The figure below illustrates prediction error, otherwise known as residual information, between the image content of a block and the predicted block:

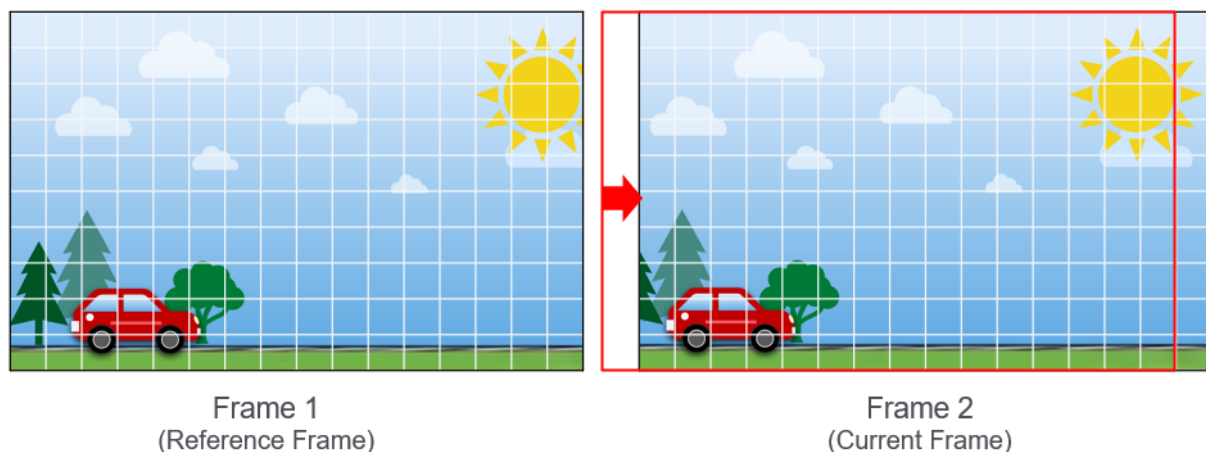


48. Aspects of an image that do not change from frame to frame do not need

to be motion compensated, and are instead “skipped” i.e., “copied” from the reference frame. ’808 Patent, 10:63-67; Frojdh, [0011]. The figure below illustrates how a block, highlighted in yellow, is copied, i.e., “skipped” from the reference frame to the current frame:



49. Finally, a technique called global motion compensation may be used to generate predicted macroblocks from a reference frame in instances where, for example, the camera pans or a large portion of the frame is displaced by the same motion vector. *See, e.g.,* ’808 Patent, 12:48-14:10. The figure below illustrates predicting a current frame based on global motion of a reference frame:



VIII. OVERVIEW OF THE '808 PATENT

A. Subject Matter Overview of the '808 Patent

50. The '808 Patent is titled "Method for Coding Motion in a Video Sequence" and issued on May 12, 2009. The '808 Patent issued from U.S. Patent Application No. 10/390,549 (the "'549 Application"), which was filed on March 14, 2003. The '808 Patent claims priority to U.S. Provisional Application No. 60/365,072, which was filed on March 15, 2002. I have reviewed the '072 Application, and in my opinion the following terms from the independent claims of the '808 Patent are not described in sufficient detail that a POSITA could have reasonably concluded at the time that the inventor possessed of those aspects of the purported invention:

- "forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector" (claims 1, 7, 10, 16);
- "providing in an encoded bitstream an indication of the skip coding mode" (claims 1, 10);
- "receiving an indication of a skip coding mode for a first segment" (claim 7, 16);
- "A video encoder for encoding a video sequence" (claim 10);
- "A video decoder for decoding an encoded video sequence" (claim 16);
- "a coding controller for assigning a skip coding mode to a first segment" (claim 10);
- "a multiplexer for providing in an encoded bitstream an indication of the skip coding mode" (claim 10);

- “a demultiplexer for receiving an indication of a skip coding mode assigned to a first segment” (claim 16);
- “a motion estimation block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment” (claim 10).

51. A significant portion of the '808 Patent's specification is devoted to the “Background of the Invention” section, which provides an overview of video coding and discusses purported shortcomings of prior art solutions '808 Patent, 1:15-14:10. For example, the Background section describes the structure and function of prior art generic video encoders and decoders, including the manner in which inter-coded and intra-coded frames of a video are encoded and decoded. '808 Patent, 3:44-10:22. The Background section additionally provides an overview of certain prior art video coding solutions developed by various standards bodies and/or industry organizations. '808 Patent, 10:23-14:5.

52. More specifically, the Background section of the '808 Patent explains that “motion compensated prediction [is used] to reduce the temporal redundancy in [a] sequence,” and that “[f]rames of a video sequence which are compressed using motion-compensated prediction are generally referred to as INTER-coded, or P-frames.” '808 Patent, 3:13-15, 3:26-28. The Background section continues to explain that “[m]otion-compensated prediction alone rarely provides a sufficiently precise representation of the image content of a video frame and therefore it is typically necessary to provide a so-called ‘prediction error’ (PE) frame with each INTER-coded frame. The prediction

error frame represents the difference between a decoded version of the INTER-coded frame and the image content of the frame to be coded.” ’808 Patent, 3:28-35. Further, “[a]ny frame encoded in the INTER-coded format requires a reference frame for motion-compensated prediction.” ’808 Patent, 7:5-6.

53. The Background section of the ’808 Patent then goes on to discuss certain prior art solutions for coding INTER-coded frames. One such solution addressed in the Background section is from T. Weigland: “Joint Model Number 1” Doc. JVT-A003, Joint Video Team of ISO/IEC MPEG and ITU-TVCEG, January 2002 (“JM1” or “JM1 of the JVT codec”). ’808 Patent, 10:23-12:47. According the Background section of the ’808 Patent, JM1 teaches dividing macroblocks to be inter coded into a number of subblocks and associating motion information with each of the subblocks. ’808 Patent, 10:47-54.

54. The Background of the ’808 Patent also describes how JM1 further teaches assigning a “skip mode” to a macroblock, the “skip mode” indicating “that the macroblock is to be copied from the reference video frame without motion compensated prediction.” ’808 Patent, 10:63-67. “The motion estimation for the skip mode is a very simple one [because] a constant zero valued vector is assigned for this mode.” ’808 Patent, 11:8-11. The Background section then explains that for non-skip mode macroblocks, JM1 codes a macroblock based on a “cost function” that “combines the prediction error with number of estimated bits needed to code the macroblock and thus

measures the relative efficiency of each coding mode.” ’808 Patent, 11:11-18.

55. The Background section states that JM1 “has no special provision for taking account of global motion in video sequences,” and discusses other video coding standards that do address global motion. ’808 Patent, 13:51-53. In particular, the Background section reviews global motion compensation, as used by the ISO MPEG-4 and ITU-T H.263+ video coding standards, and global motion vector coding as described in Doc. VCEG-020, ITU-T Video Coding Experts Group (VCEG) Meeting, Pattaya, Thailand 4-7 Dec. 2001. ’808 Patent, 12:48-14:10. According to the Background section, “the idea behind global motion compensation is to generate a reference frame for motion compensation that cancels the effects of global motion,” but that doing so requires “complex operations.” ’808 Patent, 12:59-66, 13:36-44 (discussing “additional complexity” related to other prior art approach). The Background section further states that global motion vector coding is a “simplified version of global motion compensation” where “[t]he reference frame is used as is, but additional information is transmitted to describe the global motion and additional macroblock modes are used to indicate when global motion vectors are used.” ’808 Patent, 13:31-36. In other words, the Background section states, the identified prior art solutions suffer from various shortcomings. ’808 Patent, 13:45-14:5.

56. The ’808 Patent purports to improve on the prior art, and address the asserted shortcomings described above, through “a redefinition of the skip mode

concept used in JM1 of the JVT codec.” ’808 Patent, 14:14-18. The ’808 Patent provides the following overview of its “redefined” skip mode, in which a macroblock may be associated with a zero or non-zero motion vector:

According to the invention, the skip mode concept is redefined in such a way that a macroblock assigned to skip mode is either associated with a zero (non-active) motion vector, in which case it is treated in the same way as a conventional skip mode macroblock and copied directly from the reference frame, or it is associated with a non-zero (active) motion vector.

’808 Patent, 14:23-29, *see also, id.*, 17:47-52, 19:28-51.

57. The ’808 Patent explains that in the redefined skip mode, whether to assign a zero or non-zero motion vector to a macroblock is based on the motion of surrounding macroblocks:

The decision as to whether a macroblock should be associated with a zero or non-zero motion vector is made by analysing the motion of other macroblocks or sub-blocks in a region surrounding the macroblock to be coded. If it is found that the surrounding region exhibits a certain type of motion, a non-zero motion vector representative of that motion is generated and associated with the current macroblock. In particular, the continuity, velocity or deviation of motion in the surrounding macroblocks or sub-blocks can be analyzed. For example, if the motion in the

surrounding region exhibits a certain level of continuity, a certain common velocity, or a particular form of divergence, a motion vector representative of that motion can be assigned to the current macroblock to be coded. On the other hand, if the region surrounding the current macroblock does not exhibit such continuity, common velocity or divergence and has an insignificant level of motion, the macroblock to be coded is assigned a zero motion vector, causing it to be copied directly from the reference frame, just as if it were a conventional SKIP mode macroblock. In this way, according to the invention, SKIP mode macroblocks can adapt to the motion in the region surrounding them, enabling global or regional motion to be taken account of in an efficient manner.

'808 Patent, 14:29-51.

58. The '808 Patent describes how the surrounding macroblocks used may be previously encoded macroblocks:

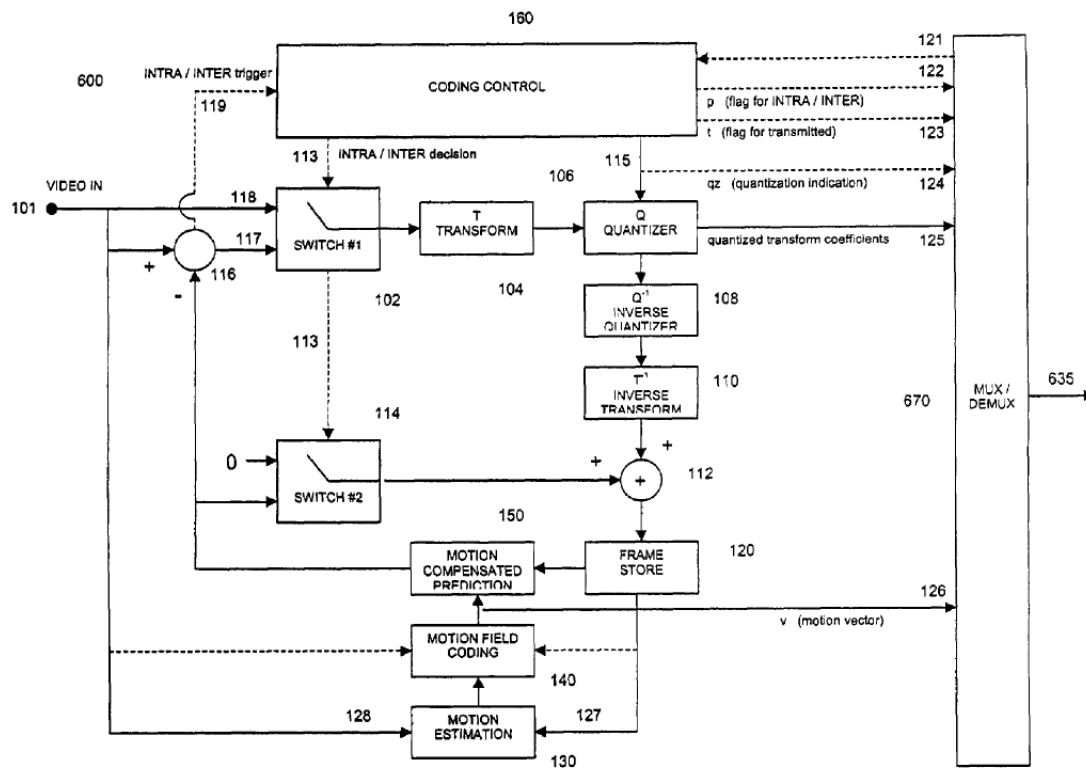
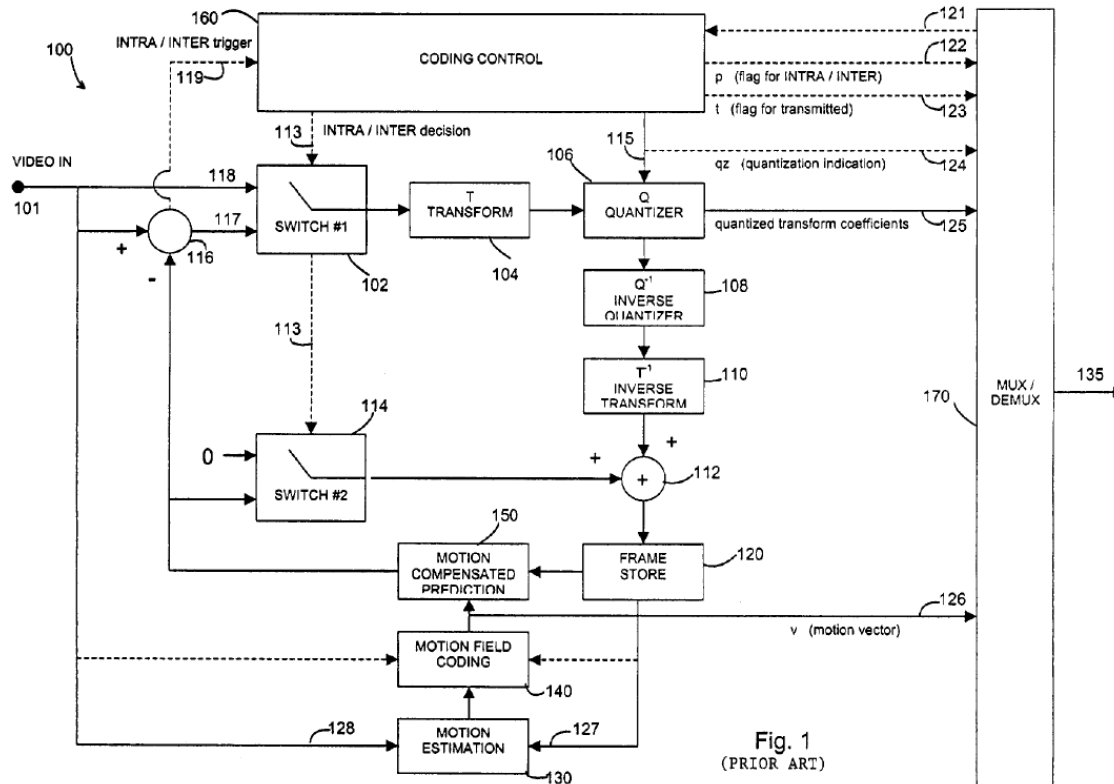
In an advantageous embodiment of the invention, the surrounding macroblocks or sub-blocks whose motion is analysed are previously encoded macroblocks neighboring the macroblock to be coded. This ensures that motion information relating to the region the surrounding a macroblock is available in the encoder (decoder) when a current macroblock is being encoded (decoded) and can be used directly to determine the motion vector to be assigned to the current macroblock. This approach enables the motion analysis of the surrounding region performed in the encoder

to be duplicated exactly in the decoder. This, in turn, means that according to the invention, no additional information must be sent to the decoder in order to model global or regional motion.

'808 Patent, 14:52-64.

59. More specifically, the '808 Patent explains that an encoder analyzes the motion of image segments surrounding the macroblock to be coded, and “[i]f it determines that the surrounding region exhibits a certain type of motion, for example it has characteristics indicative of global or regional motion, it generates a non-zero valued skip mode motion vector representative of the motion.” '808 Patent, 17:58-64.

60. The '808 Patent states that “a minimal amount of modification is required to incorporate the method according to the invention into existing video coding systems that employ the concept of skip mode macroblocks.” '808 Patent, 15:11-14. For example, it explains that Figure 6, which shows an encoder according to the purported invention, “is substantially identical to that of the prior art video encoder shown in FIG. 1, with appropriate modifications to the motion estimation part necessary to implement the video encoding method according to the invention.” '808 Patent, 16:7-14. The figures are indeed substantively identical. Figures 1 and 6 are reproduced below for reference:



61. The '808 Patent similarly characterizes its Figure 7, which depicts a decoder according to the purported invention, as “substantially identical to that of the prior art video decoder shown in FIG. 2, with appropriate modifications to those parts of the decoder that perform motion estimation operations.” '808 Patent, 20:29-32. The figures are indeed substantively identical. Figures 2 and 7 are also reproduced below:

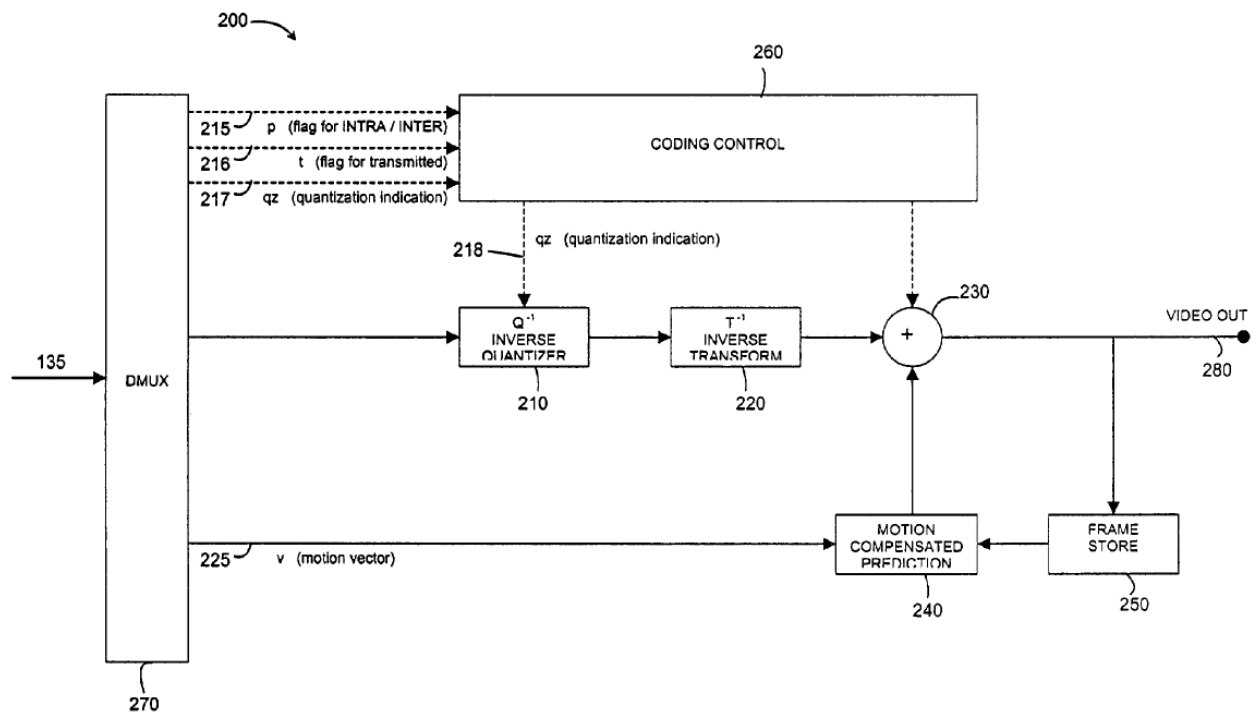


Fig. 2
(PRIOR ART)

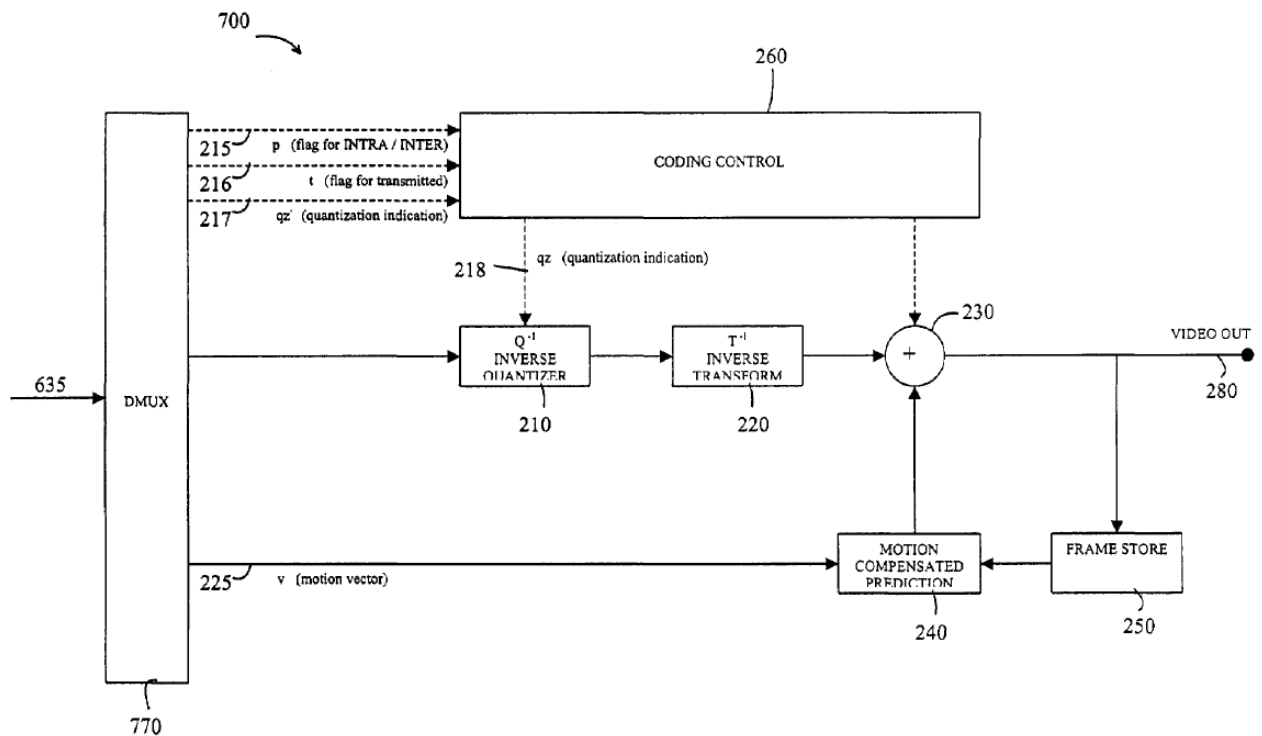


Fig. 7

B. Brief Summary of '808 Patent Prosecution History

62. The provisional application leading to the '808 Patent was filed on March 15, 2002.

63. The '549 Application was originally filed with 27 claims. File History, 54-61. Relevant to the '808 Patent, independent claims 1 and 8 generally related to methods of motion compensated prediction in encoding and decoding a digital video sequence, respectively, and claims 12 and 19 generally related to a video encoder and video decoder using motion compensated prediction, respectively. *Id.* Each of these independent claims recited a “skip coding mode,” which when assigned to a first segment of a frame indicated one of two things:

(i) that the segment has an insignificant level of motion, in which case, forming a prediction for the segment by copying directly from a corresponding region of the second frame, or

(ii) that the segment has a motion characteristic of global or regional motion in the video sequence, in which case, forming a prediction for the segment by motion compensated prediction with respect to the second frame using motion information representative of said global or regional motion.”

File History, 54, pending claim 1, *see also* pending claims 8, 12, 19. The Examiner rejected these pending independent claims and their dependents based on a combination of U.S. 5,701,164 to Kato and U.S. 5,442,400 to Sun, with Kato providing all of the disclosure except the recited “skip coding mode.” File History, 97-100.

64. In response, Applicant amended pending independent claims 1, 8, 12, and 19, added new dependent claims 28-70, and canceled or amended previous claims such that all claims ultimately depended from claims 1, 8, 12, or 19. File History, 106-144. Relevant here, the pending independent claims were amended to shift their focus to “assigning a skip coding mode to a first segment of a first frame of the sequence” and “assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode....” File History, 106, pending claim 1; *see also* pending claims 8,

12, 19. Applicant then distinguished the amended independent claims from Sun on the basis of the unique use of the term “skip coding mode” as recited in the pending claims. Specifically, Applicant argued that Sun taught “skip coding mode” as acknowledged in the AAPA, wherein the skip coding mode “indicates that [a] macroblock is to be copied from the reference video frame,” while the “skip coding mode” as recited in the pending claims “can be a zero motion vector, or a predicted non-zero motion vector at least partially based on the motion information of a neighboring segment.” File History, 145-146.

65. Without comment regarding the Applicant’s arguments in amending the claims, the Examiner issued another obviousness rejection, based on the combination of U.S. 7,200,275 to Srinivasan and U.S. 6,6893,987 to Sugahara. File History, 158-177.

66. In response, Applicant argued that the portions of Srinivasan relied upon by the Examiner were not prior art. File History, 183-184. The Examiner, without comment as to the substance of Applicant’s argument, ultimately allowed the claims, after minor clarifying amendments from the Applicant. File History, 217, 239, 244.

67. A certificate of correction, changing the dependency of claim 43 from claim 1 to claim 7 was later issued. File History, 277.

IX. CLAIM CONSTRUCTION

68. I have given all the claim terms of the Challenged Claims their plain and ordinary meaning, as would have been understood by a POSITA, at the time of the

alleged invention, unless otherwise discussed below.

A. “skip coding mode”

69. I understand that in the ITC investigation, the Administrative Law Judge (“ALJ”) has construed “skip coding mode” to mean “a coding mode in which a zero (non-active) motion vector or a non-zero (active) motion vector is associated with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question.” Order Construing Claim Terms, 15. All parties point to the portion of the ’808 specification that explains that the patentee “redefined” the SKIP mode as known in the prior art “to allow representation of a global and regional motion.” Respondent CC Brief, 11-12; Nokia CC Brief, 11-12; Staff CC Brief. Reproduced below is an excerpt from the ’808 specification discussing the “redefined” SKIP mode:

According to the invention, the coding modes used by encoder 600 correspond to those provided by JM1 of the JVT codec (shown in Table 3), with the exception that the SKIP mode is redefined to allow representation of global and regional motion. More specifically, the SKIP mode is modified in such a way that a zero (non-active) motion vector or a non-zero (active) motion vector is associated with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question. In the following this type of

motion vector will be referred to as a “skip mode motion vector.

’808 Patent, 17:43-53, *see also, id.* 19:28-51.

70. I further understand that the parties and staff disputed whether residual information¹ can be provided with a macroblock coded using the skip coding mode. Respondent CC Brief, 17. I understand that the Respondent argued that residual information can be included in the skip coding mode, while the Complainant argued that skip coding mode “precludes the possibility of residual information.” Respondent CC Brief, 17; Nokia CC Brief, 19-20. I further understand that the Staff did not argue for a construction of “skip coding mode” in which it is explicit that residual information can be included. Staff CC Brief, 9. Instead, the Staff noted that “the claim language uses permissible language for the use of prediction error information, generally,” and “the silence in the claim regarding residual information leaves open many different design choices.” Staff CC Brief, 9. I understand that the ALJ adopted the Staff’s position when construing the term, namely that “In its silence, the definition in the ’808 patent allows for both possibilities [where residual cannot be sent and where residual may be sent].”

¹ I understand the parties have agreed that “residual information” refers to prediction error. This is consistent with how a POSITA would have understood the term.

71. The table below summarizes the parties,' Staff's, and ALJ's constructions for "skip coding mode," and whether residual information can be included in the mode:

	"skip coding mode" construction²	Residual Information
Respondent	A coding mode in which a zero (non-active) motion vector or a nonzero (active) motion vector is associated with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question, and residual information can be provided for each skip mode Macroblock	Residual information can be included in skip coding mode.
Complainant	A coding mode in which a zero (non-active) motion vector or a non-zero (active) motion vector is associated with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question.	Residual information is precluded in skip coding mode.
Staff &ALJ	A coding mode in which a zero (non-active) motion vector or a non-zero (active) motion vector is associated with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question.	"[T]he silence in the claim regarding residual information leaves open many different design choices" "In its silence, the definition in the '808 patent allows for both possibilities."

² Respondent CC Brief, 17.

72. I understand that Petitioner here argues that if the Board determines that construction of “skip coding mode” is needed, then the Board should adopt Respondent’s construction. I agree with that construction.

73. Each of dependent claims 30, 41, 49, and 60 (which are substantively identical and depend from each of the four independent claims in the ’808 Patent) recite “wherein no residual information is provided for the first segment in the encoded bitstream.” ’808 Patent, claims 30, 41, 49, 60. I have replicated and highlighted the relevant portions of the independent claims 1, 7, 10, and 16, and dependent claims 30, 41, 49, and 60 below:

1. A method of encoding a video sequence, the method comprising: assigning a skip coding mode to a first segment of a first frame of the sequence; 	7. A method of decoding an encoded video sequence, the method comprising: receiving an indication of a skip coding mode for a first segment; 	10. A video encoder for encoding a video sequence, the encoder comprises: a coding controller for assigning a skip coding mode to a first segment; 	16. A video decoder for decoding an encoded video sequence, the decoder comprising: a demultiplexer for receiving an indication of a skip coding mode
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			assigned to a first segment;
30. A method according to claim 1, wherein no residual information is provided for the first segment in the encoded bitstream.	41. A method according to claim 7, wherein no residual information is provided for the first segment in the encoded bitstream.	49. An encoder according to claim 10, wherein no residual information is provided for the first segment in the encoded bitstream.	60. A decoder according to claim 16, wherein no residual information is provided for the first segment in an encoded bitstream.

74. I understand that Petitioner (also Respondent in the ITC) argues that “skip coding mode” as recited in the independent claims should be construed with the additional language “and residual information can be provided for each skip mode macroblock” in order to avoid vitiating the limitations of depending claims 30, 41, 49, and 60. Respondent CC Brief, 17-19. This is also consistent with the ’808 Patent’s specification, which teaches embodiments in which residual information is provided for the skip coding mode. E.g., ’808 Patent, 16:51-55, 21:18-22, Figs. 6-7. I agree with Petitioner that this additional language is necessary to resolve the dispute between the

parties in the ITC and is how a POSITA would have understood the term “skip coding mode” at the time of the purported invention of the ’808 Patent. However, as I explain further below, the challenged claims of the ’808 Patent are invalid regardless of the which party’s construction is applied, and I understand that this means that the Board need not construe the claims here.

75. I understand that Patent Owner (“PO”), on the other hand, argues that “skip coding mode” “precludes the possibility that [] any ‘residual information’ can be provided for the reconstruction of pixel values of the macroblock.” Nokia’s CC Brief, 19-20. In what appears to be an effort to avoid vitiating claims 30, 41, 49, and 60 with its construction of “skip coding mode,” PO further argues that these claims are not rendered superfluous by its claim construction because those claims exclude providing residual information for the first segment “in the encoded bitstream,” whereas its proposed construction precludes providing residual information in the “skip coding mode.” Nokia’s CC Brief, 21.

76. In my opinion, PO’s proposed claim construction and argument relies on drawing a line between the characteristics of a “skip coding mode” used to code a macroblock, and the bitstream that encodes the skip code macroblock. That is, PO argues that its construction of “skip coding mode,” which precludes the possibility of residual information for a macroblock, nonetheless allows for the possibility of residual information in the bitstream encoding that very macroblock.

77. In my opinion, PO's attempts to have it both ways, where residual information can be precluded from the "skip coding mode" used for a macroblock, yet however may be part of the bitstream for that macroblock (absent the further limitations of dependent claims 30, 41, 49, and 60), is inconsistent with how a POSITA would have understood the '808 Patent's redefinition of "skip coding mode," '808 Patent, 17:43-53, which as I explained above encompasses embodiments that send residual information in the "skip coding mode," *id.*, 16:51-55, 21:18-22, Figs. 6-7.

78. However, regardless of where PO wishes to draw lines around the '808 Patent's "skip coding mode," the prior art renders obvious the Challenged Claims, as explained in the grounds below. Under Petitioner's proposed construction for "skip coding mode," which is how a POSITA at the time of the purported invention would have understood the term, the prior art discussed in the set of grounds based on Karczewicz renders obvious the Challenged claims. Under PO's incorrect construction of the term, the prior art discussed in the set of grounds based on Frojdh renders obvious the Challenged Claims. And both grounds demonstrate that the Challenged Claims are obvious if the ALJ's and Staff's construction is applied.

X. DETAILED EXPLANATION OF GROUNDS

A. Ground 1: Obviousness over Karczewicz (Claims 1, 2, 6, 7, 9-11, 15, 16, 20-25, 28-30, 32, 34, 36, 39-41, 43, 44, 47-49, 51-54, 58-60, and 62-65)

1. Karczewicz

79. Karczewicz describes an "apparatus, and an associated method, for

encoding, and decoding, a video sequence utilizing motion compensation prediction.” Karczewicz, 1:7-8. In particular, Karczewicz teaches at least five different ways, or modes, for coding a segment of a frame in a video sequence:

Therefore, with respect to motion vector fields, a given segment S can be coded in any of various manners. For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment. Or, the segment can be coded by using a prediction motion vector field extrapolated from a neighboring segment together with a compressed refinement motion vector field. Alternately, the segment can be coded using only a compressed motion vector field without utilization of a prediction field. If the prediction field is set to zero, however, refinement information is sent. The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$. And, for example, the segment can be coded using intra coding in which no motion vector field is utilized.

Karczewicz, 31:14-25, claim 61 (“In a method of encoding a video sequence ... defining a set of coding modes”), claim 64 (“A method according to claim 61 wherein said set of coding modes comprises: a first coding mode ... a second coding mode ... a third coding mode”), claim 65.

80. Karczewicz teaches in some of these coding modes:

Motion fields of a segment are predicted from adjacent segments of a video frame and by using orthogonal affine motion vector field models. Through operation of an embodiment of the present invention, motion vector fields are formed with a reduced number of bits while still maintaining a low prediction error.

Karczewicz, 1:09-13.

81. Karczewicz explains that a motion vector field “is a set of motion vectors of all pixels of the current frame.” Karczewicz 20:11-13, *see also*, 8:3-10 (“motion vectors actually identify the origin of pixels in the current frame by comparison with the reference frame. Coding continues until the origin of each segment in the current frame has been identified. The resulting representation can be thought of as a ‘motion vector field’ describing the overall correspondence between the two frames.”). Karczewicz further teaches using an affine motion model³ to approximate a motion vector and generate a set of motion coefficients, which allow for more efficient transmission of motion vectors because the basis functions for the affine motion model are known to both encoder and decoder, so only the coefficients need to be transmitted.

³ An affine motion vector field model is “a special class of motion model whose mathematical form is such as to allow translational, rotational, and skewing movements between frames.” Karczewicz, 14:2-5.

Karczewicz, 13:29-14:9. Karczewicz explains that motion vectors of an image segment are calculated from the motion vector fields assigned to the segment. *E.g.*, Karczewicz, 23:10-26. Thus, a POSITA would have understood that each of Karczewicz's modes assigns motion vectors to a segment and represents those motion vectors through motion vector fields.

82. Karczewicz begins by providing a background and overview of known video coding techniques. Karczewicz explains that coding for every pixel in a video sequence would take a very large amount of data that would be impractical to transmit over low bit-rate communications channels. Karczewicz, 1:23-3:15. Karczewicz then provides an overview of motion compensated prediction, a technique widely used for reducing temporal redundancy in successive frames of a video:

Video coding schemes are utilized to reduce the amount of data required to represent such video sequences. A key of many video coding schemes is a manner by which to provide motion compensated prediction. Motion compensated prediction, generally, provides a manner by which to improve frame compression by removing temporal redundancies between frames. Operation is predicated upon the fact that, within a short sequence of the same general image, most objects remain in the same location whereas others move only short distances. Such motion is described as a two- dimensional motion vector.

Karczewicz, 3:16-24.

83. Put plainly, because “a typical video sequence [is] recorded at a comparatively rapid frame rate ... there are only small changes from one frame to the next. Usually the background is stationary and only some parts of the image undergo some form of movement. Alternatively, if the camera itself is moving, all elements undergo some consistent movement.” Karczewicz, 5:22-27. At a high level, motion compensated prediction takes advantage of these assumptions by coding and transmitting only the differences between a previously coded frame and a current frame. Karczewicz, 5:30-6:5.

84. Providing further detail, Karczewicz explains that in motion predictive coding, both encoder and decoder “maintain a record of a reference frame [previously coded frame] and the current frame is coded with reference to the stored frame.” Karczewicz, 7:7-9. The decoder then reconstructs the current frame using the stored reference frame and the transmitted difference information. Karczewicz, 7:9-11. Karczewicz explains that this is accomplished by examining a current frame “on a segment-by-segment basis in order to determine the correspondence between itself and the reference frame.” Karczewicz, 7:12-14. Practically, this requires that the segmentation scheme is predefined between the encoder and decoder, and Karczewicz provides examples of common segmentation schemes:

Frequently, the current image is simply divided into regular blocks of pixels e.g. the comparison may be done macroblock by macroblock. Alternatively, the frame may be

divided on some other basis; perhaps in an attempt to better identity the different elements of the image contained therein and thus enable a more accurate determination of the motion within the frame.

Karczewicz, 7:15-19. Segments are typically macroblocks, but Karczewicz leaves open the possibility for other segmentation schemes. Karczewicz, 7:15-20 (“Frequently, the current image is simply divided into regular block of pixels e.g. the comparison may be done macroblock by macroblock.”), Karczewicz, 31:7-9.

85. Karczewicz explains that in the next step, a best match for a given segment in the current frame is determined in the reference frame, and “the correspondence between the segment and the reference frame is coded using ‘motion vectors.’” Karczewicz, 8:1-3. Karczewicz teaches that “[a] motion vector can be considered as a displacement vector with x and y (horizontal and vertical) components, which actually points back from the segment of the current frame to pixel locations in a reference frame.” Karczewicz, 8:3-6. Karczewicz further explains that in order to provide for even more efficient coding, a motion field model known to both the encoder and decoder can be used, such that only motion field model coefficients (rather than entire functions) need to be transmitted in order to code for motion vectors with sufficient accuracy. Karczewicz, 8:24-9:7.

86. Karczewicz recognizes that the accuracy of the motion field model is limited by the functions chosen for the model. It explains that this problem is

compensated for by constructing a “prediction error frame, containing the difference between the coded current frame and the original current frame” at the encoder and transmitting the prediction error frame information along with the motion field model coefficients to the decoder:

Finally, and in order to compensate for the errors introduced by the motion field coding process, typical motion predictive encoders include an error estimation function. Information about the prediction error is transmitted to the decoder, together with the motion field model coefficients. In order to estimate the error introduced in the motion field coding process, a motion predictive encoder typically also includes a decoding section, identical to that found in the receiver. Once the current frame has been encoded using the motion predictive methods described above, the decoding section of the encoder reconstructs the current frame and compares it with the original version of the current frame. It is then possible to construct an "prediction error frame," containing the difference between the coded current frame and the original current frame. This information, together with the motion field model coefficients and perhaps some information about the segmentation of the current frame, is transmitted to the decoder.

Karczewicz, 9:14-27.

87. After summarizing these known methods for coding video sequences, Karczewicz notes that “significant amounts of data are still required to represent a video

sequence.” Karczewicz, 9:28-29.

88. Karczewicz teaches improvements to the prior art that reduce the amount of data required to represent a video sequence while at the same time preserving low prediction error. Karczewicz, 10:18-21. For example, as described above, Karczewicz teaches at least five coding modes. Karczewicz, 31:14-25. Karczewicz further teaches that two of those coding modes exploit, where present, the similarity between motion vector fields of neighboring segments by computing a motion vector field of a segment from its previously coded neighboring segment. Karczewicz, 11:1-8, 31:14-25 (“For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment”), claims 61, 64, 65. Karczewicz explains that this calculation may use a small refinement field to account for differences between motion vectors of neighboring segments, but that in some circumstances this refinement field may be zero:

The similarity of affine motion vector fields of neighboring segments of a video frame is exploited by utilizing affine prediction motion vector fields. If, for instance, two neighboring segments have similar motion vector fields, one of the motion vector fields can be computed from the other merely with the addition of a small, or even negligible, i.e., zero, refinement field. For each segment of a video frame, an affine motion model is selected which achieves satisfactorily low prediction error with as few non-zero coefficients as possible.

Karczewicz, 11:1-8.

89. Specifically, after coding a first segment, Karczewicz teaches determining whether it is “‘more efficient’ to model the second segments in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself.”

Karczewicz, 14:27-15:1. Karczewicz explains that this technique can provide advantages to coding efficiency:

The benefit of this approach to motion predictive coding may not be immediately apparent. However, in many cases, it is found that after projection of the motion field model from a neighboring segment, very little or even zero refinement information is required. This can result in a significant reduction in the amount of data that must be transmitted from encoder to decoder. In the case where zero refinement information is required, the motion vector field of the second segment can be predicted purely on the basis of motion coefficients already stored in the decoder.

Karczewicz, 15:26-16:3.

90. Notably, Karczewicz also explains that the second segment “can also be coded by using a zero motion vector field, e.g., a copy from the reference frame.”

Karczewicz, 31:20-24.

91. Finally, Karczewicz acknowledges that a prediction error, determined in the customary way, i.e., as the difference between the motion compensated predicted

version of the current frame and the current frame itself, can be sent to the decoder along with the motion vector information:

Difference values formed by the subtractor 24 are provided to a prediction error coder 42. The prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error. And, in turn, the prediction error coder 42 is coupled to the multiplexor 34 and to a prediction error decoder 46. The prediction error decoding block decodes the prediction error which is added to the MC predicted current frame by the adder 38 and the result is stored in the frame memory 26. The decoder 14 is here shown to include a demultiplexer 52, a prediction error decoder 54, a motion compensated predictor 36, a summer 56, and a frame memory 26. The predictor 36 of the encoder and of the decoder are commonly numbered as are the frame memories 26 of the respective devices.

Karczewicz, 20:21-21:5, *see also* Karczewicz, 22:5-6, Fig. 1.

2. Claim 1 and Dependents: “A method of encoding a video sequence”

a. Claim 1

(1) 1[pre]: A method of encoding a video sequence, the method comprising:

92. To the extent the preamble is limiting, Karczewicz discloses or suggests a

method of encoding a video sequence. For example, Karczewicz discloses an “apparatus, and an associated method, for encoding, and decoding, a video sequence utilizing motion compensated prediction.” Karczewicz, 1:7-8.

(2) 1[a]: assigning a skip coding mode to a first segment of a first frame of the sequence;

93. Karczewicz discloses or suggests this limitation.

94. As background, Karczewicz uses the terms “prediction field” and “refinement field” to describe the workings of its described coding modes. Karczewicz explains that a “prediction field” is “the motion field model predicted from the neighboring segment(s).” Karczewicz, 16:18-21. Karczewicz further explains that the neighboring segment(s) are “previously coded.” Karczewicz, 17:10-14. And Karczewicz explains that the “refinement field” refers to “the difference between the prediction field and the motion field model determined specifically for the segment itself.” Karczewicz, 16:21-23. Both the prediction field and the refinement field may be affine motion fields. Karczewicz, 16:21-23. In short:

- The motion field model for a segment is the sum of the prediction field and the refinement field;
- A motion predicted segment is obtained by applying the motion field model to a reference segment (i.e., from a segment from a previously coded frame);
- Prediction error is the difference between an actual segment and the motion predicted segment; and therefore

- Prediction error is also the difference between the actual segment and the application of the sum of the prediction field and the refinement field to a reference segment.

95. Karczewicz further describes how “[t]he sum of the prediction field and the refinement field should thus be equivalent to the motion field model determined by applying the affine motion model to the segment itself.” Karczewicz, 16:23-27. In other words, the prediction field predicts the motion of a segment based on the motion predictions for that segment’s neighbors, and the refinement field accounts for differences between that neighbor-based prediction and a prediction based on the segment itself.

96. Karczewicz explains that “there are several different ways in which a given segment can be coded.” Karczewicz, 17:1-2. As described above in Section X.A.1 (overview of Karczewicz), Karczewicz provides at least five different ways or manner in which a segment can be coded. Karczewicz, 31:14-25. Karczewicz additionally refers to these ways of coding a segment as “coding modes.” For example, claim 61 of Karczewicz recites that there are “a set of coding modes” for coding a segment, and claims 64 and 65 recite characteristics of a “first coding mode” through a “fifth coding mode” that correspond to the five different ways Karczewicz explained a segment can be coded:

61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and

a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:

defining a set of coding modes for said second neighboring segment; calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes; choosing that one of said set of cost functions with a smallest absolute value; defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring segment; encoding information about said second neighboring segment according to said chosen coding mode.

64. A method according to claim 61 wherein said set of coding modes comprises: a first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model; a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame; a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second

neighboring segment is represented by said prediction motion field model and a refinement motion field model.

65. A method according to claim 64 wherein said set of coding modes further comprises: a fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame; a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.

Karczewicz, claims 61, 64, 65.

97. Karczewicz determines which of these modes to assign to a given segment based on which coding mode is the most efficient in a rate distortion sense. Specifically, Karczewicz teaches that when encoding a second segment of an inter frame (here, mapped to the claimed “first segment”) an encoder “considers whether it is ‘more efficient’ to model the second segment in terms of the affine motion model previously determined for [a] first segment, rather than according to the newly determined affine motion coefficients for the second segment itself.” Karczewicz, 14:27-15:1. Karczewicz explains that “efficiency” is based on “rate distortion,” which considers “both a measure of the image distortion and a measure of the amount of data required to achieve that level of distortion.” Karczewicz, 14:12-17. In other words, Karczewicz teaches balancing the reduction in data coding against the potential quality loss of the coded video sequence.

98. Each of the ways or manners in which a segment can be coded, as taught

by Karczewicz, is a coding mode. Below, I briefly explain characteristics of each of the five coding modes taught by Karczewicz.

99. In the first coding mode, “[t]he segment may be represented as a prediction field only.” Karczewicz, 17:9-10, 31:16-17, claim 64 (“... a first coding mode wherein ... said second neighboring segment is represented by said prediction motion field model”). Karczewicz explains that “[t]his situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero.” Karczewicz, 17:10-14. In other words, Karczewicz’s first coding mode teaches coding a second segment based on neighboring segment(s), when doing so adequately represents the segment or when it is efficient to do so (e.g., from a rate distortion point of view).

100. In the second coding mode, “[t]he segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame.” Karczewicz, 17:14-18, 31:20-21, claim 64 (“...a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame ...”). In other words, in Karczewicz’s second coding mode, the motion field model for a segment may be coded without using the motion information of

neighboring segment(s).

101. In the third coding mode, “[a] given segment can be represented as a sum of a prediction field and a refinement field.” Karczewicz, 17:8-9, 31:17-20, claim 64 (“...a third coding mode wherein...said second neighboring segment is represented by said prediction motion field model and a refinement field model.”). In other words, Karczewicz’s third coding mode codes a second segment based on both a motion field model predicted from neighboring segment(s) (the prediction field), as well as additional information used to help achieve acceptable distortion (the refinement field).

102. In the fourth coding mode, “[t]he segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame.” Karczewicz, 31:22-24, claim 65 (“a fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame...”).

103. In the fifth coding mode, “the segment can be coded using intra coding in which no motion vector field is utilized.” Karczewicz, 31:24-25, claim 65 (“... a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.”).

104. Karczewicz teaches determining which of these five coding modes to use, for a given segment, based on which of the coding modes is most efficient (e.g., in a rate-distortion sense). Specifically, Karczewicz teaches that when encoding a second segment of an inter frame (which corresponds to the claimed “first segment”) an

encoder determines the most efficient way to code the segment, taking into consideration the motion models of the segment's previously coded neighbors.

The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is "more efficient" to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.

Karczewicz, 14:27-15:6.

105. Karczewicz explains that "efficiency" is considered in the "rate-distortion" sense, which balances image distortion and the amount of data that it would take to code the segment:

It should be emphasized here that an aim of this method is not merely to minimize the prediction error, but to find the affine motion field model that yields the best match for a segment in a "rate-distortion" sense. This means that the best match is determined by taking into account both a measure

of image distortion and a measure of the amount of data required to achieve that level of distortion.

Karczewicz, 14:12-17.

106. Regardless of which of the five coding modes is chosen, and consistent with how it describes use of prediction error in the prior art, Karczewicz teaches that a prediction error is determined as the difference between the motion compensated predicted frame, which uses the coding mode (and corresponding motion vector information) chosen, and the current input video frame. Karczewicz, 20:21-29; 9:14-27. When a non-zero prediction error for a segment is calculated, it is encoded and sent to a decoder. Karczewicz, 20:22-26. Karczewicz however, does not explicitly teach what happens when zero prediction error is calculated.

107. In my opinion, a POSITA would have found it obvious, based on the teachings of Karczewicz and coding standards at the time, not to send prediction error for a segment if a prediction error of zero is calculated. Karczewicz teaches efficiently coding segments in the rate-distortion sense, Karczewicz, 14:12-17, so a POSITA would have found it obvious that instead of coding numerous zeros for the prediction error of pixels in a segment, no prediction error would be sent. Indeed, as explained below with regard to Karczewicz's MCI bit, Karczewicz already teaches a mechanism for indicating a set of all-zero refinement or non-refinement motion field coefficients. Karczewicz, 37:5-13. A POSITA would have found it obvious to use a similar indicator to code a zero prediction error for a segment. Doing so would have been no more than

use of a known technique (using a single bit to indicate an all-zero field) to improve a similar method (sending an all-zero prediction error) in the same way (efficiently indicating all zero values). It also would have been obvious to use another bit or indicator, similar to the MCI bit, to code zero prediction error because it would have been one of a limited number of choices (e.g., coding zero prediction error or indicating zero prediction error without coding it).

108. Furthermore, in cases where the prediction errors for a segment were all zero, a POSITA would have found it obvious to omit (i.e., to not explicitly encode) the zero valued prediction errors. In the contemporary coding standards of the time, including H.262, H.263 (and variants such as H.263+ and H.263++), as well as in the emerging H.26L standard, a block-based transform such as the discrete cosine transform (DCT) or an integer approximation thereto was applied to each block of prediction error values to obtain a corresponding block of “transform coefficients.” E.g., Karczewicz, 24:12-14; Wang, 194, Fig. 9.12; Bhaskaran, 168; H.263 (EX-1009) at Section 5.4.2, Table 16, Table 17, pp. 41-44, Section 6.2, pp. 46-47; JM-1r1 (EX-1012) at Section 4.3, pp. 30-32. The resulting transform coefficients were then quantized to reduce precision by discarding low-order bits and placed into a 1D or “Zig-Zag” ordering to obtain a 1D sequence of quantized transform coefficient values that typically contained many “runs” of consecutive zero values. This 1D sequence of quantized transform coefficients was then run-length encoded, where each run of consecutive zero values was represented by

a count of the number of consecutive zero values paired with an encoding of the non-zero value that terminated the run. A special flag called “LAST” in H.263 (“this is the last non-zero coefficient in this block,” H.263 at Section 5.4.2 on p. 41) and “EOB” in H.26L (“End Of Block”, *see* JM-1r1 (EX-1012) at 32) was used to signal that all remaining values in the 1D sequence of quantized transform coefficients were equal to zero. Since a block (or “segment”) with all prediction errors equal to zero would necessarily result in all transform coefficients also being zero, it would have been obvious to a POSITA to simply encode a “LAST” or “EOB” flag instead of explicitly encoding an entire block of zero-valued quantized transform coefficients. *See, e.g.*, JM-1r1 (EX-1012), Section 4.3.3.2 on p. 31 (“remember that a lot of 4x4 blocks only have EOB”).

109. Either way, it would have been obvious to not code and send prediction error where Karczewicz calculates that there is zero prediction error for a segment.

110. In my opinion, Karczewicz thus teaches assigning a “skip coding mode,”

as the term should be construed⁴, to a second segment of an inter frame⁵ (“first segment of a first frame of the sequence”) in instances where the second segment is either encoded using a zero motion vector, Karczewicz, 31:22-24, or with just a prediction field, i.e., a non-zero motion vector associated with a neighboring segment. Karczewicz, 17:8-14, 31:22-24. Although Karczewicz describes the use of a zero motion vector and a non-zero motion vector in terms of different coding modes, a POSITA would have understood that the combined functionality of the two coding modes (i.e., encompassing both a zero motion vector and a non-zero motion vector) is identical to what the ’808 Patent refers to as the “modified” “skip coding mode.” I note that a POSITA would have understood the two “modes” of Karczewicz which describe coding a segment with a zero motion vector and a prediction field only, respectively, are together a “skip coding mode” because Karczewicz indicates these modes in the

⁴ I.e., “a coding mode in which a zero (non-active) motion vector or a nonzero (active) motion vector is associated with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question, and residual information can be provided for each skip mode Macroblock.”

⁵ Karczewicz explains that a first frame of a sequence is transmitted in INTRA format, and a POSITA would have understood that the recited “first frame of the sequence” refers to the first inter-coded frame of a sequence. Karczewicz, 13:17-23.

same way.

111. Karczewicz teaches that a single indicator, the motion coefficient indicator (MCI), has a zero value only in the two modes that comprise the functionality of the “skip coding mode” discussed above. Specifically, “the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).” Karczewicz, 37:5-8. “An all-zero pattern [of motion coefficients]...can be signaled by the MCI bit alone.” Karczewicz, 37:12-13. Thus, a zero MCI bit indicates Karczewicz’s two inter coding modes that correspond to the “redefined” “skip coding mode.” Specifically, when a segment is coded with a zero motion vector, the MCI bit is zero because that indicates “[a]n all-zero pattern [of motion coefficients].” Karczewicz, 37:12-13. And when a segment is coded with just a prediction field, the MCI bit is also zero because it indicates that there are no motion coefficients for the segment (i.e., no refinement field). Karczewicz, 37:5-8. These are the only two modes taught by Karczewicz which include a zero MCI bit, so a POSITA would have understood that if a segment is coded with a zero MCI bit, it is assigned a “skip coding mode.”

112. In the alternative, a POSITA would have found it obvious to combine Karczewicz’s coding mode where a segment is coded solely with a prediction motion vector field, and Karczewicz’s coding mode where a segment is coded by a zero motion

vector. A POSITA would have found this combination obvious because it minimizes the number of bits needed to encode the segment (e.g., utilizing the zero motion vector when appropriate, otherwise utilizing the prediction motion vector field, without refinement, when encoding motion information for the segment). And as I discuss below in reference to claim 6 (Section X.A.2.c, claim 6), based on Karczewicz's teachings a POSITA would have understood that there are situations in which a segment, coded based on the neighboring segments that have already been coded, is coded with a zero motion vector. It therefore would have been obvious, based on Karczewicz's teachings, to treat the two coding modes (one associated with a zero motion vector, the other associated with a non-zero motion vector) as a single coding mode. Such a coding mode that allows for a zero motion vector or a non-zero motion vector would account for the overlap in functionalities of Karczewicz's coding modes. And a POSITA would have recognized such a coding mode would provide certain advantages, including in efficiency (for example, by eliminating the need to indicate two overlapping coding modes, therefore reducing the number of bits needed to indicate the coding mode).

113. For these reasons, a POSITA would have also understood that Karczewicz teaches "assign[ing]" a "skip coding mode" by determining which of its coding modes is the most efficient, in the rate-distortion sense, for coding the second segment.

114. Regardless of which coding mode is assigned to Karczewicz's second

segment, Karczewicz teaches also calculating and sending prediction error between the motion compensated predicted version of the frame and the actual current frame. Karczewicz, 20:21-29. A POSITA would have understood that prediction error information is thus calculated and sent for segments coded using any of Karczewicz's coding modes. For the same reasons, a POSITA would have understood that prediction error information is also calculated and sent for the "skip coding mode" taught or suggested by Karczewicz, as discussed above. In other words, Karczewicz teaches that residual information can be provided with the skip coded macroblock in the form of prediction error information. Thus, Karczewicz teaches a "skip coding mode" under the correct construction of the term⁶.

115. Finally, a POSITA would have understood that the decision to code a second segment with a zero motion vector or motion vector associated with a neighboring segment depends on the characteristics of the motion in the neighboring

⁶ Karczewicz also teaches that the second segment may be coded with a non-zero motion vector without reference to a neighboring segment's motion vector. Karczewicz, 17:14-18, 31:20-21. I note that in such a case, a POSITA would have understood that the second segment is not assigned a "skip coding mode" because Karczewicz's second segment is not assigned a zero motion vector or a nonzero motion vector based at least in part on the motion information of a second segment neighboring the first segment.

segment(s) (i.e., depending on the characteristics of the motion in image segments surrounding the macroblock in question) because Karczewicz teaches determining the efficient coding mode by balancing distortion due to coding the second segment with reference to a neighboring segment against the amount of data required to transmit the motion vector information of the second segment. Karczewicz, 15:16-20.

(3) 1[b]: assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

116. Karczewicz discloses or suggests this limitation.

117. As I explain in Section X.A.2.a(2) (limitation 1[a]), Karczewicz teaches assigning a “skip coding mode” to a second segment (which I map here to the recited “first segment”) based on how efficient it is, when accounting for rate-distortion, to use skip coding mode. And as I explain in Section X.A.2.a(2) (limitation 1[a]), skip coding mode can be used with a zero motion vector or a non-zero motion vector. Thus, the second segment, coded with skip coding mode, is further assigned either a prediction motion vector field “extrapolated from a neighboring segment” or a “zero motion vector field, e.g., a copy from the reference frame.” Karczewicz, 31:16-24. Karczewicz therefore discloses or suggests “assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment,” as recited by this limitation.

118. Karczewicz teaches that “assigning” is “based at least in part on the motion

information of a second segment neighboring the first segment.” Karczewicz teaches that if it is more efficient from a rate-distortion point of view, a second segment (which I here map to the recited “first segment”) is coded with reference to the motion information of a first, previously coded segment (which I here map to the recited “second segment”). Karczewicz, 15:16-20. Thus, Karczewicz teaches that the “assigning” of the zero motion or a predicted non-zero motion vector for the skip coding mode for its second segment is based at least in part on the motion information of a neighboring segment because Karczewicz’s rate-distortion efficiency calculation weighs using motion coefficients from a neighboring, previously coded segment, against motion coefficients calculated for the second segment. For example, Karczewicz teaches determining the most efficient coding, in the rate-distortion sense, by minimizing for the Lagrangian value λ in its equations 7 through 10. Karczewicz 24:18-27:11.

119. Karczewicz further teaches that the “predicted non-zero motion vector for the skip coding mode” is “based at least in part on the motion information of a second segment neighboring the first segment.” Karczewicz describes how the prediction motion vector field is “extrapolated from a neighboring segment.” Karczewicz, 31:16-17, 25:14-17 (“the prediction motion vector field is obtained by extrapolating the affine motion vector field of a neighboring, e.g., adjacent segment”), 25:19-23 (“the prediction motion vector field is obtained from a combination of affine motion vector fields of

several neighboring segments”). Thus, the prediction motion vector field of Karczewicz’s “skip coding mode” (which I map here to the recited “predicted non-zero motion vector for the skip coding mode”) is based at least in part on the motion information of a previously coded neighboring segment (which I map here to the recited “second segment neighboring the first segment”).

120. Karczewicz therefore discloses or suggest this limitation.

(4) 1[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector; and

121. Karczewicz discloses or suggests this limitation.

122. Specifically, Karczewicz teaches forming a prediction frame for its second segment (which I here map to the recited “first segment”) with respect to a reference frame, assigning to the second segment either a zero motion vector or a motion vector based on one or more previously coded segments (which I here map to the recited “second segment”). *E.g.*, Karczewicz, 21:17-21 (“the compressed motion vectors and the reference frame are used to construct a prediction frame []. The prediction frame is a coded version of the current frame [], calculated using the motion vector field...and the pixel values of the reference frame.”), 20:17-20 (“The encoder is further shown to include a motion compensated (MC) predictor 36. The predictor 36 is also coupled to the frame memory 26. The predictor 36 is operable to generate a prediction frame which

is supplied to the subtractor 24 and also to a summer 38.”), 21:18-21 (“The prediction frame is a coded version of the current frame $I_n(x, y)$ calculated using the motion vector field determined by the motion estimator 22 and the motion field coder 28 and the pixel values of the reference frame $R_{ref}(x, y)$.”); *see also, id.*, 16:16-18 (“In a general case, the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left”), 20:17-20, 21:6-21, 25:13-24, 26:13-20, 27:15-30, 31:13-24 (“For instance, the segment can be coded using only prediction motion vector fields extrapolated from a neighboring segment.... The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame.”).

(5) 1[d]: providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.

123. Karczewicz discloses or suggests this limitation.

124. Karczewicz describes that “the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).” Karczewicz, 37:5-8. Karczewicz goes on to explain that “[a]n all-zero pattern [of motion coefficients] ... can be signaled by the MCI bit alone.” Karczewicz, 37:12-13. In my opinion, a POSITA would have understood that if the MCI bit is zero, it acts as “an indication of the skip coding mode” because the two inter coding modes disclosed by Karczewicz whose functionalities correspond to the “modified” “skip

coding mode” I discuss in Section X.A.2.a(2) (limitation 1[a]) are the only two in which no motion coefficients are sent. As noted above, Karczewicz teaches that an all-zero motion coefficient pattern (i.e., coding a segment with a zero motion vector) is indicated by the MCI bit alone, so no motion coefficients are sent, and when a second segment is coded with a prediction motion vector field alone, no motion coefficients are used because the motion coefficients of a previously coded segment or segments are used instead.

125. Karczewicz further discloses that “one bit is sent to the decoder 14 to signal whether the prediction field of a neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate.” Karczewicz, 32:18-20.

126. Karczewicz further discloses or suggests “wherein no further motion vector information for the first segment is coded in the encoded bitstream,” as additionally recited by this limitation. For example, as described above (Section X.A.2.a(2), limitation 1[a]), Karczewicz describes coding modes in which only a prediction motion vector field or a zero motion vector field is coded. In those coding modes, other information taught by Karczewicz for use in other coding modes (e.g., the refinement motion field) is not coded. Since prediction motion vector field or a zero motion vector field is coded, but other information (such as the refinement motion field) is not coded, Karczewicz discloses or suggests that “no further motion vector information” for the second segment (i.e., the recited “first segment”) is encoded.

b. Claim 2: A method according to claim 1, wherein the second segment is a previously encoded segment neighboring the first segment.

127. Karczewicz discloses or suggests claim 2. Specifically, and as discussed with respect to Claim 1, Karczewicz discloses that the prediction field for its second segment (which I here map to the recited “first segment”) is “represented in terms of the motion field of one or more of its previously coded neighbors⁷,” (which I here map to the recited “second segment”). Karczewicz, 17:10-14 (“The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero.”), *see also, id.*, 14:27-15:6 (“The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is ‘more efficient’ to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients

⁷ Karczewicz discloses that coding and decoding is done in raster scan order. Karczewicz, 31:8-10 (“The coding of a frame is performed by scanning from left-to-right and top-to-bottom, macroblock by macroblock.”).

for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.”), 16:4-30; 17:23-28 (“Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder.”).

c. Claim 6: A method according to claim 1, wherein if the second segment has zero motion vector, the zero motion vector is assigned for skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

128. Karczewicz discloses or suggests claim 6. Specifically, as explained in Sections X.A.2.a(2) (limitation 1[a]) and X.A.2.a(3) (limitation 1[b]), Karczewicz discloses coding a second segment (which I here map to the recited “first segment”) with reference to a previously coded neighboring segment (which I here map to the recited “second segment”) via a prediction motion vector field. Karczewicz also discloses that the second segment may be coded with a zero motion vector. Karczewicz, 31:22-24. Accordingly, a POSITA would have understood that when a previously coded neighboring segment has a zero motion vector, Karczewicz teaches coding its

second segment with a zero motion vector. This is because Karczewicz does not treat neighboring segments with zero motion any different from non-zero motion neighboring segments when encoding a second segment. As long as it is efficient from the rate-distortion point of view, Karczewicz thus teaches coding a second segment with a zero motion vector if its neighboring segment has a zero motion vector. And in such a case, Karczewicz teaches that when a zero motion vector is coded, the segment is copied from the reference frame, i.e., “formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” Karczewicz, 31:22-24 (“The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$.”).

129. I have been asked to assume that Patent Owner will argue that Karczewicz does not allow neighboring segments with zero motion vectors to be candidates for a prediction motion vector field based on Karczewicz’s disclosure at 32:20-22. (“A neighboring segment S_K is a candidate for prediction of motion vector field of a segment S_i only if it has a nonzero motion vector field.”). Such an argument would be misplaced because Karczewicz practices the additional limitations of this claim regardless. Based on the context of the disclosure, which I have reproduced below, a POSITA would have understood that this disclosure relates to prediction neighbor candidates at the decoder side, and further that it is perfectly harmonized with its disclosure regarding encoding:

In the exemplary implementation, one bit is sent to the decoder 14 to signal whether the prediction field of a

neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate. A neighboring segment S_K is a candidate for prediction of motion vector field of a segment S_i only if it has a nonzero motion vector field.

Karczewicz, 32:18-22.

130. Specifically, if a second segment is encoded with a zero motion vector, which may be based on the motion vectors of its neighbors if it is efficient to do so in the rate-distortion sense, then the decoder would not receive a prediction motion vector field for that segment (which is coded with a zero motion vector) and there would not be any prediction neighbor candidates. Indeed, Karczewicz explains as much in an exemplary implementation, where it discusses sending a motion coefficient indicator bit (“MCI”) to indicate the presence of motion coefficients in the bitstream. Karczewicz, 37:5-8 (“In the exemplary implementation, the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).”). Karczewicz goes on to explain that “when motion coefficients are transmitted...a motion coefficient pattern (MCP) is first sent to indicate which coefficients have non-zero values. An all-zero pattern is the only non-valid pattern, as this possibility can be signaled by the MCI bit alone.” Karczewicz, 37:9-13. Thus, Karczewicz teaches that at the decoder, there are prediction motion vector field

candidates and coefficients only if a segment is coded with a non-zero motion vector field. But this does not affect Karczewicz's teachings about how a segment may be encoded with a zero motion vector.

d. Claim 23

(1) 23[pre]: A method according to claim 1, wherein if the second segment has a non-zero motion vector,

131. To the extent the preamble is limiting, Karczewicz discloses or suggests that a previously coded neighboring segment (which I here map to the recited "second segment") has a non-zero motion vector. *E.g.*, Karczewicz, 32:20-22 ("A neighboring segment S_K is a candidate for prediction of motion vector field of a segment S_i only if it has a nonzero motion vector field.").

(2) 23[a]: the method further comprising deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and

132. Karczewicz discloses or suggests this limitation for the same reasons as discussed in Sections X.A.2.a(2) (limitation 1[a]) and X.A.2.a(3) (limitation 1[b]). Karczewicz discloses that a second segment "can be coded using only prediction motion vector fields extrapolated from a neighboring segment." Karczewicz, 31:16-20. Specifically, Karczewicz discloses that "[o]nce the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:

EQUATION 20

$$\Delta x_{prd}(x,y)=\beta_1^k + \beta_2^k \cdot (y-y_o^k) + \beta_3^k \cdot (x-x_o^k)$$

$$\Delta y_{prd}(x,y)=\beta_4^k + \beta_5^k \cdot (y-y_o^k) + \beta_6^k \cdot (x-x_o^k)$$

where x_o^k, y_o^k are coordinates of the upper left-most pixel in the neighboring segment S_k and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment S_k . In equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment S_k .” Karczewicz, 33:18-34:2.

133. Where the one or several neighboring segments has a non-zero motion vector field, a POSITA would have understood that Karczewicz teaches “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.”

(3) 23[b]: the predicted non-zero motion vector is assigned for the skip coding mode of the first segment; and

134. Karczewicz discloses or suggests this limitation. As discussed in Section X.A.2.a(3) (limitation 1[b]), after the “skip coding mode” is assigned based on Karczewicz’s determination that it is efficient to do so in the rate distortion sense, Karczewicz teaches that its second segment (which I here map to the recited “first segment”) is coded with a prediction motion vector field “extrapolated from a neighboring segment.” Karczewicz, 31:16-17. Because Karczewicz already discloses

coding its second segment with a non-zero motion vector, a POSITA would have understood that coding Karczewicz's second segment with a prediction motion vector field extrapolated from a neighboring vector would mean that the second segment is coded with a non-zero motion vector, i.e., "[assigning] the predicted non-zero motion vector [] for the skip coding mode of the first segment."

(4) 23[c]: the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.

135. Karczewicz discloses or suggests this limitation. As discussed in Section X.A.2.a(4) (limitation 1[c]), Karczewicz teaches forming a motion vector prediction field for its second segment (which I here map to the recited "first segment") with respect to a reference frame based on one or more previously coded segments (which I here map to the recited "second segment"). E.g., Karczewicz, 13:29-30, 16:16-18, 21:6-21, 25:13-24, 26:13-20, 31:13-24. Where the "skip coding mode" is assigned to a prediction motion vector field extrapolated from a neighboring segment, Karczewicz, 31:16-17, a POSITA would have understood that "the prediction for the first segment is formed by motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector" because the non-zero motion vector of the neighboring segment would be used to form the prediction of Karczewicz's second segment.

e. Claim 24: A method according to claim 1, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

136. Karczewicz discloses or suggests claim 24. Karczewicz does not explicitly discuss how previously coded neighboring segments (which I here map to the recited “second segment”) are predicted because for the purposes of describing the invention, Karczewicz needs only that the neighboring segment be previously coded (and thus known to both the encoder and decoder). E.g., Karczewicz, 17:25-28 (“motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder.”). However, Karczewicz does disclose that a segment may be assigned a zero motion vector, wherein it is copied from the reference frame. Karczewicz, 31:22-24 (“The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame”), 13:29-30 (“[a] motion vector field that describes the mapping of pixel values between the reference frame and the first segment of the current frame”). Thus, if a previously coded neighboring segment (which I here map to the recited “second segment”) has a zero motion vector, it would be predicted using the reference picture. Further, if the previously coded neighboring segment has a zero motion vector and it is efficient, from a rate distortion point of view, for Karczewicz’s second segment (which I here map to the recited “first segment”) to have

a zero motion vector, the prediction with respect to Karczewicz's second segment would also be with respect to the reference frame, as I explain in Section X.A.2.c (claim 6).

f. Claim 25: A method according to claim 1, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

137. Karczewicz discloses or suggests claim 25 for the same reasons as discussed in Section X.A.2.e (claim 24) because Karczewicz is agnostic as to whether the reference frame is “immediately preceding” the current frame. Karczewicz, 5:30-6:2 (“[a] so-called reference frame [] is usually, but not necessarily, the frame immediately preceding that currently being coded.”). Thus, the reference frame may be immediately preceding a current frame. I note that beyond the requirement that “the second segment is predicted using motion-compensated prediction from a second reference picture immediately proceeding the picture second segment belongs to,” which Karczewicz also discloses or suggests, claim 25 is identical to claim 6.

g. Claim 28: A method according to claim 1, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

138. Karczewicz discloses claim 28 for the same reasons as discussed in Section X.A.2.a(3) (limitation 1[b]). For example, Karczewicz discloses deriving a motion

vector for a second segment (which I here map to the recited “first segment”) based upon the motion field of one or more of its previously-coded neighbors. E.g., Karczewicz, 17:8-14 (“The segment may be represented as a prediction field only. This situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors...”).

h. Claim 29: A method according to claim 1, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

139. Karczewicz discloses claim 29 for the same reasons as discussed in Section X.A.2.a(3) (limitation 1[b]). For example, Karczewicz discloses that the motion vector for its second segment (which I here map to the recited “first segment”) may be derived from “one or more of its previously coded neighbors.” Karczewicz, 17:10-14, 16:16-19 (“the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left. Alternatively, it can form some kind of average, using the motion field model for both neighbors.”). Accordingly, Karczewicz discloses deriving a predicted non-zero motion vector for its second segment from at least two previously coded neighboring segments (the recited “second segment” and “third segment”).

i. Claim 30: A method according to claim 1, wherein no residual information is provided for the first segment in the encoded bitstream.

140. Karczewicz discloses or suggests claim 30 for the reasons discussed in

Sections X.A.2.a(2) (limitation 1[a]) and X.A.2.a(3) (limitation 1[b]). Specifically, Karczewicz discloses that “[t]he prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.” Karczewicz, 20:22-25. Thus, a POSITA would have understood that where the difference between the current input video and the MC predicted version of Karczewicz’s second segment (which I here map to the recited “first segment”) is zero, then the prediction error for that segment would be zero. And for the reasons discussed in Section X.A.2.a(2) (limitation 1[a]), a POSITA would have found it obvious not to send prediction error when it is calculated to be zero. Thus, “no residual information is provided.”

3. Claim 7 and Dependents: “A method of decoding an encoded video sequence”

a. Claim 7

(1) 7[pre]: A method of decoding an encoded video sequence, the method comprising:

141. To the extent the preamble is limiting, Karczewicz discloses or suggests a method of decoding a video sequence. For example, Karczewicz explains that the prediction error transmitted with the motion vector field is calculated as “the differences in pixel value between the current input video frame and the MC predicted version of the frame.” Karczewicz, 20:22-25.

(2) 7[a]: receiving an indication of a skip coding mode for a first segment;

142. Karczewicz discloses or suggests this limitation. As explained in Section X.A.2.a(5) (limitation 1[d]), Karczewicz teaches sending to the decoder, and the decoder receiving, a zero MCI that signals that no motion coefficients are sent for a segment. Karczewicz, 37:12-13 (“An all-zero pattern [for motion coefficients] ... can be signaled by the MCI bit alone”). And as explained in Section X.A.2.a(2) (limitation 1[a]), a POSITA would have understood a zero MCI bit is an “indication of a skip coding mode” for Karczewicz’s second segment because it indicates that no motion coefficients are used to code the segment.

(3) 7[b]: assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

143. Karczewicz discloses or suggests this limitation for the same reasons as discussed in Section X.A.2.a(3) (limitation 1[b]) because Karczewicz’s decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22 (“The functional elements of the MC predictor 36 are similar for both the encoder and the decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment in the frame. The motion vector field is computed based upon a prediction motion vector field ($\Delta x_{prd}(x,y), \Delta y_{prd}(x,y)$) and the

refinement motion vector field coefficients.”).

(4) 7[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.

144. Karczewicz discloses or suggests this limitation for the same reasons as discussed in Section X.A.2.a(4) (limitation 1[c]) because Karczewicz’s decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22.

b. Claim 9: A method according to claim 7, wherein if a segment in a previously decoded region surrounding the first segment has zero motion vector, the zero-motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

145. Karczewicz discloses or suggests claim 9 for the same reasons as discussed in Section X.A.2.c (claim 6) because Karczewicz’s decoding method performs the same steps as the encoding method for forming a prediction of a segment, wherein said prediction field is based on a previously decoded region or “second segment,” as recited in claim 6. Karczewicz explains that at the decoder, “the prediction motion vector field is derived from one or several neighboring segments which have already been decoded.” Karczewicz, 27:24-26. The ’808 Patent describes how macroblocks neighboring a macroblock to be coded are part of a “region surrounding” that macroblock. ’808 Patent, 19:28-36 (“In a first preferred embodiment of the invention surrounding motion

analysis block 802 classifies the motion in the region surrounding the macroblock according to the following three step procedure. Firstly, surrounding motion analysis block retrieves motion information for the macroblocks or sub-blocks surrounding the macroblock to be coded (i.e. previously encoded macroblocks neighboring the macroblock to be coded, as shown in FIG. 9) and generates a median motion vector prediction for the macroblock.”). Thus, Karczewicz’s previously coded neighboring segments are “in a region surrounding” Karczewicz’s second segment.

c. Claim 32: A method according to claim 7, wherein if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

146. Karczewicz discloses or suggests claim 32 for the same reasons as discussed in Section X.A.2.c (claim 6) because Karczewicz’s decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22.

d. Claim 34: A method according to claim 7, wherein if the second segment has a non-zero motion vector, the method further comprising deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and the predicted non-zero motion vector is assigned for the skip coding mode of the first segment; and the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.

147. Karczewicz discloses or suggests claim 34 for the same reasons as

discussed in Section X.A.2.d (claim 23) because Karczewicz's decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22.

e. Claim 36: A method according to claim 7, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

148. Karczewicz discloses or suggests claim 36 for the same reasons as discussed in Section X.A.2.e (claim 24) because Karczewicz's decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22.

f. Claim 39: A method according to claim 7, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

149. Karczewicz discloses or suggests claim 39 for the same reasons as discussed in Section X.A.2.g (claim 28) because Karczewicz's decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22.

g. Claim 40: A method according to claim 7, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

150. Karczewicz discloses or suggests claim 40 for the same reasons as discussed in Section X.A.2.h (claim 29) because Karczewicz's decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22.

h. Claim 41: A method according to claim 7, wherein no residual information is provided for the first segment in the encoded bitstream.

151. Karczewicz discloses or suggests claim 41 for the same reasons as discussed in Section X.A.2.i (claim 30) because Karczewicz's decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-22.

i. Claim 43: A method according to claim 7, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

152. Karczewicz discloses or suggests claim 43 for the same reasons as discussed in Section X.A.2.f (claim 25) because the decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz, 27:17-

22.

j. Claim 65: A method according to claim 7, wherein no further motion vector information for the first segment is retrieved from the encoded bitstream.

153. Karczewicz discloses or suggests claim 65 for the same reasons as discussed in Section X.A.2.a(5) (limitation 1[d]) because the decoding method performs the same steps as the encoding method for forming a prediction of a segment. Karczewicz 27:17-22. Further, in Karczewicz's "skip coding mode," no refinement field is sent, so a POSITA would have understood that "no further motion vector information for the first segment is retrieved from the encoded bitstream" when decoding a segment assigned a "skip coding mode."

4. Claim 10 and Dependents: "A video encoder for encoding a video sequence"

a. Claim 10

(1) 10[pre]: A video encoder for encoding a video sequence, the encoder comprises:

154. To the extent the preamble is limiting, Karczewicz discloses or suggests an encoder for encoding a video sequence. For example, Karczewicz discloses an "apparatus, and an associated method, for encoding, and decoding, a video sequence utilizing motion compensated prediction." Karczewicz, 1:7-8. Karczewicz's encoder and decoder are depicted in Karczewicz's Figure 1, reproduced below:

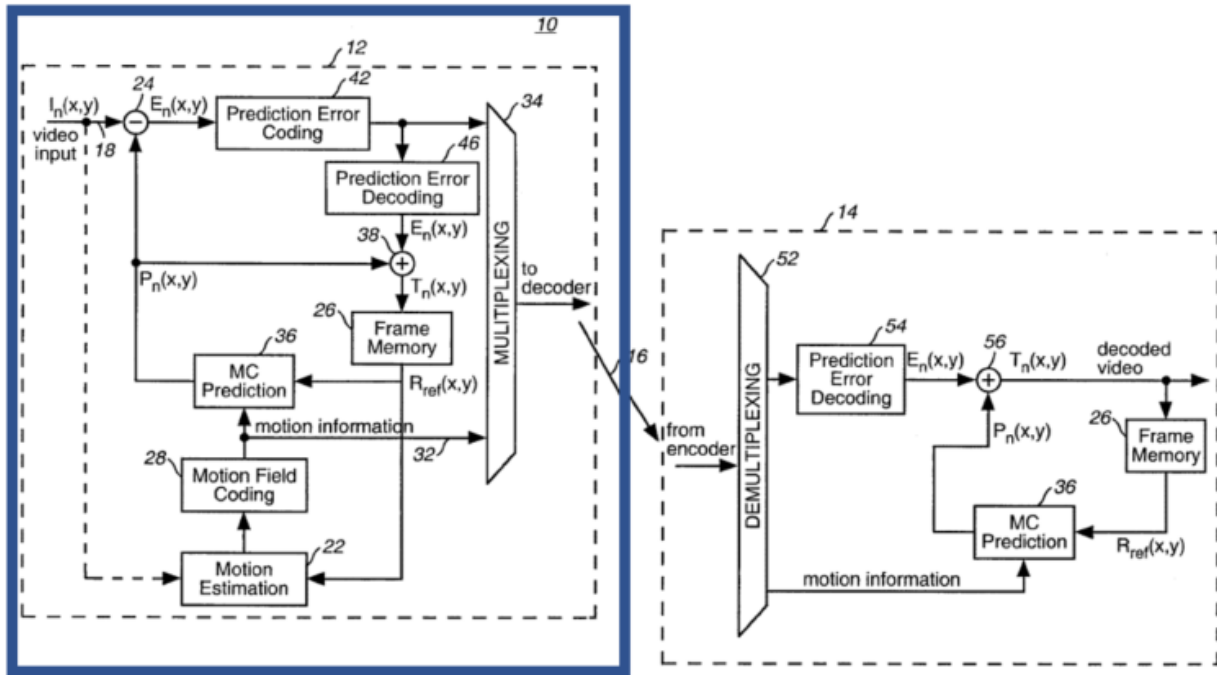


FIG. 1

Karczewicz, Fig. 1 (annotated).

(2) 10[a]: a coding controller for assigning a skip coding mode to a first segment;

155. Karczewicz discloses or suggests this limitation.

156. As background, Karczewicz uses the terms “prediction field” and “refinement field” to describe operation of its disclosed coding modes. Karczewicz explains that a “prediction field” is “the motion field model predicted from the neighboring segment(s).” Karczewicz, 16:19-21. Karczewicz further explains that the neighboring segment(s) are “previously coded.” Karczewicz, 17:10-14. And Karczewicz explains that the “refinement field” refers to “the difference between the prediction field and the motion field model determined specifically for the segment

itself.” Karczewicz, 16:21-23. Both the prediction field and the refinement field may be affine motion fields. Karczewicz, 16:21-23. The below set of equations helps illustrate the relationship between the terms Karczewicz uses to describe its teachings. Karczewicz, 16:23-27. In short:

- The motion field model for a segment is the sum of the prediction field and the refinement field;
- A motion predicted segment is obtained by applying the motion field model to a reference segment (i.e., from a segment from a previously coded frame);
- Prediction error is the difference between an actual segment and the motion predicted segment; and therefore
- Prediction error is also the difference between the actual segment and the application of the sum of the prediction field and the refinement field to a reference segment.

157. Karczewicz further describes how “[t]he sum of the prediction field and the refinement field should thus be equivalent to the motion field model determined by applying the affine motion model to the segment itself.” Karczewicz, 16:23-27. In other words, the prediction field predicts the motion of a segment based on the motion predictions for that segment’s neighbors, and the refinement field accounts for differences between that neighbor-based prediction and a prediction based on the segment itself.

158. Karczewicz explains that “there are several different ways in which a given segment can be coded.” Karczewicz, 17:1-2. As described above in Section X.A.1 (overview of Karczewicz), Karczewicz provides at least five different ways or manner in which a segment can be coded. Karczewicz, 31:14-25. Karczewicz additionally refers to these ways of coding a segment as “coding modes.” For example, claim 61 of Karczewicz recites that there are “a set of coding modes” for coding a segment, and claims 64 and 65 recite characteristics of a “first coding mode” through a “fifth coding mode” that correspond to the five different ways Karczewicz explained a segment can be coded:

61. In a method of encoding a video sequence, said video sequence being formed of at least a current video frame and a reference video frame, the current video frame comprising at least a first neighboring segment and a second neighboring segment, an improvement of a method for motion compensated prediction of the current video frame comprising:

defining a set of coding modes for said second neighboring segment; calculating a set of cost functions, each one of said cost functions being associated with one of said set of coding modes; choosing that one of said set of cost functions with a smallest absolute value; defining that one of said set of coding modes associated with said smallest absolute value as a chosen coding mode for said second neighboring

segment; encoding information about said second neighboring segment according to said chosen coding mode.

64. A method according to claim 61 wherein said set of coding modes comprises: a first coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a prediction motion field model and said second neighboring segment is represented by said prediction motion field model; a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame; a third coding mode wherein a motion field model from said first neighboring segment is projected into said second neighboring segment to form a projection field model and said second neighboring segment is represented by said prediction motion field model and a refinement motion field model.

65. A method according to claim 64 wherein said set of coding modes further comprises: a fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame; a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.

Karczewicz, claims 61, 64, 65.

159. Karczewicz determines which of these modes to assign to a given segment based on which coding mode is the most efficient in a rate-distortion sense.

Specifically, Karczewicz teaches that when encoding a second segment of an inter frame (here, mapped to the claimed “first segment”) an encoder “considers whether it is ‘more efficient’ to model the second segment in terms of the affine motion model previously determined for [a] first segment, rather than according to the newly determined affine motion coefficients for the second segment itself.” Karczewicz, 14:27-15:1. Karczewicz explains that “efficiency” is based on a “rate-distortion” criterion which considers “both a measure of image distortion and a measure of the amount of data required to achieve that level of distortion.” Karczewicz, 14:12-17. In other words, Karczewicz teaches balancing the reduction in data coding against the potential quality loss of the coded video sequence.

160. Each of the ways or manners in which a segment can be coded, as taught by Karczewicz, is a coding mode. Below, I briefly explain characteristics of each of the five coding modes taught by Karczewicz.

161. In the first coding mode, “[t]he segment may be represented as a prediction field only.” Karczewicz, 17:9-10, 31:16-17, claim 64 (“... a first coding mode wherein ... said second neighboring segment is represented by said prediction motion field model”). Karczewicz explains that “[t]his situation may arise when the segment can be adequately represented in terms of the motion field of one or more of its previously coded neighbors and no refinement information is necessary, or in a case where the encoder has found it efficient to reduce the refinement field to zero.” Karczewicz,

17:10-14. In other words, Karczewicz's first coding mode teaches coding a second segment based solely on neighboring segment(s), when doing so adequately represents the segment or when it is efficient to do so (e.g., from a rate-distortion point of view).

162. In the second coding mode, "[t]he segment in question may be coded using a motion model determined specifically for the segment using the reference frame. In this case, as described above, the prediction field is set to zero and the refinement field is set equal to the motion field model determined from the reference frame." Karczewicz, 17:14-18, 31:20-21, claim 64 ("...a second coding mode wherein said second neighboring segment is represented by a motion field model derived from said reference frame..."). In other words, in Karczewicz's second coding mode, the motion field model for a segment may be coded without using the motion information of neighboring segment(s).

163. In the third coding mode, "[a] given segment can be represented as a sum of a prediction field and a refinement field." Karczewicz, 17:8-9, 31:17-20, claim 64 ("...a third coding mode wherein ... said second neighboring segment is represented by said prediction motion field model and a refinement motion field model."). In other words, Karczewicz's third coding mode codes a second segment based on both a motion field model predicted from neighboring segment(s) (the prediction field), as well as additional information used to help achieve acceptable distortion (the refinement field).

164. In the fourth coding mode, "[t]he segment can also be coded by using a

zero motion vector field, e.g., a copy from the reference frame.” Karczewicz, 31:22-24, claim 65 (“a fourth coding mode wherein said second neighboring segment is encoded using pixel values from said reference frame...”).

165. In the fifth coding mode, “the segment can be coded using intra coding in which no motion vector field is utilized.” Karczewicz, 31:24-25, claim 65 (“...a fifth coding mode wherein said second neighboring segment is encoded using pixel values from said current frame.”).

166. Karczewicz teaches determining which of these five coding modes to use, for a given segment, based on which of the coding modes is most efficient (e.g., in a rate-distortion sense). Specifically, Karczewicz teaches that when encoding a second segment of an inter frame (which corresponds to the claimed “first segment”) an encoder determines the most efficient way to code the segment, taking into consideration the motion models of the segment’s previously coded neighbors.

The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is "more efficient" to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself. The rationale is as follows: Since the motion coefficients for the first segment have already been determined and transmitted to the decoder, it may be possible to reduce the amount of information that must be

transmitted to the decoder while encoding the second segment. Hence an improvement in coding efficiency may be obtained.

Karczewicz, 14:27-15:6.

167. Karczewicz explains that “efficiency” is considered in the “rate-distortion” sense, which balances image distortion and the amount of data that it would take to code the segment:

It should be emphasized here that an aim of this method is not merely to minimize the prediction error, but to find the affine motion field model that yields the best match for a segment in a "rate-distortion" sense. This means that the best match is determined by taking into account both a measure of image distortion and a measure of the amount of data required to achieve that level of distortion.

Karczewicz, 14:12-17.

168. Regardless of which of the five coding modes is chosen, and consistent with how it describes use of prediction error in the prior art, Karczewicz teaches that a prediction error is determined as the difference between the motion compensated predicted frame, which uses the coding mode (and corresponding motion vector information) chosen, and the current input video frame. Karczewicz, 20:21-29; 9:14-27. When a non-zero prediction error for a segment is calculated, it is encoded and sent to a decoder. Karczewicz, 20:22-26. When, in contrast, a zero prediction error is

calculated, a POSITA would have understood, and found it obvious that no prediction error is sent by the encoder to the decoder for the reasons I explain in Section X.A.2.a(2).

169. In my opinion, Karczewicz thus teaches assigning a “skip coding mode,” as the term should be construed⁸, to a second segment of an inter frame⁹ (“first segment of a first frame of the sequence”) in instances where the second segment is either encoded using a zero motion vector, Karczewicz, 31:22-24, or with just a prediction field, i.e., a non-zero motion vector associated with a neighboring segment. Karczewicz, 17:8-14, 31:22-24. Although Karczewicz describes the use of a zero motion vector and a non-zero motion vector in terms of different coding modes, a POSITA would have understood that the combined functionality of the two coding modes (i.e., encompassing both a zero motion vector and a non-zero motion vector) is

⁸ I.e., “a coding mode in which a zero (non-active) motion vector or a nonzero (active) motion vector is associated with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question, and residual information can be provided for each skip mode Macroblock.”

⁹ Karczewicz explains that a first frame of a sequence is transmitted in INTRA format, and a POSITA would have understood that the recited “first frame in the sequence” refers to the first inter-coded frame of a sequence. Karczewicz, 13:17-23.

identical to what the '808 Patent refers to as the “modified” “skip coding mode.” I note that a POSITA would have understood the two “modes” of Karczewicz which describe coding a segment with a zero motion vector and a prediction field only, respectively, are together a “skip coding mode” because Karczewicz indicates these modes in the same way. Karczewicz teaches that a single indicator, the motion coefficient indicator (MCI), has a zero value only in the two modes that comprise the functionality of the “skip coding mode” discussed above. Specifically, “the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).” Karczewicz, 37:5-8. “An all-zero pattern [of motion coefficients]...can be signaled by the MCI bit alone.” Karczewicz, 37:12-13. Thus, a zero MCI bit indicates Karczewicz’s two inter coding modes that correspond to the “redefined” “skip coding mode.” Specifically, when a segment is coded with a zero motion vector, the MCI bit is zero because that indicates “[a]n all-zero pattern [of motion coefficients].” Karczewicz, 37:12-13. And when a segment is coded with just a prediction field, the MCI bit is also zero because it indicates that there are no motion coefficients for the segment (i.e., no refinement field). Karczewicz, 37:5-8. These are the only two modes taught by Karczewicz which include a zero MCI bit, so a POSITA would have understood that if a segment is coded with a zero MCI bit, it is assigned a “skip coding mode.”

170. In the alternative, a POSITA would have found it obvious to combine Karczewicz's coding mode where a segment is coded solely with a prediction motion vector field, and Karczewicz's coding mode where a segment is coded by a zero motion vector. A POSITA would have found this combination obvious because it minimizes the number of bits needed to encode the segment (e.g., utilizing the zero motion vector when appropriate, otherwise utilizing the prediction motion vector field, without refinement, when encoding motion information for the segment). And as I discuss below in reference to claim 6 (Section X.A.2.c), based on Karczewicz's teachings a POSITA would have understood that there are situations in which a segment, coded based on the neighboring segments that have already been coded, is coded with a zero motion vector. It therefore would have been obvious, based on Karczewicz's teachings, to treat the two coding modes (one associated with a zero motion vector, the other associated with a non-zero motion vector) as a single coding mode. Such a coding mode that allows for a zero motion vector or a non-zero motion vector would account for the overlap in functionalities of Karczewicz's coding modes. And a POSITA would have recognized such a coding mode would provide certain advantages, including in efficiency (for example, by eliminating the need to indicate two overlapping coding modes, therefore reducing the number of bits needed to indicate the coding mode).

171. For these reasons, a POSITA would have also understood that Karczewicz teaches "assign[ing]" a "skip coding mode" by determining which of its coding modes

is the most efficient, in the rate-distortion sense, for coding the second segment.

172. Karczewicz's Motion Field Coder 28 determines which of its modes most efficiently codes a segment, and is thus a "coding controller" for assigning a skip coding mode. Karczewicz 11:19-23 ("The motion field coder is operable to form a compressed motion vector field which is formed of a set of motion vectors of all pixels of a current frame."), 20:11-16 ("The motion field coder 28 is operable to form a motion vector field which is a set of motion vectors of all pixels of the current frame."), Figs. 1-2.

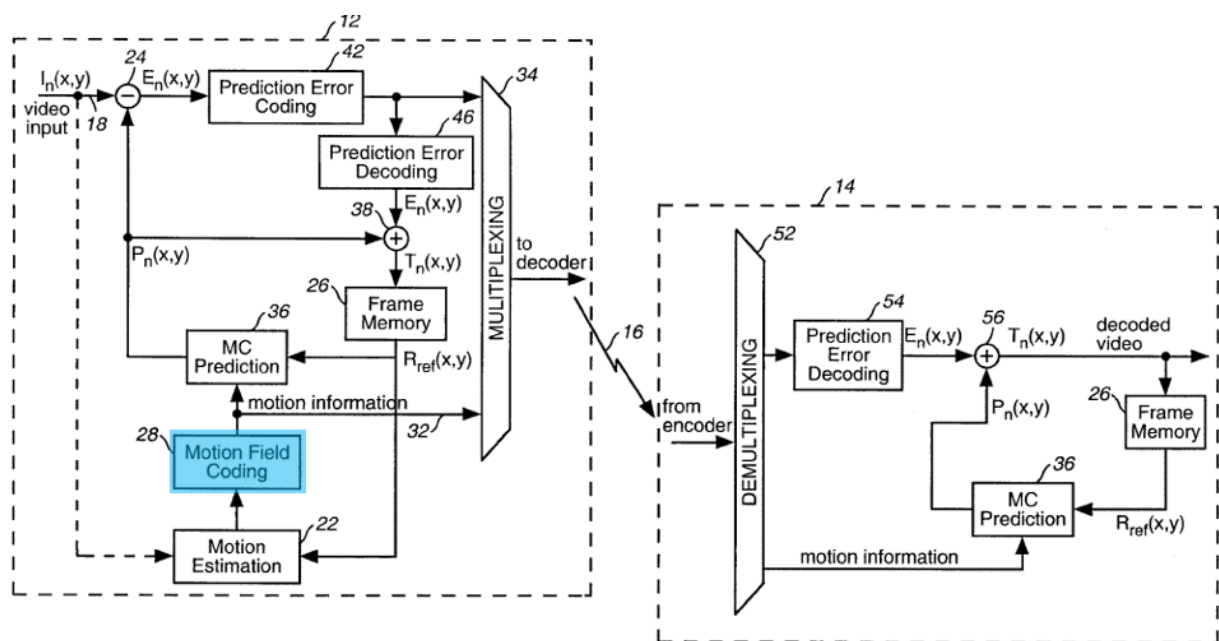


FIG. 1

Karczewicz, Fig. 1 (annotated).

173. Regardless of which coding mode is assigned to Karczewicz's second segment, Karczewicz teaches also calculating prediction error between the motion compensated predicted version of the frame and the actual current frame. Karczewicz,

20:21-29. For the reasons discussed in Section X.A.2.a(2) (element 1[a]), a POSITA would have found it obvious that where a prediction error of zero is calculated, Karczewicz would not send prediction error. In other words, Karczewicz teaches that residual information can be (but is not necessarily) provided with the skip coded macroblock in the form of prediction error information. Thus, Karczewicz teaches a “skip coding mode” under the correct construction of the term¹⁰.

174. Finally, a POSITA would have understood that the decision to code a second segment with a zero motion vector or motion vector associated with a neighboring segment depends on the characteristics of the motion in the neighboring segment(s) (i.e., depending on the characteristics of the motion in image segments surrounding the macroblock in question) because Karczewicz teaches determining the efficient coding mode by balancing distortion due to coding the second segment with

¹⁰ Karczewicz also teaches that the second segment may be coded with a non-zero motion vector without reference to a neighboring segment’s motion vector. Karczewicz, 17:14-18, 31:20-21. I note that in such a case, a POSITA would have understood that the second segment is not assigned a “skip coding mode” because Karczewicz’s second segment is not assigned a zero motion vector or a nonzero motion vector based at least in part on the motion information of a second segment neighboring the first segment.

reference to a neighboring segment against the amount of data required to transmit the motion vector information of the second segment. Karczewicz, 15:15-20.

(3) 10[b]: a motion estimation block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

175. Karczewicz discloses or suggests this limitation. Karczewicz's motion field coder 28 forms a motion vector field for a second segment with input from the motion estimator 22. Karczewicz, 20:11-13, 21:18-21, Fig. 1. As I explain below in Section X.A.4.a(4) (limitation 10[c]), Karczewicz's motion compensated predictor 36 generates a prediction frame with input from the motion field coding and the frame memory. Karczewicz, 20:17-20, 21:16-21. A POSITA would have understood that together, the motion field coder 28 and motion compensated predictor 36 are the recited "motion estimation block" that performs the functions attributed to it in limitations 10[b] and 10[c].

176. As to this limitation, Karczewicz's motion field coder 28 "determine[s] a previously encoded segment of the current frame, or a combination of such segments, whose motion vector field, or fields, is best suitable for predicting the motion field of a ... current segment." Karczewicz, 26:13-16, *see also, id.*, 26:9-20. It also determines "a mathematically efficient representation" for a segment. Karczewicz, 26:21-25. And the motion field coder 28 forms the motion vector field for Karczewicz's second

(4) 10[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector; and

177. Karczewicz discloses or suggests this limitation. Specifically, Karczewicz’s motion compensated predictor 36 uses the reference frame and the motion vectors assigned to Karczewicz’s second segment (i.e., the zero motion vector or the predicted non-zero motion vector assigned for the skip coding mode) to form a prediction for that segment. Karczewicz, 21:16-21, 21:3-5, 16:16-18, 20:17-20, 21:6-21, 23:6-9, 25:13-24, 26:13-20 27:15-30. Together, the motion compensated predictor 36 and motion field coder 28 form the recited “motion estimate block” as discussed in Section X.A.4.a(3) (limitation 10[b]).

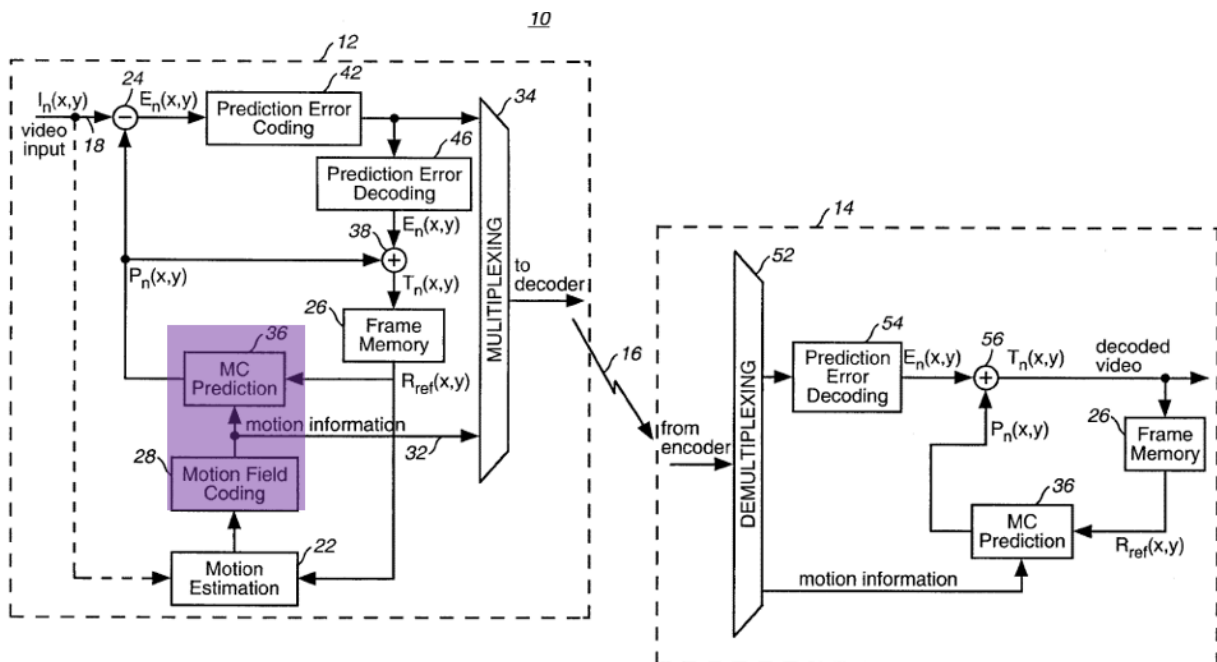


FIG. 1

Karczewicz, Fig. 1 (annotated).

(5) 10[d]: a multiplexer for providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.

178. Karczewicz discloses or suggests this limitation. Karczewicz discloses a multiplexor 34 that provides an encoded bitstream to the decoder. Karczewicz, 20:13-16, Fig. 1.

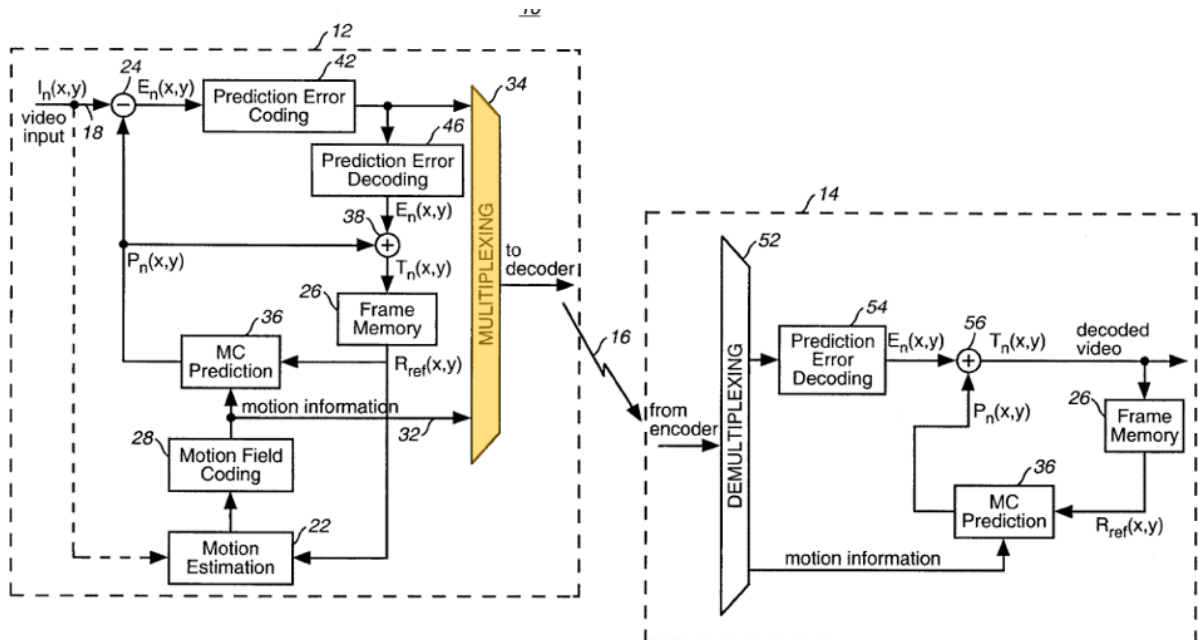


FIG. 1

Karczewicz, Fig. 1 (annotated).

179. Karczewicz further discloses that “the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).” Karczewicz, 37:5-8. Karczewicz goes on to explain that “[a]n all-zero pattern

[of motion coefficients] ... can be signaled by the MCI bit alone.” Karczewicz, 37:12-13. In my opinion, a POSITA would have understood that if the MCI bit is zero, it acts as “an indication of the skip coding mode” because the two inter coding modes disclosed by Karczewicz whose functionalities correspond to the “modified” “skip coding mode” I discuss in Section X.A.4.a(2) (limitation 10[a]) are the only two inter coding modes in which no motion coefficients are sent. As noted above, Karczewicz teaches that an all-zero motion coefficient pattern (i.e., coding a segment with a zero motion vector) is indicated by the MCI bit alone, so no motion coefficients are sent, and when a second segment is coded with a prediction motion vector field alone, no motion coefficients are used because the motion coefficients of a previously coded segment or segments are used instead.

180. Karczewicz further discloses that “one bit is sent to the decoder 14 to signal whether the prediction field of a neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate.” Karczewicz, 32:18-20. Karczewicz thus teaches that “no further motion vector information for the first segment is coded in the encoded bitstream” because neither the bit indicating whether a prediction motion vector field is used nor the information indicating which previously coded neighbor or neighbors to use for the prediction motion vector field is “motion vector information.

181. A POSITA would have understood that Karczewicz’s multiplexor 34 encodes these two bits in the encoded bitstream because the multiplexor encodes the

video for transmission to the decoder. Karczewicz, 20:13-16, Fig. 1.

b. Claim 11: An encoder according to claim 10, wherein the second segment is a previously encoded segment neighboring the first segment.

182. Karczewicz discloses or suggests claim 11. As I explained with respect to claim 10, Karczewicz discloses that the prediction field for its second segment (which I here map to the recited “first segment”) is “represented in terms of the motion field of one or more of its previously coded neighbors¹¹,” (which I here map to the recited “second segment”). Karczewicz, 17:10-14, *see also, id.*, 14:27-15:6 (“The second segment has one previously coded neighboring segment (i.e. the first segment). The encoder now considers whether it is ‘more efficient’ to model the second segment in terms of the affine motion model previously determined for the first segment, rather than according to the newly determined affine motion coefficients for the second segment itself.”), 16:4-30; 17:23-28 (“Whenever a segment is coded using a prediction field, whether there is an associated refinement field or not, it is necessary to provide information about the neighboring segment(s) used in the prediction. It is not necessary

¹¹ Karczewicz discloses that frames are coded in raster scan order, i.e., “from left-to-right and top-to-bottom, macroblock by macroblock.” Karczewicz, 31:8-10. This means that previously coded neighboring segments must be either to the left or above the segment being currently coded.

to transmit any motion coefficient data because the motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder.”).

c. Claim 15: An encoder according to claim 10, wherein if a segment in a region surrounding the first segment has zero motion vector, the encoder is arranged to assign the zero motion vector for the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

183. Karczewicz discloses or suggests claim 15. As I explain in Sections X.A.4.a(2) (limitation 10[a]) and X.A.4.a(3) (limitation 10[b]), Karczewicz discloses coding a second segment (which I here map to the recited “first segment”) with reference to a previously coded neighboring segment. The ’808 Patent describes how macroblocks neighboring a macroblock to be coded are part of a “region surrounding” that macroblock. ’808 Patent, 19:28-36 (“In a first preferred embodiment of the invention surrounding motion analysis block 802 classifies the motion in the region surrounding the macroblock according to the following three step procedure. Firstly, surrounding motion analysis block retrieves motion information for the macroblocks or sub-blocks surrounding the macroblock to be coded (i.e. previously encoded macroblocks neighboring the macroblock to be coded, as shown in FIG. 9) and generates a median motion vector prediction for the macroblock.”). Thus, Karczewicz’s previously coded neighboring segments are “in a region surrounding” Karczewicz’s second segment.

184. Karczewicz teaches that its second segment may be coded with a zero motion vector field. Karczewicz, 31:22-24. Based on this, a POSITA would have understood, or at the very least found it obvious that, Karczewicz teaches coding its second segment with a zero motion vector if it is efficient to do so from a rate-distortion point of view. This is because, when encoding a second segment, Karczewicz does not treat neighboring segments, i.e., “segment in a region surrounding the first segment,” with zero motion any differently from neighboring segments with non-zero motion. As long as it is efficient from the rate-distortion point of view, Karczewicz thus teaches coding a second segment with a zero motion vector if its neighboring segment has a zero motion vector. And in such a case, Karczewicz teaches that when a zero motion vector is coded, the segment is copied from the reference frame, i.e., “formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” Karczewicz, 31:22-24 (“The segment can also be coded by using a zero motion vector field, e.g., a copy from the reference frame $R_{ref}(x,y)$.”).

185. I have been asked to assume that Patent Owner will argue that Karczewicz does not allow neighboring segments with zero motion vectors to be candidates for a prediction motion vector field based on Karczewicz’s disclosure at 32:20-22. (“A neighboring segment S_K is a candidate for prediction of motion vector field of a segment S_i only if it has a nonzero motion vector field.”). Such an argument would be misplaced because Karczewicz practices the additional limitations of this claim regardless. Based

on the context of the disclosure, which I have reproduced below, a POSITA would have understood that this disclosure is about prediction neighbor candidates at the decoder side, and further that it is perfectly harmonized with its disclosure regarding encoding:

In the exemplary implementation, one bit is sent to the decoder 14 to signal whether the prediction field of a neighbor is used or not, but only in the case when there is at least one prediction neighbor candidate. A neighboring segment S_K is a candidate for prediction of motion vector field of a segment S_i only if it has a nonzero motion vector field.

Karczewicz, 32:18-22.

186. Specifically, if a second segment is encoded with a zero motion vector, which may be based on the motion vectors of its neighbors if it is efficient to do so in the rate-distortion sense, then the decoder would not receive a prediction motion vector field for that segment (which is coded with a zero motion vector) and there would not be any prediction neighbor candidates. Indeed, Karczewicz explains as much in an exemplary implementation, where it discusses sending a motion coefficient indicator bit (“MCI”) to indicate the presence of motion coefficients in the bitstream. Karczewicz, 37:5-8 (“In the exemplary implementation, the presence of motion coefficients in the bitstream is signaled by one bit whenever refinement or nonrefinement motion coefficients can be expected. This bit is referred to as a motion coefficient indicator (MCI).”). Karczewicz goes on to explain that “when motion

coefficients are transmitted...a motion coefficient pattern (MCP) is first sent to indicate which coefficients have nonzero values. An all-zero pattern is the only non-valid pattern, as this possibility can be signaled by the MCI bit alone.” Karczewicz 37:9-13. Thus, Karczewicz teaches that at the decoder, there are prediction motion vector field candidates and coefficients only if a segment is coded with a non-zero motion vector field. But this does not affect Karczewicz’s teachings about how a segment may be encoded with a zero motion vector.

d. Claim 21: A multimedia terminal, comprising an encoder according to claim 10.

187. Karczewicz discloses or suggests claim 21. For example, Karczewicz proposes implementing its teachings to “communications systems,” including during video conferencing. Karczewicz, 1:19-22; A POSITA would have understood that communications systems used for video conferencing are “multimedia terminals” because they render at least video and sound media, and that each such terminal would comprise both an encoder and a decoder to allow for two-way communication.

a. Claim 44

(1) 44[pre]: An encoder according to claim 10, wherein if the second segment has a non-zero motion vector,

188. To the extent the preamble is limiting, Karczewicz discloses or suggests that a previously coded neighboring segment (which I here map to the recited “second segment”) has a non-zero motion vector. *E.g.*, Karczewicz, 32:20-22 (“A neighboring

segment S_K is a candidate for prediction of motion vector field of a segment S_i only if it has a nonzero motion vector field.”).

(2) 44[a]: the motion estimation block is further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and

189. Karczewicz discloses or suggests this limitation for the same reasons as discussed in Sections X.A.4.a(2) (limitation 10[a]) and X.A.4.a(3) (limitation 10[b]). Karczewicz discloses that a second segment “can be coded using only prediction motion vector fields extrapolated from a neighboring segment.” Karczewicz, 31:16-20. Specifically, Karczewicz discloses that “[o]nce the neighboring segment has been selected for the prediction of the current segment, the prediction motion vector field is simply the extrapolation of the motion vector field of the segment inside the pixel domain covered by the current segment as follows:

EQUATION 20

$$\Delta x_{prd}(x,y) = \beta_1^k + \beta_2^k \cdot (y - y_o^k) + \beta_3^k \cdot (x - x_o^k)$$

$$\Delta y_{prd}(x,y) = \beta_4^k + \beta_5^k \cdot (y - y_o^k) + \beta_6^k \cdot (x - x_o^k)$$

where x_o^k, y_o^k are coordinates of the upper left-most pixel in the neighboring segment S_k and $\beta_1^k, \dots, \beta_6^k$ are integer-valued coefficients corresponding to the motion field of segment S_k . In equation 20, the superscript k indicates that the coefficients are associated with the neighboring segment S_k .” Karczewicz, 33:18-34:2. Karczewicz teaches that

this calculation of the prediction motion vector field is performed by its motion field coder 28, which is part of the recited “motion estimation block,” as explained in Section X.A.4.a(3) (limitation 10[b]). Karczewicz, 26:9-20 (motion field coder 28 determines which previously-encoded segment(s) of the current frame is best suitable for the prediction motion field and computes the prediction motion field).

190. Where the one or several neighboring segments has a non-zero motion vector field, a POSITA would have understood that Karczewicz teaches “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.”

(3) 44[b]: the predicted non-zero motion vector is assigned for the skip coding mode for the first segment; and

191. Karczewicz discloses or suggests this limitation. As discussed in Section X.A.4.a(3) (limitation 10[b]), after the “skip coding mode” is assigned based on Karczewicz’s determination that it is efficient to do so in the rate distortion sense, Karczewicz teaches that its second segment (which I here map to the recited “first segment”) is coded with a prediction motion vector field “extrapolated from a neighboring segment.” Karczewicz, 31:16-17. Because Karczewicz already discloses coding its second segment with a non-zero motion vector, a POSITA would have understood that coding Karczewicz’s second segment with a prediction motion vector field extrapolated from a neighboring vector would mean that the second segment is coded with a non-zero motion vector, i.e., the predicted non-zero motion vector is

assigned for the skip coding mode of the first segment.”

(4) 44[c]: the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.

192. Karczewicz discloses or suggests this limitation. As discussed in Section X.A.4.a(4) (limitation 10[c]), Karczewicz teaches its MC predictor 36 forming a prediction for its second segment (which I here map to the recited “first segment”) with respect to a reference frame based on one or more previously coded segments (which I here map to the recited “second segment”). *E.g.*, Karczewicz, 13:29-30, 16:16-18, 21:6-21, 25:13-24, 26:13-20, 31:13-24. Where the “skip coding mode” is assigned to a prediction motion vector field extrapolated from a neighboring segment, Karczewicz, 31:16-17, a POSITA would have understood that “the prediction for the first segment is formed by motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector” because the non-zero motion vector of the neighboring segment would be used to form the prediction of Karczewicz’s second segment.

b. Claim 47: An encoder according to claim 10, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

193. Karczewicz discloses or suggests claim 47 for the same reasons as discussed in Section X.A.4.a(3) (limitation 10[b]). Karczewicz discloses its motion field coder 28, i.e., part of the “motion estimation block,” computing a motion vector

for a second segment based upon the motion field of one or more of its previously coded neighbors. *E.g.*, Karczewicz, 26:9-20. A POSITA would have understood computing a motion vector based upon the motion field of one or more previously coded neighbors, as taught by Karczewicz, to be “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment” because “computing” and “deriving” are used to describe the same process.

c. Claim 48: An encoder according to claim 10, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

194. Karczewicz discloses claim 48 for the same reasons as discussed in Section X.A.4.a(3) (limitation 10[b]). For example, Karczewicz discloses that the motion vector for its second segment (which I here map to the recited “first segment”) may be derived from “one or more of its previously coded neighbors.” Karczewicz, 17:10-14, 16:16-19 (“the encoder can try to predict the motion coefficients for a given segment using the motion field model for the segment above it or to the left. Alternatively, it can form some kind of average, using the motion field model for both neighbors.”). Accordingly, Karczewicz discloses deriving a predicted non-zero motion vector for its second segment from at least two previously coded neighboring segments (the recited “second segment” and “third segment”).

d. Claim 49: An encoder according to claim 10, wherein no residual information is provided for the first segment in the encoded bitstream.

195. Karczewicz discloses or suggests claim 49 for the reasons discussed in Sections X.A.4.a(2) (limitation 10[a]) and X.A.4.a(3) (limitation 10[b]). Specifically, Karczewicz discloses that “[t]he prediction error coder determines the differences in pixel value between the current input video frame and the MC predicted version of the frame in order to produce an indication of the prediction error.” Karczewicz, 20:22-25. Thus, a POSITA would have understood that where the difference between the current input video and the MC predicted version of Karczewicz’s second segment (which I here map to the recited “first segment”) is zero, then the prediction error for that segment would be zero. And for the reasons discussed in Section X.A.4.a(2) (limitation 10[a]), a POSITA would have found it obvious not to send prediction error when it is calculated to be zero. Thus, “no residual information is provided.”

e. Claim 51: An encoder according to claim 10, wherein if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

196. Karczewicz discloses or suggests claim 51 for the same reasons as discussed in Section X.A.4.c (claim 15) because a POSITA would have understood Karczewicz’s previously coded neighboring segment to be both a “segment in a region surrounding the first segment” as recited in claim 15 and the “second segment” as

recited in claim 51.

f. Claim 52: An encoder according to claim 10, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

197. Karczewicz discloses or suggests claim 52. Karczewicz does not explicitly discuss how previously coded neighboring segments (which I here map to the recited “second segment”) are predicted because for the purposes of describing the invention, Karczewicz needs only that the neighboring segment be previously coded (and thus known to both the encoder and decoder). E.g., Karczewicz 17:25-28 (“motion field model(s) of the previously coded neighboring segment(s) are already known to (i.e., stored in) the decoder.”). However, Karczewicz does disclose that a segment may be assigned a zero motion vector, wherein it is copied from the reference frame. Karczewicz, 31:22-24 (“The segment can also be coded using a zero motion vector field, e.g., a copy from the reference frame”), 13:29-30 (“[a] motion vector field that describes the mapping of pixel values between the reference frame and the first segment of the current frame”). Thus, if a previously coded neighboring segment (which I here map to the recited “second segment”) has a zero motion vector, it would be predicted using the reference picture. Further, if the previously coded neighboring segment has a zero motion vector and it is efficient, from a rate distortion point of view, for

Karczewicz's second segment (which I here map to the recited "first segment") to have a zero motion vector, the prediction with respect to Karczewicz's second segment would also be with respect to the reference frame, as I explain in Section X.A.4.c (claim 15).

g. Claim 53: An encoder according to claim 10, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

198. Karczewicz discloses or suggests claim 53 for the same reasons as discussed in Section X.A.4.e (claim 51) because Karczewicz is agnostic as to whether the reference frame is "immediately preceding" the current frame. Karczewicz, 5:30-6:2 ("[a] so-called reference frame [] is usually, but not necessarily, the frame immediately preceding that currently being coded."). Thus, the reference frame may be immediately preceding a current frame. I note that beyond the requirement that "the second segment is predicted using motion-compensated prediction from a second reference picture immediately proceeding the picture second segment belongs to," which Karczewicz also discloses or suggests, claim 53 is identical to claim 51.

5. Claim 16 and Dependents: “A video decoder for decoding an encoded video sequence”

a. Claim 16

(1) 16[pre]: A video decoder for decoding an encoded video sequence, the decoder comprising:

199. To the extent the preamble is limiting, Karczewicz discloses or suggests a video decoder for decoding an encoded video sequence. For example, Karczewicz discloses an “apparatus, and an associated method, for encoding, and decoding, a video sequence utilizing motion compensated prediction.” Karczewicz, 1:7-8. I have reproduced and annotated Karczewicz’s Figure 1 below, which depicts Karczewicz’s encoder and decoder:

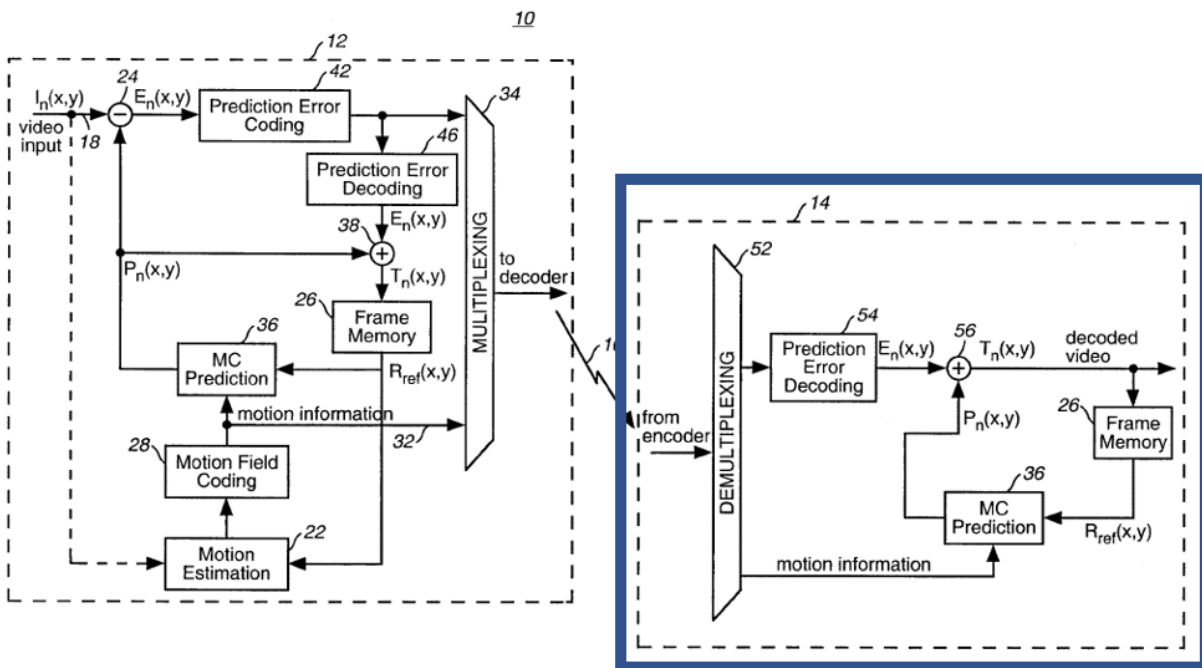


FIG. 1

Karczewicz, Fig. 1 (annotated).

(2) 16[a]: a demultiplexer for receiving an indication of a skip coding mode assigned to a first segment;

200. Karczewicz discloses or suggests this limitation. Karczewicz discloses that its decoder comprises a demultiplexer 52 that receives the encoded bitstream (and thus the recited “indication of a skip coding mode assigned to a first segment”) sent by Karczewicz’s encoder, as discussed in Section X.A.4.a(5) (limitation 10[d]). Karczewicz, 21:1 (“The decoder 14 is here shown to include a demultiplexer 52”), Fig. 1.

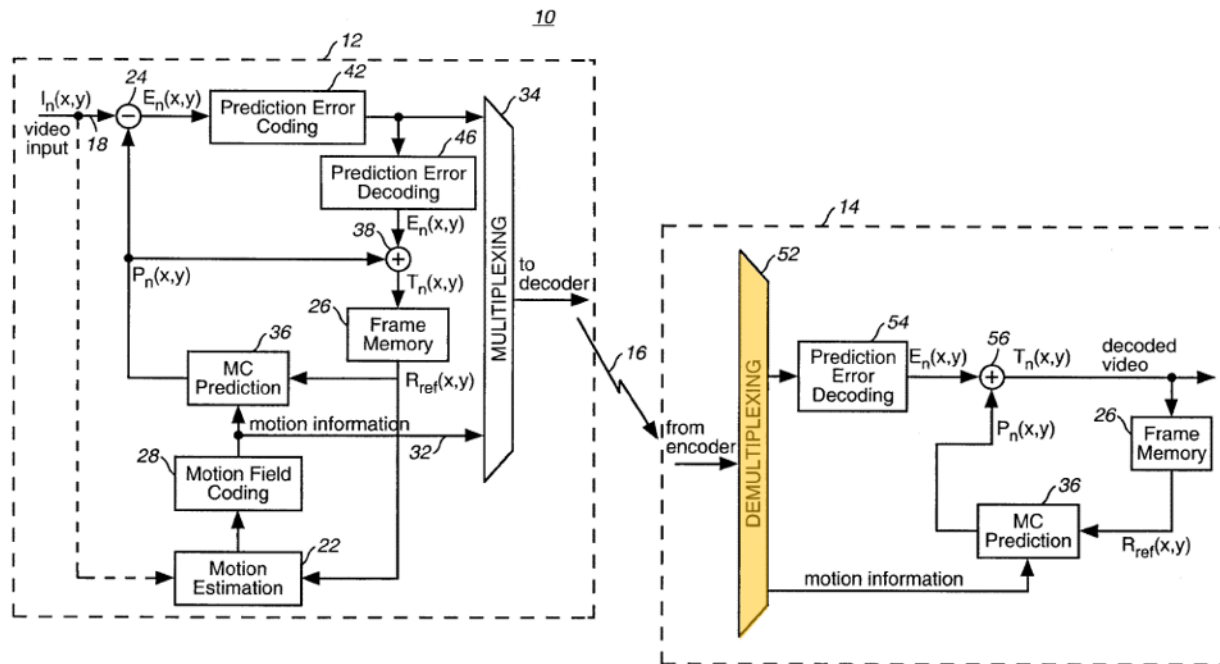


FIG. 1

Karczewicz, Fig. 1 (annotated).

(3) 16[b]: a motion compensated prediction block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

201. Karczewicz discloses or suggests this limitation. Specifically, Karczewicz discloses its decoder comprising a motion compensated predictor 36 that utilizes the prediction motion vector field and the refinement vector field received from the encoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment within the frame. Karczewicz, 27:17-23 (“The functional elements of the MC predictor 36 are similar for both the encoder and decoder and the MC predictor is operable, at both the encoder and decoder to reconstruct the pixels of a current frame by calculating the motion vector fields of each segment with the frame. The motion vector field is computed based upon a prediction motion vector field [] and the refinement motion vector field coefficients.”), Figs. 1, 3. In Karczewicz’s “skip coding mode,” the motion compensated predictor 36 assigns a zero motion vector or a predicted non-zero motion vector to Karczewicz’s second segment based on the values of the prediction motion vector field or a zero motion vector as discussed in Section X.A.4.a(3) (limitation 10[b]).

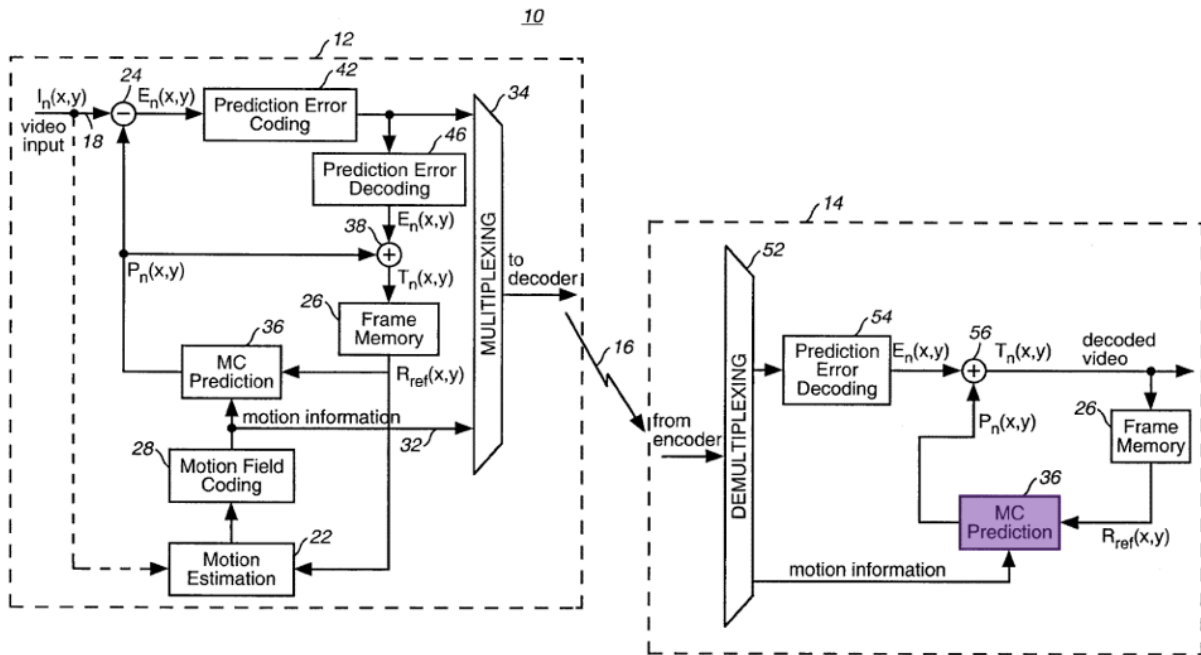


FIG. 1

Karczewicz, Fig. 1 (annotated).

(4) 16[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.

202. Karczewicz discloses or suggests this limitation for the same reasons as discussed in Section X.A.4.a(4) (limitation 10[c]). Specifically, Karczewicz discloses its motion compensated predictor 36 forming a prediction frame using the motion vector (i.e., “the assigned either zero motion vector or predicted non-zero motion vector”) and the reference frame. Karczewicz, 21:16-21 (“In the motion compensated predictor 36, the compressed motion vectors and the reference frame are used to construct a prediction frame, $P_n(x,y)$.”), 27:17-22.

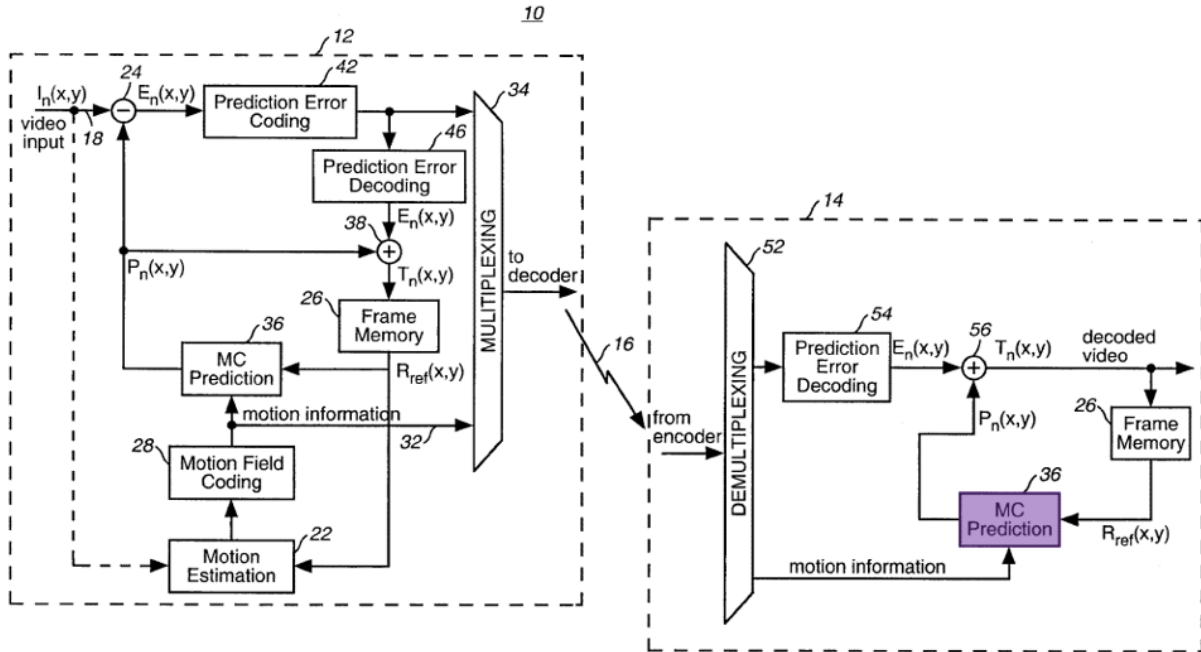


FIG. 1

Karczewicz, Fig. 1 (annotated).

b. Claim 20: A decoder according to claim 16, wherein if a segment in a region surrounding the first segment has zero motion vector, the zero motion vector is assigned for the skip coding mode of the first segment, and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

203. Karczewicz discloses or suggests claim 20 for the same reasons as discussed in Section X.A.4.c (claim 15). Where a second segment is assigned a zero-motion vector in the circumstances discussed in Section X.A.4.c (claim 15), i.e., in Karczewicz, where a previously coded segment is assigned a zero-motion vector, those same circumstances would be present for the second segment on the decoder side. Further, when the decoder receives, from the encoder as discussed in Section X.A.4.a(5)

(limitation 10[d]), a zero MCI bit and no bit indicating a neighboring segment for a prediction neighbor candidate, a zero-motion vector is assigned to Karczewicz's second segment by the decoder. The decoder's MC predictor 36 then forms a prediction for the second segment in the same way as discussed in Section X.A.4.c (claim 15). Karczewicz, 27:17-22.

c. Claim 22: A multimedia terminal comprising a decoder according to claim 16.

204. Karczewicz discloses or suggests claim 22 for the same reasons as discussed in Section X.A.4.d (claim 21).

d. Claim 54: A decoder according to claim 16, wherein if the second segment has a zero motion vector, the zero-motion vector is assigned to the skip coding mode for the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

205. Karczewicz discloses or suggests claim 54 for the same reasons as discussed in Section X.A.5.b (claim 20) because a POSITA would have understood Karczewicz's previously coded neighboring segment to be both a "segment in a region surrounding the first segment" as recited in claim 20 and the "second segment" as recited in claim 54.

e. Claim 58: A decoder according to claim 16, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

206. Karczewicz discloses or suggests claim 58 for the same reasons as

discussed in Section X.A.4.b (claim 11) because Karczewicz's motion compensated predictor 36 functions the same way at the encoder and decoder. Karczewicz, 27:17-28:11. And as explained in Section X.A.5.a(3) (limitation 16[b]), Karczewicz teaches its motion compensated predictor 36 assigning a predicted non-zero motion vector to Karczewicz's second segment based on the values of the prediction motion vector field received from the encoder.

207. I note that independent claim 16 recites “[a] decoder comprising: ... a motion compensated prediction block.” This claim, which depends from claim 16, recites “the motion estimation block,” although no “motion estimation block” is introduced in claim 16 or elsewhere in this claim. I understand that this reference to “the motion estimation block” in claim 58 may render the claim indefinite. To the extent this claim is found to not be indefinite, a POSITA would have understood that the limitations attributed to “the motion estimation block,” as recited in the claim, would have been performed by the “motion compensated prediction block” recited in claim 16 because of the two components of the decoder recited in claim 16, the recited function of the “most compensated prediction block” more closely matches the additional limitation of this claim than the function of the recited “demultiplexer.”

f. Claim 59: A decoder according to claim 16, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

208. Karczewicz discloses or suggests claim 59 for the same reasons as

discussed in Section X.A.4.c (claim 15) because Karczewicz's motion compensated predictor 36 functions the same way at the encoder and decoder. Karczewicz, 27:17-28:11. And as I explain in Section X.A.5.a(3) (limitation 16[b]), Karczewicz teaches its motion compensated predictor 36 assigning a predicted non-zero motion vector to Karczewicz's second segment based on the values of the prediction motion vector field received from the encoder. And Karczewicz teaches that the prediction motion vector may be obtained "from a combination of affine motion vector fields of several neighboring segments," i.e., "based at least in part on the motion vector of the second segment and the motion vector of a third segment neighboring the first segment." Karczewicz, 25:19-23.

209. I note that Claim 59 recites "the motion estimation block," which I understand from Counsel may render the claim indefinite for the same reasons described above in Section X.A.5.e (claim 58). To the extent this claim is found to not be indefinite, a POSITA would be understood that the limitations attributed to "the motion estimation block," as recited in the claim, would have been performed by the "motion compensated prediction block" recited in claim 16 because of the two components of the decoder recited in claim 16, the recited function of the "most compensated prediction block" more closely matches the additional limitation of this claim than the function of the recited "demultiplexer."

g. Claim 60: A decoder according to claim 16, wherein no residual information is provided for the first segment in an encoded bitstream.

210. Karczewicz discloses or suggests claim 60 for the same reasons as discussed in Section X.A.4.d (claim 49) because Karczewicz's decoder may not receive prediction error information from the encoder (i.e., "residual information") about its second segment (which I here map to the recited "first segment"), e.g., where there is no prediction error sent.

h. Claim 62: A decoder according to claim 16, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

211. Karczewicz discloses or suggests claim 62 for the same reasons as discussed in Section X.A.4.f (claim 52) because Karczewicz's motion compensated predictor functions in the same way at the encoder and decoder. Karczewicz, 27:17-28:11.

i. Claim 63: A decoder according to claim 16, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

212. Karczewicz discloses or suggests claim 63 for the same reasons as discussed in Section X.A.4.g (claim 53) because Karczewicz's decoder its decoding method.

j. Claim 64: A decoder according to claim 16, wherein no further motion vector information for the first segment is retrieved from an encoded bitstream.

213. Karczewicz discloses or suggests claim 64 for the same reasons as discussed in Section X.A.3.j (limitation 10[d]) because Karczewicz's "skip coding mode" does not provide a refinement motion vector field (i.e., "further motion vector information for the first segment").

B. Ground 2A: Obviousness over Frojdh (Claims 1, 2, 7, 23, 28-30, 34, 39-41, 65)

1. Frojdh

214. Frojdh is titled "Global Motion Compensation for Video Pictures." Frojdh is a publication of U.S. Patent Application No. 10/306,349, which was filed on November 27, 2002. Frojdh claims priority to U.S. Provisional Application No. 60/334,979, which was filed November 30, 2001, and which was incorporated by

reference in its entirety by Frojdh. As I discuss below, in my opinion, claim 15 of Frojdh, as well the disclosures of Frojdh to which I refer in the invalidity explanations below, are described in Frojdh's provisional application.

215. As with the '808 Patent, Frojdh describes the use of motion prediction in digital video compression. Frojdh, [0002]. In particular, Frojdh describes how its digital video compression method "employs global motion compensation" "wherein macroblocks are grouped into slices and global motion compensation information is transmitted with encoded slices." Frojdh, [0002]. Similar to how the '808 Patent describes in its Background a SKIP mode, Frojdh describes how "there may be parts of a frame that contain little or no change from corresponding parts of the previous frame. Such regions can thus be skipped or non-coded, in order to maximize compression efficiency." Frojdh, [0004]. Frojdh further describes how in certain video codecs, a mode in which a part of a frame (e.g., a macroblock) is skipped is referred to as a COPY mode: "Furthermore, there is one COPY mode, which uses no MV and no coefficients. This is the cheapest mode to signal. In fact, run-length coding is used to signal a number of copied (skipped) macroblocks with one codeword." Frojdh, [0047].

216. Frojdh additionally describes how one aspect of its digital video compression system is "a new mode for global motion compensation, referred to as Implicit Global Motion Compensation (IGMC). This mode can be used as a tool in many coding scenarios which require a more useful MB mode than COPY mode, in

order to minimize the total number of bits needed for motion vectors.” Frojdh, [0022]. Frojdh further explains how “[i]n COPY mode the motion vector is always zero. In contrast, IGMC uses implicit motion vectors that are predicted.” *Id.*

217. Frojdh provides further detail on the predicted implicit motion vector used in IGMC, describing how “[t]he motion vector used for motion compensating the macroblock is predicted from neighboring blocks. More specifically, in applying this embodiment to a particular image block in the current frame, a collocated block in a previous frame, dislocated by a motion vector is copied from the previous frame. The motion vector is predicted from neighboring blocks in the current frame, that is, from blocks which are adjacent to or proximate to the particular image block.” Frojdh, [0055].

218. Frojdh further describes how “the macroblock COPY (aka SKIP) mode is reinterpreted as” IGMC. Frojdh, [0055]. That is, “[t]he IGMC mode can be used to replace the COPY mode in coding an image block.” *Id.* And Frojdh additionally describes how in IGMC mode, “no explicit motion vector is sent with the encoded slice” and the mode operates “without coefficients or explicitly coded motion vectors.” *Id.*

a. Priority Analysis

219. Frojdh is entitled to a priority date of November 30, 2001, based on the filing of U.S. Provisional Application No. 60/334,979 (“Frojdh Provisional”). As I explain below (1) Frojdh Provisional supports at least claim 15 of Frojdh, and (2) the subject matter relied upon for prior art in Frojdh was effectively filed in Frojdh

Provisional.

220. The table below shows Frojdh Provisional supports at least claim 15 of Frojdh.

Frojd, Claim 15	
Limitation	Disclosure in Frojd Provisional
A method of video data compression for use with slices derived by segmenting a video frame into a sequence of slices, wherein each slice comprises one or more image blocks, said method comprising the steps of:	<u>§ 6: SOLUTION</u> “We propose to apply global motion compensation on frames segmented into slices, i.e. self-contained units that do not use motion vectors from macroblocks outside itself for prediction.” (Frojd Provisional, 11.) “11. Example 7 where one global motion vector is coded for each slice. This applies for all blocks of the slice.” (Frojd Provisional, 12.)
identifying a signal in each encoded slice that indicates whether global motion compensation (GMC) is to be used in reconstructing the slice;	<u>§ 6: SOLUTION</u> “1. Whether or not GMC should be used is signaled for each slice together with global motion information (vectors).” (Frojd Provisional, 11.)
identifying GMC information in an encoded slice if GMC is to be used in reconstructing the slice, and	<u>§ 6: SOLUTION</u> “3. Example 1 where all slices can have different GMC information (GMC usage and GM vectors).” (Frojd Provisional, 11.) “5. Four global motion vectors $\underline{r}^0$, $\underline{r}^x$, $\underline{r}^y$, and $\underline{r}^{xy}$ are coded for each slice. These are used as in H.263 Annex P to calculate the global motion compensation using bilinear interpolation for each pixel contained in the slice.” (Frojd Provisional, 11.)

decoding the data of respective encoded slices to generate corresponding decoded slices.	<u>§ 4: STATE-OF-THE-ART</u> “The first frame is encoded as a still image, called an intra frame. Such a frame is self-contained and does not depend on previously coded frames. However, they are not only used at the start of the sequence, but also advantageous to use at instances where the video changes abruptly, such as scene cuts, or where it is desirable to have a random-access point, from which a decoder can start decoding without having to decode the previous part of the bitstream.” (Frojdh Provisional, 6.) “In contrast, an inter frame is coded as a motion-compensated difference image relative to an earlier frame. By using an already decoded frame (reconstructed frame) as reference, the video coder can signal for each macro block a set of motion vectors (MVs) and coefficients. The motion vectors (one or several depending on how the macroblock is partitioned) inform the decoder how to spatially translate the corresponding region of the reference frame in order to make a prediction for the macroblock under consideration. This is referred to as motion compensation.” (Frojdh Provisional, 6.) <u>§ 7: MERITS OF INVENTION</u> “By addressing global motion compensation on a slice level, 1. error resilience of the coded bitstream is improved, as each slice will be self-contained regarding motion compensation information.
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	2. compression efficiency can be improved, as a better fit for the global motion can be found for smaller regions.” (Frojdih Provisional, 13.)
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221. As illustrated above, Frojdih Provisional discloses encoding slices within a frame using GMC. And Frojdih Provisional further discloses decoding inter-coded frames utilizing motion compensation (e.g., GMC). Moreover, because of the necessarily symmetrical design of the system that Frojdih Provisional discloses—without which it could not operate properly—Frojdih Provisional further teaches a decoding method that is the inverse of the encoding method. That is, Frojdih Provisional discloses decoding encoded slices. In other words, Frojdih Provisional discloses encoding slices with an indication that GMC is to be used, and further discloses decoding the encoded slices, as recited by claim 15 of Frojdih.

222. Frojdih Provisional further discloses the subject matter relied upon for prior art in Frojdih. In general, Frojdih is relied upon in my discussion below for the disclosure of a video encoding and decoding system that assigns a skip coding mode (“IGMC”) to a segment, with either a zero motion vector (“COPY mode”) or a predicted non-zero motion vector (a motion vector “defined by the prediction from neighboring blocks”) based on motion information from other segments (including neighboring segments). Each of these aspects of Frojdih are disclosed in Frojdih Provisional. *See, e.g.*, Frojdih Provisional, 5-6 (“further improvements in compression efficiency can result from coding a global motion separately...referred to as global motion compensation

(GMC)”), 9 (“there is one COPY mode, which uses no MV [Motion Vector] and no coefficients”), 12 (“Implicit Global Motion Compensation (IGMC)”), 12 (“Just as for inter MB modes, the motion vectors for this mode are defined by the prediction from neighboring blocks”).

223. The table below provides exemplary citations, showing how the subject matter relied upon for prior art in Frojdh, as described in detail in the descriptions of each limitation, was effectively filed in Frojdh Provisional.

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0002]	<u>§ 3: BACKGROUND</u> “This invention relates to the compression of digital video signals.” (Frojdh Provisional, 5.) “The present invention addresses the problem of using global compensation for frames with slices. By signaling global motion compensation for each slice, the advantages of global motion compensation can be used without neglecting error resilience.” (Frojdh Provisional, 6.)
[0004]	<u>§ 3: BACKGROUND</u> “This invention relates to the compression of digital video signals. In non-compressed form, these typically contain large amounts of data, whereas the actual information content is considerably smaller due to high temporal and spatial correlations. In the coding process one can utilize the temporal redundancy by making so-called motion compensated predictions, where regions of a frame (picture) are predicted from similar regions of a previous frame. If no region in the past gives a good match, predictions within a frame can be used to reduce spatial redundancy. With a successful prediction scheme, the prediction error will be small and the amount of information that has to be coded greatly reduced. Moreover, by transforming pixels to a frequency domain, e.g. using discrete cosine transform, spatial correlations give further gains in efficiency.” (Frojdh Provisional, 5.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0006]	<u>§ 3: BACKGROUND</u> “High temporal correlations are characteristic of video. Hence, much effort in optimizing video compression is focused on making accurate temporal predictions of regions of a frame. The better the prediction, the less bits are needed to code the discrepancy. The prediction itself is coded as instructions on how to translate, or maybe even scale or rotate, a:0 already coded region in the past. If many regions of a frame have similar motion, such as in a pan or zoom, further improvements in compression efficiency can result from coding a global motion separately, which then applies to all or some regions of the frame. The technique is often referred to as global motion compensation (GMC).” (Frojdh Provisional, 5-6.)
[0007]	<u>§ 3: BACKGROUND</u> “There are several reasons, however, why one should not address the whole frame when global motion compensation is used. The first one is due to error resilience. In order to prevent error propagation from corrupted parts of an image, prediction is often constrained within bounded segments called slices. Each slice of a frame should therefore be self-contained also regarding global motion information. Another reason is that global motion compensation may not be relevant for an entire frame, although smaller parts of the frame could benefit from global motion compensation applied to each part separately.” (Frojdh Provisional, 6.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0009]	§ 4: STATE-OF-THE-ART “A typical video coder, such as ITU-T Recommendations H.261 and H.263, MPEG-1 part 2, MPEG-2 part 2 (H.262), or MPEG-4 part 2, operates by sequentially code a video sequence frame by frame. A frame is further divided into blocks that are coded sequentially row by row, starting at the top left corner and ending at the bottom right corner. A typical block size is that of a macroblock (MB) covering 16x16 luminance pixels.” (Frojdh Provisional, 6.)
[0010]	§ 4: STATE-OF-THE-ART “The first frame is encoded as a still image, called an intra frame. Such a frame is self-contained and does not depend on previously coded frames. However, they are not only used at the start of the sequence, but also advantageous to use at instances where the video changes abruptly, such as scene cuts, or where it is desirable to have a random-access point, from which a decoder can start decoding without having to decode the previous part of the bitstream. The pixel values of intra-coded macroblocks are usually transformed to a frequency domain, e.g. using discrete cosine transform. and the transform coefficients quantized in order to reduce the size of the resulting bitstream.” (Frojdh Provisional, 6.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0011]	§ 4: STATE-OF-THE-ART “In contrast, an inter frame is coded as a motion-compensated difference image relative to an earlier frame. By using an already decoded frame (reconstructed frame) as reference, the video coder can signal for each macro block a set of motion vectors (MVs) and coefficients. The motion vectors (one or several depending on how the macroblock is partitioned) inform the decoder how to spatially translate the corresponding region of the reference frame in order to make a prediction for the macroblock under consideration. This is referred to as motion compensation. The difference between the prediction and the original is encoded in terms transform coefficients. However, not all macroblocks of an inter frame need to be motion compensated. If the change from the reference macro block to the current macroblock is small, it can be skipped, i.e. not coded but signaled to be copied. On the other hand, if the macroblocks differ substantially, it may be better to code it as an intra macroblock.” (Frojdh Provisional, 6-7.)
[0017]	§ 4: STATE-OF-THE-ART “Global motion compensation is also specified in the MPEG-4 visual standard using so-called S(GMC)-VOPs. Here the global motion compensation is applied pixel-by-pixel as for H.263 Annex P. However, one can still choose on a macro block level whether the (interpolated) global motion compensated reference-frame should be used or not.” (Frojdh Provisional, 8.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0022]	<u>§ 6: SOLUTION</u> “15. When GMC is enabled, no explicit global motion vector is sent. We refer to this as Implicit Global Motion Compensation (IGMC), where the macroblock COPY mode is reinterpreted an inter MB mode without coefficients. Just as for inter MB modes, the motion vectors for this mode are defined by the prediction from neighboring blocks. This mode can be used for macroblocks with only one motion vector (16x16 block).” (Frojdh Provisional, 12.) <u>§ 7: MERITS OF INVENTION</u> “We also introduce a new mode for global motion compensation, which we call Implicit Global Motion Compensation (IGMC). This mode can be used as a tool in many coding scenarios where a more useful MB mode than COPY with GMC based on explicit MVs can minimize the total number of bits spent on motion vectors.” (Frojdh Provisional, 13.)

[0023]	<u>§ 4: STATE-OF-THE-ART</u> “In contrast, an inter frame is coded as a motion-compensated difference image relative to an earlier frame. By using an already decoded frame (reconstructed frame) as reference, the video coder can signal for each macro block a set of motion vectors (MVs) and coefficients. The motion vectors (one or several depending on how the macroblock is partitioned) inform the decoder how to spatially translate the corresponding region of the reference frame in order to make a prediction for the macroblock under consideration. This is referred to as motion compensation.” (Frojdh Provisional, 6.) <u>§ 6: SOLUTION</u> “15. When GMC is enabled, no explicit global motion vector is sent. We refer to this as Implicit Global Motion Compensation (IGMC), where the macroblock COPY mode is reinterpreted an inter MB mode without coefficients. Just as for inter MB modes, the motion vectors for this mode are defined by the prediction from neighboring blocks. This mode can be used for macroblocks with only one motion vector (16x16 block).” (Frojdh Provisional, 12.) “16. Example 15 where the COPY mode refers to a macroblock partitioned into smaller blocks, such as 4x4 pixels etc. The motion vector for each such block is predicted, as for inter macroblocks.” (Frojdh Provisional, 13.) “In all examples where we refer to image blocks of certain sizes, such as 4x4 pixels, one can also use image blocks of other dimensions, such as 16x16, 16x8, 8x16, 8x8, 4x.8, 8x4, 4x4, and so on.” (Frojdh Provisional, 13.) <u>§ 7: MERITS OF INVENTION</u> “We also introduce a new mode for global motion compensation, which we call Implicit Global Motion Compensation (IGMC). This mode can be used as a tool in many coding scenarios where a more useful MB mode than
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Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
	COPY with GMC based on explicit MVs can minimize the total number of bits spent on motion vectors.” (Frojdh Provisional, 13.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0024]	<u>§ 6: SOLUTION</u> “We propose to apply global motion compensation on frames segmented into slices, i.e. self-contained units that do not use motion vectors from macroblocks outside itself for prediction. By coding global motion vectors for each slice, all motion vectors within the slice can be constructed in a self-contained way. The global motion vectors can be applied differently to each slice, or can be used to repeat global motion vectors referencing the entire frame. The following is a list of implementation examples on how Global Motion Compensation (GMC) can be signaled: 1. Whether or not GMC should be used is signaled for each slice together with global motion information (vectors). 2. Example 1 where all slices repeat the same GMC information (GMC usage and GM vectors). 3. Example 1 where all slices can have different GMC information (GMC usage and GM vectors). 4. Example 2 and 3 where also all GMC information is repeated on picture level, such as in the picture header.” (Frojdh Provisional, 11.) “10. Example 7 where two global motion vectors are coded for each slice. These refer to the left-most and right-most 4x4 image blocks, respectively, of the bounding box of the slice. For blocks along a vertical axis the global motion vectors are the same, whereas along a horizontal axis they are interpolated linearly from the two coded global-motion vectors. 11. Example 7 where one global motion vector is coded for each slice. This applies for all blocks of the slice.” (Frojdh Provisional, 12.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0047]	<u>§ 4: STATE-OF-THE-ART</u> “ITU-T is currently developing a new video-coding standard, Recommendation H.26L, which is also likely to be jointly published as an International Standard by ISO/IEC called MPEG-4 AVC (ISO/IEC 14496-10). The current H.26L follows the above-mentioned general video coding design with frames and macroblocks, where each picture is encoded by a picture header followed by macroblocks. See Figure 2 for a symbolic representation of the bitstream syntax.” (Frojdh Provisional, 8.) “The macroblocks of an inter frame can have one of several modes. which currently include 7 inter modes (16x16, 16x8, 8x16, 8x8, 8x4, 4x4), 1 intra mode for 4x4 and 23 intra modes for 16x16. Here NxM refers to the size of the blocks the macroblock is partitioned into. For inter MBs, each block has an MV each and for intra MBs, each block is predicted as a unit. Furthermore, there is one COPY mode, which uses no MV and no coefficients. This is the cheapest mode to signal. In fact, run-length coding is used to signal a number of copied (skipped) macroblocks with one codeword. The first 8 non-copy modes are listed in Table 1.” (Frojdh Provisional, 9.)
[0054]	<u>§ 6: SOLUTION</u> “12. When GMC is enabled, a macroblock COPY mode signals that the encoder shall copy the macroblock from the (global) motion compensated reference picture. Hence, the displacements or motion vectors are given by the (interpolated) global motion vectors. No coefficients are coded. 13. Example 12 where coefficients are coded as well. 14. Example 12, where the mode of example 13 is added as different macroblock mode.” (Frojdh Provisional, 12.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0055]	<u>§ 4: STATE-OF-THE-ART</u> “In contrast, an inter frame is coded as a motion-compensated difference image relative to an earlier frame. By using an already decoded frame (reconstructed frame) as reference, the video coder can signal for each macro block a set of motion vectors (MVs) and coefficients. The motion vectors (one or several depending on how the macroblock is partitioned) inform the decoder how to spatially translate the corresponding region of the reference frame in order to make a prediction for the macroblock under consideration. This is referred to as motion compensation.” (Frojdh Provisional, 6.) <u>§ 6: SOLUTION</u> “15. When GMC is enabled, no explicit global motion vector is sent. We refer to this as Implicit Global Motion Compensation (IGMC), where the macroblock COPY mode is reinterpreted an inter MB mode without coefficients. Just as for inter MB modes, the motion vectors for this mode are defined by the prediction from neighboring blocks. This mode can be used for macroblocks with only one motion vector (16x16 block).” (Frojdh Provisional, 12.) <u>§ 7: MERITS OF INVENTION</u> “We also introduce a new mode for global motion compensation, which we call Implicit Global Motion Compensation (IGMC). This mode can be used as a tool in many coding scenarios where a more useful MB mode than COPY with GMC based on explicit MVs can minimize the total number of bits spent on motion vectors.” (Frojdh Provisional, 13.)

Paragraph of Frojdh	Relevant Excerpts from Frojdh Provisional
[0056]	<u>§ 6: SOLUTION</u> “The following is a list of implementation examples on how Global Motion Compensation (GMC) can be signaled: 1. Whether or not GMC should be used is signaled for each slice together with global motion information (vectors).” (Frojdh Provisional, 11.) “The above examples can be combined with the different macroblock modes to take advantage of global motion compensation. Some, but not all, mode may use the (interpolated) global motion vectors. The following is a list of possible modes: 12. When GMC is enabled, a macroblock COPY mode signals that the encoder shall copy the macroblock from the (global) motion compensated reference picture. Hence, the displacements or motion vectors are given by the (interpolated) global motion vectors. No coefficients are coded.” “15. When GMC is enabled, no explicit global motion vector is sent. We refer to this as Implicit Global Motion Compensation (IGMC), where the macroblock COPY mode is reinterpreted an inter MB mode without coefficients. Just as for inter MB modes, the motion vectors for this mode are defined by the prediction from neighboring blocks. This mode can be used for macroblocks with only one motion vector (16x16 block).” (Frojdh Provisional, 12.)

2. Claim 1 and Dependents: “A method of encoding a video sequence”

a. Claim 1

(1) 1[pre]: A method of encoding a video sequence, the method comprising:

224. To the extent the preamble is limiting, Frojdh discloses or suggests a method of encoding a video sequence. As I described above (in Section X.B.1, Ground 2A, overview of Frojdh), Frojdh describes “a method for compression of video signal data.” Frojdh, [0002]; Frojdh Provisional, 5-6. Frojdh further explains that the described method involves taking “[d]igital video signals, in non-compressed form,” and utilizing “video compression, or coding,...to reduce the amount of data which is actually required for certain tasks, such as storage of the video signals or for transmitting them from one location to another.” Frojdh, [0004]; Frojdh Provisional, 5.

225. Frojdh characterizes the results of the described video data compression as “coded” or “encoded” video data. *See, e.g.*, Frojdh, [0002], [0024]; Frojdh Provisional, 5-6, 11-12. That is, Frojdh’s described method for compressing video data results in coded or encoded video data. Frojdh therefore discloses or suggests a method of encoding a video sequence.

(2) 1[a]: assigning a skip coding mode to a first segment of a first frame of the sequence;

226. Frojdh discloses or suggests this limitation.

227. I understand Patent Owner has argued that “skip coding mode” should be

construed as “a coding mode in which a zero (non-active) motion vector or a nonzero (active) motion vector is associated in an encoded bitstream with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question.” I further understand Patent Owner has argued that, under Patent Owner’s construction of “skip coding mode,” residual information is precluded. In contrast, I understand that under Petitioner’s (Respondent in the ITC) construction of “skip coding mode” residual information can be included.

228. Below I describe how, under at least Patent Owner’s claim construction, Frojdh’s IGMCM mode discloses or suggests a “skip coding mode.”

229. I understand Patent Owner’s construction of “skip coding mode” to encompass two features. First, that it requires a coding mode in which a zero (non-active) motion vector or a nonzero (active) motion vector is associated in an encoded bitstream with each skip mode macroblock. And second, that the association of the motion vector with the skip mode macroblock (whether zero or nonzero) depends on characteristics of the motion in image segments surrounding the macroblock. I address each feature in turn below.

230. First, Frojdh discloses that its IGMCM mode is associated with a zero (non-active) motion vector or a nonzero (active) motion vector.

231. Frojdh describes, as background, how “much effort in optimizing video compression is focused on making accurate temporal predictions of regions of a frame.”

Frojd, [0006]; Frojd Provisional, 5-6. Frojd explains how these temporal predictions can be “coded as instructions on how to translate, or even scale or rotate, a previously coded region.” *Id.* And Frojd describes a refinement on these temporal predictions, where “[i]f many regions of a frame have similar motion, such as in a pan or zoom, further improvements in compression efficiency can result from coding a global motion separately, which then applies to all or some regions of the frame.” *Id.* Frojd refers to this refinement as “global motion compensation (GMC).” *Id.*

232. Frojd further describes that the instructions characterizing the temporal predictions (e.g., motion vectors) indicate “how to spatially translate the corresponding regions of [a] reference frame in order to make a prediction for the macroblock under consideration” in the current frame. Frojd, [0011]; Frojd Provisional, 6-7. Frojd refers to this use of a reference frame and motion vectors to form a prediction for a macroblock in the current frame as “motion compensation.” *Id.*

233. Frojd also explains that there are situations in which a macroblock does not require motion compensation. For example, Frojd describes that “[i]f the change from the reference macroblock to the current macroblock is small, the macroblock can be coded in COPY mode, i.e. not coded per se but signaled to be copied.” Frojd, [0011]; Frojd Provisional, 6-7. Frojd elaborates that “[i]n COPY mode the motion vector is always zero.” Frojd, [0022]; Frojd Provisional, 12-13. In some instances, Frojd refers to the copy operation that is performed during COPY mode as a skip.

Frojd, [0047]; Frojd Provisional, 8-9. Similarly, Frojd alternatively describes COPY mode as SKIP mode. Frojd, [0055]; Frojd Provisional, 6, 12-13. Frojd therefore describes a COPY mode or SKIP mode in which a macroblock is associated with a zero (non-active) motion vector.

234. Frojd also describes a mode in which a macroblock is associated with a motion vector predicted based on the motion vectors of neighboring macroblocks. In particular, Frojd describes what it refers to as IGM mode:

As a further benefit, the invention introduces a new mode for global motion compensation, referred to as Implicit Global Motion Compensation (IGMC). This mode can be used as a tool in many coding scenarios which require a more useful MB mode than COPY mode, in order to minimize the total number of bits needed for motion vectors. In COPY mode the motion vector is always zero. In contrast, IGM uses implicit motion vectors that are predicted.

Frojd, [0022]; Frojd Provisional, 12-13.

235. Frojd describes that when IGM mode is used:

The motion vector used for motion compensating the macroblock is predicted from neighboring blocks. More specifically, in applying this embodiment to a particular image block in the current frame, a collocated block in a previous frame, dislocated by a motion vector is copied from the previous frame. The motion vector is predicted from

neighboring blocks in the current frame, that is, from blocks which are adjacent to or proximate to the particular image block.

Frojd, [0055]; Frojd Provisional, 6, 12-13.

236. Frojd further describes that the predicted motion vector is based on “the prediction from neighboring blocks.” Frojd Provisional, 12.¹² That is, the motion vector predicted in IGMC mode (predicted from neighboring blocks’ motion vectors) is used to characterize the dislocation of a block from the previous frame. Because the motion vector for a block is predicted from the neighboring blocks’ motion vectors, and in contrast to COPY mode where the motion vector is always zero, the motion vector predicted using IGMC mode may be non-zero. The motion vectors in IGMC mode may therefore be non-zero (active) motion vectors. Frojd further describes that IGMC may be used as the coding mode for macroblocks. Frojd, [0023]; Frojd Provisional, 6, 12-13. That is, the predicted motion vector described above may be used to predict a macroblock. Frojd therefore teaches or suggests an IGMC mode in which a macroblock is associated with a non-zero (active) motion vector.

237. Frojd further teaches or suggests that its IGMC mode can predict a zero

¹² The Frojd Provisional was incorporated by reference in its entirety by Frojd.

Frojd, [0001].

(non-active) motion vector. As I described above, in IGMC mode the motion vector for a macroblock is predicted based on the motion vectors of neighboring blocks. Frojdh, [0055]; Frojdh Provisional, 6, 12-13.¹³ And as I additionally described above, macroblocks may be associated with a zero motion vector (e.g., when COPY mode is used for those macroblocks). Frojdh, [0022]; Frojdh Provisional, 12-13.

238. A POSITA would have understood that when neighboring blocks have zero motion vectors, then IGMC mode can result in a motion vector predicted for a block (based on the zero motion vectors of the neighboring blocks) that is also zero. In particular, calculating the motion vector for a macroblock based on the median of motion vectors of the neighboring macroblocks was one of few well-known ways to predict a motion vectors based on neighboring motion vectors. For example, JM-1r1 describes a “median prediction” in which the predicted motion vector for a macroblock is formed as the median of neighboring macroblocks. JM-1r1, 22-23. Similarly, Ismaeil recognized that predicting the motion vector for a macroblock based on the median of previously coded motion vectors corresponding to surrounding macroblocks was a “popular” form of prediction. Ismaeil, 70. Therefore when Frojdh describes, for its IGMC mode, predicting the motion vector for a macroblock based on the motion vectors

¹³ The Frojdh Provisional was incorporated by reference in its entirety by Frojdh.

Frojdh, [0001].

of neighboring macroblocks, it would have been obvious to calculate the predicted motion vector based on the median of the neighboring macroblocks' motion vectors. Moreover, a POSITA would have understood that calculating the median of zero motion vectors (corresponding to neighboring macroblocks' motion vectors) results in a zero motion vector.

239. Based on Frojdh's teaching that neighboring macroblocks can have zero motion vectors, and because it would be obvious in Frojdh's IGMC mode that the predicted motion vector for a block is based on the median of the neighboring block' motion vectors, a POSITA would have understood that the motion vector predicted for a macroblock using IGMC mode can also be a zero motion vector (e.g., when the neighboring macroblocks have zero motion vectors). Further, a POSITA would have understood that the neighboring macroblocks could have zero motion vectors because those macroblocks were coded using COPY mode, or because those macroblocks were themselves coding using IGMC mode. Frojdh therefore teaches or suggests an IGMC mode in which a macroblock is associated with a zero (non-active) motion vector. Frojdh's IGMC mode therefore teaches or suggests the first feature of "skip coding mode" (a coding mode in which a zero (non-active) motion vector or a nonzero (active) motion vector is associated with a macroblock).

240. To the extent that Frojdh's IGMC mode alone does not teach or suggest the first feature of "skip coding mode" (e.g., a coding mode in which a zero (non-active)

motion vector or a nonzero (active) motion vector is associated with a macroblock) as I have described above, Frojdh further describes a coding mode (e.g., global motion compensation (GMC)) comprised of both the IGMC mode and COPY (aka SKIP) mode that teaches or suggests this feature of “skip coding mode.”

241. As I described above, Frojdh describes both a COPY mode (in which the motion vector is always zero) and an IGMC mode (in which the motion vector is predicted based on the neighboring macroblocks). Frojdh, [0022], [0023]; Frojdh Provisional, 6, 12-13. Frojdh further describes that either COPY mode or IGMC mode may be used when GMC is enabled. Frojdh Provisional, 12 (“The above examples can be combined with the different macroblock modes to take advantage of global motion compensation...The following is a list of possible modes.”)¹⁴ In other words, GMC in Frojdh allows either COPY mode (with a zero motion vector) or IGMC mode (with a predicted motion vector, which can be non-zero or zero) to be used for a macroblock. Such would have been obvious to a POSITA in light of Frojdh’s teachings of the benefits of COPY mode as the “cheapest mode to signal,” while also describing how IGMC mode is a “reinterpret[ation]” of COPY mode. Frojdh, [0047], [0055]; Frojdh Provisional, 6, 8-9, 12-13. That is, the IGMC mode (when used) takes the place of (i.e.,

¹⁴ The Frojdh Provisional was incorporated by reference in its entirety by Frojdh. Frojdh, [0001].

is a reinterpretation of) COPY mode, and therefore it would be beneficial to still be able to utilize COPY mode under GMC for the benefits it provides (e.g., cheapest mode to signal). For this additional reason, Frojdh teaches or suggests the first feature of “skip coding mode.”

242. Addressing the second feature of Patent Owner’s construction of “skip coding mode,” Frojdh further teaches or suggests that whether to use a zero motion vector or non-zero motion vector depends on the characteristics of the motion in image segments surrounding the macroblock in question. For example, Frojdh describes using “neighboring image blocks of the current frame” to predict a motion vector in IGMC mode. Frojdh, [0023]; Frojdh Provisional, 6, 12-13. Frojdh further explains how the neighboring blocks are used to predict the motion vector:

The motion vector used for motion compensating the macroblock is predicted from neighboring blocks. More specifically, in applying this embodiment to a particular image block in the current frame, a collocated block in a previous frame, dislocated by a motion vector is copied from the previous frame. The motion vector is predicted from neighboring blocks in the current frame, that is, from blocks which are adjacent to or proximate to the particular image block.

Frojdh, [0055]; Frojdh Provisional, 6, 12-13.

243. And the provisional application to which Frojdh claims priority further

clarifies that the motion vector is predicted from “the prediction from neighboring blocks.” Frojdh Provisional, 12.¹⁵ In other words, characteristics of the motion of surrounding image segments (e.g., the predictions for those image segments) are used to predict the motion vector for a macroblock in IGMC mode.

244. Neighboring image blocks thus play a central role in the operation of Frojdh’s IGMC mode. Frojdh describes how IGMC mode is “one of several possible macroblock-coding modes” that can be used, and that IGMC mode “can be used as a tool in many coding scenarios which require a more useful MB mode than COPY mode, in order to minimize the total number of bits needed for motion vectors.” Frojdh, [0022], [0023]; Frojdh Provisional, 6, 12-13. A POSITA would have understood that whether IGMC mode is the right coding mode to use, out of several possible macroblock-coding modes, would depend on the outcome of using IGMC mode (as compared to the other available macroblock-coding modes) on a macroblock (e.g., how well the motion vector predicted using IGMC mode serves as a prediction for the macroblock). And as discussed above, the IGMC motion vector is predicted from the neighboring image blocks of the current frame. In other words, Frojdh teaches or suggests that whether to use IGMC mode, and the predicted motion vector used during

¹⁵ The Frojdh Provisional was incorporated by reference in its entirety by Frojdh. Frojdh, [0001].

IGMC mode (whether a zero or non-zero motion vector), depends on the neighboring image blocks of the current frame (“characteristics of the motion in image segments surrounding the macroblock in question”).

245. For at least the reasons discussed above, Frojdh teaches or suggests a coding mode (IGMC mode) in which a zero (non-active) motion vector or a nonzero (active) motion vector is associated in an encoded bitstream with each skip mode macroblock, depending on the characteristics of the motion in image segments surrounding the macroblock in question. The IGMC mode disclosed by Frojdh, alone or in combination with COPY mode, therefore teaches or suggests the recited “skip coding mode,” under at least Patent Owner’s claim construction.

246. Frojdh additionally teaches or suggests the additional elements of this limitation. Specifically, Frojdh teaches or suggests assigning the skip coding mode (e.g., IGMC mode, or to the extent IGMC mode alone does not teach a “skip coding mode,” GMC mode with IGMC and COPY) to a first segment of a first frame of a sequence. For example, Frojdh describes “applying [IGMC mode] to a particular image block in the current frame.” Frojdh, [0055]; Frojdh Provisional, 6, 12-13. And Frojdh describes signaling the use of COPY when GMC is enabled. Frojdh, [0054]; Frojdh Provisional, 12. Frojdh therefore teaches or suggests assigning (applying) a skip coding mode (IGMC mode, or GMC with IGMC and COPY) to a first segment (particular image block) of a first frame (the current frame) of the sequence.

(3) 1[b]: assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

247. Frojdh discloses or suggests this limitation.

248. As I explained above in Section X.B.2.a(2) (Ground 2A, limitation 1[a]), Frojdh teaches or suggests assigning a “skip coding mode” for a particular image block (the recited “first segment”), that utilizes a zero motion vector or a predicted non-zero motion vector based on characteristics of the motion in image segments surrounding the segment in question. Specifically, Frojdh describes how its IGMC mode “can be used as a tool in many coding scenarios which require a more useful MB mode than COPY mode,” and “uses implicit motion vectors that are predicted.” Frojdh, [0022]; Frojdh Provisional, 12-13. Frojdh also describes how the prediction motion vector of IGMC mode is based on “the prediction from neighboring blocks.” Frojdh Provisional, 12.¹⁶ As I explained above in Section X.B.2.a(2) (Ground 2A, limitation 1[a]), a POSITA would understand that Frojdh teaches or suggests the IGMC mode predicting a motion vector that can be zero or non-zero (e.g., calculated from the median of neighboring blocks’ motion vectors, which themselves can be zero or non-zero). Frojdh therefore

¹⁶ The Frojdh Provisional was incorporated by reference in its entirety by Frojdh.

Frojdh, [0001].

teaches or suggests assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode (IGMC mode alone or in combination with COPY, as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a])) for the first segment (the particular image block).

249. Frojdh additionally teaches or suggests “based at least in part on the motion information of a second segment neighboring the first segment,” as additionally recited by this claim limitation. In my view, “based at least in part” could be interpreted as modifying either the “assigning” or “predicted non-zero motion vector” elements of this limitation. Under either reading, Frojdh teaches or suggests this additional element of the limitation.

250. If “based at least in part on the motion information of a second segment neighboring the first segment” is read to modify “assigning” in this claim limitation, Frojdh teaches or suggests this limitation. Frojdh describes how, in IGMC mode, “[t]he motion vector is predicted from neighboring blocks in the current frame, that is, from blocks which are adjacent to or proximate to the particular image block.” Frojdh, [0055]; Frojdh Provisional, 6, 12-13. For example, the predicted motion vector may be based on “the prediction from neighboring blocks.” Frojdh Provisional, 12.¹⁷ And, as

¹⁷ The Frojdh Provisional was incorporated by reference in its entirety by Frojdh. Frojdh, [0001].

described above, Frojdh's IGM mode (and the associated predicted motion vector) "can be used as a tool in many coding scenarios which require a more useful MB mode than COPY mode." Frojdh, [0022]; Frojdh Provisional, 12-13. Frojdh additionally describes how COPY mode (and its zero motion vector) "is the cheapest mode to signal. In fact, run-length coding is used to signal a number of copied (skipped) macroblocks with one codeword." Frojdh, [0047]; Frojdh Provisional, 8-9. That is, Frojdh describes how the zero motion vector and the predicted non-zero vector have different advantages. For example, the zero motion vector is the cheapest to signal, while the predicted non-zero motion vector may be more useful. A POSITA would have understood that whether the predicted non-zero motion vector is "more useful" than the zero motion vector would depend on the motion vectors (e.g., the predicted non-zero motion vector), and how the motion vectors perform coding a macroblock (e.g., the amount of error introduced coding the macroblock with a zero motion vector or a predicted non-zero motion vector, the bits required to transmit the macroblock encoded using the zero motion vector or the predicted non-zero motion vector, and so on).

251. In other words, as described above, Frojdh teaches or suggests using motion information in a neighboring segment (the recited "second segment") to predict a motion vector. And further, Frojdh additionally teaches or suggests assigning the predicted motion vector, or some other motion vector (e.g., a zero motion vector), depending on which motion vector corresponds with the "more useful MB mode" in a

coding scenario, where which is “more useful” depends on the motion vectors (e.g., how they perform).

252. Frojdh therefore further teaches or suggests that the assignment of the zero or predicted non-zero motion vector is based at least in part on the motion information (prediction) of a second segment neighboring the first segment (neighboring block in the current frame, adjacent to or proximate to the particular image block).

253. If “based at least in part on the motion information of a second segment neighboring the first segment” is read to modify “predicted non-zero motion vector for the skip coding mode” in this claim limitation, Frojdh also teaches or suggests this limitation. As I discussed above, Frojdh describes predicting a motion vector based on the predictions of neighboring blocks. Frojdh, [0055]; Frojdh Provisional, 6, 12-13.¹⁸ A POSITA would have understood that the neighbor block predictions include motion information, such as motion vectors of the neighboring blocks. Frojdh therefore teaches or suggests predicting a non-zero motion vector based at least in part on the motion information (prediction) of a second segment neighboring the first segment (neighboring block in the current frame, adjacent to or proximate to the particular image block).

¹⁸ The Frojdh Provisional was incorporated by reference in its entirety by Frojdh.

Frojdh, [0001].

(4) 1[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector; and

254. Frojdh discloses or suggests this limitation.

255. Frojdh describes that when “making so-called motion-compensated predictions,...regions of a video frame are predicted from similar regions of a previous frame.” Frojdh, [0004]; Frojdh Provisional, 5. And as explained in Section X.B.2.a(2) (Ground 2A, limitation 1[a]), Frojdh describes assigning an implicit global motion compensation (IGMC) mode to a particular image block (the recited “first segment”) during motion compensation.

256. Frojdh further describes that when IGMC mode is used for the particular image block (the “first segment”), pixels are copied from a collocated image block, in a previous frame, that is dislocated (i.e., displaced) based on a predicted motion vector:

The invention can be directed to a method of video data compression for use with image blocks derived by dividing a video frame into a sequence of blocks. In a preferred embodiment, the blocks are macroblocks comprising 16×16 (luminance) pixels and where one of several possible macroblock-coding modes is an implicit global motion compensation (IGMC) mode. This mode is used to copy pixels from a previous frame of a collocated block,

dislocated by a motion vector that is predicted from neighboring image blocks of the current frame.

Frojd, [0023]; *see also* Frojd, [0055]; Frojd Provisional, 6, 12-13.

257. That is, Frojd teaches or suggests forming a prediction (copying pixels based on a predicted motion vector) for the first segment (the particular image block) with respect to a reference frame (the previous frame) based at least in part on the assigned motion vector (the predicted motion vector) for the skip coding mode (IGMC mode alone or in combination with COPY, as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a])), wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.

(5) 1[d]: providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.

258. Frojd discloses or suggests this limitation.

259. As described in Section X.B.2.a(1) (Ground 2A, limitation 1[pre]), Frojd describes a method of video signal data compression, otherwise known as encoding. Frojd additionally describes that the output of encoding is a bitstream. Frojd, [0009], [0010]; Frojd Provisional, 6.

260. Frojd describes how a signal may be applied to the encoded data (e.g., in the bitstream), to indicate characteristics of the encoded data, such as the use of global motion compensation or whether COPY mode was used. Frojd, [0024], [0054]; Frojd

Provisional, 11-12. Frojdh further describes that “a bitstream representing a coded image block can include a syntactic element which may be interpreted to indicate either the IGMC mode or the COPY mode.” Frojdh, [0056]; Frojdh Provisional, 11-12. That is, Frojdh describes including in the bitstream an indication of the video compression used, and more specifically, whether IGMC mode or COPY mode was used. Frojdh therefore teaches or suggests “providing in an encoded bitstream an indication of the skip coding mode.”

261. Frojdh also describes that IGMC mode operates “without coefficients or explicitly coded motion vectors,” and when IGMC is used, “no explicit motion vector is sent with the encoded slice 40.” Frojdh, [0055]; Frojdh Provisional, 6, 12-13. Similarly, Frojdh also describes that COPY mode “uses no MV and no coefficients.” Frojdh, [0047]; Frojdh Provisional, 8-9. In other words, whether IGMC mode is used (to assign a predicted non-zero motion vector or a zero motion vector) or whether COPY mode is used (as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a])), Frojdh teaches that no explicit motion vector is included in the encoded bitstream. Frojdh therefore teaches or suggests that “no further motion vector information for the first segment is coded in the encoded bitstream.”

b. Claim 2: A method according to claim 1, wherein the second segment is a previously encoded segment neighboring the first segment.

262. Frojdh discloses or suggests this claim.

263. Frojdh describes that in IGMC mode the motion vector of the current

macroblock is predicted using “neighboring blocks in the current frame, that is, from blocks which are adjacent to or proximate to the particular image block.” Frojd, [0055]; Frojd Provisional, 6, 12-13. In particular, the predicted motion vector may be based on “the prediction from neighboring blocks.” Frojd Provisional, 12.¹⁹ And as described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), at least one of these neighboring blocks in the current frame is the “second segment...neighboring the first segment.” That is, Frojd describes that the neighboring blocks (including the recited “second segment”), based on which the motion vector of the particular image block (the recited “first segment”) is predicted, themselves have predictions. If the neighboring blocks have predictions (e.g., motion vectors based on which the motion vector of the particular image block is predicted), then the neighboring blocks have been previously encoded. Frojd therefore teaches or suggests that the “second segment is a previously encoded segment.”

264. Frojd’s teaching is reinforced by the conventional manner in which frames are encoded. A POSITA would have understood that the blocks (or segments) of a frame are encoded in a specific sequence, typically in a raster-scan order (left-to-right, top-to-bottom). Frojd explains the same, describing how blocks of a frame “are

¹⁹ The Frojd Provisional was incorporated by reference in its entirety by Frojd.

Frojd, [0001].

coded sequentially row by row, starting at the top left corner and ending at the bottom right corner.” Frojdh, [0009]; Frojdh Provisional, 6. In other words, when a particular block or segment within a frame is being processed for encoding (the recited “first segment”), at least one of the neighboring blocks in the current frame (the recited “second segment”) from which the IGM mode predicts the motion vector must precede the particular image block in the encoding order (e.g., it is an image block immediately to the left and/or top, per raster-scan order or sequential coding order described by Frojdh). It is by encoding the at least one of the neighboring blocks (e.g., immediately to the left and/or top) (the recited “second segment”), prior to encoding the particular image block (the recited “first segment”), that the neighboring block would have a prediction (e.g., a motion vector). And as I described above, the neighboring block’s prediction is used to form the prediction of the particular image block (the recited “first segment”). Therefore, the neighboring block in the current frame (the recited “second segment”) would have preceded the particular image block (the recited “first segment”) in raster-scan order or the sequential coding order described by Frojdh, and therefore would have been previously encoded, such that those neighboring blocks have motion vectors.

c. Claim 23

(1) 23[pre]: A method according to claim 1, wherein if the second segment has a non-zero motion vector,

265. To the extent the preamble is limiting, as described in Section X.B.2.a(3)

(Ground 2A, limitation 1[b]), Frojdh discloses or suggests that a neighboring segment (i.e., the recited “second segment”) can have a non-zero motion vector.

(2) 23[a]: the method further comprising deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and

266. Frojdh discloses or suggests this limitation. As described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), Frojdh teaches or suggests assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment. And as further described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), the assignment is based at least in part on the motion information of a second segment neighboring the first segment. In particular, Frojdh describes that the “motion vector is predicted from neighboring blocks in the current frame, that is, from blocks which are adjacent to or proximate to the particular image block.” Frojdh, [0055]; Frojdh Provisional, 6, 12-13. Frojdh further describes that the predicted motion vector is based on “the prediction from neighboring blocks.” Frojdh Provisional, 12.²⁰

267. When Frojdh describes that a motion vector is predicted based on the predictions of neighboring blocks, a POSITA would have understood these neighboring block predictions to be motion vectors (e.g., from a prior encoding step). In other

²⁰ The Frojdh Provisional was incorporated by reference in its entirety by Frojdh.

Frojdh, [0001].

words, Frojdh teaches or suggests neighboring predicted motion vectors. Frojdh therefore teaches or suggests that the predicted motion vector is “deriv[ed]...based at least in part on the motion vector of the second segment,” as recited by this limitation.

268. Further, a POSITA would have understood that if one of the neighboring blocks has a non-zero motion vector, then the motion vector predicted in skip coding mode for the first segment could be non-zero as well (since, as described above, the motion vector prediction is based on the neighboring motion vectors). Frojdh therefore teaches or suggests “deriving the predicted non-zero motion vector.”

(3) 23[b]: the predicted non-zero motion vector is assigned for the skip coding mode of the first segment; and

269. Frojdh discloses or suggests this limitation for the same reasons as discussed in Section X.B.2.c(2) (Ground 2A, limitation 23[a]) and Section X.B.2.a(3) (Ground 2A, limitation 1[b]).

270. As described in Section X.B.2.c(2) (Ground 2A, limitation 23[a]), Frojdh teaches or suggests “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.” As additionally described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), Frojdh teaches or suggests “assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment.” And as further described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), Frojdh additionally teaches or suggests that the predicted non-zero motion vector, as well as the assignment of the predicted non-zero motion vector or the

zero motion vector, is based at least in part on the motion information of a second segment neighboring the first segment.” In other words, based on the above, Frojdh teaches or suggests deriving a predicted non-zero motion vector based on motion information (e.g., motion vectors) of neighboring segments, and assigning a motion vector (the predicted non-zero motion vector or zero motion vector) to a first segment based on the neighboring motion information.

271. In light of these teachings of Frojdh, in which the motion vector of a segment is predicted and assigned based on a neighboring segment’s motion vector, Frojdh further teaches or suggests that when a segment (the recited “second segment”) has motion information (e.g., a non-zero motion vector), then the motion vector predicted for and assigned to a neighboring segment (the recited “first segment”) may be a non-zero motion vector as well. For example, and as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a]), it was well-known to calculate the predicted motion vector for a block based on the median of neighboring blocks’ motion vectors. When neighboring blocks’ motion vectors are non-zero, the median of those motion vectors (i.e., a predicted motion vector) would be non-zero as well. Moreover, Frojdh explains using for a block a motion vector predicted from the neighboring blocks, and therefore teaches or suggests assigning the motion vector to the block (the recited “first segment”) as well. Frojdh, [0022]; Frojdh Provisional, 12-13. That is, Frojdh teaches or suggests that when blocks have non-zero motion vectors, the motion vector predicted

for and assigned to a neighboring block may also be a non-zero motion vector.

272. Frojdh therefore teaches or suggests “the predicted non-zero motion vector is assigned for the skip coding mode of the first segment” when the second segment has a non-zero motion vector.

(4) 23[c]: the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.

273. Frojdh discloses or suggests this limitation for the same reasons as discussed in Section X.B.2.c(3) (Ground 2A, limitation 23[b]) and Section X.B.2.a(4) (Ground 2A, limitation 1[c]).

274. As described in Section X.B.2.a(4) (Ground 2A, limitation 1[c]), Frojdh teaches or suggests “forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.” And as described in Section X.B.2.c(3) (Ground 2A, limitation 23[b]), Frojdh teaches or suggests “the predicted non-zero motion vector is assigned for the skip coding mode of the first segment.” In other words, based on the above, Frojdh teaches or suggests assigning a predicted non-zero motion vector based on which a prediction is formed, with respect to a reference frame, for a first segment. Frojdh therefore teaches or suggests “the prediction for the first segment is formed by a...prediction with respect to the reference frame based at least in part on the predicted

non-zero motion vector,” as recited by this claim limitation.

275. Frojdh further describes how a predicted motion vector is “used for motion compensating [a] macroblock.” Frojdh, [0055]; Frojdh Provisional, 6, 12-13. In other words, a motion vector assigned for the first segment (e.g., the predicted non-zero motion vector) is used to perform “a motion compensated prediction,” as additionally recited by this claim limitation.

276. Frojdh therefore teaches or suggests “the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.”

d. Claim 28: A method according to claim 1, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

277. Frojdh teaches or suggests this claim for the same reasons discussed above in Sections X.B.2.a(3) (Ground 2A, limitation 1[b]) and X.B.2.c(2) (Ground 2A, limitation 23[a]). In particular, as described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), Frojdh teaches or suggests assigning a zero motion vector or a predicted non-zero motion vector based at least in part on motion information of a second segment. And as additionally described in Section X.B.2.c(2) (Ground 2A, limitation 23[a]), Frojdh teaches or suggests deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

e. Claim 29: A method according to claim 1, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

278. Frojdih teaches or suggests this claim for the same reasons discussed above in Sections X.B.2.a(3) (Ground 2A, limitation 1[b]) and X.B.2.c(2) (Ground 2A, limitation 23[a]). In particular, as described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), Frojdih teaches or suggests assigning a zero motion vector or a predicted non-zero motion vector based at least in part on motion information of a second segment.

279. In particular, Frojdih describes that “[t]he motion vector is predicted from neighboring blocks in the current frame, that is, from blocks which are adjacent to or proximate to the particular image block.” Frojdih, [0055]; Frojdih Provisional, 6, 12-13. Frojdih’s description that the prediction is based on neighboring blocks means that the prediction may be based on more than one neighboring block – i.e., a “second segment” and a “third segment” as recited by the claim. And as additionally described in Section X.B.2.c(2) (Ground 2A, limitation 23[a]), Frojdih discloses that the prediction is based on “the prediction from neighboring blocks,” Frojdih Provisional § 6, and therefore teaches or suggests deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment. For the same reasons, Frojdih additionally teaches or suggests deriving the predicted non-zero motion vector based at least in part on the motion vector of the third segment as well.

f. Claim 30: A method according to claim 1, wherein no residual information is provided for the first segment in the encoded bitstream.

280. Frojdh discloses or suggests this claim.

281. In particular, Frojdh describes encoding the difference between a predicted and original region of a frame in terms of transform coefficients:

The motion vectors (one or several depending on how the macroblock is partitioned) inform the decoder how to spatially translate the corresponding regions of the reference frame in order to make a prediction for the macroblock under consideration. This is referred to as motion compensation. The difference between the prediction and the original is encoded in terms of transform coefficients.

Frojdh, [0011]; Frojdh Provisional, 6-7.

282. Similarly, the '808 patent describes representing the difference between a predicted and original frame in terms of a prediction error:

Motion-compensated prediction alone rarely provides a sufficiently precise representation of the image content of a video frame and therefore it is typically necessary to provide a so-called "prediction error" (PE) frame with each INTER-coded frame. The prediction error frame represents the difference between a decoded version of the INTER-coded frame and the image content of the frame to be coded. More specifically, the prediction error frame comprises values that represent the difference between pixel values in the frame to

be coded and corresponding reconstructed pixel values formed on the basis of a predicted version of the frame in question.

'808 Patent, 3:28-39.

283. In other words, “difference between the prediction and the original” as used by Frojdh is equivalent to “prediction error” as described by the '808 patent. Moreover, it was well understood by a POSITA that “residual information” as recited by the claim encompassed “prediction error.” In other words, Frojdh’s “difference between the prediction and the original” describes “residual information” as recited in the claims.

284. Frojdh further describes that when IGMCM mode is used (the recited “skip coding mode,” alone or in combination with COPY as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a])), the macroblock is coded “without coefficients or explicitly coded motion vectors.” Frojdh, [0055]; Frojdh Provisional, 6, 12-13. That is, no transform coefficients encoding the difference between the prediction and the original (i.e., no transform coefficients characterizing a prediction error) are used in the macroblock coding. Frojdh therefore teaches or suggests “no residual information is provided for the first segment in the encoded bitstream.”

3. Claim 7 and Dependents: “A method of decoding an encoded video sequence”

a. Claim 7

(1) 7[pre]: A method of decoding an encoded video sequence, the method comprising:

285. To the extent the preamble is limiting, Frojdh discloses or suggests a method of decoding a video sequence.

286. In particular, Frojdh describes “a method for compression of video signal data...which employs global motion compensation.” Frojdh, [0002]; Frojdh Provisional, 5-6. Frojdh additionally describes how “[b]y using an already decoded frame (reconstructed frame) as reference,” the results of motion compensation (e.g., motion vectors) can “inform [a] decoder how to spatially translate the corresponding regions of [a] reference frame in order to make a prediction for [a] macroblock under consideration. This is referred to as motion compensation.” Frojdh, [0011]; Frojdh Provisional, 6-7. Frojdh further describes encoding a portion of a frame (such as a slice) using motion compensation information, and using the motion compensation information to “reconstruct” the corresponding original portion of the frame. Frojdh, [0024]; Frojdh Provisional, 11-12.

287. In other words, Frojdh describes how the motion compensation information, generated by its encoding process, is used both to encode a portion of a frame as well as to decode the encoded frame data. Frojdh therefore teaches or suggests “[a] method of decoding an encoded video sequence.”

288. Furthermore, as described above, the “reconstruct[ing]” (that is, decoding) of a portion of a frame is done using the motion compensation information generated by Frojdh’s encoding method. In order for the decoding method to reconstruct, or decode, a frame portion using the motion compensation information from the encoding method, the decoding method must therefore perform decoding steps corresponding to those of the encoding method (such as generating motion compensation information).

(2) 7[a]: receiving an indication of a skip coding mode for a first segment;

289. Frojdh discloses or suggests this limitation. As described in Section X.B.2.a(2) (Ground 2A, limitation 1[a]), Frojdh teaches or suggests assigning a skip coding mode to a first segment as part of a method of encoding video data. As described in Section X.B.2.a(5) (Ground 2A, limitation 1[d]), Frojdh additionally teaches or suggests including an indication of the skip coding mode in the encoded video data. And as described in Section X.B.3.a(1) (Ground 2A, limitation 7[pre]), Frojdh further teaches or suggests that its decoding method performs steps corresponding to its encoding method. Because Frojdh describes an indication of the skip coding mode provided in the encoded video data of its encoding method, and teaches or suggests a decoding method corresponding to the encoding a method, a POSITA would have understood that decoding the encoded video data therefore includes receipt of the indication of the skip coding mode (i.e., the IGMC mode alone or in combination with COPY, as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a])). Frojdh

therefore teaches or suggests receiving an indication of a skip coding mode for a first segment.

(3) 7[b]: assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

290. Frojdh discloses or suggests this limitation for the same reasons as discussed in Section X.B.2.a(3) (Ground 2A, limitation 1[b]) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) because Frojdh's decoding method performs the same steps as the encoding method for assigning either a zero motion vector or a predicted non-zero motion vector for a first segment coded with skip coding mode.

(4) 7[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.

291. Frojdh discloses or suggests or suggests this limitation for the same reasons as discussed in Section X.B.2.a(4) (Ground 2A, limitation 1[c]) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) because Frojdh's decoding method performs the same steps as the encoding method for forming a prediction for the first segment based at least in part on the assigned motion vector for the skip coding mode.

b. Claim 34: A method according to claim 7, wherein if the second segment has a non-zero motion vector, the method further comprising deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and the predicted non-zero motion vector is assigned for the skip coding mode of the first segment; and the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.

292. Frojdh discloses or suggests this claim for the same reasons as discussed in Section X.B.2.c (Ground 2A, claim 23) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) because Frojdh's decoding method performs the same steps as the encoding method for forming a prediction of a segment.

c. Claim 39: A method according to claim 7, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

293. Frojdh discloses or suggests this claim for the same reasons as discussed in Section X.B.2.d (Ground 2A, claim 28) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) because Frojdh's decoding method performs the same steps as the encoding method for forming a prediction of a segment.

d. Claim 40: A method according to claim 7, further comprising: deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

294. Frojdh discloses or suggests this claim for the same reasons as discussed in Section X.B.2.e (Ground 2A, claim 29) and Section X.B.3.a(1) (Ground 2A,

limitation 7[pre]) because Frojdh's decoding method performs the same steps as the encoding method for forming a prediction of a segment.

e. Claim 41: A method according to claim 7, wherein no residual information is provided for the first segment in the encoded bitstream.

295. Frojdh discloses or suggests this claim for the same reasons as discussed in Section X.B.2.f (Ground 2A, claim 30) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) because Frojdh's decoding method performs the same steps as the encoding method for forming a prediction of a segment.

f. Claim 65: A method according to claim 7, wherein no further motion vector information for the first segment is retrieved from the encoded bitstream.

296. Frojdh discloses or suggests this claim for the same reasons as discussed in Section X.B.2.a(5) (Ground 2A, limitation 1[d]) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) because Frojdh's decoding method performs the same steps as the encoding method for forming a prediction of a segment.

C. Ground 2B: Obviousness over Frojdh in view of H.263 (Claims 6, 9, 24, 25, 32, 36, and 43)

1. H.263 (1998)

297. ITU-T Recommendation H.263 is titled "Video coding for low bit rate communication." The revision of H.263 I reference herein (otherwise known as H.263+, H.263 (1998), or the 1998 version of H.263) was ratified by the ITU-T in February 1998, and I understand was made available to the public no later than May 11,

2000. H.263, i; Munford, 7-8. I understand that H.263 is therefore prior art to the '808 patent.

298. H.263 “specifies a coded representation that can be used for compressing the moving picture component of audio-visual services at low bit rates.” H.263, 1. That is, H.263 is a video compression standard. H.263 describes “a hierarchical structure with four primary layers,” that include a (1) picture; (2) Group of Blocks (GOB), or slice, or video picture segment; (3) macroblock; and (4) block. H.263, 13.

299. In H.263, “[t]he primary form of prediction is inter-picture and may be augmented by motion compensation.” H.263, 11. For example, when INTER coding (also called a P-picture) is used, a picture and/or macroblocks therein are predicted using a temporally previous reference picture. H.263, 11. In contrast, when INTRA coding (also called an I-picture) is used, no temporal prediction is applied. H.263, 11. When the *inter*-picture prediction (e.g., INTER coding) is augmented by motion compensation, by default “[t]he decoder will accept one [motion] vector per macroblock.”²¹ H.263, 12.

300. H.263 specifies how a decoder determines the motion vector for a

²¹ In sections of the H.263 standard that pertain to motion compensation, a POSITA would understand that the terms *vector* and *macroblock vector* generally mean *motion vector* unless otherwise specified.

macroblock when motion compensation is used. In particular, H.263 describes “differential motion vectors,” where “[t]he macroblock vector is obtained by adding predictors to the vector differences indicated by [Motion Vector Data].” H.263, 44. Motion Vector Data, otherwise referred to as MVD, “represents a pair of difference values” (e.g., a horizontal component difference and a vertical component difference), and is encoded in the macroblock data received by a decoder (e.g., from an encoder). H.263, 33-34, 38-40, 45, Fig. 10. H.263 additionally describes that the other component used in obtaining the macroblock vector when motion compensating a macroblock, the predictor, “is the median value of the three candidate predictors,” where the median is calculated separately for the horizontal and vertical components. H.263, 44-45. Further, “the [three] candidate predictors for the differential coding are taken from three surrounding macroblocks” neighboring the macroblock being decoded. H.263, 44. That is, H.263 describes forming a vector predictor for a macroblock based on the motion vectors (candidate predictors) of neighboring macroblocks. In other words, H.263 teaches using motion vectors of neighboring macroblocks to determine the motion vector of a macroblock being decoded. H.263 further provides various rules for specifying the candidate predictors corresponding to neighboring macroblocks to account for special cases (e.g., when a neighboring macroblock was INTRA coded and/or fell outside the boundaries of the current slice or picture), which I describe in greater detail below. H.263, 44-45.

301. While H.263 describes forming a macroblock vector based on predictors, and the rules for calculating predictors, under the heading of “Decoding process” (H.263, 44), it would have been obvious to a POSITA that an H.263 encoder calculates predictors (based on candidate predictors) using the same rules specified under H.263’s “Decoding process.” As described above, H.263 describes how a decoder obtains a macroblock vector “by adding predictors to the vector differences indicated by MVD,” where the MVD is part of the macroblock data (e.g., received from an encoder). H.263, 33-34, 38-40, 44, Fig. 10. Because the encoder provides the MVD (e.g., in a bitstream) to be used by the decoder to obtain a macroblock vector, both the encoder and decoder must perform the same steps for calculating the predictors to be used in combination with (e.g., added to) the MVD. Otherwise, if the encoder and decoder followed different rules to calculate predictors, the decoder would obtain a different macroblock vector than the one obtained and used by the encoder for encoding the macroblock, despite the MVD being the same at both the encoder and decoder. H.263 indicates the same, when it describes how “[t]he video coder provides a self-contained digital bitstream...The video decoder performs the reverse process.” H.263, 2. In other words, H.263’s description of calculating predictors from candidate predictors, and the handling of the special cases therein, apply equally to H.263 encoders.

302. H.263 Annex P (“Reference picture resampling”) “describes the use and syntax of a resampling process which can be applied to the previous decoded reference

picture in order to generate a ‘warped’ picture for use in predicting the current picture.” H.263, 116. As described in Annex P, “[t]his resampling syntax can specify the relationship of the current picture to a prior picture having a different source format, and can also specify a ‘global motion’ warping alteration of the shape, size, and location of the prior picture with respect to the current picture.” H.263, 116. In other words, H.263 Annex P describes global motion compensation based on warping a reference frame.

2. Motivation to combine Frojdh and H.263

303. A POSITA would have been motivated to combine Frojdh’s teachings of an improved method of global motion compensation, and particularly its implicit global motion compensation (IGMC), with the H.263 video coding standard.

304. Frojdh, as part of its Background, recognized the shortcomings of the way in which global motion compensation (GMC) was provided by the proposed and ratified video standards of the day, including H.263, MPEG-4 Part 2, and the nascent Recommendation H.26L (which was never ratified, but eventually became H.264). Frojdh, [0012]-[0019]. For example, Frojdh recognized that conventional GMC suffered from reduced error resilience. Frojdh, [0020]. Frojdh’s IGMC improved upon conventional GMC by improving error resilience, while also minimizing the total number of bits needed for motion vectors. Frojdh, [0021]-[0022]. Frojdh, however, did not attempt to define or describe an entire video coding framework. Rather, Frojdh describes its IGMC as “a new mode for global motion compensation.” Frojdh, [0022].

In other words, Frojdh's IGMCM would have been incorporated as "a new mode" into an existing video coding standard to provide the improved global motion compensation described by Frojdh.

305. At the time of the priority date of the '808 Patent, H.263 was one of the leading ratified video coding standards in use. Developed as an improvement over the prior video coding standards on which it was based (e.g., H.261 and H.262), H.263 provided numerous advantages over those older standards, particularly in terms of efficiency and video quality. These advantages helped H.263 enjoy a widespread adoption and deployment, particularly in internet streaming applications. For example, H.263 was used for popular internet video streaming applications such as Sorenson Video 3, Sorenson Spark, Macromedia Flash MX v6, Flash Player 6, and later for Google Video and YouTube. And H.263, like Frojdh (Frojdh, [0003]), was also intended for widespread use in low bit rate applications, such as videoconferencing systems. H.263, 1; Wang, 217.

306. A POSITA, aware of the wide adoption of H.263, would have been motivated to improve the video coding standard. In particular, a POSITA would have known of the H.263 implementation of global motion compensation (as I described in X.C.1, Ground 2B, H.263) as well as its shortcomings (e.g., as described by Frojdh), and, as described below, would have been motivated to improve upon it by incorporating Frojdh's IGMCM as a "new mode" of H.263.

307. As described above, a POSITA would have understood that Frojdh's IGMC could have been used as a "new mode" that would enhance the performance of base video coding standards by addressing global motion more effectively. *See, e.g.,* Frojdh, [0002]-[0022]. Thus, a POSITA would have recognized that integrating Frojdh into a video coding standard like H.263 would have enhanced motion compensation without altering the core functionality of the existing framework. This is especially relevant in scenarios where videos exhibit substantial global motion, such as panning or zooming effects commonly found in media and broadcast content. Indeed, Frojdh explicitly mentions H.263's existing global motion technique, and then proposes IGMC to address shortcomings of that technique. Frojdh, [0012]-[0015], [0021].

308. A POSITA would have recognized the benefits of adding Frojdh's IGMC to a comprehensive and widely adopted coding framework like H.263, in order to fully utilize the improved global motion compensation capabilities provided by IGMC. Given H.263's status and capabilities (as I described above), it would have been the logical choice for a POSITA to combine the two. For example, integrating Frojdh with H.263 would have allowed the latter to leverage enhanced global motion compensation techniques (as taught by Frojdh) which could further optimize video quality, particularly in streaming applications where bandwidth efficiency and minimizing visual artifacts are crucial. This enhancement would have improved visual quality in videos with camera and object movements, thereby expanding the use cases of H.263

into more dynamic video applications.

309. Moreover, the integration of Frojdh into H.263 would have allowed H.263 to use Frojdh's IGMC mode and enjoy the benefits resulting from the combination (as I explained above). By incorporating Frojdh's IGMC, the combined system would be capable of providing global motion compensation without needing to transmit motion vector information, as Frojdh describes. Frojdh, [0022], [0055]. A POSITA would further have understood that under the combined system, macroblocks encoded according to the conventional H.263 standard (i.e., not employing IGMC) may in contrast utilize transmitted motion vector information, such as the motion vector difference (MVD). This selective application of Frojdh's technology within the H.263 framework, which incorporates Frojdh's IGMC as a "new mode" of H.263 without altering other aspects of H.263, would have allowed for the enhanced motion compensation of IGMC to be applied where it is most beneficial and without unnecessary complexity or redundancy.

310. Further, a POSITA would have reasonably expected success in combining H.263 with Frojdh. Specifically, as I explained above, at the time of the '808 priority date, H.263 was already established as a standard for video compression, especially in internet streaming and video conferencing. A POSITA would have understood that Frojdh's techniques could have been used as a "new mode," or enhancement, aimed at improving global motion compensation within existing video coding frameworks. A

POSITA would also have recognized Frojdh's techniques could be readily incorporated into H.263 without altering its core functionality. Additionally, the combination would have yielded predictable results. Both H.263 and Frojdh would continue to function as intended in the combination, each enhancing the other. Moreover, Frojdh's improved motion compensation techniques are compatible with the existing framework of H.263, which would have allowed for the improvements to be realized without compromising the integrity and efficiency of the H.263 standard. The combination would be well within the capabilities of a POSITA because it would merely require modifying the H.263 encoder and decoder behavior with regards to interpretation of the "COPY (aka SKIP) mode" according to the teaching of Frojdh in order to implement Frojdh's IGMC mode within H.263. Frojdh, [0055]. It would also be within the capabilities of a POSITA to modify the H.263 encoder and decoder behavior to support IGMC in combination with COPY (as described in Section X.B.2.a(2), Ground 2A, limitation 1[a]).

3. Claim 6: A method according to claim 1, wherein if the second segment has zero motion vector, the zero motion vector is assigned for skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

311. The combination of Frojdh and H.263 discloses or suggests this claim.

312. As described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), Frojdh's IGMC mode (alone or in combination with COPY, as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a])) teaches or suggests assigning either a zero motion vector

or a predicted non-zero motion vector for the first segment based at least in part on the motion information of a second segment neighboring the first segment.

313. Frojdh describes how its IGMC mode “can be used as a tool in many coding scenarios which require a more useful MB mode than COPY mode,” and “uses implicit motion vectors that are predicted.” Frojdh, [0022]; Frojdh Provisional, 12-13. Frojdh also describes how the prediction motion vector of IGMC mode is based on “the prediction from neighboring blocks.” Frojdh Provisional, 12; Frojdh, [0055]; Frojdh Provisional, 6, 12-13. However, Frojdh omits the specific details of exactly how the predicted motion vector for a macroblock may be derived from the motion vectors of the neighboring blocks. In the combination of H.263 with Frojdh, a POSITA would therefore look to H.263 to provide these details.

314. H.263 describes a motion vector predictor with two components (horizontal and vertical), where “[f]or each component, the predictor is the median value of the three candidate predictors for this component.” H.263, 44-45. H.263 further describes how “the candidate predictors for the differential coding are taken from three surrounding macroblocks as indicated in Figure 12.” H.263, 44. In other words, when calculating a motion vector predictor (excluding the H.263 decision rules for special cases, which I describe below), and with reference to Figure 12 of H.263, the motion vector predictor for a current macroblock (MV in the figure) is calculated as the median of the motion vectors of the neighboring left, top, and top-right macroblocks

(MV1, MV2, and MV3 in the figure, respectively). That is, H.263 describes calculating a macroblock's motion vector (predictor) as the component-wise median of its three neighboring macroblocks' motion vectors (candidate predictors). Below I have reproduced and annotated H.263's Figure 12, to highlight (in blue) the use of the neighboring candidate predictors when none of the special cases apply.

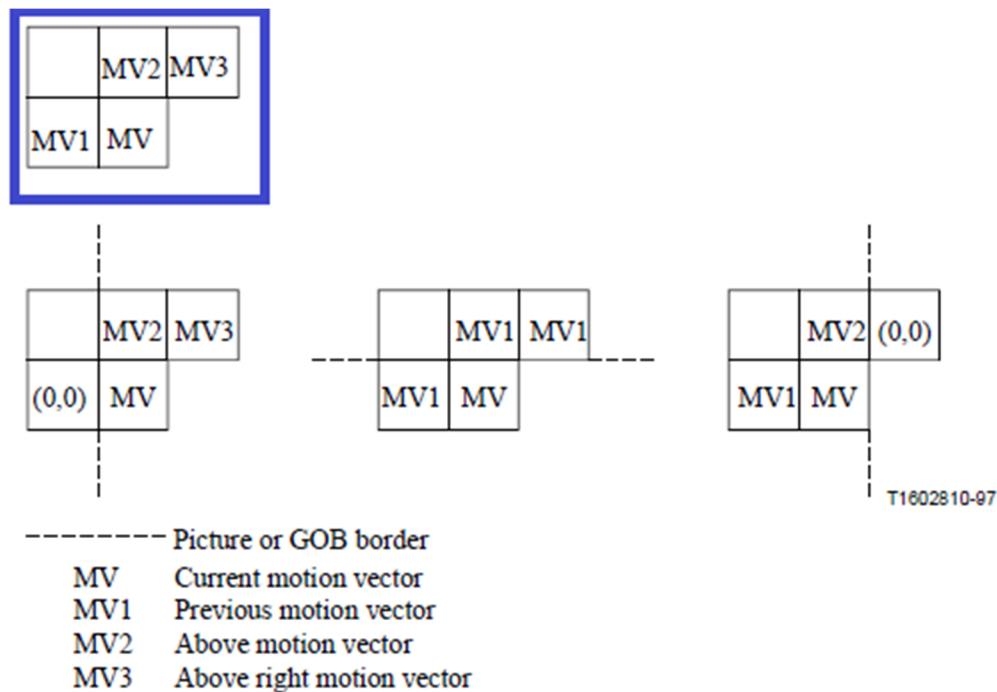


Figure 12/H.263 – Motion vector prediction

H.263, Fig. 12 (annotated).

315. As described above (Section X.C.1 (Ground 2B, H.263 overview), H.263 additionally provides rules to be applied to account for special cases (e.g., when the current macroblock is at a border):

In the special cases at the borders of the current GOB, slice, or picture, the following decision rules are applied in increasing order:

- 1) When the corresponding macroblock was coded in INTRA mode (if not in PB-frames mode with bidirectional prediction) or was not coded ($COD = 1$), the candidate predictor is set to zero.
- 2) The candidate predictor MV1 is set to zero if the corresponding macroblock is outside the picture or the slice (at the left side).
- 3) Then, the candidate predictors MV2 and MV3 are set to MV1 if the corresponding macroblocks are outside the picture (at the top) or outside the GOB (at the top) if the GOB header of the current GOB is non-empty; or outside the slice when in Slice Structured mode.
- 4) Then, the candidate predictor MV3 is set to zero if the corresponding macroblock is outside the picture (at the right side).

H.263, 44-45.

316. Therefore, H.263 describes that when a current macroblock is at the top border of a picture or GOB, then by application of the third decision rule, the candidate predictors that would have been provided by the motion vectors of the top and top-right neighboring macroblocks (MV2 and MV3, respectively) instead are set to be the motion

vector of the left neighboring macroblock (MV1). In other words, all three candidate predictors are set as the left neighboring macroblock's motion vector. Below I have reproduced and annotated H.263's Figure 12, to highlight (in green) the application of the third decision rule, illustrating how the motion vector of the left neighbor is used for the three candidate predictors.

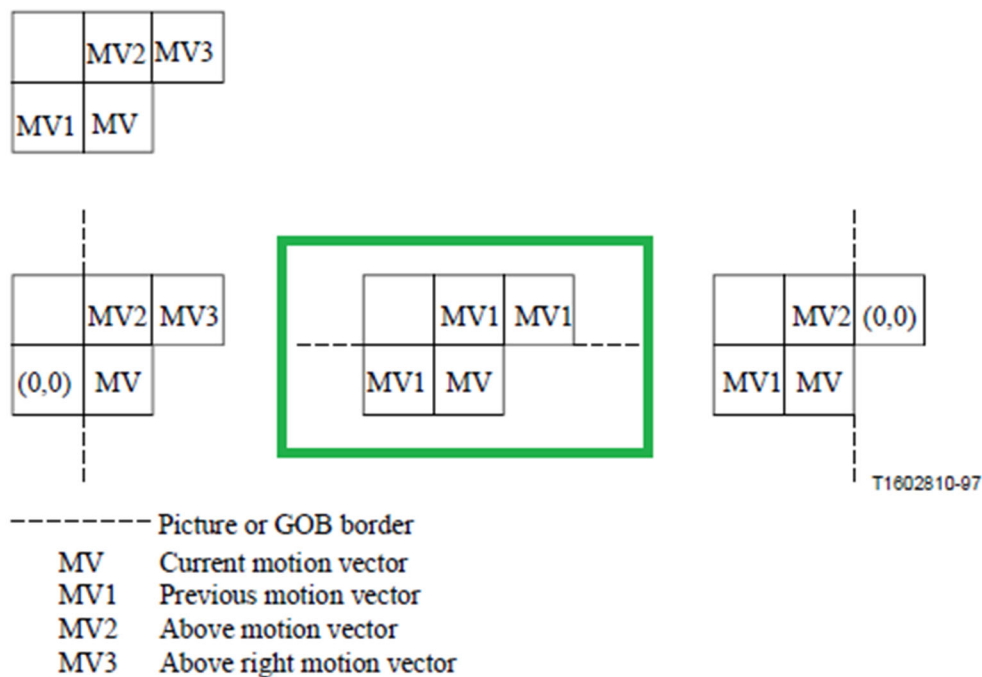


Figure 12/H.263 – Motion vector prediction

H.263, Fig. 12 (annotated).

317. Further, a POSITA would have known that the median of three numbers, all of which have the same value, is equal to that value. That is, when the three candidate predictors are the motion vector of the left neighboring macroblock (MV1) due to application of rule 3, the predicted motion vector of the current macroblock (MV), which is calculated as the median of the candidates, equals MV1 as well.

318. In other words, H.263 teaches that a motion vector predicted for a macroblock may take on the same value as the motion vector of a neighboring macroblock (e.g., the motion vector of the left neighbor, when macroblock is at a top boundary). In such occurrences, if the neighboring macroblock's motion vector (MV1) is a zero motion vector, then the current macroblock's predicted motion vector (MV) will be calculated as a zero motion vector as well. H.263 therefore teaches or suggests "if the second segment has zero motion vector, the zero motion vector is assigned."

319. Frojdh additionally describes "copy[ing] pixels from a previous frame of a collocated block, dislocated by a motion vector." Frojdh, [0023]; Frojdh Provisional, 6, 12-13. And Frojdh describes that when the motion vector is zero (e.g., in COPY mode), no motion compensation is needed and the reference frame can be used for the predicted macroblock without spatial translation. Frojdh, [0011]; Frojdh Provisional, 6-7. In other words, Frojdh describes that when a zero motion vector is used, image data from a reference frame is used for the same spatial location of the current frame. Frojdh therefore teaches or suggests that when a zero motion vector is assigned for the first segment, "prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector."

320. The combination of the teachings of Frojdh and H.263 therefore teaches or suggests this claim.

4. Claim 24: A method according to claim 1, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

321. The combination of Frojdh and H.263 discloses or suggests this claim.

322. As described in Section X.C.3 (Ground 2B, claim 6), the combination of Frojdh and H.263 discloses or suggests that (e.g., in Frojdh's IGMC mode) "if the second segment has zero motion vector, the zero motion vector is assigned for skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector." The aforementioned limitation is substantially similar to "if the second segment has a zero motion vector..., the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector," as recited by this claim. Therefore, the combination of Frojdh and H.263 teaches or suggests the noted limitations of this claim for the same reasons already described.

323. Furthermore, the combination of Frojdh and H.263 additionally teaches or suggests that the "second segment is predicted using motion-compensated prediction from the reference picture," as additionally recited in this claim. As described in Section X.B.2.b (Ground 2A, claim 2), Frojdh teaches or suggests that the second segment is a

“previously encoded segment.” Further, H.263 describes how the previously encoded second segment can be predicted using motion-compensated prediction, with the result of a zero motion vector being predicted for the second segment.

324. As described above in Section X.C.1 (Ground 2B, H.263 overview), when describing motion compensation used to predict a motion vector for a current macroblock, H.263 provides rules to be applied to the candidate predictors (used in calculating the current macroblock’s predicted motion vector) to account for special cases involving the current macroblock:

In the special cases at the borders of the current GOB, slice, or picture, the following decision rules are applied in increasing order:

- 1) When the corresponding macroblock was coded in INTRA mode (if not in PB-frames mode with bidirectional prediction) or was not coded ($COD = 1$), the candidate predictor is set to zero.
- 2) The candidate predictor MV1 is set to zero if the corresponding macroblock is outside the picture or the slice (at the left side).
- 3) Then, the candidate predictors MV2 and MV3 are set to MV1 if the corresponding macroblocks are outside the picture (at the top) or outside the GOB (at the top) if the GOB header of the current GOB is non-empty; or outside the slice when in Slice Structured mode.

- 4) Then, the candidate predictor MV3 is set to zero if the corresponding macroblock is outside the picture (at the right side).

H.263, 44-45.

325. Furthermore, one or more of the rules can be applied if the corresponding conditions are met. H.263, 44 (“In the special cases...the following decision rules are applied in increasing order”). And the rules, alone and/or in combinations, illustrate examples of how a motion compensated macroblock can be predicted to have a zero motion vector.

326. For example, if a current macroblock is at the left border of a slice and the top border of a picture or GOB, the second decision rule and third decision rule apply, in that order, due to the respective conditions being met. As a result, the candidate predictor corresponding to the left neighbor macroblock (MV1) is set to zero (by application of decision rule 2). And then, the MV1 candidate predictor (set to 0 by application of decision rule 2) is used as the candidate predictor corresponding to the top neighbor (MV2) and the top-right neighbor (MV3) by application of decision rule 3 (as described in Section X.C.3 (Ground 2B, claim 6)). In other words, all three candidate predictors are set to zero, which would result (based on the calculated median of three zero vectors) in a calculated prediction motion vector for the current macroblock of zero. Below I have reproduced and annotated H.263’s Figure 12, to highlight (in red) the application of the second decision rule, and highlight (in green)

the application of the third decision rule, illustrating how all three candidate predictors for a macroblock can be set to the zero vector:

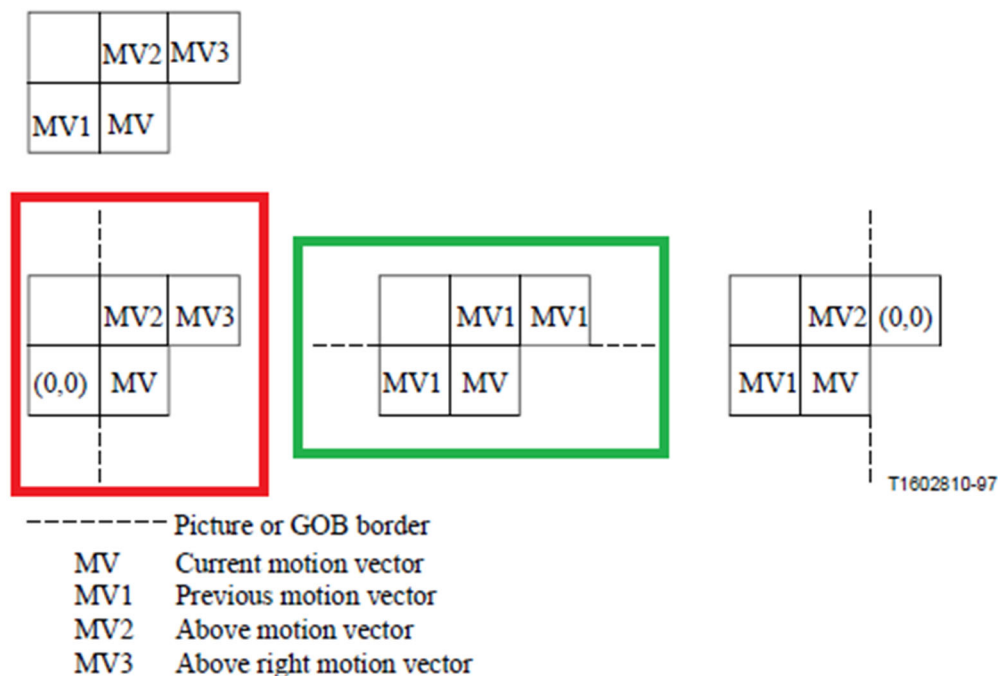


Figure 12/H.263 – Motion vector prediction

H.263, Fig. 12 (annotated).

327. A POSITA would have recognized, in light of the rules described by H.263, that there are other circumstances in which a macroblock undergoing motion compensated prediction will result in a predicted zero vector. For example, if a current macroblock's neighbor was INTRA coded, then by application of decision rule 1 the candidate predictor corresponding to the INTRA coded neighbor is set to zero. H.263, 44. A POSITA would have recognized that if at least two of the three neighboring macroblocks corresponding to candidate predictors (e.g., left, top, and top-right) were INTRA coded, such that by application of decision rule 1 the candidate predictors are

set to the zero vector, then median of those candidate predictors (i.e., the predicted motion vector of the current macroblock) would also be a zero vector. As a still further example, if the current macroblock is at the top border of a picture or GOB, and the current macroblock's left neighbor was INTRA coded, then by application of decision rule 1 and decision rule 3 (in that order), all three candidate predictors would be set to zero vector (H.263, 44-45), resulting in a predicted motion vector for the current macroblock that is also a zero vector.

328. In other words, H.263 describes various ways in which a macroblock undergoing motion compensated prediction can be predicted to have a zero motion vector. That is, H.263 teaches or suggests “if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction,” as recited by the claim. And as described in Section X.C.3 (Ground 2B, claim 6), H.263 teaches or suggests that when “the second segment has a zero motion vector,” it can be “assigned to the skip coding mode of the first segment.”

329. H.263 therefore describes that when a current macroblock (the recited “first segment”) is at the top border of a picture or GOB, if the current macroblock's left neighbor (the recited “second segment”) has a predicted zero vector, then by application of decision rule 3 (H.264, 45), the current macroblock will be predicted to have a zero vector as well. And further, the predicted motion vector of the left neighbor, which H.263 also refers to as the “[p]revious motion vector” (H.263, Fig. 12), could

have been predicted to have a zero vector via motion-compensated prediction for any of the reasons described above (e.g., the left neighbor being at the left border of the slice, the left neighbor's left neighbor being INTRA coded, etc.).

5. Claim 25: A method according to claim 1, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

330. The combination of Frojdh and H.263 teaches or suggests this claim.

331. As described in Section X.C.4 (Ground 2B, claim 24), the combination of Frojdh and H.263 teaches or suggests (e.g., with Frojdh's IGMCM mode) "wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector." The combination of Frojdh and H.263 therefore teaches or suggests "wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture..., the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector,"

as recited in this claim, for the same reasons discussed above.

332. Further, the combination of Frojdh and H.263 teaches or suggests that the second reference picture is “immediately preceding the picture second segment belongs to,” as additionally recited by the claim. In particular, Frojdh is agnostic as to whether a reference frame is “immediately preceding” a current frame. For example, Frojdh describes that “[t]his mode is used to copy pixels from a previous frame of a collocated block, dislocated by a motion vector that is predicted from neighboring image blocks of the current frame.” Frojdh, [0023]; Frojdh Provisional, 6, 12-13. And H.263 describes that by default (e.g., when a Temporal Reference for Prediction (TRP) bit is not present), “the most recent temporally previous anchor picture shall be used for prediction.” H.263, 30. A POSITA would therefore have understood that a previous frame as described by Frojdh may be an immediately preceding frame, and furthermore that a most recent temporally previous anchor picture as described by H.263 *is* an immediately preceding frame when intervening B-pictures are absent.²² Therefore, the combination of Frojdh and H.263 teaches that the claimed second reference picture may

²² A POSITA would understand that the absence of intervening B-pictures was expected to occur in practice because the use of B-pictures in H.263 is optional; *see* H.263, 11-12 (“In total, H.263 has seven basic picture types (of which only the first two [I-pictures and P-pictures] are mandatory)...”).

immediately precede the picture that the claimed segment belongs to.

6. Claim 9: A method according to claim 7, wherein if a segment in a previously decoded region surrounding the first segment has zero motion vector, the zero-motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

333. The combination of Frojdh and H.263 discloses or suggests this claim.

334. As described in Section X.C.3 (Ground 2B, claim 6), the combination of Frojdh and H.263 teaches or suggests “wherein if the second segment has zero motion vector, the zero motion vector is assigned for skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” As additionally described in Section X.B.2.a(3) (Ground 2A, limitation 1[b]), Frojdh teaches or suggests “a second segment neighboring the first segment.” And as further described in Section X.B.2.b (Ground 2A, claim 2), Frojdh teaches or suggests that the “the second segment is a previously encoded segment neighboring the first segment.”

335. In other words, the combination of Frojdh and H.263 teaches or suggests a previously encoded neighboring segment. The '808 Patent describes how macroblocks neighboring a macroblock to be coded are part of a “region surrounding” that macroblock. '808 Patent, 19:28-36 (“In a first preferred embodiment of the invention surrounding motion analysis block 802 classifies the motion in the region surrounding the macroblock according to the following three step procedure. Firstly,

surrounding motion analysis block retrieves motion information for the macroblocks or sub-blocks surrounding the macroblock to be coded (i.e. previously encoded macroblocks neighboring the macroblock to be coded, as shown in FIG. 9) and generates a median motion vector prediction for the macroblock.”). Therefore, the “second segment neighboring the first segment” taught or suggested by Frojdh is in a previously encoded “region surrounding the first segment,” as recited by the claim. Furthermore, a POSITA would have understood that a decoding method would perform the same steps as its corresponding encoding method, and in processing the received bitstream would need to decode blocks or segments in the same order that they were encoded and placed in the bitstream by the encoder. Thus, for the same reasons described above, the combination of Frojdh and H.263 teaches or suggests that the claimed second segment is “in a previously decoded region surrounding the first segment,” as recited by this claim. And as described in Section X.B.3.a(1) (Ground 2A, limitation 7[pre]), Frojdh teaches or suggests that its decoding method performs steps corresponding to its encoding method. Therefore, the combination of Frojdh and H.263 teaches or suggests this claim because the combined decoding method performs the same steps as the encoding method for forming a prediction of a segment.

7. Claim 32: A method according to claim 7, wherein if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

336. The combination of Frojdh and H.263 discloses or suggests this claim for the same reasons as discussed in Section X.C.3 (Ground 2B, claim 6) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]), because the combined decoding method performs the same steps as the encoding method for forming a prediction of a segment.

8. Claim 36: A method according to claim 7, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

337. The combination of Frojdh and H.263 discloses or suggests this claim for the same reasons as discussed in Section X.C.4 (Ground 2B, claim 24) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]), because the combined decoding method performs the same steps as the encoding method for forming a prediction of a segment.

9. Claim 43: A method according to claim 7, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

338. The combination of Frojdh and H.263 discloses or suggests this claim for

the same reasons as discussed in Section X.C.5 (Ground 2B, claim 25) and Section X.B.3.a(1) (Ground 2A, limitation 7[pre]), because the combined decoding method performs the same steps as the encoding method for forming a prediction of a segment.

D. Ground 2C: Obviousness over Frojdh in view of AAPA (Claims 10, 11, 16, 21, 22, 44, 47-49, 58-60, and 64)

1. '808 Patent Background (AAPA)

339. The '808 Patent background describes a generic video coding system with exemplary video encoder and decoder. '808 Patent, 3:44-52. The exemplary video encoder includes a control manager, motion estimator, a motion field coder, a motion compensated predictor, and a video multiplex coder. '808 Patent, 4:1-12, Figure 1. And the exemplary video decoder includes a control manager, video multiplex decoder, and motion compensated prediction block. '808 Patent, 8:19-26, Figure 2. In other words, the encoder and decoder components recited in the claims discussed below were admitted as prior art by the '808 Patent. Moreover, other video encoders and decoders resembling the exemplary video encoder and decoder of the '808 Patent background were well known before the earliest claimed priority date of the '808 Patent. For example, Bhaskaran's block diagram of an H.261 video encoder included coding control, motion estimation, and motion compensation blocks, and its block diagram of an H.261 video decoder included a motion compensation block. Bhaskaran, 199, 202. As a further example, Wang illustrated a typical encoder with a control block, motion estimation block, motion compensation block, and variable length coder (VLC), and a

typical decoder with inverse VLC and motion compensation block. Wang, 293-296.

2. Motivation to combine Frojdh and AAPA

340. A POSITA would have been motivated to combine AAPA's teachings of an exemplary video encoder and video decoder with Frojdh's video coding and decoding methods, respectively.

341. Frojdh discloses a method for compression of video signal data, and describes both an encoder and decoder to predict video data. Frojdh, [0002], [0011]. In other words, Frojdh discloses an encoder used to compress video data, as well as a decoder used to de-compress video data. However, Frojdh does not describe the implementation details of the encoder and decoder, other than that they are used to predict video data. A POSITA would have been motivated to look to AAPA's teachings for the implementation details of video encoders and video decoders, as both Frojdh and AAPA describe performing motion compensation for video. Frojdh, [0002]; '808 Patent, 3:11-21.

342. Second, this combination merely amounts to using known techniques (AAPA's exemplary video encoder and video decoder, and the components therein) to improve a similar system (Frojdh's video coder and decoder, respectively) in the same way (to perform motion compensation of video using intra-frame and inter-frame).

343. Third, this combination also merely amounts to combining prior art elements (AAPA's video encoder with coding control, motion compensated prediction, and multiplexer, and AAPA's video decoder with coding control, motion compensated

prediction, and demultiplexer) according to known methods (as evidenced AAPA, which shows that a POSITA would have known how to use the disclosed video encoder and video decoder components in a similar video coding system).

3. Claim 10 and Dependents: “A video encoder for encoding a video sequence”

a. Claim 10

(1) 10[pre]: A video encoder for encoding a video sequence, the encoder comprises:

344. To the extent the preamble is limiting, the combination of Frojdh and AAPA teaches this claim limitation.

345. For example, Frojdh describes “a method for compression of video signal data...which employs global motion compensation.” Frojdh, [0002]; Frojdh Provisional, 5-6. Frojdh further describes the use of an encoder when performing motion compensation. Frojdh, [0054]; Frojdh Provisional, 12.

346. Furthermore, Figure 1 of the '808 Patent, reproduced below and labeled as prior art shows “an exemplary video encoder.” '808 Patent, 4:44–60 (“FIG. 1 employs a combination of INTRA- and INTER-coding to produce a compressed (encoded) video bit-stream”), 3:61–8:18.

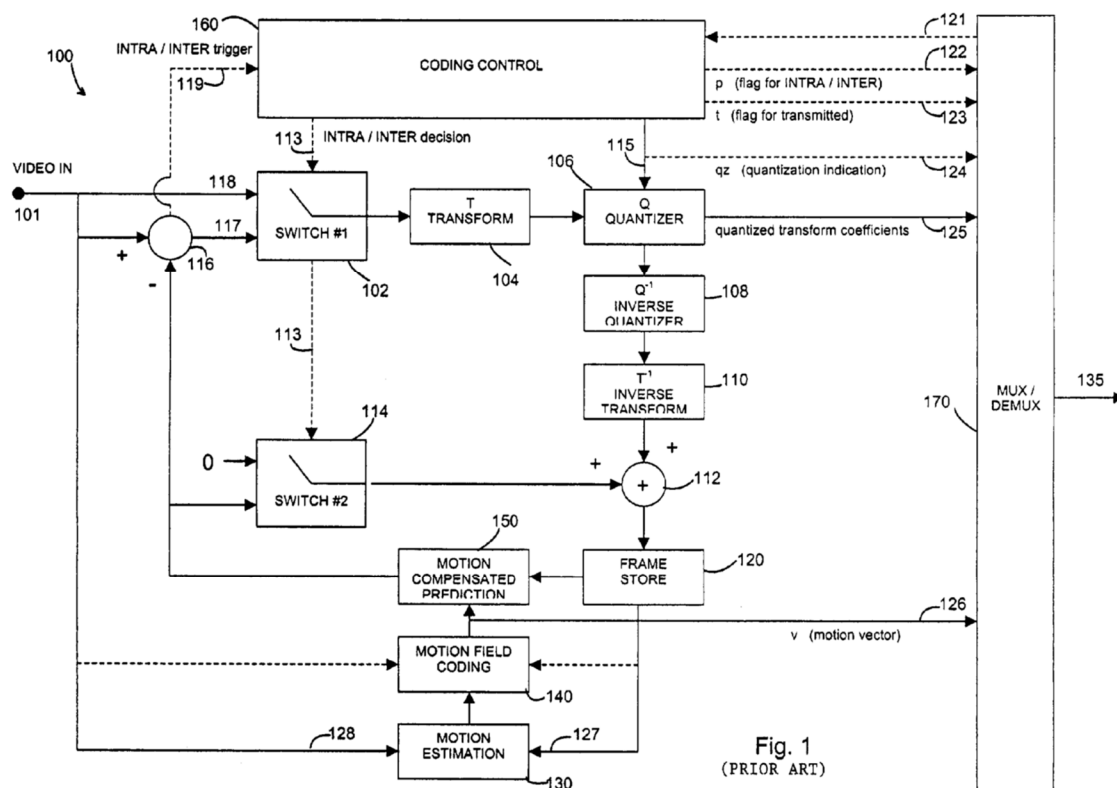


Fig. 1
(PRIOR ART)

'808 Patent, Fig. 1.

(2) 10[a]: a coding controller for assigning a skip coding mode to a first segment;

347. The combination of Frojdh and AAPA teaches this limitation.

348. Figure 1 of the '808 Patent illustrates a "coding control 160" block within the exemplary video encoder, which the '808 patent background also refers to as a "control manager 160." '808 Patent, 3:61-4:6, Figure 1. The '808 Patent background explains that the control manager performs various control functions, including switching the video encoder between INTRA-mode and INTER-mode encoding. '808

Patent, 4:29-56. Because the control manager performs various control functions for the encoder (e.g., controlling the switch between INTRA-mode and INTER-mode encoding), a POSITA would have understood that the described control manager is a “coding controller” as recited by this claim limitation.

349. Furthermore, a POSITA would have been motivated to use the control manager (“coding controller”) to perform the assignment of a skip coding mode, as Frojdh teaches or suggests (as described in Section X.B.2.a(2) (Ground 2A, limitation 1[a])). In particular, since the control manager determines what coding mode to use when encoding a segment, a POSITA would have been motivated use it to apply the skip coding mode to a segment.

(3) 10[b]: a motion estimation block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

350. The combination of Frojdh and AAPA teaches this limitation.

351. Figure 1 of the '808 Patent illustrates a “motion estimation block 130” within the exemplary video encoder, which “produce[s] a motion vector for [a] macroblock.” '808 Patent, 4:1-3, 7:30-60, Figure 1. The combination of Frojdh and AAPA therefore teaches or suggests “a motion estimation block for assigning” a motion vector.

352. Furthermore, a POSITA would have been motivated to use the motion estimation block (as described in the background of the '808 Patent), to assign either a

zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment, as Frojdh teaches or suggests (as described in Section X.B.2.a(3) (Ground 2A, limitation 1[b])). Since the motion estimation block of the '808 Patent background produces a motion vector for a macroblock, a POSITA would have been motivated to use the motion estimation block to assign the zero motion vector or predicted non-zero motion vector.

(4) 10[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector; and

353. The combination of Frojdh and AAPA teaches this limitation.

354. The '808 Patent background describes how “the first step in forming a prediction for a macroblock of the current frame is performed by motion estimation block 130.” '808 Patent, 7:30-32. Therefore, a POSITA would have been motivated to use the motion estimation block to form a prediction based at least in part on an assigned motion vector for the same reasons as discussed in Section X.B.2.a(4) (Ground 2A, limitation 1[c]).

(5) 10[d]: a multiplexer for providing in an encoded bitstream an indication of the skip coding mode, wherein no further motion vector information for the first segment is coded in the encoded bitstream.

355. The combination of Frojdh and AAPA teaches this limitation.

356. In particular, the '808 Patent describes, as background, that “[t]he encoder 100 also comprises a video multiplex coder 170 which forms a single bit-stream from the various types of information produced by the encoder 100 for further transmission to a remote receiving terminal or, for example, for storage on a mass storage medium, such as a computer hard drive (not shown).” ’808 Patent, 4:6–12. This video multiplex coder is labeled “MUX/DEMUX” in Figure 1, which a POSITA would have understood refers to a multiplexer/demultiplexer. Therefore, a POSITA would have understood that the background of the '808 Patent describes a “multiplexer,” as recited by this limitation.

357. Furthermore, as described above, the background of the '808 Patent describes how the multiplexer “forms a single bit-stream from the various types of information produced by the encoder 100 for further transmission to a remote receiving terminal.” ’808 Patent, 4:6–12. Based on the description in the background of the '808 Patent of using the multiplexer to encode into the bitstream various information from the encoder, a POSITA would have been motivated to use the multiplexer to provide in an encoded bitstream an indication of the skip coding mode without coding further motion vector information for the segment (as described in Section X.B.2.a(5) (Ground 2A, limitation 1[d])).

b. Claim 11: An encoder according to claim 10, wherein the second segment is a previously encoded segment neighboring the first segment.

358. The combination of Frojdh and AAPA teaches this claim.

359. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.B.2.b (Ground 2A, claim 2), Frojdh teaches or suggests “the second segment is a previously encoded segment neighboring the first segment.” Therefore, the combination of Frojdh and AAPA teaches or suggests this claim because the combination’s encoder implements Frojdh’s encoding method.

c. Claim 21: A multimedia terminal, comprising an encoder according to claim 10.

360. The combination of Frojdh and AAPA teaches this claim.

361. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the “encoder according to claim 10.”

362. AAPA further discloses or suggests the additional limitations of claim 21. For example, the ’808 Patent discloses, in background, the use of video compression techniques when the available bandwidth is low, such as in videotelephony systems. ’808 Patent, 2:25-34. The ’808 Patent background further explains that these video compression techniques include reducing temporal redundancy, such as through motion-compensated prediction. ’808 Patent, 2:35-46, 3:11-35. Further, the exemplary video encoder described in the ’808 Patent background performs motion-compensated prediction. ’808 Patent, 7:3-4. As I described above, the exemplary video encoder of the ’808 Patent background “receiv[es] a digital video signal from a camera or other video source,” and “employs a combination of INTRA- and INTER-coding to produce

a compressed (encoded) video bit-stream.” ’808 Patent, 3:47-50, 3:61-63.

363. Moreover, using a video encoder in a videotelephony system was not taught by the ’808 Patent background alone. For example, Wang described the use of video coding for video phone applications. Wang, 217.

364. In light of the teachings of AAPA, a POSITA would have found it obvious to use the encoder taught by the Frojdh-AAPA combination in an environment with limited bandwidth, such as in a videotelephony system. A POSITA would further have understood that a videotelephony system is a “multimedia terminal,” as recited by the claim, because it performs the two-way reception and transmission of audio and video signals. The Frojdh-AAPA combination therefore teaches a videotelephony system (“multimedia terminal”) with the encoder taught by the combination.

d. Claim 44

(1) 44[pre]: An encoder according to claim 10, wherein if the second segment has a non-zero motion vector,

365. To the extent the preamble is limiting, the combination of Frojdh and AAPA teaches this claim limitation.

366. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.B.2.c(1) (Ground 2A, limitation 23[pre]), Frojdh teaches or suggests “if the second segment has a non-zero motion vector.” Therefore, the combination of Frojdh and AAPA teaches or suggests this claim limitation because the combination’s encoder

implements Frojdh's encoding method.

(2) 44[a]: the motion estimation block is further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment; and

367. The combination of Frojdh and AAPA teaches this limitation.

368. As described in Section X.B.2.c(2) (Ground 2A, limitation 23[a]), Frojdh teaches or suggests “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.” Therefore, the combination of Frojdh and AAPA teaches or suggests this claim limitation because the combination's encoder implements Frojdh's encoding method. And as described in Section X.D.3.a(3) (Ground 2C, limitation 10[b]), the motion estimation block of the combination of Frojdh and AAPA assigns a zero motion vector or predicted non-zero motion vector. A POSITA would have understood that the motion estimation block of the Frojdh and AAPA combination derives the predicted non-zero motion vector that Frojdh teaches or suggests.

(3) 44[b]: the predicted non-zero motion vector is assigned for the skip coding mode for the first segment; and

369. The combination of Frojdh and AAPA teaches this limitation.

370. As described in Section X.B.2.c(3) (Ground 2A, limitation 23[b]), Frojdh teaches or suggests “the predicted non-zero motion vector is assigned for the skip coding mode of the first segment.” Therefore, the combination of Frojdh and AAPA

teaches or suggests this claim limitation because the combination's encoder implements Frojdh's encoding method.

(4) 44[c]: the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector.

371. The combination of Frojdh and AAPA teaches this limitation.

372. As described in Section X.B.2.c(4) (Ground 2A, limitation 23[c]), Frojdh teaches or suggests "the prediction for the first segment is formed by a motion compensated prediction with respect to the reference frame based at least in part on the predicted non-zero motion vector." Therefore, the combination of Frojdh and AAPA teaches or suggests this claim because the combination's encoder implements Frojdh's encoding method.

e. Claim 47: An encoder according to claim 10, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

373. The combination of Frojdh and AAPA teaches this claim.

374. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the "encoder according to claim 10." And as described in Section X.B.2.d (Ground 2A, claim 28), Frojdh teaches or suggests "deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment." Therefore, the combination of Frojdh and AAPA teaches or suggests this claim because the combination's encoder implements Frojdh's encoding method.

f. Claim 48: An encoder according to claim 10, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

375. The combination of Frojdh and AAPA teaches this claim.

376. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.B.2.e (Ground 2A, claim 29), Frojdh teaches or suggests “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.” Therefore, the combination of Frojdh and AAPA teaches or suggests this claim because the combination’s encoder implements Frojdh’s encoding method.

g. Claim 49: An encoder according to claim 10, wherein no residual information is provided for the first segment in the encoded bitstream.

377. The combination of Frojdh and AAPA teaches this claim.

378. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.B.2.f (Ground 2A, claim 30), Frojdh teaches “wherein no residual information is provided for the first segment in the encoded bitstream.” Therefore, the combination of Frojdh and AAPA teaches this claim because the combination’s encoder implements Frojdh’s encoding method.

4. Claim 16 and Dependents: “A video decoder for decoding an encoded video sequence”

a. Claim 16

(1) 16[pre]: A video decoder for decoding an encoded video sequence, the decoder comprising:

379. To the extent the preamble is limiting, the combination of Frojdh and AAPA teaches this claim limitation.

380. For example, Frojdh describes “a method for compression of video signal data ... which employs global motion compensation.” Frojdh, [0002]; Frojdh Provisional, 5-6. Frojdh further discloses that a decoder is used during motion compensation. Frojdh, [0011]; Frojdh Provisional, 6-7.

381. Furthermore, Figure 2 of the '808 Patent, reproduced below and labeled as prior art shows “a generic video decoder.” '808 Patent, 15:27–29, 8:19–10:22 (“Operation of the video decoder 200, shown in FIG. 2 will now be described. The decoder 200 comprises a video multiplex decoder 270, which receives an encoded video bit-stream 135 from the encoder 100 and demultiplexes it into its constituent parts, an inverse quantizer 210, an inverse DCT transformer 220, a motion compensated prediction block 240, a frame store 250, a combiner 230, a control manager 260, and an output 280.”).

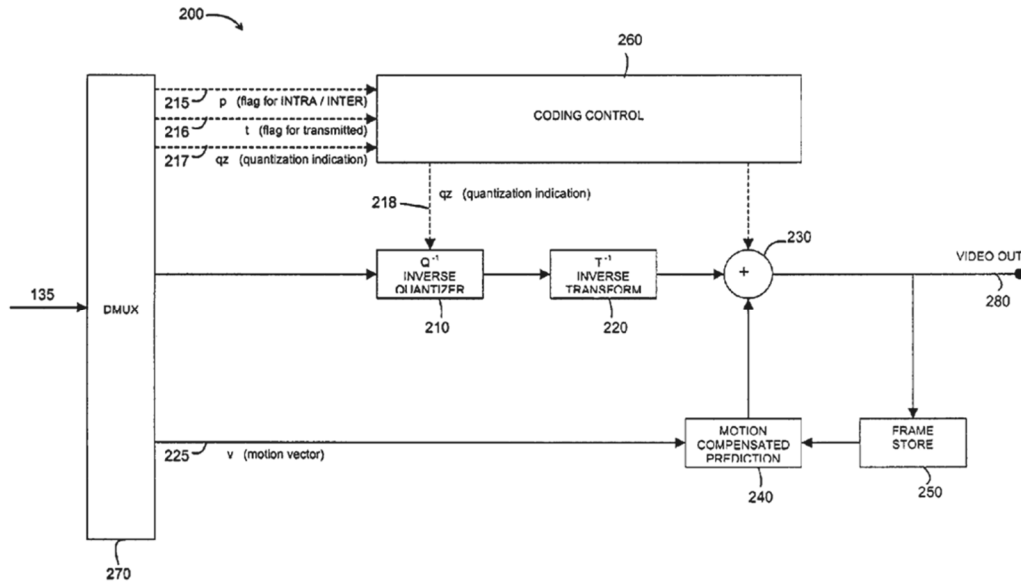


Fig. 2
(PRIOR ART)

'808 Patent. Fig. 1.

382. The combination of Frojdh and AAPA therefore teaches or suggests “[a] video decoder for decoding an encoded video sequence.”

383. Moreover, the '808 Patent background describes how its exemplary video decoder 200 “is arranged to receive and decode the video bit-stream produced by encoder 100 in order to produce a reconstructed video sequence.” '808 Patent, 3:47-52. For example, the '808 Patent background describes how the exemplary video decoder “reconstructs a motion vector for the macroblock using the same motion model as that used to encode the INTER-coded macroblock in encoder 100.” '808 Patent, 9:56-60. Furthermore, a POSITA would have understood that the encoder must form predictions for motion vectors as well as pixel values in a way that can also be performed at the decoder. For this reason, the encoder must itself contain a decoder in

order to obtain reference pictures for use in encoding that will be the same as those that will be used at the decoder. The '808 Patent background illustrates this clearly, where it may be seen that the exemplary video encoder 100 of Fig. 1 contains a decoder (as shown by exemplary video decoder 200, illustrated in Fig. 2). Therefore the exemplary video decoder 200 must implement the same method shown by the decoder path (e.g., blocks 108, 110, 112, 120, and 150) in the exemplary video encoder of Fig. 1. Thus, a POSITA would have understood that the methods performed by the exemplary decoder must match the methods performed by the exemplary encoder. In other words, just as Frojdh describes how its video decoder “reconstructs” a video sequence using information from its encoder (as described in Section X.B.3.a(1) (Ground 2A, limitation 7[pre])), the '808 Patent's exemplary video decoder described in its background also reconstructs a video sequence based on information from its encoder (e.g., the video bit-stream) using the same steps (e.g., the same motion model). The decoder of the Frojdh-AAPA combination therefore performs decoding steps corresponding to those of the combination's encoder and encoding steps, in order to reconstruct, or decode, a video sequence from the output of the combination's encoder.

(2) 16[a]: a demultiplexer for receiving an indication of a skip coding mode assigned to a first segment;

384. The combination of Frojdh and AAPA teaches this limitation.

385. In particular, the '808 Patent discloses, as background, that “[t]he decoder 200 comprises a video multiplex decoder 270, which receives an encoded video bit-

stream 135 from the encoder 100 and demultiplexes it into its constituent parts....” ’808 Patent, 8:19–10:22. This video multiplex decoder is labeled “DMUX” in Figure 2, which a POSITA would have understood refers to a demultiplexer. Therefore, a POSITA would have understood that the background of the ’808 Patent describes a “demultiplexer,” as recited by this limitation.

386. Based on the teaching or suggestion by the combination of Frojdh and AAPA of an encoder “providing in an encoded bitstream an indication of the skip coding mode,” as described in Section X.D.3.a(5) (Ground 2C, limitation 10[d]), and that the combination’s decoder performs steps corresponding to the combination’s encoder (as described in Section X.D.4.a(1) (Ground 2C, limitation 16[pre])), a POSITA would have understood that the combination’s decoder receives an indication of the skip coding mode. And based on the description in the ’808 Patent of the video multiplex decoder as receiving an encoded video bitstream and demultiplexing it into its constituent parts, a POSITA would have been motivated to use the video multiplex decoder for receiving the indication of a skip coding mode assigned to a first segment as the Frojdh and AAPA combination teaches or suggests (and as additionally described in Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) and Section X.B.3.a(2) (Ground 2A, limitation 7[a])).

(3) 16[b]: a motion compensated prediction block for assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment; and

387. The combination of Frojdh and AAPA teaches this limitation.

388. Based on the teaching or suggestion by the combination of Frojdh and AAPA of an encoder “assigning either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment,” as described in Section X.D.3.a(3) (Ground 2C, limitation 10[b]), and that the combination’s decoder performs steps corresponding to the combination’s encoder (as described in Section X.D.4.a(1) (Ground 2C, limitation 16[pre]), a POSITA would have understood that the combination’s decoder assigns either a zero motion vector or a predicted non-zero motion vector for the skip coding mode. Further, Figure 2 of the ’808 Patent includes a “motion compensated prediction block 240,” which “reconstructs a motion vector for the macroblock using the same motion model as that used to encode the INTER-coded macroblock in encoder 100.” ’808 Patent, 8:19-26, 9:56-60, Figure 2. Since the motion compensated prediction block of the ’808 Patent background “reconstructs a motion vector,” a POSITA would have been motivated to use the motion compensated prediction block to assign either a zero motion vector or a predicted non-zero motion vector for the skip coding mode for the first segment based at least in part on the motion information of a second segment neighboring the first segment, as the

Frojdth and AAPA combination teaches or suggests (and as additionally described in Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) and Section X.B.3.a(3) (Ground 2A, limitation 7[b])).

(4) 16[c]: forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector.

389. The combination of Frojdth and AAPA teaches this limitation.

390. Based on the teaching or suggestion by the combination of Frojdth and AAPA of an encoder “forming a prediction for the first segment with respect to a reference frame based at least in part on the assigned motion vector for the skip coding mode, wherein the assigned motion vector is one of the zero motion vector and the predicted non-zero motion vector,” as described in Section X.D.3.a(4) (Ground 2C, limitation 10[c]), and that the combination’s decoder performs steps corresponding to the combination’s encoder (as described in Section X.D.4.a(1) (Ground 2C, limitation 16[pre])), a POSITA would have understood that the combination’s decoder forms a prediction for a first segment with respect to a reference frame. Further, the ’808 Patent background describes that “the motion compensated prediction block 240 forms an array of pixel values for each block of the macroblock by copying corresponding pixel values from the region of pixels identified by the motion vector. The prediction, that is the blocks of pixel values derived from the reference frame, are passed from motion compensated prediction block 240.” ’808 Patent, 10:4-12. A POSITA would have been

motivated to use a motion compensated prediction block (as described in the background of the '808 Patent) to form a prediction for a first segment with respect to a reference frame, as recited by this limitation, as the Frojdh and AAPA combination teaches or suggests (and as additionally described in Section X.B.3.a(1) (Ground 2A, limitation 7[pre]) and Section X.B.3.a(4) (Ground 2A, limitation 7[c])).

b. Claim 22: A multimedia terminal comprising a decoder according to claim 16.

391. The combination of Frojdh and AAPA teaches this claim.

392. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.”

393. AAPA further describes the additional limitations of this claim. As I described in Section X.D.3.c (Ground 2C, claim 21), the '808 Patent background describes using video compression (such as motion-compensated prediction) in videotelephony systems, and in combination with Frojdh teaches or suggests a videotelephony system that includes the combination's encoder. The '808 Patent background additionally describes that its exemplary video decoder “is arranged to receive and decode the video bit-stream produced by encoder 100 in order to produce a reconstructed video sequence.” '808 Patent, 3:47-52. The exemplary video decoder includes a motion compensated prediction block, which “us[es] the same motion model as that used to encode the INTER-coded macroblock in encoder 100.” '808 Patent, 8:20-26, 9:56-60.

394. Just as a POSITA would have found it obvious to include a video encoder of the Frojdh-AAPA combination in a videotelephony system (e.g., to provide video compression, including motion-compensated prediction, due to bandwidth limitations) (as described in Section X.D.3.c (Ground 2C, claim 21)), a POSITA would similarly have found it obvious to include the combination's video decoder in the videotelephony system. Including a video decoder of the Frojdh-AAPA combination in a videotelephony system would be obvious to a POSITA to, for example, decode encoded video received from a videotelephony system with the combination's encoder (e.g., a receiving telephony system and transmitting telephony system, respectively).

395. A POSITA would further have understood that a videotelephony system is a "multimedia terminal," as recited by the claim, because it performs the two-way reception and transmission of audio and video signals. The Frojdh-AAPA combination therefore teaches a videotelephony system ("multimedia terminal") with the decoder taught by the combination.

c. Claim 58: A decoder according to claim 16, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.

396. I note that independent claim 16 recites "[a] decoder comprising: ... a motion compensated prediction block." This claim, which depends from claim 16, recites "the motion estimation block," although no "motion estimation block" is introduced in claim 16 or elsewhere in this claim. I understand that this reference to

“the motion estimation block” in claim 58 may render the claim indefinite. To the extent this claim is found to not be indefinite, a POSITA would have understood that the limitations attributed to “the motion estimation block,” as recited in the claim, would have been performed by the “motion compensated prediction block” recited in claim 16.

397. To the extent claim 58 is not indefinite for the reasons described above, the combination of Frojdh and AAPA teaches this claim.

398. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.” As additionally described in Section X.D.3.e (Ground 2C, claim 47), the combination of Frojdh and AAPA teaches or suggests an encoder “arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment.” And as described in Section X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination of Frojdh and AAPA teaches or suggests that the combination’s decoder performs steps corresponding to the combination’s encoder. Therefore the combination of Frojdh and AAPA teaches or suggests a decoder arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment. And since the motion compensated prediction block of the ’808 Patent background “reconstructs a motion vector” (as described in X.D.4.a(3) (Ground 2C, limitation 16[b])), a POSITA would have been motivated to use the motion compensated prediction block to “deriv[e]

the predicted non-zero motion vector based at least in part on the motion vector of the second segment.” Further, as described in Section X.B.3.c (Ground 2A, claim 39), Frojdh teaches or suggests “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment.” Therefore, the combination of Frojdh and AAPA further teaches this claim because the combination’s decoder implements Frojdh’s decoding method.

d. Claim 59: A decoder according to claim 16, wherein the motion estimation block further arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.

399. Claim 59 recites “the motion estimation block,” which I understand may render the claim indefinite for the same reasons described above in Section X.D.4.c (Ground 2C, claim 58). To the extent this claim is found to not be indefinite, a POSITA would have understood that the limitations attributed to “the motion estimation block,” as recited in the claim, would have been performed by the “motion compensated prediction block” recited in claim 16.

400. To the extent claim 59 is not indefinite for the reasons described above, the combination of Frojdh and AAPA teaches this claim.

401. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.” As additionally described in Section X.D.3.f (Ground 2C, claim 48), the combination of Frojdh and AAPA teaches or suggests an encoder “arranged to derive the predicted non-zero

motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.” And as described in Section X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination of Frojdh and AAPA teaches or suggests that the combination’s decoder performs steps corresponding to the combination’s encoder. Therefore the combination of Frojdh and AAPA teaches or suggests a decoder arranged to derive the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment. And since the motion compensated prediction block of the ’808 Patent background “reconstructs a motion vector” (as described in X.D.4.a(3) (Ground 2C, limitation 16[b])), a POSITA would have been motivated to use the motion compensated prediction block to “deriv[e] the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.” Further, as described in Section X.B.3.d (Ground 2A, claim 40), Frojdh teaches or suggests “deriving the predicted non-zero motion vector based at least in part on the motion vector of the second segment and motion vector of a third segment neighboring the first segment.” Therefore, the combination of Frojdh and AAPA further teaches this claim because the combination’s decoder implements Frojdh’s decoding method.

e. Claim 60: A decoder according to claim 16, wherein no residual information is provided for the first segment in an encoded bitstream.

402. The combination of Frojdh and AAPA teaches this claim.

403. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.” As additionally described in X.D.3.g (Ground 2C, claim 49), the combination of Frojdh and AAPA teaches or suggests an encoder “wherein no residual information is provided for the first segment in the encoded bitstream.” And as described in Section X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination of Frojdh and AAPA teaches or suggests that the combination’s decoder performs steps corresponding to the combination’s encoder. Therefore the combination of Frojdh and AAPA teaches or suggests a decoder, “wherein no residual information is provided for the first segment in an encoded bitstream.” And as further described in Section X.B.3.e (Ground 2A, claim 41), Frojdh teaches or suggests “wherein no residual information is provided for the first segment in the encoded bitstream.” Therefore, the combination of Frojdh and AAPA further teaches this claim because the combination’s decoder implements Frojdh’s decoding method.

f. Claim 64: A decoder according to claim 16, wherein no further motion vector information for the first segment is retrieved from an encoded bitstream.

404. The combination of Frojdh and AAPA, teaches this claim.

405. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.” As additionally described in Section X.D.3.a(5) (Ground 2C, limitation 10[d]), the combination of Frojdh and AAPA teaches an encoder “wherein no further motion vector information

for the first segment is coded in the encoded bitstream.” And as described in Section X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination of Frojdh and AAPA teaches or suggests that the combination’s decoder performs steps corresponding to the combination’s encoder. Therefore the combination of Frojdh and AAPA teaches or suggests a decoder, “wherein no further motion vector information for the first segment is retrieved from an encoded bitstream.” As further described in Section X.B.3.f (Ground 2A, claim 65), Frojdh further teaches decoding “wherein no further motion vector information for the first segment is retrieved from the encoded bitstream.” The combination of Frojdh and AAPA therefore further teaches this claim because the combination’s encoder performs the same steps as the combination’s decoder.

E. Ground 2D: Obviousness over Frojdh in view of AAPA and H.263 (Claims 15, 20, 51-54, 62, and 63)

1. Motivation to combine Frojdh, AAPA, and H.263

406. A POSITA would have been motivated to combine the teachings of H.263 with the Frojdh-AAPA combination for the same reasons as discussed in Section X.C.2 (Ground 2B, Motivation to combine Frojdh and H.263) and Section X.D.2 (Ground 2C, Motivation to combine Frojdh and AAPA).

407. That is, for the same reasons as discussed in Section X.C.2 (Ground 2B, Motivation to combine Frojdh and H.263), a POSITA would have been motivated to combine Frojdh’s IGMCM as a “new mode” of H.263. And as discussed in Section X.D.2 (Ground 2C, Motivation to combine Frojdh and AAPA), a POSITA would have been

motivated to combine AAPA's teachings of an exemplary video encoder and video decoder with Frojdh's video coding and decoding methods. Therefore, a POSITA would have been motivated to combine the exemplary video encoder and decoder of AAPA with Frojdh's IGMC "new mode" of H.263.

408. Further, a POSITA would have had a reasonable expectation of success combining H.263 with the Frojdh-AAPA combination. A POSITA would have recognized that Frojdh's techniques could be readily incorporated into H.263 without altering its core functionality, utilizing the exemplary video encoder and decoder of AAPA, and that the combination would yield predictable results. Further, the combination would be well within the capabilities of a POSITA, because it would merely require modifying the H.263 encoder and decoder behavior with regard to interpretation of the "COPY (aka SKIP) mode," according to Frojdh's teachings, to implement IGMC within H.263 (as discussed in Section X.C.2, Ground 2B, Motivation to combine Frojdh and H.263), and carrying out those encoder and decoder behavior using the exemplary video encoder and decoder of AAPA, respectively.

2. Claim 15: An encoder according to claim 10, wherein if a segment in a region surrounding the first segment has zero motion vector, the encoder is arranged to assign the zero motion vector for the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

409. The combination of Frojdh, H.263, and AAPA teaches this claim.

410. As described in Section X.D.3.a (Ground 2C, claim 10), the combination

of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.C.3 (Ground 2B, claim 6), the combination of Frojdh and H.263 teaches “if the second segment has zero motion vector, the zero motion vector is assigned for skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.”

411. Further, as described in Sections X.B.2.a(3) (Ground 2A, limitation 1[b]) and X.D.3.a(3) (Ground 2C, limitation 10[b]), Frojdh teaches “a second segment neighboring the first segment.” As additionally described in Section X.C.6 (Ground 2B, claim 9), the ’808 Patent defines that a first macroblock neighboring a second macroblock is in a “region surrounding” the second macroblock. Therefore, a “second segment neighboring the first segment,” as taught or suggested by Frojdh, is “a segment in a region surrounding the first segment,” as recited by the claim. Thus, Frojdh additionally teaches or suggests, for the same reasons as described above, that the recited second segment is “in a region surrounding the first segment,” as recited by this claim.

412. Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim because the combination’s encoder implements the combination’s encoding method.

3. Claim 51: An encoder according to claim 10, wherein if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

413. The combination of Frojdh, H.263, and AAPA teaches this claim.

414. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.E.2 (Ground 2D, claim 15), the combination of Frojdh and H.263 teaches “wherein if a segment in a region surrounding the first segment has zero motion vector, the encoder is arranged to assign the zero motion vector for the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim because a POSITA would have understood the “second segment” of this claim is a “segment in a region surrounding the first segment” as recited in claim 15.

4. Claim 52: An encoder according to claim 10, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

415. The combination of Frojdh, H.263, and AAPA teaches this claim.

416. As described in Section X.D.3.a (Ground 2C, claim 10), the combination

of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.C.4 (Ground 2B, claim 24), the combination of Frojdh and H.263 teaches “wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim because the combination’s encoder implements the combination’s encoding method.

5. Claim 53: An encoder according to claim 10, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

417. The combination of Frojdh, H.263, and AAPA teaches this claim.

418. As described in Section X.D.3.a (Ground 2C, claim 10), the combination of Frojdh and AAPA teaches the “encoder according to claim 10.” And as described in Section X.C.5 (Ground 2B, claim 25), the combination of Frojdh and H.263 teaches “wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector

is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim because the combination’s encoder implements the combination’s encoding method.

6. Claim 20: A decoder according to claim 16, wherein if a segment in a region surrounding the first segment has zero motion vector, the zero motion vector is assigned for the skip coding mode of the first segment, and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

419. The combination of Frojdh, H.263, and AAPA teaches this claim.

420. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.” As described in X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination’s decoder performs steps corresponding to the combination’s encoder. And as described in Section X.E.2 (Ground 2D, claim 15), the combination of Frojdh, H.263, and AAPA teaches an encoder “wherein if a segment in a region surrounding the first segment has zero motion vector, the encoder is arranged to assign the zero motion vector for the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.”

421. Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim

because the combination's decoder performs steps corresponding to the combination's encoder.

7. Claim 54: A decoder according to claim 16, wherein if the second segment has a zero motion vector, the zero-motion vector is assigned to the skip coding mode for the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

422. The combination of Frojdh, H.263, and AAPA teaches this claim.

423. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.” As described in X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination's decoder performs steps corresponding to the combination's encoder. And as described in Section X.E.3 (Ground 2D, claim 51), the combination of Frojdh, H.263, and AAPA teaches an encoder “wherein if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” As further described in Section X.C.7 (Ground 2B, claim 32), the combination of Frojdh and H.263 teaches a decoding method where “if the second segment has a zero motion vector, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.”

424. Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim because the combination's decoder performs steps corresponding to the combination's encoder. And the combination further teaches this claim because the combination's decoder implements the Frojdh-H.263 combination's decoding method.

8. Claim 62: A decoder according to claim 16, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

425. The combination of Frojdh, H.263, and AAPA teaches this claim.

426. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the "decoder according to claim 16." As described in X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination's decoder performs steps corresponding to the combination's encoder. And as described in Section X.E.4 (Ground 2D, claim 52), the combination of Frojdh, H.263, and AAPA teaches an encoder "wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector." And further as described in Section X.C.8 (Ground 2B, claim 36), the combination of Frojdh and H.263 teaches a decoding method "wherein if the second segment has a zero motion vector and the

second segment is predicted using motion-compensated prediction from the reference picture, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim because the combination’s decoder performs steps corresponding to the combination’s encoder. And the combination further teaches this claim because the combination’s decoder implements the Frojdh-H.263 combination’s decoding method.

9. Claim 63: A decoder according to claim 16, wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.

427. The combination of Frojdh, H.263, and AAPA teaches this claim.

428. As described in Section X.D.4.a (Ground 2C, claim 16), the combination of Frojdh and AAPA teaches the “decoder according to claim 16.” As described in X.D.4.a(1) (Ground 2C, limitation 16[pre]), the combination’s decoder performs steps corresponding to the combination’s encoder. As described in Section X.E.5 (Ground 2D, claim 53), the combination of Frojdh, H.263, and AAPA teaches an encoder “wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture

immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” And as described in Section X.C.9 (Ground 2B, claim 43), the combination of Frojdh and H.263 teaches a decoding method “wherein if the second segment has a zero motion vector and the second segment is predicted using motion-compensated prediction from a second reference picture immediately preceding the picture second segment belongs to, the zero motion vector is assigned to the skip coding mode of the first segment and the prediction for the first segment is formed with respect to a corresponding segment of the reference frame associated with the zero motion vector.” Therefore, the combination of Frojdh, H.263, and AAPA teaches this claim because the combination’s decoder performs steps corresponding to the combination’s encoder. And the combination further teaches this claim because the combination’s decoder implements the Frojdh-H.263 combination’s decoding method.

XI. CONCLUSION

429. I currently hold the opinions expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

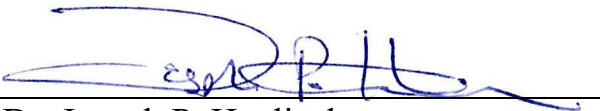
430. I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct to the best of my knowledge. I

understand that willful false statements are punishable by fine or imprisonment or both.

See 18 U.S.C. § 1001.

Date: May 10, 2024

By:

A handwritten signature in blue ink, appearing to read "Dr. J. P. Havlicek", is written over a horizontal line.

Dr. Joseph P. Havlicek