UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

DYNAMIC DATA TECHNOLOGIES, LLC, ***Plaintiff,*** v. **APPLE INC.,** ***Defendant.***	**Civil Action No. 2-18-cv-00464-RWS** **JURY TRIAL DEMANDED**

FIRST AMENDED COMPLAINT FOR PATENT INFRINGEMENT

Dynamic Data Technologies, LLC ("Dynamic Data") brings this action and makes the following allegations of patent infringement relating to U.S. Patent Nos.: 8,135,073 (the "'073 patent"); 6,714,257 (the "'257 patent"); 8,073,054 (the "'054 patent"); 6,774,918 (the "'918 patent"); 8,184,689 (the "'689 patent"); 6,996,177 (the "'177 patent"); 8,311,112 (the "'112 patent"); 6,646,688 (the "'688 patent"); 7,894,529 (the "'529 patent"); 7,542,041 (the "'041 patent"); 7,571,450 (the "'450 patent"); 7,982,799 (the "'799 patent"); and 6,996,175 (the "'175 patent) (collectively, the "patents-in-suit"). Defendant Apple Inc. ("Apple" or "Defendant") infringes each of the patents-in-suit in violation of the patent laws of the United States of America, 35 U.S.C. § 1 *et seq*.

CO-PENDING ENFORCEMENT PROCEEDINGS IN EUROPE AND THE PEOPLE'S REPUBLIC OF CHINA

1. Dynamic Data's portfolio of over 1,200 patent assets encompasses core technologies in the field of image and video processing. The patent portfolio held by Dynamic Data is international in scope and includes several hundred European and Chinese patent grants.

2. In an effort to facilitate the licensing of Philips' foundational technology, Dynamic Data is pursuing remedies for infringement of its patents in venues throughout the world. Simultaneous to the filing of its Original Complaint in this matter, Dynamic Data filed a patent enforcement action against Apple Retail Germany B.V. & Co. KG, Apple Distribution International, and Apple, Inc. in Düsseldorf, Germany.[1] Dynamic Data is represented by the law firm Weitnauer Rechtsanwälte of Berlin, Germany in its European enforcement actions.

3. Contemporaneous to the filing of this First Amended Complaint, Dynamic Data is filing patent enforcement actions against Apple Computer Trading (Shanghai) Co., Ltd. and Apple Electronic Products Trading (Beijing) Co., Ltd. in the Beijing Specialized Intellectual Property Tribunal in the People's Republic of China. Dynamic Data is seeking injunctive relief relating to the sale of products containing Apple's A10 Fusion, A11 Bionic, A12 Bionic, and A12X Bionic system on chips ("SoC"). In its People's Republic of China enforcement actions Dynamic Data is represented by Bisheng Shi and Cliff Yang of the Zhong Lun law firm.

4. In addition to ensuring that its intellectual property is appropriately licensed, Dynamic Data has expanded its portfolio of motion estimation and motion compensation patents. On November 19, 2018, Dynamic Data acquired a further set of 85 patent assets from NXP B.V. relating to motion estimation and motion compensation.

5. Dynamic Data's patents arose from the research and development efforts of Koninklijke Philips N.V. ("Philips"). Founded in 1891, for well over a century, Philips pioneered ground breaking technologies, including compact audio cassettes, magnetic resonance imaging (MRI) machines, and compact discs.

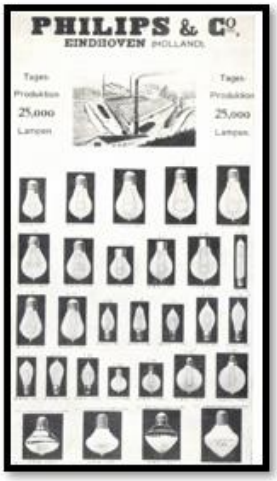
[1] *See* In der Zivilsache Dynamic Data Technologies LLC gegen Apple Retail Germany B.V. & Co. KG u.a., AktNr: 010470-18.

6. The groundbreaking inventions in image and video processing taught in the patents-in-suit were pioneered by Philips. Video and image processing were at the heart of Philips' business for over fifty years. In 1891, Philips, then known as Philips & Company, was founded in Eindhoven, Netherlands to manufacture carbon-filament lamps.[2] In the 1920s, Philips began to produce vacuum tubes and small radios, which would augur Philips' later entry into video and audio processing.

N.A. Halbertsma, *The Birth of a Lamp Factory In 1891*, PHILIPS TECHNICAL REVIEW, Vol. 23 at 230, 234 (1961).

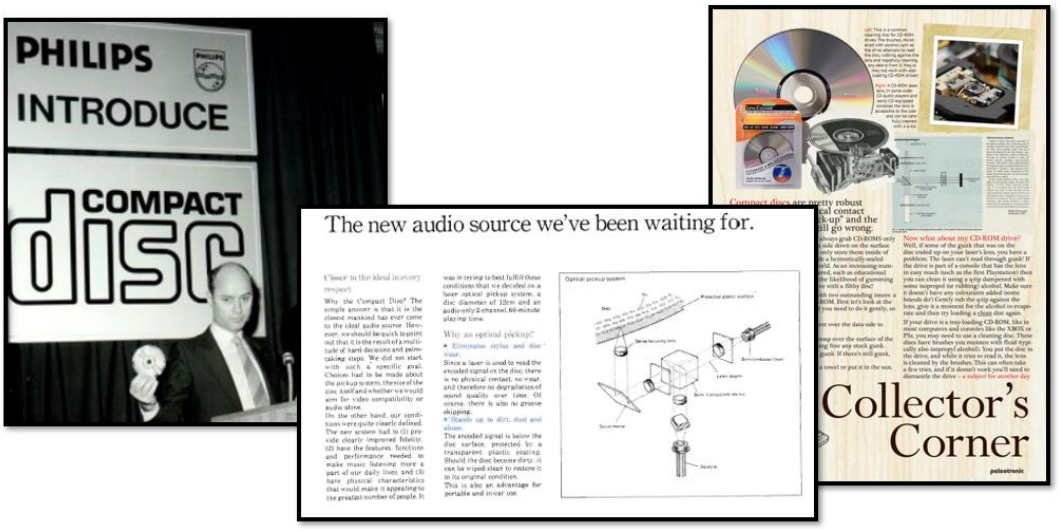
7. In 1962, Philips introduced the first audio cassette tape.[3] A year later, Philips launched a small battery-powered audio tape recorder that used a cassette instead of a loose spool.[4] Philips C-cassette was later used as the first mass storage device for early personal computers in the 1970s and 1980s.

[2] Gerard O'Regan, A BRIEF HISTORY OF COMPUTING at 99 (2012).
[3] Gerard O'Regan, PILLARS OF COMPUTING: A COMPENDIUM OF SELECT, PIVOTAL TECHNOLOGY FIRMS at 172 (2015) ("Philips invented the compact cassette for audio storage in 1962.")
[4] Anthony Pollard, GRAMOPHONE: THE FIRST 75 YEARS at 231 (1998).



THE ROTARIAN MAGAZINE, Vol. 101 No. 6 at 70 (December 1962) (advertisement showing Philips Norelco device which used cassettes for recording audio for transcription); Fred Chandler, *European Mfrs. Bid For Market Share*, BILLBOARD MAGAZINE AT P-6 (April 8, 1967) (image of the Philips EL 3300 battery-operated tape recorder which was released in 1963); Jan Syrjala, *Car Stereo: How Does The Music Sound?*, N.Y. TIMES at 2-M (September 25, 1966) (showing Philips's Norelco Cassette "the Philips device has two tiny reels inside it, with the tape traveling from one to the other").

8. In 1971, Philips demonstrated the world's first videocassette records (VCR). A year later, Philips launched the world's first home video cassette recorder, the N1500. In 1982, Philips teamed with Sony to launch the Compact Disc; this format evolved into the DVD and later Blu-ray, which Philips launched with Sony in 1997 and 2006 respectively.



Hans Peek, Jan Bergmans, Jos Van Haaren, Frank Toolenaar, and Sorin Stan, ORIGINS AND SUCCESSORS OF THE COMPACT DISC: CONTRIBUTIONS OF PHILIPS TO OPTICAL STORAGE at 15 (2009) (showing image of Joop Sinjou of Philips introducing the compact disc in March 1979); Advertisements for Philip's Compact Disc Products (1982).

9. In the late 1990s and early 2000s, Philips pioneered the development of technologies for encoding and decoding of video and audio content. At the time most of the technologies claimed by the patents in Dynamic Data's portfolio were invented, Philips' subsidiary primarily responsible for Philips' work in this field, Philips Semiconductor was the world's sixth largest semiconductor company.[5] The video encoding technologies developed by Philips Semiconductor enable video streaming on set-top boxes, smartphones, popular gaming consoles, Internet-connected computers, and numerous other types of media streaming devices.

10. Philips Semiconductor dedicated significant research and development resources to advancing the technology of video compression and transmission by reducing file sizes and

[5] *Company News; Philips in $1 Billion Deal for VLSI Technology*, THE NEW YORK TIMES (May 4, 1999), *available at*: https://www.nytimes.com/1999/05/04/business/company-news-philips-in-1-billion-deal-for-vlsi-technology.html.

decreasing the processing resources required to transmit the data.[6] Philips Semiconductor was among the first companies aggressively driving innovation in the field of video processing:

> The late 1980s and early 1990s saw the announcement of several complex, programmable VSPs. Important examples include chips from Matsushita, NTT, Philips [Semiconductors], and NEC. All of these processors were high-performance parallel processors architected from the ground up for real-time video signal processing. . . . The Philips VSP-1 and NEC processor were probably the most heavily used of these chips.[7]

11. Starting in the 1960s Philips pioneered the development of audio and video technologies that would establish itself as a leader in the field that would later develop into the audio and video encoding fields. Continuing Philips' pioneering history in these fields, the patents-in-suit disclose cutting-edge video compression and transmission technologies.

12. Dynamic Data's patent portfolio includes over 1,200 patent assets, with over 470 issued patents granted by patent offices around the world. Dynamic Data owns numerous patents issued by the United States Patent and Trademark Office, including each of the patents-in-suit, The State Intellectual Property Office of the People's Republic of China,[8] the European Patent Office,[9] the German Patent and Trademark Office,[10] the Japan Patent Office,[11] and many other national patent offices.

13. Philips Semiconductor's pioneering work in the area of video processing and encoding has resulted in various inventions that are fundamental to today's video processing

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[6] HU, YU HEN, PROGRAMMABLE DIGITAL SIGNAL PROCESSORS: ARCHITECTURE, PROGRAMMING, AND APPLICATIONS, at 190 (Dec. 6, 2001) ("Philips Semiconductors developed early dedicated video chips for specialized video processors.").
[7] *Id.* at 191.
[8] *See, e.g.*, CN100504925C; CN100438609C; CN1679052B; CN1333373C; CN1329870C; CN1303818C.
[9] *See, e.g.*, European Patent Nos. EP1032921B1; EP1650978B1; EP1213700B1; EP1520409B1.
[10] *See, e.g.*, German Patent Nos. DE60120762; DE50110537; DE60126151; DE60348978; DE602004049357.
[11] *See, e.g.*, Japanese Patent Nos. JP4583924B2; JP5059855B2; JP5153336B2; JP4637585B2.

technologies. Dynamic Data is the owner by assignment of over 1,200 of these patent assets, which include over 475 patents issued by patent offices around the world.

14. Highlighting the importance of the patents-in-suit is the fact that the patents-in-suit have been cited by over 400 U.S. and international patents and patent applications by a wide variety of the largest companies operating in the field. For example, the patents-in-suit have been cited by companies such as:

- Samsung Electronics Co., Ltd.[12]
- Qualcomm Inc.[13]
- Google LLC[14]
- Intel Corporation[15]
- Broadcom Corporation[16]
- Microsoft Corporation[17]
- Sony Corporation[18]
- Fujitsu Ltd.[19]
- Panasonic Corporation[20]
- Matsushita Electric Industrial Company Limited[21]

[12] *See, e.g.*, U.S. Patent Nos. 6,930,729; 7,911,537; 7,532,764; 8,605,790; and 8,095,887.
[13] *See, e.g.*, U.S. Patent Nos. 7,840,085; 8,649,437; 8,750,387; 8,918,533; 9,185,439; 9,209,934; 9,281,847; 9,319,448; 9,419,749; 9,843,844; 9,917,874; and 9,877,033.
[14] *See, e.g.*, U.S. Patent No. 8,787,454 and U.S. Patent Appl. No. 10/003,793.
[15] *See, e.g.*, U.S. Patent Nos. 7,554,559; 7,362,377; and 8,462,164.
[16] *See, e.g.*, U.S. Patent Nos. 8,325,273 and 9,377,987.
[17] *See, e.g.*, U.S. Patent Nos. 7,453,939; 7,670,227; 7,408,986; 7,421,129; 7,558,320; and 7,929,599.
[18] *See, e.g.*, U.S. Patent Nos. 7,218,354 and 8,174,615.
[19] *See, e.g.*, U.S. Patent Nos. 7,092,032 and 8,290,308.
[20] *See, e.g.*, U.S. Patent Nos. 8,164,687 and 8,432,495.
[21] *See, e.g.*, U.S. Patent Nos. 7,362,378 and 7,423,961.

THE PARTIES

DYNAMIC DATA TECHNOLOGIES, LLC

15. Dynamic Data Technologies, LLC ("Dynamic Data" or "Plaintiff") is a limited liability company organized under the laws of Delaware.

16. In an effort to obtain compensation for Philips' pioneering work in the fields of video data encoding, decoding, and transmission, Dynamic Data acquired the patents-in-suit along with the several hundred additional issued United States and international Patents.

17. Dynamic Data pursues the reasonable royalties owed for Apple's use of the inventions claimed in Dynamic Data's patent portfolio, which primarily arise from Philips' groundbreaking technology, both here in the United States and throughout the world.

APPLE INC.

18. On information and belief, Apple Inc. ("Apple"), is a California corporation with its principal place of business at 1 Infinite Loop, Cupertino, California 95014. Apple may be served through its registered agent CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201. On information and belief, Apple is registered to do business in the State of Texas, and maintains offices and facilities throughout the Eastern District of Texas and the State of Texas, including a facility in Austin, Texas employing more than 5,000 employees.

19. On information and belief, Apple conducts business operations within the Eastern District of Texas in its facilities at 6121 West Park Boulevard, Plano, Texas 75093 and 2601 Preston Road, Frisco, Texas 75034.

20. On information and belief, Apple has sells and markets its products within the Eastern District of Texas, including the products accused of infringing the patents-in-suit, from its retail location in Plano and Frisco.

21. On information and belief, Apple has entered into contracts with the State of Texas valued at several hundred thousand dollars.

JURISDICTION AND VENUE

22. This action arises under the patent laws of the United States, Title 35 of the United States Code. Accordingly, this Court has exclusive subject matter jurisdiction over this action under 28 U.S.C. §§ 1331 and 1338(a).

23. Upon information and belief, this Court has personal jurisdiction over Apple in this action because Apple has committed acts within the Eastern District of Texas giving rise to this action and has established minimum contacts with this forum such that the exercise of jurisdiction over Apple would not offend traditional notions of fair play and substantial justice. Apple, directly and/or through subsidiaries or intermediaries (including distributors, retailers, and others), has committed and continues to commit acts of infringement in this District by, among other things, offering to sell and selling products and/or services that infringe the patents-in-suit. Moreover, Apple is registered to do business in the State of Texas, has offices and facilities in the State of Texas and the Eastern District of Texas, and actively directs its activities to customers located in the State of Texas.

24. On information and belief, Apple has directly financially benefitted from doing business with the State of Texas. For example, Apple has entered into contract (DIR-TSO-3789) with the State of Texas whereby Apple is paid by the State of Texas to provide Apple products and related services.

25. Venue is proper in this district under 28 U.S.C. §§ 1391(b)-(d) and 1400(b). Defendant Apple is registered to do business in the State of Texas, has facilities in the State of Texas and the Eastern District of Texas, and upon information and belief, has transacted business

in the Eastern District of Texas and has committed acts of direct and indirect infringement in the Eastern District of Texas. Apple maintains regular and established places of business within the Eastern District of Texas located at 6121 West Park Boulevard, Plano, Texas 75093 and 2601 Preston Road, Frisco, Texas 75034.

THE ASSERTED PATENTS

U.S. PATENT NO. 8,135,073

26. U.S. Patent No. 8,135,073 (the "'073 patent") entitled, *Enhancing Video Images Depending On Prior Image Enhancements*, was filed on December 12, 2003, and claims priority to December 19, 2002. The '073 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,799 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '073 patent. A true and correct copy of the '073 patent is attached hereto as Exhibit 1.

27. The '073 patent discloses novel methods and systems for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation.

28. The inventions disclosed in the '073 patent reduce the processing capacity required for providing video enhancements to video processing through re-mapping of previous frames for subsequent frames.

29. Accordingly, the technologies disclosed in the '073 patent enable the provision of enhanced video pictures with minimal additional hardware costs for the components required to successfully process the video data.

30. The '073 patent discloses a video decoder comprising an input for receiving a video stream containing encoded frame-based video information including an encoded first frame and an encoded second frame.

31. The ‘073 patent discloses a video decoder comprising an input for receiving video information wherein the encoding of the second frame depends on the encoding of the first frame, the encoding of the second frame includes motion vectors indicating differences in positions between regions of the second frame and corresponding regions of the first frame, the motion vectors define correspondence between regions of the second frame and corresponding regions of the first frame.

32. The ‘073 patent discloses a video decoder comprising a decoding unit for decoding the frames, wherein the decoding unit recovers the motion vectors for the second frame.

33. The ‘073 patent discloses a video decoder comprising a processing component configured to determine a re-mapping strategy for video enhancement of the decoded first frame using a region-based analysis, re-map the first frame using the re-mapping strategy, and re-map one or more regions of the second frame depending on the re-mapping strategy for corresponding regions of the first frame.

34. The ‘073 patent and its underlying patent application have been cited by 36 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘073 patent and its underlying patent application as relevant prior art:

- Canon Inc.
- Microsoft Corporation
- International Business Machines Corporation
- Qualcomm Inc.
- Digital Fountain Incorporated
- Samsung Electronics Co., Ltd.
- SK Planet Co. Ltd.

U.S. PATENT NO. 6,714,257

35. U.S. Patent No. 6,714,257 (the “‘257 patent”) entitled, *Color Key Preservation During Sample Rate Conversion*, was filed on June 29, 2001. The ‘257 patent is subject to a 35

U.S.C. § 154(b) term extension of 445 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '257 patent. A true and correct copy of the '257 patent is attached hereto as Exhibit 2.

36. The '257 patent claims specific methods and systems for processing a keyed image. For example, one or more of the '257 patent claims describe a method for scaling a keyed image where a key-only image corresponding to key regions in the keyed images is created. The key-only image is scaled to form a scaled key-only image. The keyed image is scaled for form a scaled keyed image, and the scaled key-only image is merged with the scaled keyed image.

37. The '257 patent discloses additional improvements to scaling and filtering color-keyed images.

38. The inventions taught in the '257 patent achieve improvements in scaling and filtering color-keyed images by allowing the replacement of color-keyed regions with background image information, without introducing visible artifacts.

39. The '257 patent discloses embodiments that extract the color-keyed regions from a color-keyed image, and independently scale the color-keyed regions and the non-color keyed regions.

40. The '257 patent discloses that blurring of edges in non-color-key regions are minimized by extending the non-color-key colors into color-keyed regions after the color-keyed information is extracted from the color-keyed image.

41. The '257 patent has been cited by several United States and International patents and patent applications as relevant prior art. Specifically, patents issued to Microsoft Corporation, Texas Instruments Incorporated, Samsung Corporation, Marvell International Limited, Innolux

Corporation, and China Digital Video (Beijing) Limited have all cited the '257 patent as relevant prior art.

U.S. PATENT NO. 8,073,054

42. U.S. Patent No. 8,073,054 (the "'054 patent") entitled, *Unit For And Method Of Estimating A Current Motion Vector*, was filed on December 12, 2002, and claims priority to January 17, 2002. The '054 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,162 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '054 patent. A true and correct copy of the '054 patent is attached hereto as Exhibit 3.

43. The '054 patent discloses novel methods and apparatuses for estimating a current motion vector for a group of pixels of an image.

44. The inventions disclosed in the '054 patent enable motion estimation with a relatively fast convergence in finding the appropriate motion vectors of the motion vector fields by adding a further candidate motion vector to the set of candidate motion vectors.

45. The '054 patent discloses a motion estimation unit comprising a generating unit for generating a set of candidate motion vectors for the group of pixels, with the candidate motion vectors being extracted from a set of previously estimated motion vectors.

46. The '054 patent discloses a motion estimation unit comprising a match error unit for calculating match errors of respective candidate motion vectors.

47. The '054 patent discloses a motion estimation unit comprising a selector for selecting the current motion vector from the candidate motion vectors by means of comparing the match errors of the respective candidate motion vectors, characterized in that the motion estimation unit is arranged to add a further candidate motion vector to the set of candidate motion vectors by

calculating the further candidate motion vector on basis of a first motion vector and a second motion vector, both belonging to the set of previously estimated motion vectors.

48. The '054 patent discloses a motion estimation unit that calculates the further candidate motion vector on basis of the first motion vector and the second motion vector, with the first motion vector belonging to a first forward motion vector field and the second motion vector belonging to a second forward motion vector field, with the first forward motion vector field and the second forward motion vector field being different.

49. The '054 patent discloses a motion estimation unit that arranges to calculate the further candidate motion vector by means of calculating a difference between the second motion vector and the first motion vector.

50. The '054 patent and its underlying patent application have been cited by 14 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the '054 patent and its underlying patent application as relevant prior art:

- Canon Inc.
- Huawei Technologies, Ltd.
- Imagination Technologies Ltd.
- MediaTek Inc.
- Panasonic Corp.
- Samsung Electronics Co., Ltd.
- Siemens Healthcare GmbH
- Tencent Technology (Shenzhen) Co., Ltd.

U.S. PATENT NO. 6,774,918

51. U.S. Patent No. 6,774,918 ("the '918 patent") entitled, *Video Overlay Processor with Reduced Memory And Bus Performance Requirements*, was filed on June 28, 2000. The '918 patent is subject to a 35 U.S.C. § 154(b) term extension of 591 days. Dynamic Data is the owner

by assignment of all right, title, and interest in the '918 patent. A true and correct copy of the '918 patent is attached hereto as Exhibit 4.

52. The '918 patent claims specific methods and systems for providing an overlay such as a cursor in an on-screen display in a consumer electronic device. On-screen display (OSD) data for generating an image on a display device are downloaded to an OSD unit on an integrated circuit.

53. The '918 patent discloses downloading on-screen display (OSD) data for generating an image on a display device.

54. The '918 patent further discloses downloading the on-screen display (OSD) data in segments separated by gaps.

55. The '918 patent further discloses, during a gap in downloading the on-screen display data, downloading an amount of overlay data for generating an overlay on the image generated on a display device.

56. Further, the '918 patent discloses that the overlay data downloaded during a gap comprises a portion of the overlay data.

57. The inventions disclosed in the '918 patent improve the operation and efficiency of computer components because only a portion of the overlay data is downloaded during each burst gap, thus reducing the amount of memory needed to store the overlay data. The inventions disclosed in the '918 patent further eliminate the requirement that on-chip memory be large enough to hold the data needed for an entire overlay. Instead, only one line or a part of one line of the overlay needs to be stored on-chip.

58. The '918 patent claims a technical solution to a problem unique to video processing.

59. The ‘918 patent has been cited by several United States patents and patent applications as relevant prior art. Specifically, patents issued to Realtek Semiconductor Corp., Samsung Electronics Co., Ltd., and Thomson Licensing SA have all cited the ‘918 patent as relevant prior art.

U.S. PATENT NO. 8,184,689

60. U.S. Patent No. 8,184,689 (the “’689 patent”) entitled, *Method Video Encoding And Decoding Preserving Cache Localities*, was filed on August 7, 2006, and claims priority to August 17, 2005. The ‘689 patent is subject to a 35 U.S.C. § 154(b) term extension of 948 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘689 patent. A true and correct copy of the ‘689 patent is attached hereto as Exhibit 5.

61. The ‘689 patent discloses novel methods and apparatuses for encoding and decoding video data.

62. The inventions disclosed in the ‘689 patent processing time and power consumption associated with encoding and decoding video stream data is reduced by reducing off-chip memory accesses through using simultaneous encoded/decoded images as a reference image for encoding/decoding at least one of the other simultaneously encoded/decoded images.

63. The ‘689 patent discloses a method for encoding and decoding a video stream, including a plurality of images in a video processing apparatus having a processing unit coupled to a first memory, further comprising a second memory.

64. The ‘689 patent discloses a method for encoding and decoding a video stream comprising providing a subset of image data stored in the second memory in the first memory.

65. The ‘689 patent discloses a method for encoding and decoding a video stream comprising simultaneous encoding/decoding of more than one image of the video stream, by

accessing said subset, wherein the simultaneously encoding/decoding is performed by access sharing to at least one image.

66. The ‘689 patent and its underlying patent application have been cited by several patents and patent applications as relevant prior art. Specifically, patents issued to Fujitsu Ltd., Qualcomm Inc., Sony Corporation, Sun Patent Trust, and VIXS Systems Incorporated have all cited the ‘689 patent and its underlying patent application as relevant prior art.

U.S. PATENT NO. 6,996,177

67. U.S. Patent No. 6,996,177 (the “‘177 patent”) entitled, *Motion Estimation*, was filed on July 24, 2000, and claims priority to August 22, 1999. The ‘177 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,103 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘177 patent. A true and correct copy of the ‘177 patent is attached hereto as Exhibit 6.

68. The ‘177 patent claims specific methods and devices for motion estimation and motion-compensated picture signal processing.

69. The ‘177 patent discloses a motion vector estimation method and device that carries out a block-based motion vector estimation process that involves comparing a plurality of candidate vectors to determine block-based motion vectors.

70. The ‘177 patent discloses a motion vector estimation method and device that determines at least a most frequently occurring block-based motion vector.

71. The ‘177 patent discloses a motion vector estimation method and device that carries out a global motion vector estimation process using at least the most frequently occurring block-based motion vector to obtain a global motion vector.

72. The ‘177 patent discloses a motion vector estimation method and device that applies the global motion vector as a candidate vector to the block-based motion vector estimation process.

73. The inventions disclosed in the ‘177 patent improve the operation of the computer components necessary to the performance of picture signal processing by reducing the load on the central processing unit.

74. The ‘177 patent has been cited by 16 United States and International patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘177 patent as relevant prior art:

- Qualcomm Incorporated
- LG Electronics
- Microsoft Corporation
- Samsung Electronics Co., Ltd.
- VIXS Systems Incorporated
- General Instrument Corporation

U.S. PATENT NO. 8,311,112

75. U.S. Patent No. 8,311,112 (the “’112 patent”) entitled, *System And Method For Video Compression Using Predictive Coding*, was filed on December 31, 2008. The ‘112 patent is subject to a 35 U.S.C. § 154(b) term extension of 847 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘112 patent. A true and correct copy of the ‘112 patent is attached hereto as Exhibit 7.

76. The ‘112 patent discloses novel methods and systems for video compression.

77. The ‘112 patent discloses novel technologies for video compression that perform predictive coding on a macroblock of a video frame such that a set of pixels of the macroblock is

coded using some of the pixels from the same video frame as reference pixels and the rest of the macroblock is coded using reference pixels from at least one other video frame.

78. The '112 patent discloses a system for video compression comprising an intra-frame coding unit configured to perform predictive coding on a set of pixels of a macroblock of pixels using a first group of reference pixels, the macroblock of pixels and the first group of reference pixels being from a video frame.

79. The '112 patent discloses a system for video compression comprising an inter-frame coding unit configured to perform predictive coding on the rest of the macroblock of pixels using a second group of reference pixels, the second group of reference pixels being from at least one other video frame.

80. The '112 patent and its underlying patent application have been cited by 10 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the '112 patent and its underlying patent application as relevant prior art:

- British Broadcasting Corporation
- Google LLC
- Megachips Corp.
- Olympus Corp.
- Samsung Electronics Co., Ltd.
- Sony Corporation
- Toshiba Corporation

U.S. PATENT NO. 6,646,688

81. U.S. Patent No. 6,646,688 (the "'688 patent") entitled, *High Quality Video and Graphics Pipeline*, was filed on November 10, 2000. The '688 patent is subject to a 35 U.S.C. § 154(b) term extension of 407 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '688 patent. A true and correct copy of the '688 patent is attached hereto as Exhibit 8.

82. The ‘688 patent discloses multiple embodiments for optimally processing high quality video and graphics.

83. The ‘688 patent discloses a video/graphics data processing method wherein a stream of digital video/graphics data is pre-processed to output pre-processed data.

84. The ‘688 patent further discloses substituting the color key with a pre-selected color in the processing of a color key from the pre-processed data to output resulting data.

85. The ‘688 patent discloses processing and transforming the data resulting from the processing a color key from the pre-processed data to output resulting data.

86. The ‘688 patent has been cited by multiple United States patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to Broadcom Corporation, Eastman Kodak Company, Nvidia Corporation, and Quantel Ltd. cited the ‘688 patent family as relevant prior art.

U.S. PATENT NO. 7,894,529

87. U.S. Patent No. 7,894,529 (the “’529 patent”) entitled, *Method And Device For Determining Motion Vectors*, was filed on June 1, 2006, and claims priority to June 3, 2005. The ‘529 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,301 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘529 patent. A true and correct copy of the ‘529 patent is attached hereto as Exhibit 9.

88. The ‘529 patent discloses novel methods and apparatuses for determining motion vectors that are each assigned to individual image regions.

89. The inventions disclosed in the ‘529 patent enable an increase in the resolution of video and image signals during the motion estimation process.

90. The ‘529 patent discloses a method for determining motion vectors which are assigned to individual image regions of an image.

91. The ‘529 patent discloses a method wherein an image is subdivided into a number of image blocks, and a motion estimation technique is implemented to assign at least one motion vector to each of the image blocks where a modified motion vector is generated for at least a first image block.

92. The ‘529 patent discloses a method that determines at least a second image block through which the motion vector assigned to the first image block at least partially passes.

93. The ‘529 patent discloses a method that generates the modified motion vector as a function of a motion vector assigned to at least the second image block.

94. The ‘529 patent discloses a method that assigns the modified motion vector as the motion vector to the first image block.

95. The ‘529 patent and its underlying patent application have been cited by multiple patents and patent applications as relevant prior art. Specifically, patents issued to Fujifilm Corp., and Samsung Electronics Co., Ltd. have cited the ‘529 patent and its underlying patent application as relevant prior art.

U.S. PATENT NO. 7,542,041

96. U.S. Patent No. 7,542,041 (the “041 patent”) entitled, *Runtime Configurable Virtual Video Pipeline*, was filed on April 2, 2004, and claims priority to April 3, 2003. The ‘041 patent is subject to a 35 U.S.C. § 154(b) term extension of 288 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘041 patent. A true and correct copy of the ‘041 patent is attached hereto as Exhibit 10.

97. The ‘041 patent discloses novel systems for dynamically configuring a multi-pipe pipeline system.

98. The inventions disclosed in the ‘041 patent enable a multiple-pipeline system that is dynamically configurable to effect various combinations of functions for each pipeline.

99. The inventions disclosed in the ‘041 patent teach a multiple pipeline system that includes a pool of auxiliary function blocks that are provided as required to select pipelines.

100. In one embodiment of the ‘041 patent, each pipeline of the multiple-pipeline system is configured to include a homogenous set of core functions. A pool of auxiliary functions is provided for selective insertion of auxiliary functions between core functions of select pipelines.

101. In one embodiment of the ‘041 patent, each auxiliary function includes a multiplexer that allows it to be selectively coupled within each pipeline.

102. The ‘041 patent discloses, in one embodiment, a processing system that includes a plurality of pipelines, with each pipeline of the plurality including a plurality of core pipeline elements that are configured to sequentially process data as it traverses the pipeline.

103. The ‘041 patent discloses, in one embodiment, a processing system that includes a plurality of auxiliary elements, each auxiliary element of the plurality of auxiliary elements being configured to be selectively coupled to multiple pipelines of the plurality of pipelines.

104. The ‘041 patent discloses, in one embodiment, a processing system wherein the auxiliary elements are responsive to external coupling-select signals.

105. The ‘041 patent discloses, in one embodiment, a processing system wherein a plurality of auxiliary elements are within a selected pipeline of the multiple pipelines, between a pair of core pipeline elements of the plurality of core pipeline elements to process the data as it traverses between the pair of core elements.

106. The ‘041 patent has been cited by several United States patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to Microsoft Corporation, Xilinx Inc., Canon Inc., Intel Corporation, and Nokia Oyj have cited the ‘041 patent and its underlying patent application as relevant prior art.

U.S. PATENT NO. 7,571,450

107. U.S. Patent No. 7,571,450 (the “’450 patent”) entitled, *System For And Method Of Displaying Information*, was filed on February 12, 2003, and claims priority to March 11, 2002. The ‘450 patent is subject to a 35 U.S.C. § 154(b) term extension of 846 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘450 patent. A true and correct copy of the ‘450 patent is attached hereto as Exhibit 11.

108. The ‘450 patent discloses novel methods and systems for displaying information. The inventions disclosed in the ‘450 patent enable methods and systems wherein a user does not need to make a new selection after being switched from one service to a second service.

109. The inventions disclosed in the ‘450 patent permit a user of an information display system to have selections made on a first service also presented when the user switches to a second service without requiring the user to browse through the menus to define the type of information to be displayed a second time.

110. In one embodiment of the ‘450 patent, the user selection being made on the basis of the provided options while the first service was selected is use to select the appropriate data elements of the stream of the second service.

111. The inventions disclosed in the ‘450 patent enable various content sources to share similar information models.

112. The ‘450 patent, in one embodiment, discloses a method of displaying information on a display device wherein receiving a transport stream comprises services, with the services having elementary streams of video and of data elements.

113. The ‘450 patent, in one embodiment, discloses a method of displaying information on a display device wherein user actions of making a user selection of a type of information to be displayed on the device are received.

114. The ‘450 patent, in one embodiment, discloses a method of displaying information on a display device wherein filtering to select a data element of a first one of the services on the basis of the user selection is performed.

115. The ‘450 patent, in one embodiment, discloses a method of displaying information on a display device wherein rendering to calculate an output image to be displayed on the display device, on the basis of the first data element selected by the filer is performed.

116. The ‘450 patent, in one embodiment, discloses a method of displaying information on a display device wherein switching from the first one of the services to a second one of the services, characterized in comprising a second step of filtering to select a second data-element of the second one of the services, on basis of the user selection is performed.

117. The ‘450 patent, in one embodiment, discloses a method of displaying information on a display device wherein being switched from the first one of the services to the second one of the services, with the data-element and the second data-element being mutually semantically related and a second step of rendering to calculate the output image to be displayed on the display device, on basis of the second data-element selected by the filter is performed.

118. The ‘450 patent and its underlying patent application have been cited by several patents and patent applications as relevant prior art. Specifically, patents issued to AT&T

Intellectual Property I LP, Nokia Oyj, Samsung Electronics Co., Ltd., and ZTE Corporation have all cited the '450 patent and its underlying patent application as relevant prior art.

U.S. PATENT NO. 6,996,175

119. U.S. Patent No. 6,996,175 (the "'175 patent") entitled, *Motion Vector Estimation,* was filed on December 7, 1999. The '175 patent claims priority pursuant to 35 U.S.C. § 119(a)-(d) to European Patent Applications 99201556.0 and 98204149.3. *See Notice of Allowance* at 1, U.S. PATENT APPL. SER. NO. 09/455,662 (June 3, 2005) (identifying the claim or priority under 35 U.S.C. § 119(a)-(d)). The '175 patent has a term which ends "twenty years from the filing date of the application in the United States [December 7, 1999]." MANUAL OF PATENT EXAMINING PROCEDURE ("MPEP") § 2701.III.

120. Dynamic Data is the owner by assignment of all right, title, and interest in the '175 patent. A true and correct copy of the '175 patent is attached hereto as Exhibit 12.

121. The '175 patent discloses novel methods and systems for recursive motion vector estimation. The inventions disclosed in the '175 patent enable methods and systems where candidate vectors are generated from stored vectors and one of the candidate vectors is selected (the selected vector). The selected vector is then used to generate several test vectors. Finally, one of the test vectors is used to generate an output vector.

122. The inventions disclosed in the '175 patent teach a device that performs motion estimation to significantly improve the performance of the device with respect to (1) coding efficiency, and (2) the perceptual quality of the coded pictures. Further, the '175 patent discloses a system wherein recursive motion vector estimation keeps the computation load in a reasonably low range.

123. In one embodiment of the ‘175 patent, an improvement to motion estimation is performed wherein a difference between the output and the input of the enhancement module gives a local information on the trend of the motion.

124. The inventions disclosed in the ‘175 patent enable post processing to be done inside the recursion loop of any recursive motion estimation algorithm instead of outside the recursion loop, the convergence of the recursive motion estimation algorithm is speeded up.

125. The ‘175 patent, in one embodiment, discloses a method of displaying information on a display device wherein being switched from the first one of the services to the second one of the services, with the data-element and the second data-element being mutually semantically related and a second step of rendering to calculate the output image to be displayed on the display device, on the basis of the second data-element selected by the filter is performed.

126. The ‘175 patent and its underlying patent application have been cited by 21 patents and patent applications as relevant prior art. Specifically, patents issued to Sony Corporation, Samsung Electronics Co., Ltd., and International Business Machines have all cited the ‘175 patent and its underlying patent application as relevant prior art.

U.S. PATENT NO. 7,982,799

127. U.S. Patent No. 7,982,799 (the “’799 patent”) entitled, *Method And Device For Interpolation Of An Image Information Value For Pixel Of An Interline*, was filed on December 29, 2006, and claims priority to December 30, 2005. The ‘799 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,233 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘799 patent. A true and correct copy of the ‘799 patent is attached hereto as Exhibit 13.

128. The ‘799 patent discloses novel methods and systems for interpolating an image information value for a pixel of an interline situated between two original image lines in an image.

129. The inventions disclosed in the ‘799 patent reduce or prevent ambiguities in the determination of an optimal image direction by adding a single direction values of several adjacent pixels.

130. The ‘799 patent discloses a method for interpolation of an image information value for a pixel of an interline that includes selecting from a number of image directions, to each of which a direction quality value is assigned, a direction of interpolation by comparing the direction quality values.

131. The ‘799 patent discloses a method for interpolation of an image information value for a pixel of an interline that includes determining the image information value being interpolated in dependence on image information values assigned to pixels lying adjacent to the pixel being interpolated in the direction of interpolation.

132. The ‘799 patent discloses a method for interpolation of an image information value for a pixel of an interline that includes ascertaining a direction quality value for an image direction by selecting a pixel group having at least two pixels.

133. The ‘799 patent discloses a method for interpolation of an image information value for a pixel of an interline that includes ascertaining a direction quality value for an image direction by determining a single direction quality value for each pixel of the pixel group, the single direction quality value being dependent on image information values assigned to image regions lying adjacent to the particular pixel of the group in the image direction.

134. The ‘799 patent discloses a method for interpolation of an image information value for a pixel of an interline that includes ascertaining a direction quality value for an image direction by creating the direction quality value as a function of the single direction quality values of the pixel group.

135. The ‘799 patent and its underlying patent application have been cited by several patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘799 patent and its underlying patent application as relevant prior art: NEC Corporation; Intel Corporation; Qualcomm Inc.; MediaTek, Inc.; and Zoran Corporation.

COUNT I
INFRINGEMENT OF U.S. PATENT NO. 8,135,073

136. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

137. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation.

138. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products capable of decoding video data in compliance with the H.265 standard.. The Accused Products include, but are not limited to, Apple’s iPhone, iPad, and Apple TV, and any other Apple products capable of performing decoding of video data using the H.265 standard. By way of example, the following Apple Products perform decoding pursuant to the H.265 standard: iPhone 6s, iPhone 6s Plus, iPhone SE, iPhone 7, iPhone 7 Plus, iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS Max, iPhone XS, iPad (5th generation), iPad Pro (12.9-inch), iPad Pro (9.7-inch), iPad (6th generation), iPad Pro (10.5-inch), iPad Pro 12.9-inch (2nd generation), iPad Pro 11-inch, and the iPad Pro 12.9-inch (3rd generation) (collectively, the “Apple ‘073 Product(s)”).

139. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple ‘073 Products in regular business operations.

140. On information and belief, one or more of the Apple '073 Products include technology for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation.

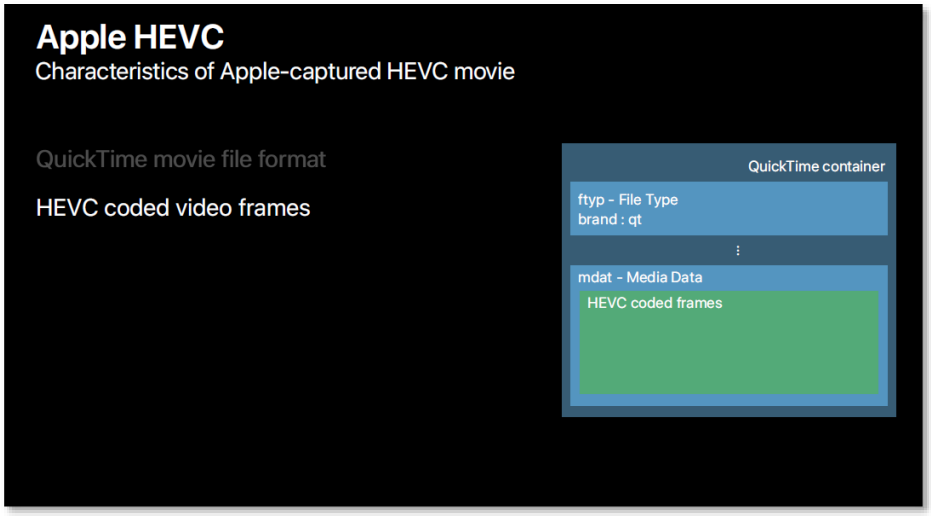
141. The Apple '073 Products contain a hardware-based decoder on the Apple A9, Apple A9X, Apple A10, Fusion, Apple A10X Fusion, Apple A11 Bionic, Apple A12 Bionic, and Apple A12X Bionic system on chip ("SoC") processors.[22]

> Apple A9 first introduced with hardware based HEVC decoder enabling devices to efficiently playback H.265/High Efficiency video content. A11 introduced a hardware encoder, enabling iPhone's Biopic generations to create and save content in the high efficiency formats. This feature optimizes the storage space while saving high definition photos and videos.

Debrath Banerjee, *A Microarchitecture Study on Apple's A11 Bionic Processor,* RESEARCHGATE PUBLICATION at 3 (May 2018) (emphasis added), *available at*: https://www.researchgate.net/publication/325053646_A_Microarchitectural_Study_on_Apple's_A11_Bionic_Processor.

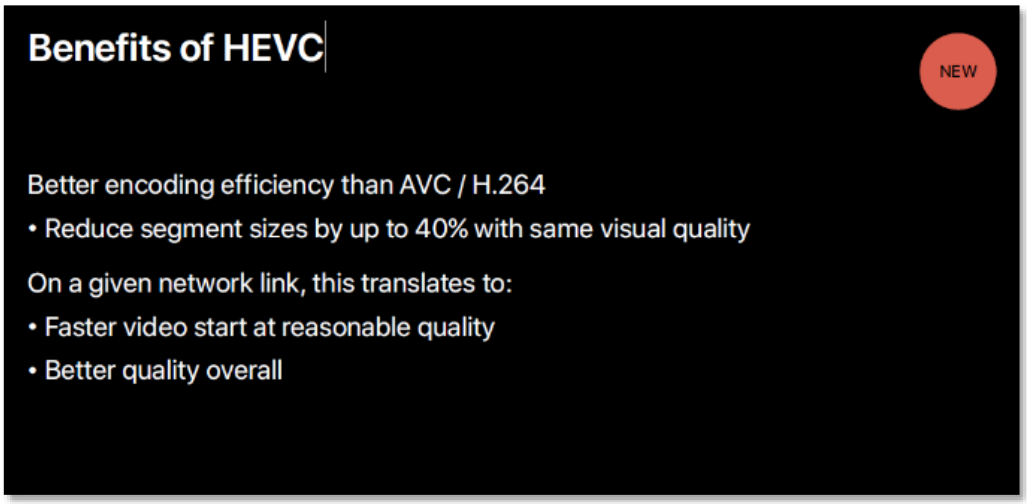
142. Further, documentation from Apple provides additional evidence that the Apple '073 Products contain "architecture [] updated to include H.265 encode and decoding acceleration."

[22] *See iOS Device Compatibility Reference*, APPLE DEVELOPER WEBSITE (October 30, 2017), *available at*: https://developer.apple.com/library/archive/documentation/DeviceInformation/Reference/iOSDeviceCompatibility/HardwareGPUInformation/HardwareGPUInformation.html (describing the



Gavin Thomson and Athar Shah, *Introducing HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 503 at 68 (2017).

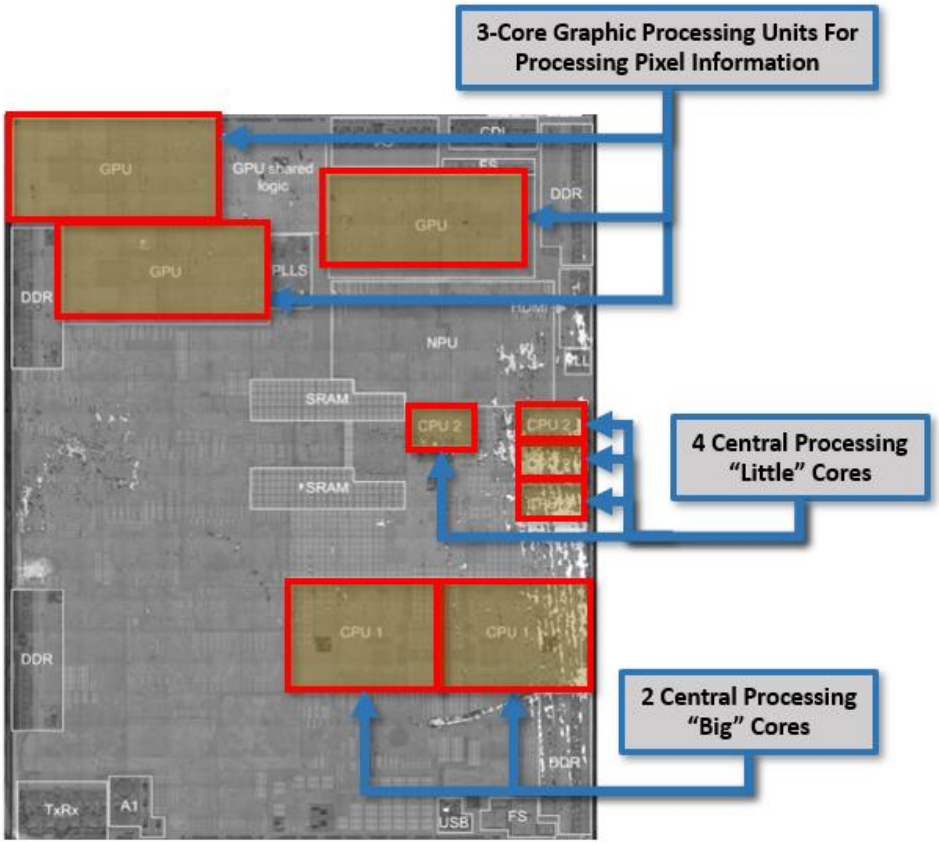
143. Apple has identified that the inclusion of HEVC decoding and encoding in the Apple '073 Products is a critical "value proposition." The below excerpt from an Apple Worldwide Developer Conference presentation describes the importance of HEVC in the Apple '073 Products.



Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 8 (2017).

144. The following image of the Apple A11 Bionic chip in the iPhone 8 Plus shows two central processing units and six core graphics processing units that process pixel information by

receiving a video stream with encoded frame-based video information including a first and second frame.

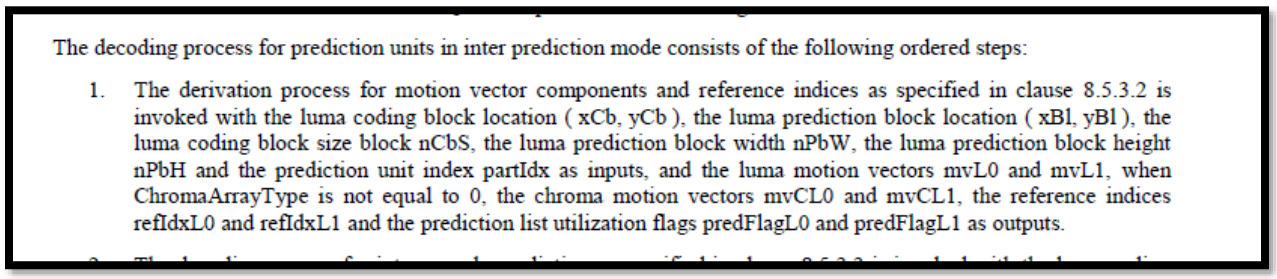


TechInsights Apple iPhone 8 Plus Teardown, TECHINSIGHTS ARTICLE (January 11, 2017) (annotations added), *available at*: https://techinsights.com/about-techinsights/overview/blog/apple-iphone-8-teardown/ ("The iPhone 8 Plus A1897 model we examined initially is confirmed to contain the A11 Bionic AP with a die mark TMHS09.").

145. On information and belief, by complying with the HEVC standard, the Apple devices – such as the Apple '073 Products - necessarily infringe the '073 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '073 patent, including but not limited to claim 14 of the '073 patent. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018) (The following sections of the HEVC Standard are relevant to Apple's infringement of the '073 patent: "8.3.2 Decoding process for

reference picture set;" "8.5.4 Decoding process for the residual signal of coding units coded in inter prediction mode;" "8.6 Scaling, transformation and array construction process prior to deblocking filter process;" "8.5.2 Inter prediction process;" "8.5.3 Decoding process for prediction units in inter prediction mode;" and "8.7.2 Deblocking filter process;" "8.7.3 Sample adaptive offset process.").

146. On information and belief, the Apple '073 Products comply with the HEVC standard, which requires that motion vectors are recovered from the second frame in the video stream.



The decoding process for prediction units in inter prediction mode consists of the following ordered steps:

1. The derivation process for motion vector components and reference indices as specified in clause 8.5.3.2 is invoked with the luma coding block location (xCb, yCb), the luma prediction block location (xBl, yBl), the luma coding block size block nCbS, the luma prediction block width nPbW, the luma prediction block height nPbH and the prediction unit index partIdx as inputs, and the luma motion vectors mvL0 and mvL1, when ChromaArrayType is not equal to 0, the chroma motion vectors mvCL0 and mvCL1, the reference indices refIdxL0 and refIdxL1 and the prediction list utilization flags predFlagL0 and predFlagL1 as outputs.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.1 (February 2018).

147. On information and belief, Apple has directly infringed and continues to directly infringe the '073 patent by, among other things, making, using, offering for sale, and/or selling technology for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation, including but not limited to the Apple '073 Products.

148. The following excerpts explain how HEVC is a form of frame-based encoded video information.

> One way of achieving high video compression is to predict pixel values for a frame based on prior and succeeding pictures in the video. Like its predecessors, H.265 features the ability to predict pixel values between pictures, and in particular, to specify in which order pictures are coded and which pictures are predicted from

> which. The coding order is specified for Groups Of Pictures (GOP), where a number of pictures are grouped together and predicted from each other in a specified order. The pictures available to predict from, called reference pictures, are specified for every individual picture.

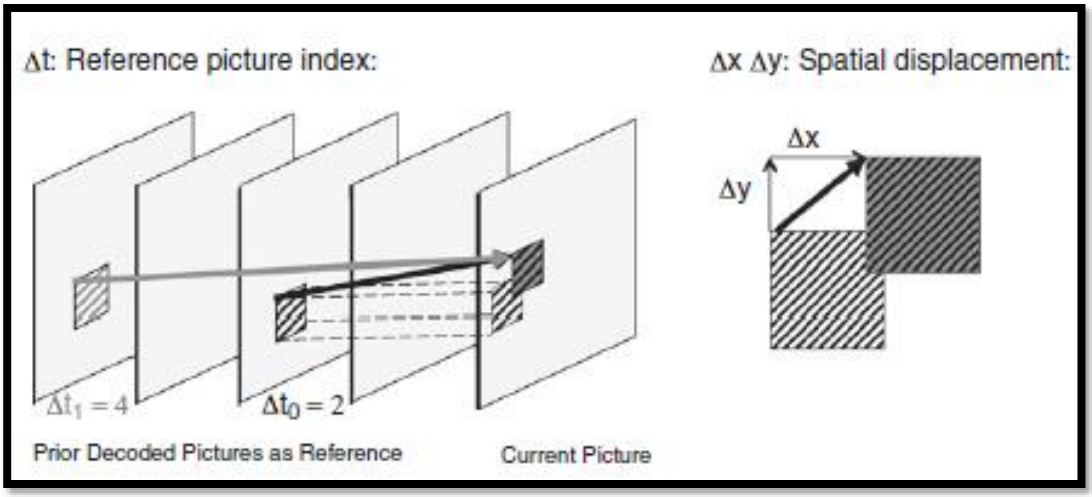
Johan Bartelmess. *Compression Efficiency of Different Picture Coding Structures in High Efficiency Video Coding (HEVC),* UPTEC STS 16006 at 4 (March 2016) (emphasis added).

149. On information and belief, the Apple '073 Products receive encoded video data that is encoded using inter-frame coding. Specifically, the encoded video stream received by the Apple '073 Products is coded using its predecessor frame. Inter-prediction used in the encoded video data received by the Apple '073 Products allows a transform block to span across multiple prediction blocks for inter-picture predicted coding units to maximize the potential coding efficiency benefits of the quadtree-structured transform block partitioning.

> The basic source-coding algorithm is a hybrid of interpicture prediction to exploit temporal statistical dependences, intrapicture prediction to exploit spatial statistical dependences, and transform coding of the prediction residual signals to further exploit spatial statistical dependences.

G. J. Sullivan, J.-R. Ohm, W.-J. Han, and T. Wiegand, *Overview of the High Efficiency Video Coding (HEVC) standard*, IEEE TRANS. CIRCUITS SYST. VIDEO TECHNOL., vol. 22, no. 12, p. 1654 (December 2012) (emphasis added).

150. The encoded video stream received by the Apple '073 Products is encoded using inter-picture prediction that makes use of the temporal correlation between pictures to derive a motion-compensated prediction (MCP) for a block of image samples. For this block-based motion compensated prediction, a video picture is divided into rectangular blocks. Assuming homogeneous motion inside one block, and that moving objects are larger than one block, for each block, a corresponding block in a previously decoded picture can be found that serves as a predictor. The general concept of inter-frame-based encoding using motion-compensated prediction based on a translational motion model is illustrated below.



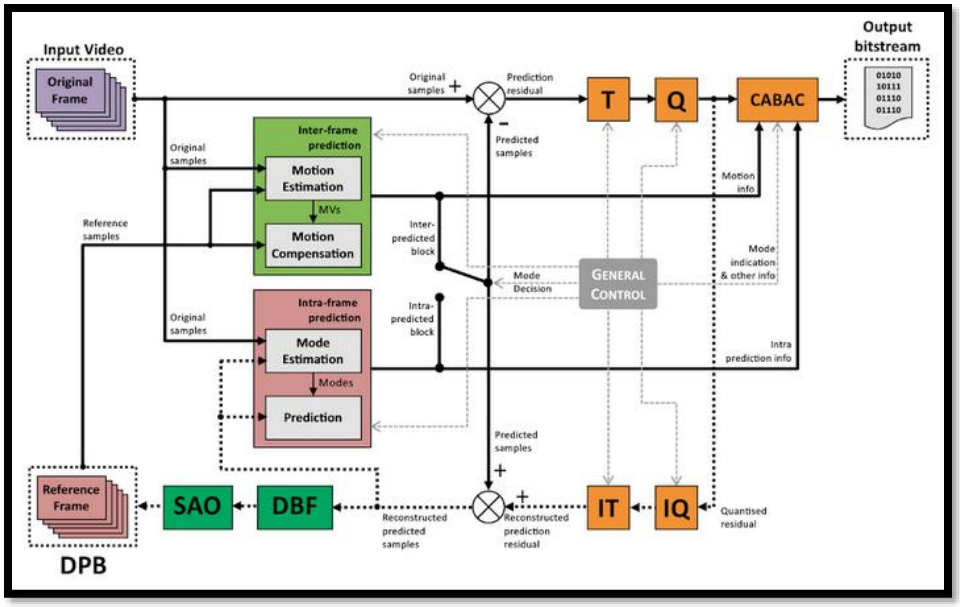
Benjamin Bross, *Inter-Picture Prediction In HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 114 (September 2014).

151. The following excerpt from an article describing the architecture of the encoded video stream received by the Apple '073 Products describes the functionality wherein the second encoded frame of the video data is dependent on the encoding of a first frame. "HEVC inter prediction uses motion vectors pointing to one reference frame . . . to predict a block of pixels."

> HEVC inter prediction uses motion vectors pointing to one reference frame (uni-prediction) or two reference frames (bi-prediction) to predict a block of pixels. The size of the predicted block, called Prediction Unit (PU), is determined by the Coding Unit (CU) size and its partitioning mode. For example, a 32×32 CU with 2N×N partitioning is split into two PUs of size 32×16, or a 16×16 CU with nL×2N partitioning is split into 4×16 and 12×16 PUs.

Mehul Tikekar, *et al., Decoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) (September 2014).

152. Further, the following diagram shows how the Apple Products receive video data encoded using inter-frame prediction. Specifically, interframe prediction generates a motion vector based on the motion estimation across a first and second frame.



Guilherme Corrêa, *et al.*, COMPLEXITY-AWARE HIGH EFFICIENCY VIDEO CODING at 16 (2015).

153. On information and belief, one or more of the Apple '073 Products reduce the processing capacity required for providing video enhancements to video processing through re-mapping of previous frames for subsequent frames.

> So, this reduces guessing with frame dropping. Let's go over what we've learned. So, with HEVC hierarchical encoding, we have improved temporal scalability. There's a much more obvious frame dropping pattern and it removes frame drop guessing during playback. We also have improved motion compensation, the reference frames are much closer to each other, so we can use more parts of other frames and it also improves compression.

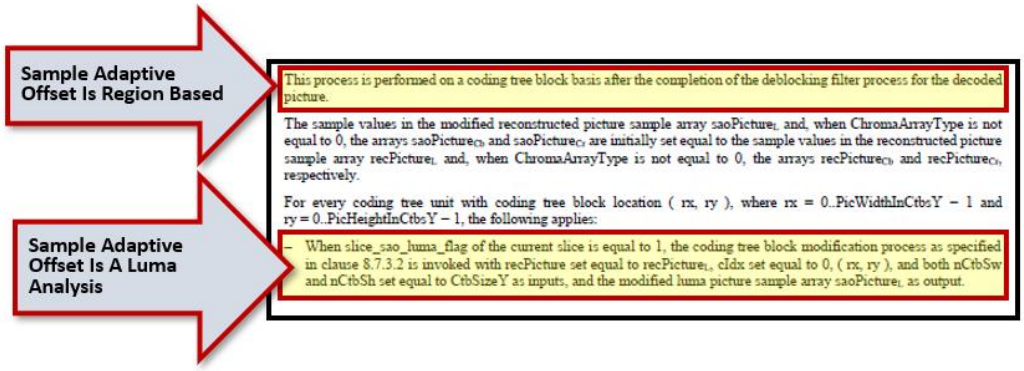
Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 Transcript (2017) (emphasis added), *available at*: https://developer.apple.com/videos/play/wwdc2017/511.

154. On information and belief, any implementation of the HEVC standard would infringe the '073 patent as every possible implementation of the standard requires: receiving a video stream containing encoded frame based video information (including both an encoded first frame and an encoded second frame); the encoded second frame that is received depends on the encoding of the first frame, the encoding of the second frame includes motion vectors indicating differences in positions between regions of the second frame and corresponding regions of the first

frame; the motion vectors define correspondence between regions of the second frame and corresponding regions of the first frame; decoding the video stream by recovering the motion vectors in the second stream; and determining a re-mapping strategy for the video enhancement of the decoded first frame using a region-based analysis where the first frame is remapped using a remapping strategy and at least one region of the second frame is remapped depending on the re-mapping strategy for corresponding regions of the first frame.

155. On information and belief, the Apple '073 Products use of sample adaptive offset is a region-based luma analysis that is applied to the decoded first frame (reference picture). "The SAO reduces sample distortion by first classifying the samples in the region into multiple categories with as selected classifier and adding a specific offset to each sample depending on its category. The classifier index and the offsets for each region are signaled in the bitstream." Andrey Norkin, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei, *In-Loop Filters In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 185 (September 2014) (emphasis added).

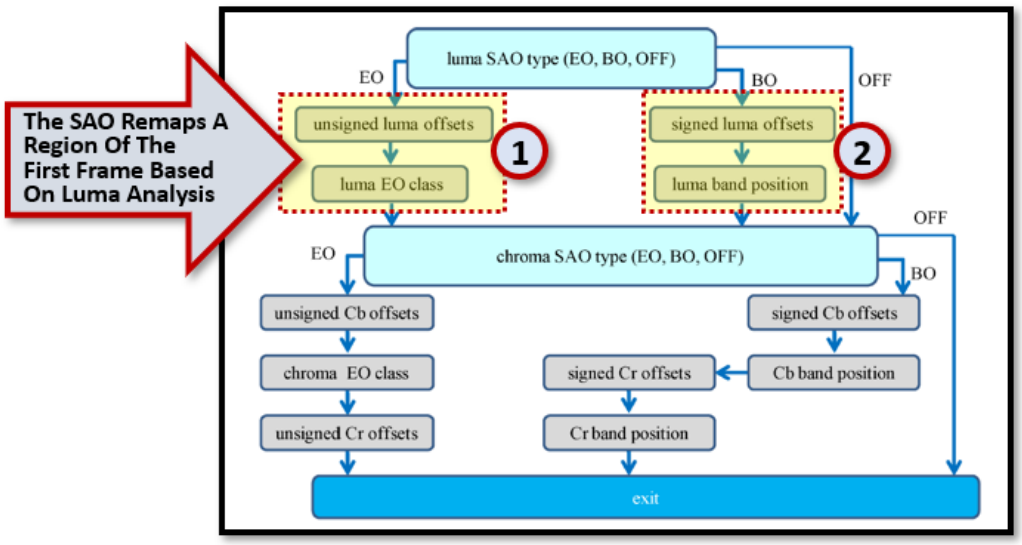
156. Further, the HEVC documentation requires that the application of a sample adaptive offset be region based (*e.g.*, applied to a coding block) ("This process is performed on a coding block basis after the completion for the deblocking filter process for the decoded picture").



High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.7.3.1 (April 2015) (annotations added).

157. On information and belief, the Apple '073 Products contain functionality wherein a decoder applies sample adaptive offset to a decoded reference frame (first frame). Further, the Apple '073 Products apply the sample adaptive offset functions to remap a portion of the region based on luminance values (luma). "SAO can be applied to not only luma but also chroma." Chih-Ming Fu, *et al.*, Sample Adaptive Offset in the HEVC Standard, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 22, NO. 12 AT 1765 (December 2012).

158. On information and belief, the Apple '073 Products apply the sample adaptive offset to a coding tree unit (region in the first frame), a luminance analysis is performed using two luminance analysis techniques: Edge Offset ("EO") and Band Offset ("BO"). Edge Offset "uses four 1-D directional patterns for sample classification: horizontal, vertical, 135° diagonal, and 45° diagonal." Chih-Ming Fu, *et al.*, Sample Adaptive Offset in the HEVC Standard, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 22, NO. 12 AT 1757 (December 2012). Band Offset "implies one offset is added to all samples of the same band. The sample value range is equally divided into 32 bands." *Id.* at 1757. The below diagram shows that the Apple '073 Products use different sample adaptive offsets in a region of the first frame in conducting a luminance analysis.



Chih-Ming Fu, *et al.*, *Sample Adaptive Offset in the HEVC Standard*, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 22, NO. 12 AT 1759 (December 2012) (annotations added showing (1) edge offset and (2) band offset luma analysis).

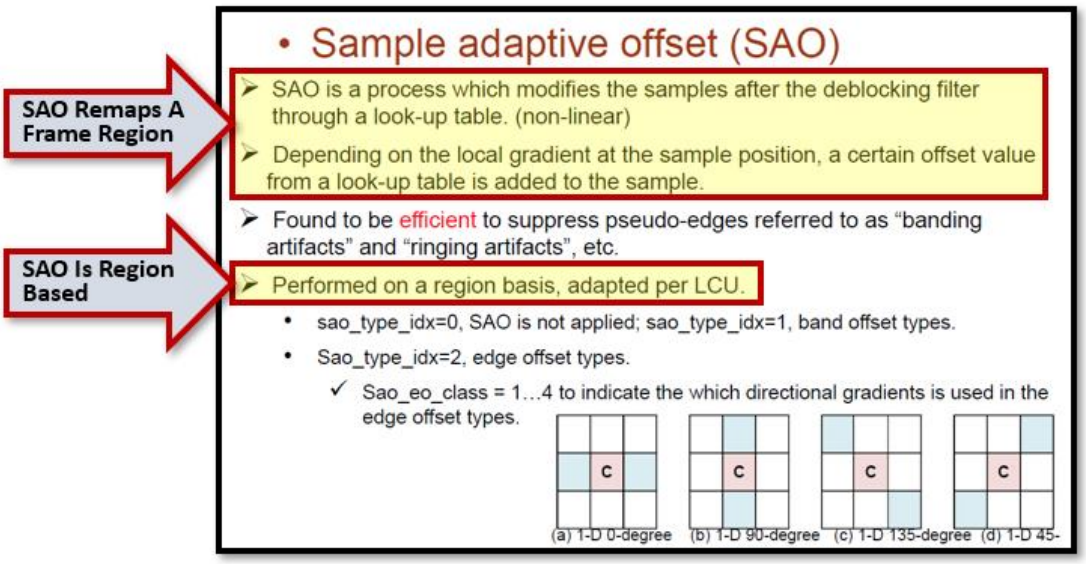
159. Further, HEVC documentation makes clear that the application of the standard adaptive offset remapping policy is based on a luminance analysis. The below shows that slices of a region have a standard adaptive offset applied based on a "luma flag."

if(sample_adaptive_offset_enabled_flag) {	
slice_sao_luma_flag	u(1)
if(ChromaArrayType != 0)	
slice_sao_chroma_flag	u(1)

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § F.7.3.6.1 (April 2015) ("sample_adaptive_offset_enabled_flag equal to 1 specifies that the sample adaptive offset process is applied to the reconstructed picture after the deblocking filter process.").

160. Commentary on the use of sample adaptive offset functionality in decoding HEVC video further confirms that the use of Sample Adaptive Offset (such as that implemented by the Apple '073 Products) is region based and remaps pixel values in a region of a frame by modifying

pixels based on an offset value. "[A]fter the deblocking filter through a look-up table . . . [and applying] a certain offset value from a look-up-table is added to the sample."[23]



Oscar C. Au, HIGH EFFICIENCY VIDEO CODING (HEVC) PRESENTATION at 43 (October 2013) (annotations added).

161. On information and belief, when the Apple '073 Products decode a second frame, the application of the remapping policy (sample adaptive offset) will be determined based on the application of sample adaptive offset to the first frame (reference picture). Thus, the application of the remapping policy (sample adaptive offset) to the first frame has the effect of increasing the quality of the reference picture such that the second frame might no longer require the application of sample adaptive offset (remapping policy).[24]

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[23] Oscar C. Au, HIGH EFFICIENCY VIDEO CODING (HEVC) PRESENTATION at 43 (October 2013).

[24] Andrey Norkin, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei, *In-Loop Filters In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 171 (September 2014) ("HEVC defines two in-loop filters, deblocking and sample adaptive offset (SAO), which significantly improve the subjective quality of decoded video sequences as well as compression efficiency by increasing the quality of the reconstructed/ reference pictures.").

> The second in-loop filter, SAO, is applied to the output of the deblocking filter and further improves the quality of the decoded picture by attenuating ringing artifacts and changes in sample intensity of some areas of a picture. The most important advantage of the in-loop filters is improved subjective quality of reconstructed pictures. In addition, using the filters in the decoding loop also increases the quality of the reference pictures and hence also the compression efficiency.

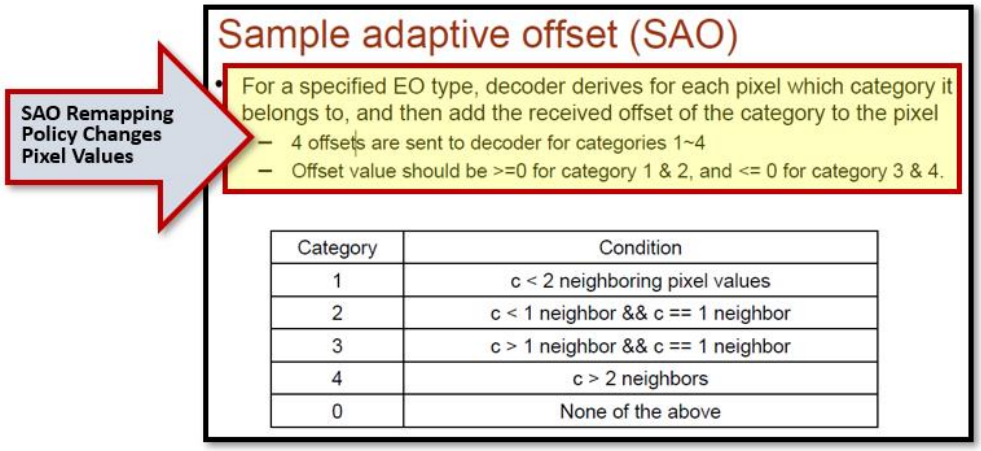
Andrey Norkin, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei, *In-Loop Filters In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 171 (September 2014) (annotations added).

162. Further, sample adaptive offset is a policy that remaps the values of pixels. If sample adaptive offset is applied to a reference frame, regions in a second frame might not require the application of the remapping policy as the reference frame that was used to generate the second frame was of a better quality.

> SAO classifies each pixel into one of four bands or one of four edge types and adds an offset to it. For band offsets, the band of each pixel depends on its value and the position of the four bands. For edge offsets, the edge of each pixel depends on the whether its value is larger or smaller than two of its neighbors. The selection between band offsets and edge offsets, position of bands, choice of neighbors for edge offsets, and values of the offsets are signaled at the CTU level for luma and chroma separately.

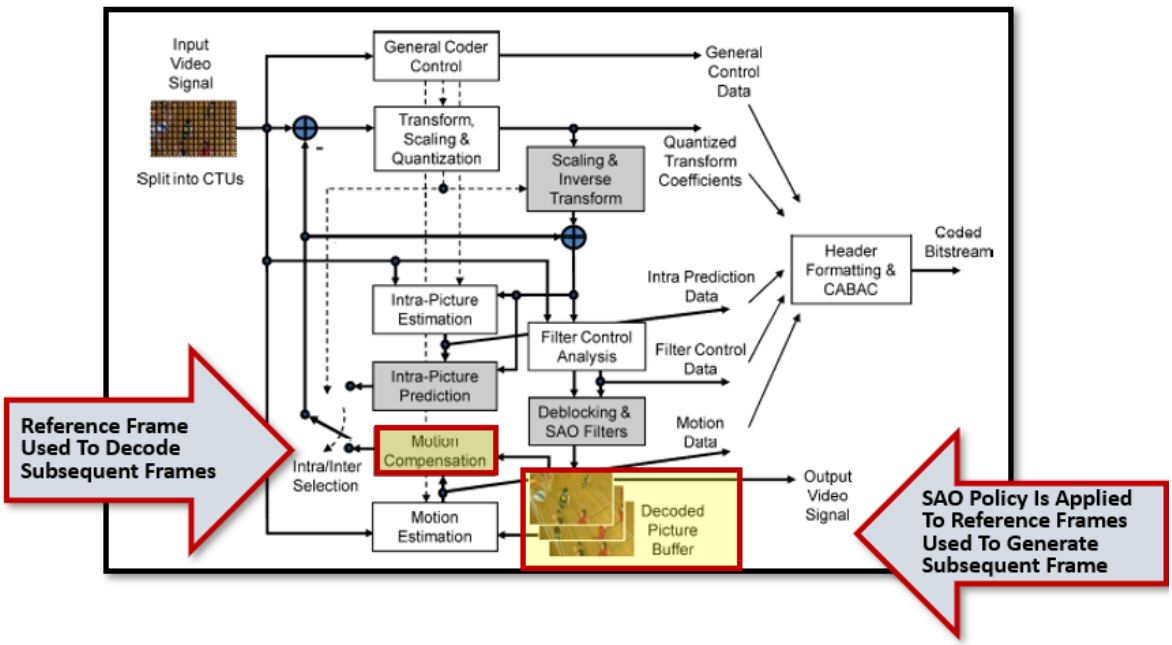
Mehul Tikekar, *et al., Decoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 335 (September 2014).

163. The following excerpt from a presentation describing HEVC decoding provides details on how the application of sample adaptive offset remaps pixel values by adding an offset to the pixel value based on a luma analysis.



Oscar C. Au, HIGH EFFICIENCY VIDEO CODING (HEVC) PRESENTATION at 44 (October 2013) (annotation added).

164. Further, the below diagram describing the process wherein HEVC video is decoded shows that sample adaptive offset is applied before the reference frames are stored in the "decoded picture buffer." Thus, the reference frames stored in the decoded picture buffer have the remapping policy applied to them, and thus when a second frame is decoded, the second frame incorporates the reference frame such that the application of the remapping policy (sample adaptive offset) to the second frame will be based on the application of the remapping policy to the first frame.



G. J. Sullivan, J.-R. Ohm, W.-J. Han, and T. Wiegand, *Overview of the High Efficiency Video Coding (HEVC) standard*, IEEE TRANS. CIRCUITS SYST. VIDEO TECHNOL., Vol. 22, No. 12 at 1651 (December 2012) (annotations added).

165. The Apple '073 Products receive encoded video data wherein the second frame includes a region encoding a motion vector difference in position between the region corresponding to the second frame indicating the first frame, the motion vector defines a region between the frame and the second frame corresponding to the first region the correspondence relationship. Specifically, the encoded video data received by the Apple '073 Products use a translational motion model wherein the position of the block in a previously decoded picture is indicated by a motion vector: Δx; Δy where Δx specifies the horizontal and Δy the vertical displacement relative to the position of the current block. The motion vectors: Δx and Δy are of fractional sample accuracy to more accurately capture the movement of the underlying object. Interpolation is applied on the reference pictures to derive the prediction signal when the corresponding motion vector has fractional sample accuracy. The previously decoded picture is referred to as the reference picture and indicated by a reference index Δt to a reference picture list. These translational motion model parameters, *i.e.*, motion vectors and reference indices, are further

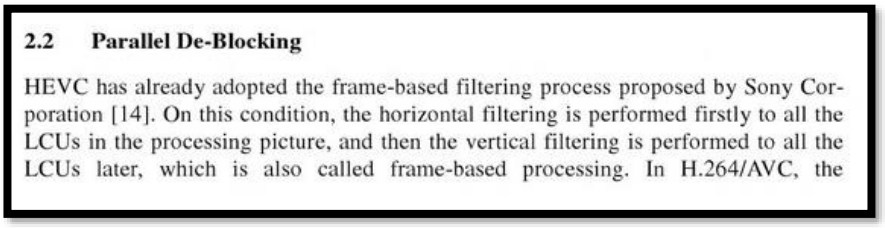
referred to as motion data. Two kinds of inter-picture prediction are allowed in modern video coding standards, namely uni-prediction and bi-prediction.

> HEVC introduces a so-called merge mode, which sets all motion parameters of an inter picture predicted block equal to the parameters of a merge candidate [6]. The merge mode and the motion vector prediction process optionally allow a picture to reuse motion vectors of prior pictures for motion vector coding.

Frank Bossen, et al., *HEVC Complexity and Implementation Analysis,* IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY VOL. 22 NO. 12 at 1686 (December (2012).

166. On information and belief, one or more of the Apple '073 Products enable the provision of enhanced video pictures with minimal additional hardware costs for the components required to successfully process the video data.

167. On information and belief, one or more of the Apple '073 Products include an input for receiving a video stream containing encoded frame-based video information including an encoded first frame and an encoded second frame.



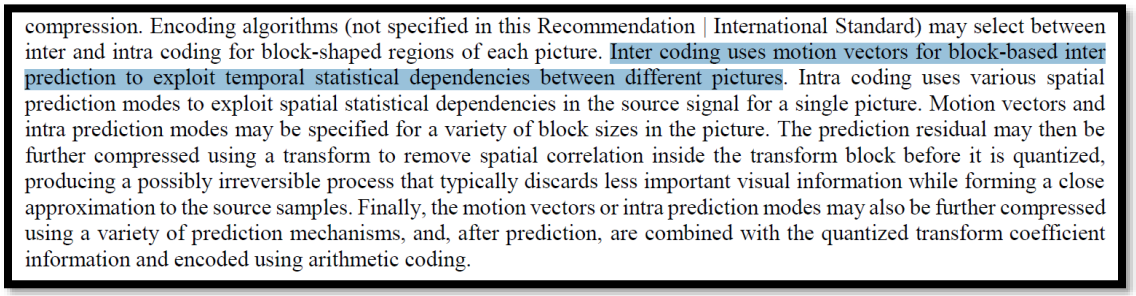
2.2 Parallel De-Blocking

HEVC has already adopted the frame-based filtering process proposed by Sony Corporation [14]. On this condition, the horizontal filtering is performed firstly to all the LCUs in the processing picture, and then the vertical filtering is performed to all the LCUs later, which is also called frame-based processing. In H.264/AVC, the

Ming-Ting Sun, *et al*., *Advances in Multimedia Information Processing,* PCM 2012: 13TH PACIFIC-RIM CONFERENCE ON MULTIMEDIA PROCEEDINGS VOLUME 7674 at 274 (December 4-6, 2012) ("HEVC has already adopted the frame-based filtering process proposed by Sony Corporation.").

168. On information and belief, one or more of the Apple '073 Products include a video decoder comprising an input for receiving video information wherein the encoding of the second frame depends on the encoding of the first frame, the encoding of the second frame includes motion vectors indicating differences in positions between regions of the second frame and corresponding regions of the first frame, the motion vectors define correspondence between regions of the second frame and corresponding regions of the first frame. The Overview of Design Characteristics for

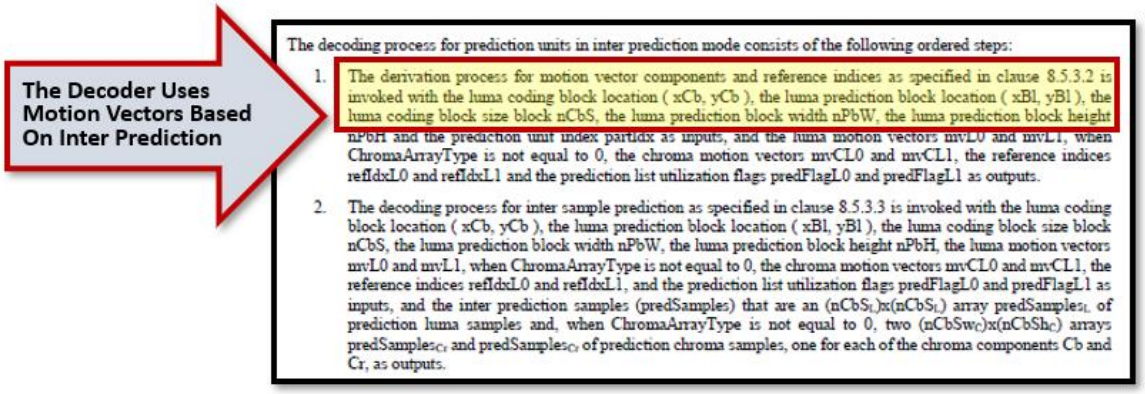
HEVC encoded video data describes the use of "motion vectors for block-based inter prediction to exploit temporal statistical dependencies between frames."



compression. Encoding algorithms (not specified in this Recommendation | International Standard) may select between inter and intra coding for block-shaped regions of each picture. Inter coding uses motion vectors for block-based inter prediction to exploit temporal statistical dependencies between different pictures. Intra coding uses various spatial prediction modes to exploit spatial statistical dependencies in the source signal for a single picture. Motion vectors and intra prediction modes may be specified for a variety of block sizes in the picture. The prediction residual may then be further compressed using a transform to remove spatial correlation inside the transform block before it is quantized, producing a possibly irreversible process that typically discards less important visual information while forming a close approximation to the source samples. Finally, the motion vectors or intra prediction modes may also be further compressed using a variety of prediction mechanisms, and, after prediction, are combined with the quantized transform coefficient information and encoded using arithmetic coding.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 0.7 (April 2015) (annotation added).

169. On information and belief, one or more of the Apple '073 Products include a video decoder comprising a decoding unit for decoding the frames, wherein the decoding unit recovers the motion vectors for the second frame. Further, HEVC documentation shows that "motion vectors are used during the decoding process for prediction units in inter prediction mode."



High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.1 (April 2015) (annotation added).

170. On information and belief, one or more of the Apple '073 Products include a video decoder comprising a processing component configured to determine a re-mapping strategy for video enhancement of the decoded first frame using a region-based analysis, re-map the first frame

using the re-mapping strategy, and re-map one or more regions of the second frame depending on the re-mapping strategy for corresponding regions of the first frame.

171. Further, documentation of the HEVC video decoding process shows that to decode video, the Apple '073 Products use a decoding unit for decoding frames where the Apple '073 Products recover the motion vectors for a second frame. Specifically, the Apple '073 Products use reference pictures (which are also referred to as "I-Frames" or the "previously decoded picture") and subsequent frames/pictures to generate motion vectors. This method of generating motion vectors for a second frame based on a first frame is referred to as a "translational motion model."

> Using a translational motion model, the position of the block in a previously decoded picture is indicated by a motion vector: Δx; Δy where Δx specifies the horizontal and Δy the vertical displacement relative to the position of the current block. The motion vectors: Δx; Δy could be of fractional sample accuracy to more accurately capture the movement of the underlying object. Interpolation is applied on the reference pictures to derive the prediction signal when the corresponding motion vector has fractional sample accuracy. The previously decoded picture is referred to as the reference picture and indicated by a reference index Δt to a reference picture list. These translational motion model parameters, i.e. motion vectors and reference indices, are further referred to as motion data.

Benjamin Bross, *Inter-Picture Prediction In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 114 (September 2014) (emphasis added).

172. On information and belief, the Apple '073 Products contain a decoder ("Decoding Unit") that uses HEVC inter prediction, which identifies "motion vectors pointing to one reference frame (uni-prediction) or two reference frames (bi-prediction) to predict a block of pixels."[25]

> Each interpicture-predicted PB is assigned one or two motion vectors and reference picture indices. To minimize worst-case memory bandwidth, PBs of luma size 4×4 are not allowed for interpicture prediction, and PBs of luma sizes 4×8 and 8×4 are

[25] Mehul Tikekar, *et al., Decoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 316 (September 2014).

> restricted to unipredictive coding. The interpicture prediction process is further described as follows.

G. J. Sullivan, J.-R. Ohm, W.-J. Han, and T. Wiegand, *Overview of the High Efficiency Video Coding (HEVC) Standard*, IEEE TRANS. CIRCUITS SYST. VIDEO TECHNOL., vol. 22, no. 12, p. 1654 (December 2012) (emphasis added).

173. On information and belief, the Apple '073 Products are available to businesses and individuals throughout the United States.

174. On information and belief, the Apple '073 Products are provided to businesses and individuals located in the Eastern District of Texas.

175. By making, using, testing, offering for sale, and/or selling products and services for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation, including but not limited to the Apple '037 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '073 patent, including at least claim 14 pursuant to 35 U.S.C. § 271(a).

176. On information and belief, Apple also indirectly infringes the '073 patent by actively inducing infringement under 35 USC § 271(b).

177. Apple has had knowledge of the '073 patent since at least service of the Original Complaint in this case or shortly thereafter, and on information and belief, Apple knew of the '073 patent and knew of its infringement, including by way of this lawsuit.

178. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '073 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '073 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '073 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple

provides the Apple '073 Products that have the capability of operating in a manner that infringe one or more of the claims of the '073 patent, including at least claim 14, and Apple further provides documentation and training materials that cause customers and end users of the Apple '073 Products to utilize the products in a manner that directly infringe one or more claims of the '073 patent.[26] By providing instruction and training to customers and end-users on how to use the Apple '073 Products in a manner that directly infringes one or more claims of the '073 patent, including at least claim 14, Apple specifically intended to induce infringement of the '073 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '073 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '073 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '073 patent, knowing that such use constitutes infringement of the '073 patent.

179. The '073 patent is well-known within the industry as demonstrated by multiple citations to the '073 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '073 patent without paying a reasonable royalty. Apple is infringing the '073 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

[26] *See, e.g.*, *iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

180. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '073 patent.

181. As a result of Apple's infringement of the '073 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT II
INFRINGEMENT OF U.S. PATENT NO. 6,714,257

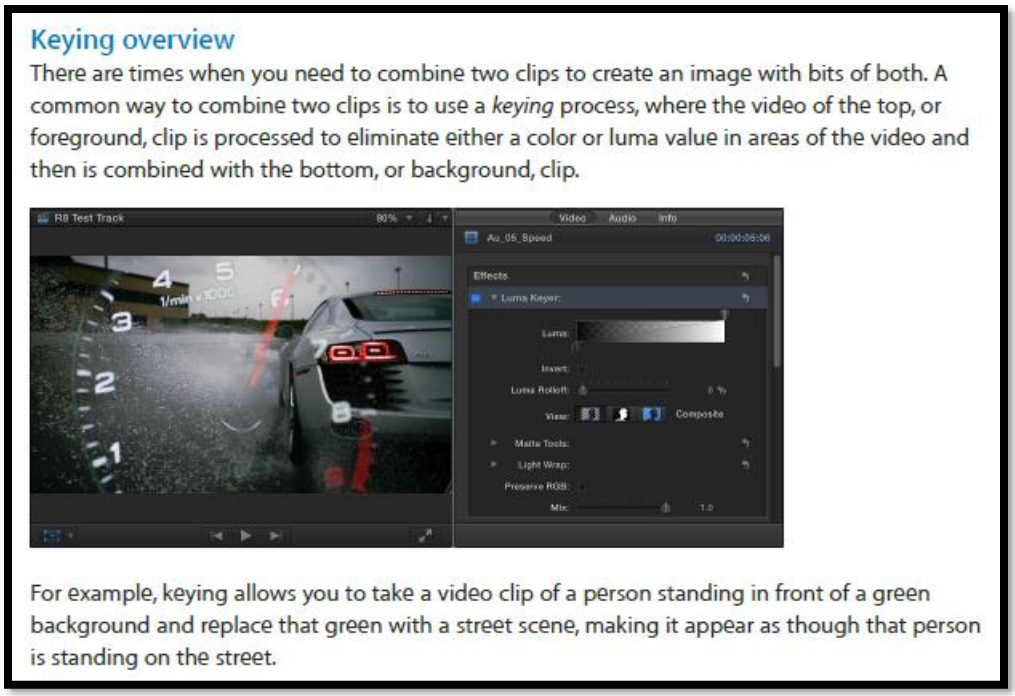
182. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

183. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for image processing.

184. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products with chroma key capabilities. The Accused Products include, but are not limited to, Apple Final Cut Pro X (collectively, the "Apple '257 Product(s)").

185. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '257 Products in regular business operations.

186. On information and belief, one or more of the Apple '257 Products include technology for image processing. The "keying functionality" in documentation for the Apple '257 Product describes the technology as processing and video content.



APPLE FINAL CUT PRO X USER GUIDE at 340 (2013) ("A common way to combine two clips is to use a keying process, where the video of the top, or foreground, clip is processed to eliminate either a color or luma value in areas of the video and then is combined with the bottom or background clip.").

187. On information and belief, one or more of the Apple '257 Products include technology for scaling a keyed image.

> Quite often your foreground image has objects that you don't want to appear in the composited output. <u>These could be production items like microphone booms and light stands or the edges of the chroma key backdrop</u>. Additionally, you might need to resize or reposition the foreground object to better fit with the background. As a final step, you can use the color corrector to adjust the foreground so that it matches the look of the background.

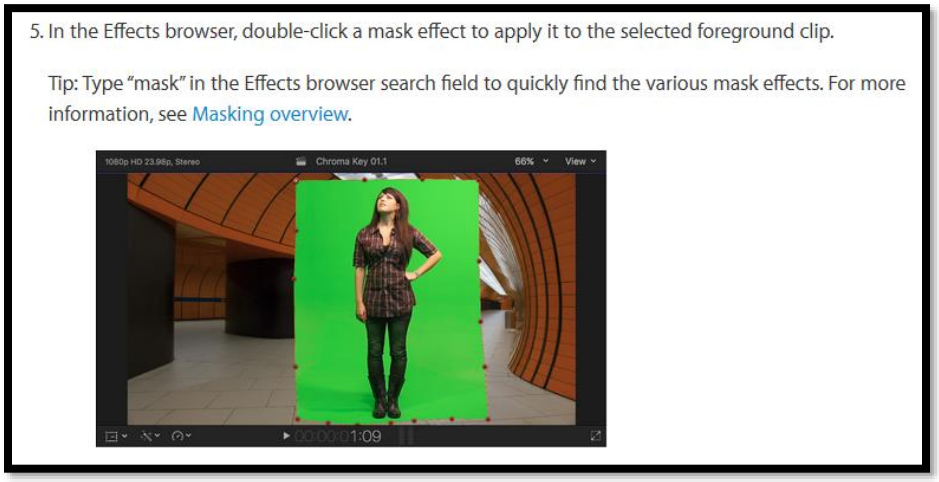
Final Cut Pro X: Finalize The Key, APPLE SUPPORT WEBSITE (last visited January 2018), *available at*: https://support.apple.com/kb/PH12667 (emphasis added).

188. On information and belief, the Apple '257 Products are available to businesses and individuals throughout the United States.

189. On information and belief, the Apple '257 Products are provided to businesses and individuals located in the Eastern District of Texas.

190. On information and belief, Apple has directly infringed and continues to directly infringe the '257 patent by, among other things, making, using, offering for sale, and/or selling technology for image processing, including but not limited to the Apple '257 Products.

191. On information and belief, the Apple '257 Products create a key-only image corresponding to key regions in a keyed image. The below excerpt from Apple documentation shows the functionality in the Apple '257 Products to create a keyed image including through the use of "mask effect."



Final Cut Pro X: Finalize The Key, APPLE SUPPORT WEBSITE (last visited January 2018), *available at*: https://support.apple.com/kb/PH12667 (emphasis added).

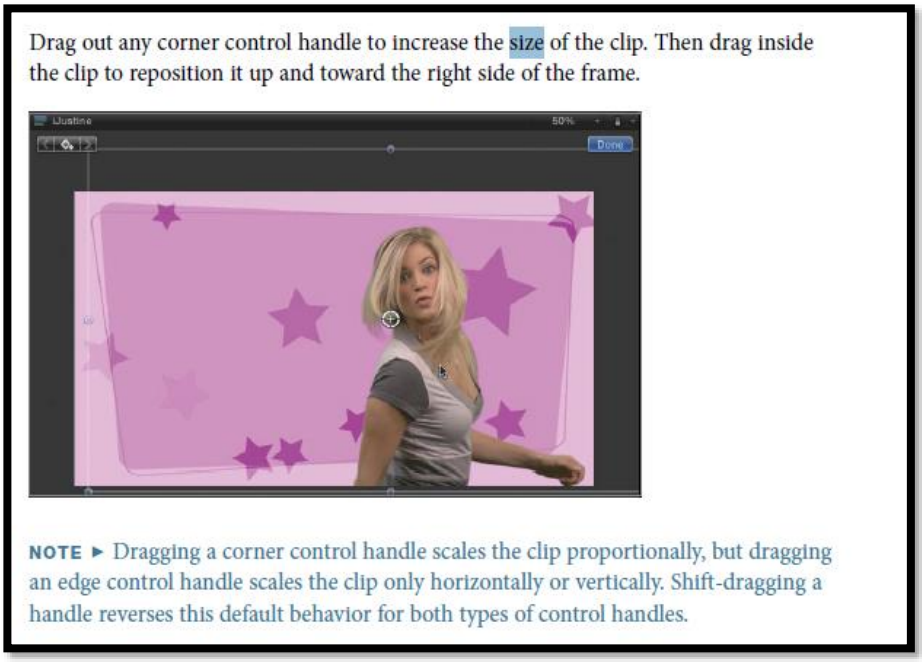
192. On information and belief, the Apple '257 Products scale the key-only image to form a scaled key-only image. The below excerpt from Apple documentation described the process of creating a key only image to form a scaled key-only image.

> Chroma: Drag the two graphs in this color wheel control to adjust the isolated range of hue and saturation that help define the keyed matte. The selected mode governs which graphs in the color wheel are adjustable. The outer graph controls the softness (edge transparency) of the matte you're creating, and can be adjusted in either Scrub Boxes or Manual mode. The inner graph controls tolerance (core transparency), and is only adjustable when in Manual mode. Drag any side of either graph to expand or contract the graph's border, which adds to or subtracts from the range of hue and saturation contributing to the key. In Manual mode, you can also drag inside the tolerance graph to adjust its overall position in the color wheel. To the left of the color wheel, a small graph displays the slope of chroma rolloff, the

> relative softness of matte edges in regions most affected by the Chroma control. Dragging the Chroma Rolloff slider (described below) modifies the shape of this slope.

APPLE FINAL CUT PRO X USER GUIDE at 347 (2013).

193. On information and belief, the Apple '257 Products contain functionality for dragging out a corner of the keyed and the key-only images.



Michael Wohl, Alexis Van Hurkman, and Mark Spencer, FINAL CUT PRO X ADVANCED TRAINING SERIES at 259 (2015) ("Drag out any corner control handle to increase the size of the clip").

194. On information and belief, the Apple '257 Products scale the keyed image to form a scaled key image.

> Quite often your foreground image will have objects that you don't want to appear in the composited output. These could be production items like microphone booms and light stands or the edges of the chroma key backdrop. Additionally, you might need to resize or reposition the foreground object to better fit with the background. As a final step, you can use the color corrector to adjust the foreground so that it matches the look of the background.

APPLE FINAL CUT PRO X USER GUIDE at 355 (2013) (emphasis added).

195. On information and belief, the Apple '257 Products merge the scaled key-only image and the scaled keyed image. The below excerpt from Apple's documentation describes the ability to resize the keyed and key-only images and merge them.

APPLE FINAL CUT PRO X USER GUIDE at 358 (2013) ("In the lower-left corner of the Viewer, choose Transform from the pop-up menu and move the image to the position you want. In the above example, you might want to move the woman to the left. You can also resize the image.") (emphasis added).

196. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the Apple '257 Products, Apple has injured Dynamic Data and is liable for directly infringing one or more claims of the '257 patent, including at least claim 9, pursuant to 35 U.S.C. § 271(a).

197. On information and belief, Apple also indirectly infringes the '257 patent by actively inducing infringement under 35 USC § 271(b).

198. On information and belief, Apple has had knowledge of the '257 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '257 patent and knew of its infringement, including by way of this lawsuit.

199. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '257 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '257 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '257 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '257 Products that have the capability of operating in a manner that infringe one or more of the claims of the '257 patent, including at least claim 9, and Apple further provides documentation and training materials that cause customers and end users of the Apple '257 Products to utilize the products in a manner that directly infringe one or more claims of the '257 patent.[27] By providing instruction and training to customers and end-users on how to use the Apple '257 Products in a manner that directly infringes one or more claims of the '257 patent, including at least claim 9, Apple specifically intended to induce infringement of the '257 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '257 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '257 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '257 patent, knowing that such use constitutes infringement of the '257 patent.

[27] *See, e.g.*, *Final Cut Pro X: Use chroma keys*, APPLE SUPPORT WEBSITE, *available at*: https://support.apple.com/kb/PH12665?locale=en_US&viewlocale=en_US (April 12, 2018); *Final Cut Pro X*, APPLE USER GUIDE (2014); *Final Cut Pro X*, LOGIC EFFECTS REFERENCE GUIDE (2012).

200. The ‘257 patent is well-known within the industry as demonstrated by multiple citations to the ‘257 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the ‘257 patent without paying a reasonable royalty. Apple is infringing the ‘257 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

201. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘257 patent.

202. As a result of Apple’s infringement of the ‘257 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT III
INFRINGEMENT OF U.S. PATENT NO. 8,073,054

203. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

204. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for estimating a current motion vector for a group of pixels of an image.

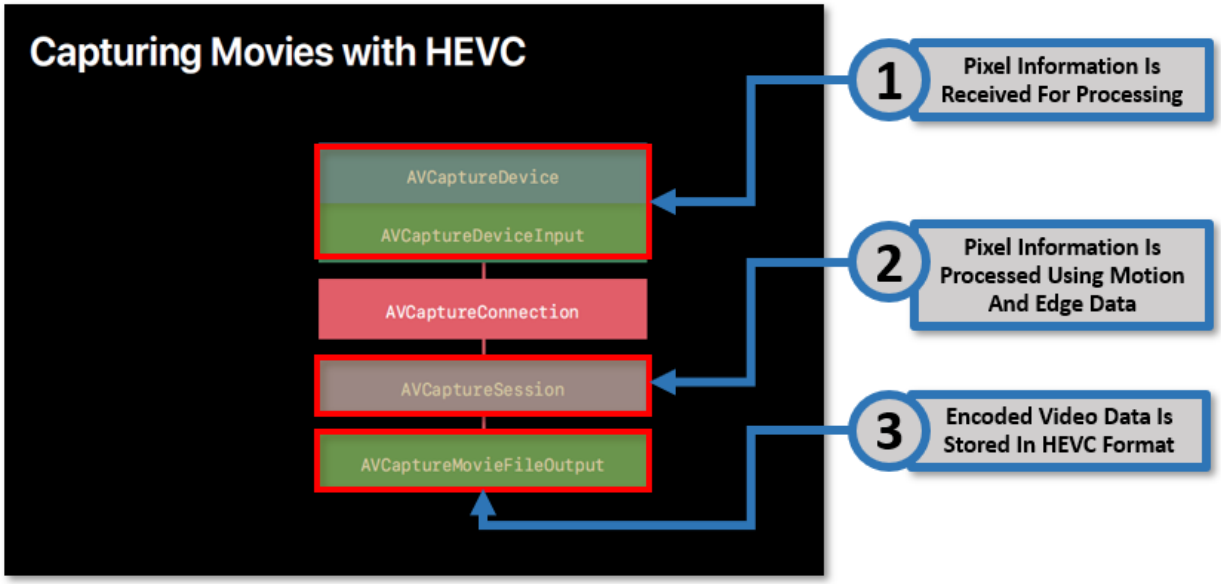
205. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products that comply with the H.265 standard. By way of example, the following Apple Products perform encoding pursuant to the H.265 standard: iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS Max, iPhone XS, iPad (6th generation), iPad Pro 11-inch (3rd generation), and the iPad Pro 12.9-inch (3rd generation) (collectively, the “Apple ‘054 Product(s)”).

206. The Apple '054 Products contain a hardware-based HEVC compliant encoder on the Apple A11 Bionic, Apple A12 Bionic, and Apple A12X Bionic system on chip ("SoC") processors.[28]

207. The following excerpt from a presentation at Apple's Worldwide Developers Conference shows that the Apple products encode video data that can be received in pixel format from a camera on the Apple device. In the below excerpt from an Apple presentation, the block identified as "AVCaptureDeviceInput" shows the pixel data that is received for processing via the "AVCaptureConnection."[29] The pixel data is then processed by the Apple SoC processing unit in the Apple '054 Products.

[28] *See iOS Device Compatibility Reference,* APPLE DEVELOPER WEBSITE (October 30, 2017), *available at*: https://developer.apple.com/library/archive/documentation/DeviceInformation/Reference/iOSDeviceCompatibility/HardwareGPUInformation/HardwareGPUInformation.html (describing the

[29] *See Setting Up a Capture Session*, APPLE DEVELOPER DOCUMENTATION (last visited December 2018), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/setting_up_a_capture_session ("An AVCaptureSession is the basis for all media capture in iOS and macOS. It manages your app's exclusive access to the OS capture infrastructure and capture devices, as well as the flow of data from input devices to media outputs.")



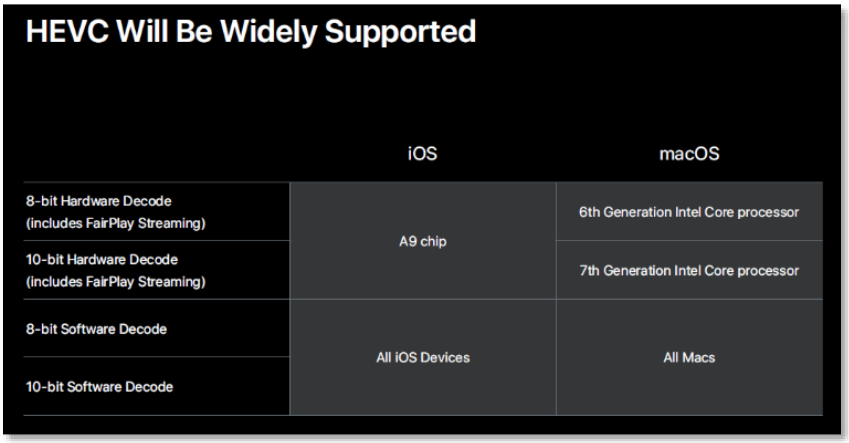
Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 29 (2017) (annotations added).

208. The following excerpts from Apple's documentation shows the Apple Products capture video using "AVCaptureSession" and then encode the video using High Efficiency Video Coding ("HEVC").

> Video captured on iPhone 8, iPhone 8 Plus, and iPhone X, and running iOS 11 or later, uses the HEVC format by default. When you use AVFoundation to capture videos, you can change the default format if you know in advance that you need a different format. If your app shares the captured video using a system share sheet, the video is automatically converted to a format compatible with the destination device, and no more work is needed.

Capturing Video in Alternative Formats, APPLE DEVELOPER DOCUMENTATION (2018) (emphasis added), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/capturing_video_in_alternative_formats.

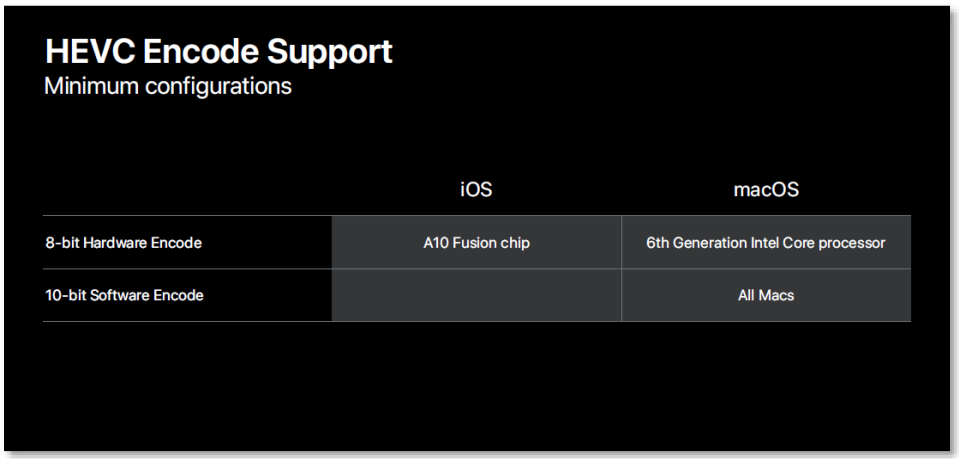
209. Apple's incorporation of H.265/HEVC encoding in the Apple '054 Products has been identified by Apple as being "widely supported."



Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 9 (2017).

210. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '054 Products in regular business operations.

211. On information and belief, one or more of the Apple '054 Products include technology for estimating a current motion vector for a group of pixels of an image. Further, HEVC encoding support has been incorporated into the Apple '054 Products as shown in the below excerpt from an Apple presentation at its Worldwide Developer Conference in 2017.

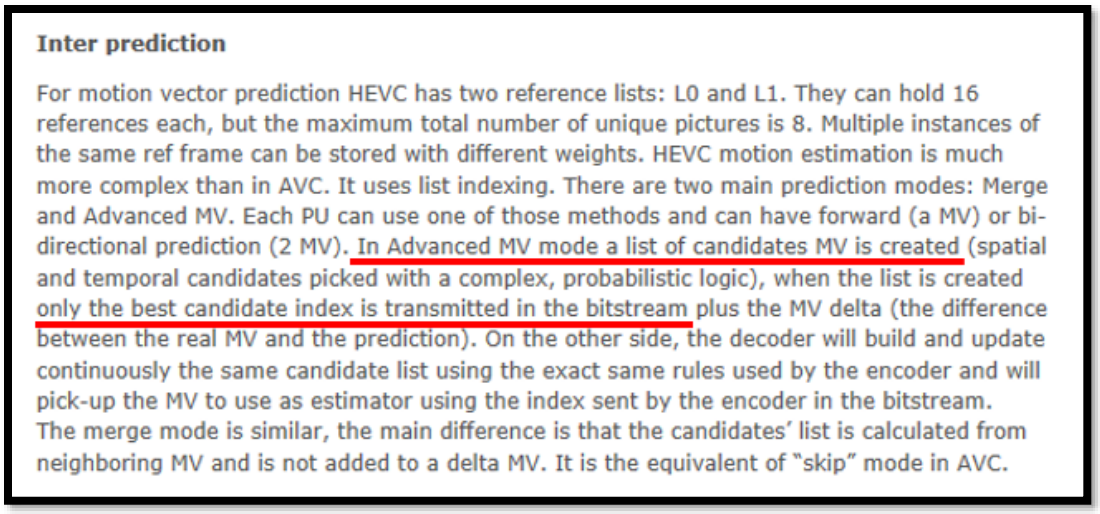


Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 52 (2017).

212. On information and belief, Apple has directly infringed and continues to directly infringe the '054 patent by, among other things, making, using, offering for sale, and/or selling technology for estimating a current motion vector for a group of pixels of an image, including but not limited to the Apple '054 Products.

213. On information and belief, by complying with the HEVC standard, Apple's devices – such as the Apple '054 Products - necessarily infringe the '054 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '054 patent, including but not limited to claim 1. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018) (The following sections of the HEVC Standard are relevant to Apple's infringement of the '054 patent: "7.3.4 Scaling list data syntax;" 7.3.6.1 General slice segment header syntax;" "7.3.6.3 Weighted prediction parameters syntax;" "7.3.8.14 Delta QP syntax;" "7.4.4 Profile, tier and level semantics;" and "7.4.7.3 Weighted prediction parameters semantics."

214. On information and belief, the Apple '054 Products comprise functionality for generating a set of candidate motion vectors for a grouping of pixels (prediction unit). The HEVC standard generates a set of candidate motion vectors for the group of pixels, with the candidate motion vectors being extracted from a set of previously estimated motion vectors. After the candidate motion vectors are generated, only the best candidate index is transmitted.



Inter prediction

For motion vector prediction HEVC has two reference lists: L0 and L1. They can hold 16 references each, but the maximum total number of unique pictures is 8. Multiple instances of the same ref frame can be stored with different weights. HEVC motion estimation is much more complex than in AVC. It uses list indexing. There are two main prediction modes: Merge and Advanced MV. Each PU can use one of those methods and can have forward (a MV) or bi-directional prediction (2 MV). In Advanced MV mode a list of candidates MV is created (spatial and temporal candidates picked with a complex, probabilistic logic), when the list is created only the best candidate index is transmitted in the bitstream plus the MV delta (the difference between the real MV and the prediction). On the other side, the decoder will build and update continuously the same candidate list using the exact same rules used by the encoder and will pick-up the MV to use as estimator using the index sent by the encoder in the bitstream. The merge mode is similar, the main difference is that the candidates' list is calculated from neighboring MV and is not added to a delta MV. It is the equivalent of "skip" mode in AVC.

Fabio Sonnati, *H265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

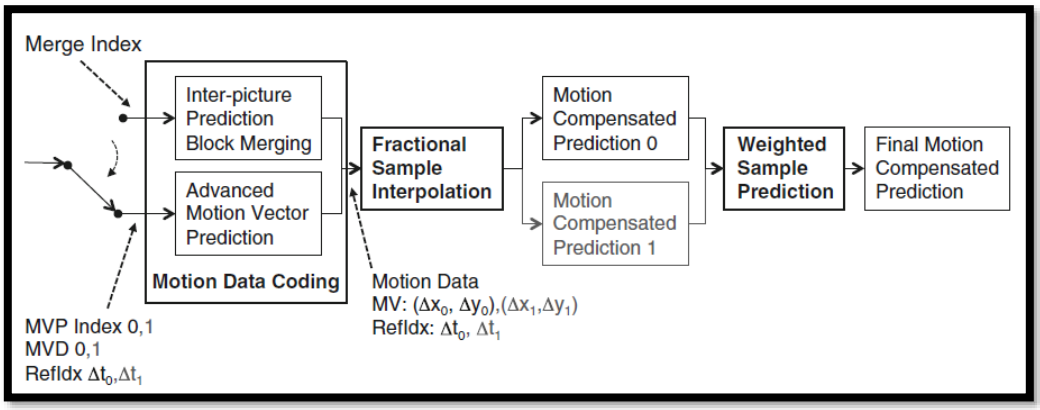
215. On information and belief, one or more of the Apple '054 Products enable motion estimation with a relatively fast convergence in finding the appropriate motion vectors of the motion vector fields by adding a further candidate motion vector to the set of candidate motion vectors.

> HEVC introduces a so-called merge mode, which sets all motion parameters of an inter picture predicted block equal to the parameters of a merge candidate [6]. The merge mode and the motion vector prediction process optionally allow a picture to reuse motion vectors of prior pictures for motion vector coding,

Frank Bossen, *et al*., *HEVC Complexity and Implementation Analysis*, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY VOL. 22 NO. 12 at 1686 (December (2012).

216. On information and belief, the following block diagram illustrates the form of encoded video data received by the Apple '054 Products. Specifically, the encoded video data received by the Apple '054 Products is encoded using inter-picture prediction where the motion data of a block is correlated with neighboring blocks. To exploit this correlation, motion data is not directly coded in the bitstream, but predictively coded based on neighboring motion data. Further, the Apple '054 Products receive data that is encoded using advanced motion vector

prediction where the best predictor for each motion block is signaled to the decoder. In addition, inter-prediction block merging derives all motion data of a block from the neighboring blocks.



Benjamin Bross, *et al*., *Inter-Picture Prediction in HEVC,* In HIGH EFFICIENCY VIDEO CODING (HEVC) at 115 (2014).

217. On information and belief, the Apple '054 products carry out a block-based motion vector estimation process that involves comparing a plurality of candidate vectors to determine block-based motion vectors. The Apple '054 Products generate two predictor candidate motion vectors (a spatial motion vector and temporal motion vector). The first predictor candidate motion vector is drawn from a list of spatial motion vector candidates.

three spatially neighboring MVs. HEVC improves the MV prediction by applying an MV prediction competition as initially proposed in [18]. In HEVC, this competition was further adapted to large block sizes with so-called *advanced motion vector prediction* (AMVP) in [19]. In the DIS *Main profile*, AMVP has two predictor candidates competing for the prediction. Two spatial motion vector predictor (MVP) candidates are considered and, when at least one of them is not available or they are redundant, a temporal motion vector prediction (TMVP) candidate is considered. The candidates

Philipp Helle, Simon Oudin, Benjamin Bross, Detlev Marpe, M. Oguz Bici, Kemal Ugur, Joel Jung, Gordon Clare, and Thomas Wiegand, *Block Merging for Quadtree-Based Partitioning in HEVC, IEEE TRANS. CIR. AND SYS. FOR VIDEO TECHNOLOGY, Vol. 22* No. 12 (December 2012) ("AMVP has two predictor candidates competing for the prediction. Two spatial motion vector predictor (MVP) candidates are considered and, when at least one of them is not available or they are redundant, a temporal motion vector prediction (TMVP) candidate is considered.").

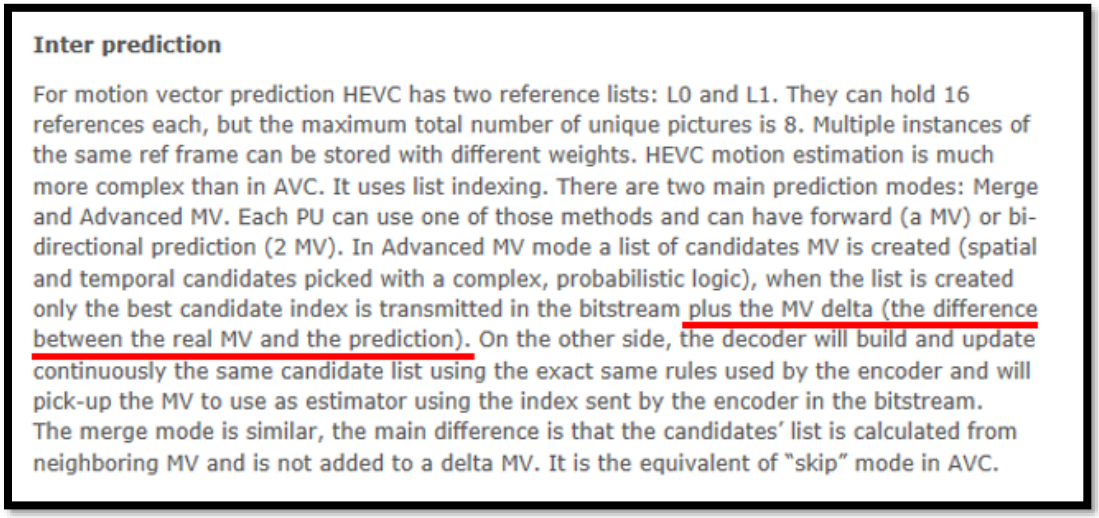
218. Apple's documentation establishes that Apple's '054 Products contain a hardware-based HEVC encoder on the Apple A11 Bionic, Apple A12 Bionic, and Apple A12X Bionic system on chip ("SoC") processors.

> Apple A9 first introduced with hardware based HEVC decoder enabling devices to efficiently playback H.265/High Efficiency video content. A11 introduced a hardware encoder, enabling iPhone's Biopic generations to create and save content in the high efficiency formats. This feature optimizes the storage space while saving high definition photos and videos.

Debrath Banerjee, *A Microarchitecture Study on Apple's A11 Bionic Processor,* RESEARCHGATE PUBLICATION at 3 (May 2018) (emphasis added).

219. On information and belief, one or more of the Apple '054 Products include a motion estimation unit comprising a generating unit for generating a set of candidate motion vectors for the group of pixels, with the candidate motion vectors being extracted from a set of previously estimated motion vectors.

220. On information and belief, the Apple '054 Products contain functionality for generating match errors of the respective candidate motion vectors. The HEVC standard calculates match errors of respective candidate motion vectors. The match errors are in some commentary on the HEVC standard as the MV delta. The MV delta is the difference between the real MV and the candidate predication.



Inter prediction

For motion vector prediction HEVC has two reference lists: L0 and L1. They can hold 16 references each, but the maximum total number of unique pictures is 8. Multiple instances of the same ref frame can be stored with different weights. HEVC motion estimation is much more complex than in AVC. It uses list indexing. There are two main prediction modes: Merge and Advanced MV. Each PU can use one of those methods and can have forward (a MV) or bi-directional prediction (2 MV). In Advanced MV mode a list of candidates MV is created (spatial and temporal candidates picked with a complex, probabilistic logic), when the list is created only the best candidate index is transmitted in the bitstream plus the MV delta (the difference between the real MV and the prediction). On the other side, the decoder will build and update continuously the same candidate list using the exact same rules used by the encoder and will pick-up the MV to use as estimator using the index sent by the encoder in the bitstream. The merge mode is similar, the main difference is that the candidates' list is calculated from neighboring MV and is not added to a delta MV. It is the equivalent of "skip" mode in AVC.

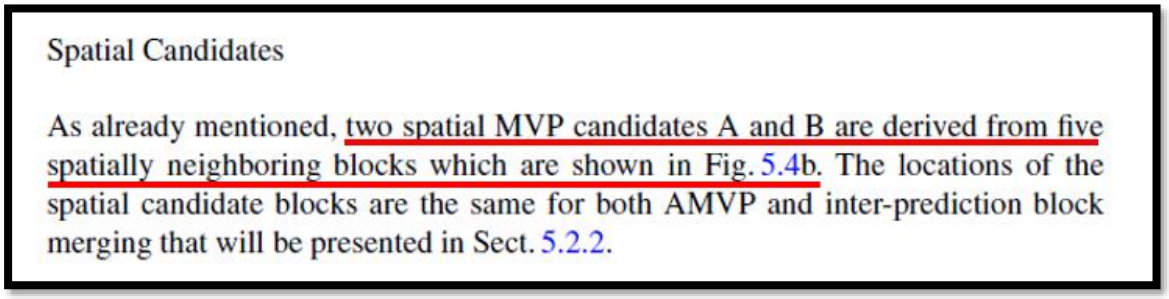
Fabio Sonnati, *H265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

221. On information and belief, any implementation of the HEVC standard would infringe the '054 patent as every implementation of the standard requires the elements in one or more claims of the '054 patent, including but not limited to claim 1, by way of example: a match error unit for calculating match errors of respective candidate motion vectors and calculating the further candidate motion vector by means of calculating a difference between the second motion vector and the first motion vector.

222. On information and belief, one or more of the Apple '054 Products include a motion estimation unit comprising a selector for selecting the current motion vector from the candidate motion vectors by means of comparing the match errors of the respective candidate motion vectors, characterized in that the motion estimation unit is arranged to add a further candidate motion vector to the set of candidate motion vectors by calculating the further candidate motion vector on basis of a first motion vector and a second motion vector, both belonging to the set of previously estimated motion vectors.

223. On information and belief, the Apple '054 Products select the current motion vector from the candidate motion vectors by comparing the match errors of the respective candidate

motion vectors, characterized in that the motion estimation unit is arranged to add a further candidate motion vector to the set of candidate motion vectors by calculating the further candidate motion vector on basis of a first motion vector and a second motion vector, both belonging to the set of previously estimated motion vectors. The first motion vector is labeled 'A' and the second motion vector is labeled 'B'.

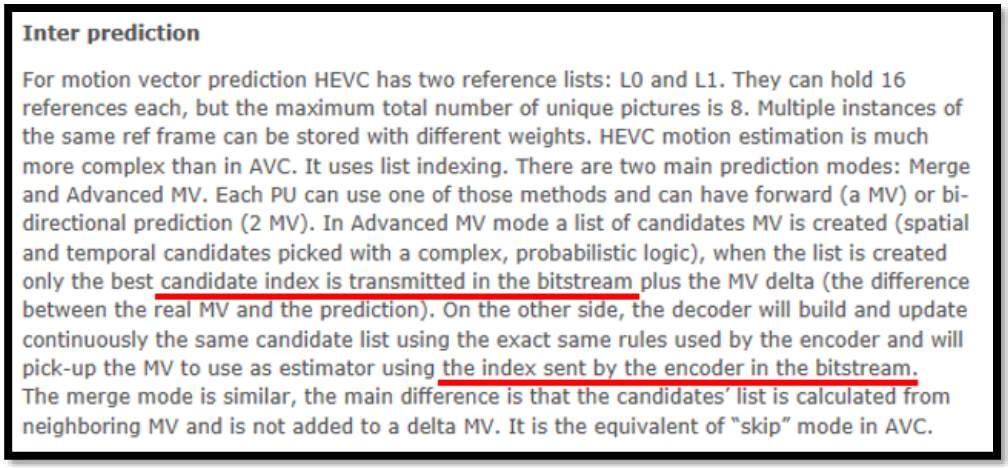


Spatial Candidates

As already mentioned, two spatial MVP candidates A and B are derived from five spatially neighboring blocks which are shown in Fig. 5.4b. The locations of the spatial candidate blocks are the same for both AMVP and inter-prediction block merging that will be presented in Sect. 5.2.2.

Gary Sullivan, *et al*., HIGH EFFICIENCY VIDEO CODING (HEVC) ALGORITHMS AND ARCHITECTURES at 117 (2014) (emphasis added).

224. Further, the Apple '054 Products perform motion vector "competition / weighted sample prediction" by comparing the match errors of the candidate motion vectors. The match errors generated by the Apple '054 Products comprise the difference value between the second motion vector and the first motion vector. Documentation of the encoding process states that the encoder will "pick up the MV [motion vector] to use as an estimator using the index sent by the encoder in the bitstream."

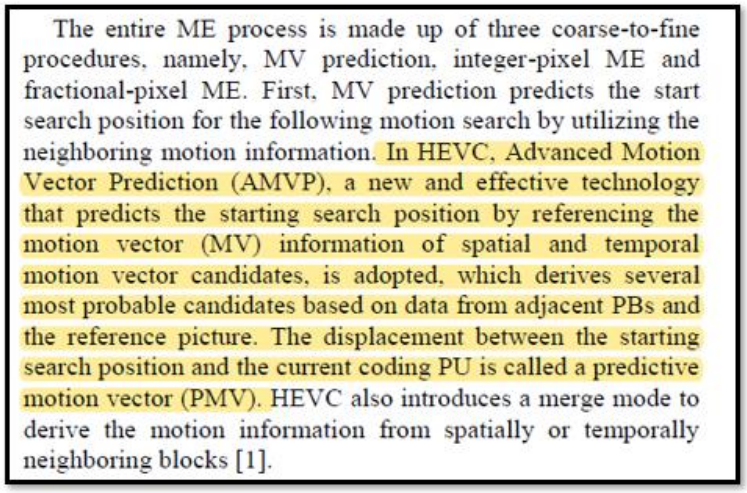


Inter prediction

For motion vector prediction HEVC has two reference lists: L0 and L1. They can hold 16 references each, but the maximum total number of unique pictures is 8. Multiple instances of the same ref frame can be stored with different weights. HEVC motion estimation is much more complex than in AVC. It uses list indexing. There are two main prediction modes: Merge and Advanced MV. Each PU can use one of those methods and can have forward (a MV) or bi-directional prediction (2 MV). In Advanced MV mode a list of candidates MV is created (spatial and temporal candidates picked with a complex, probabilistic logic), when the list is created only the best candidate index is transmitted in the bitstream plus the MV delta (the difference between the real MV and the prediction). On the other side, the decoder will build and update continuously the same candidate list using the exact same rules used by the encoder and will pick-up the MV to use as estimator using the index sent by the encoder in the bitstream. The merge mode is similar, the main difference is that the candidates' list is calculated from neighboring MV and is not added to a delta MV. It is the equivalent of "skip" mode in AVC.

Fabio Sonnati, *H265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

225. On information and belief, the Apple '054 Products calculate the square of the difference between two corresponding pixels of the spatial position of the candidate block where the motion vector is located and the spatial position where the reference motion vector is located. As a result, this value is used to assess the similarity, or the matching degree, of a candidate block. Thus, in order to obtain the best matching vector, the Apple '054 Products apply a penalty value to every candidate block with a different motion vector (*MVx, MVy*) within the search window defined by the search range in the reference frame. Finally, a candidate block with the minimum penalty value will be denoted as the best matching block and used to calculate the best motion vector from the candidate motion vectors. The below excerpt from an article discussing the selection of a best motion vector describes that the selection of a motion vector is based on the position of the motion vector.



The entire ME process is made up of three coarse-to-fine procedures, namely, MV prediction, integer-pixel ME and fractional-pixel ME. First, MV prediction predicts the start search position for the following motion search by utilizing the neighboring motion information. In HEVC, Advanced Motion Vector Prediction (AMVP), a new and effective technology that predicts the starting search position by referencing the motion vector (MV) information of spatial and temporal motion vector candidates, is adopted, which derives several most probable candidates based on data from adjacent PBs and the reference picture. The displacement between the starting search position and the current coding PU is called a predictive motion vector (PMV). HEVC also introduces a merge mode to derive the motion information from spatially or temporally neighboring blocks [1].

Yongfei Zhang, Chao Zhang, and Rui Fan, *Fast Motion Estimation in HEVC Inter Coding: An Overview of Recent Advances*, PROCEEDINGS, APSIPA ANNUAL SUMMIT AND CONFERENCE 2018 at 1 (November 2018) (emphasis added).

226. On information and belief, one or more of the Apple '054 Products include a motion estimation unit that calculates the further candidate motion vector on basis of the first motion vector and the second motion vector, with the first motion vector belonging to a first forward motion vector field and the second motion vector belonging to a second forward motion vector field, with the first forward motion vector field and the second forward motion vector field being different. Specifically, the HEVC standard arranges to calculate the further candidate motion vector by calculating a difference between the second motion vector and the first motion vector. The further candidate motion vector is calculated at the end of the process diagram below (see the red box).

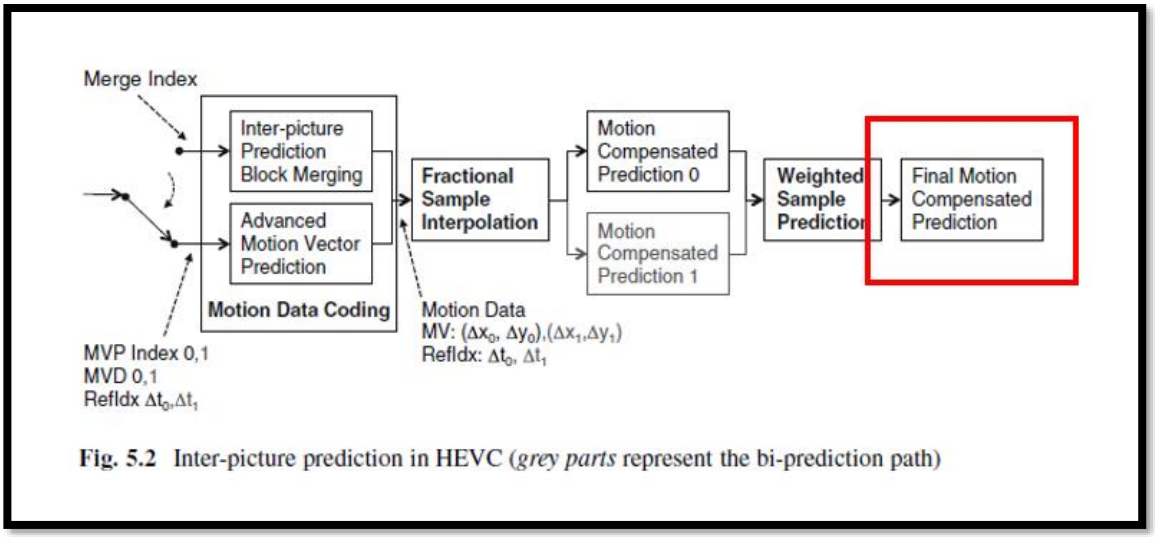


Fig. 5.2 Inter-picture prediction in HEVC (*grey parts* represent the bi-prediction path)

Gary J. Sullivan, *et al*., HEVC, HIGH EFFICIENCY VIDEO CODING (HEVC) at 115 (September 2014) (emphasis added).

227. On information and belief, one or more of the Apple '054 Products include a motion estimation unit that arranges to calculate the further candidate motion vector by means of calculating a difference between the second motion vector and the first motion vector.

228. On information and belief, the Apple '054 Products are available to businesses and individuals throughout the United States.

229. On information and belief, the Apple '054 Products are provided to businesses and individuals located in the Eastern District of Texas.

230. By making, using, testing, offering for sale, and/or selling products and services for estimating a current motion vector for a group of pixels of an image, including but not limited to the Apple '054 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '054 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

231. On information and belief, Apple also indirectly infringes the '054 patent by actively inducing infringement under 35 USC § 271(b).

232. Apple has had knowledge of the '054 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '054 patent and knew of its infringement, including by way of this lawsuit.

233. On information and belief, Apple in450tended to induce patent infringement by third-party customers and users of the Apple '054 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '054 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '054 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '054 Products that have the capability of operating in a manner that infringe one or more of the claims of the '054 patent, including at least claim 1, and Apple further provides documentation and training materials that cause customers and end users of the Apple '054 Products to utilize the products in a manner that directly infringe one or more claims of the '054 patent.[30] By providing instruction and training to customers and end-users on how to use the Apple '054 Products in a manner that directly infringes one or more claims of the '054 patent, including at least claim 1, Apple specifically intended to induce infringement of the '054 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '054 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '054 patent.

[30] *See, e.g.*, *iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '054 patent, knowing that such use constitutes infringement of the '054 patent.

234. The '054 patent is well-known within the industry as demonstrated by multiple citations to the '054 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '054 patent without paying a reasonable royalty. Apple is infringing the '054 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

235. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '054 patent.

236. As a result of Apple's infringement of the '054 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT IV
INFRINGEMENT OF U.S. PATENT NO. 6,774,918

237. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

238. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for image processing.

239. Apple designs, makes, sells, offers to sell, imports, and/or use the Apple products that implement HTTP Live Streaming ("HLS"). The Accused Products include, but are not limited

to, Apple's iPhone, iPad, and Apple TV, and any other products capable of implementing HLS (collectively, the "Apple '918 Product(s)").

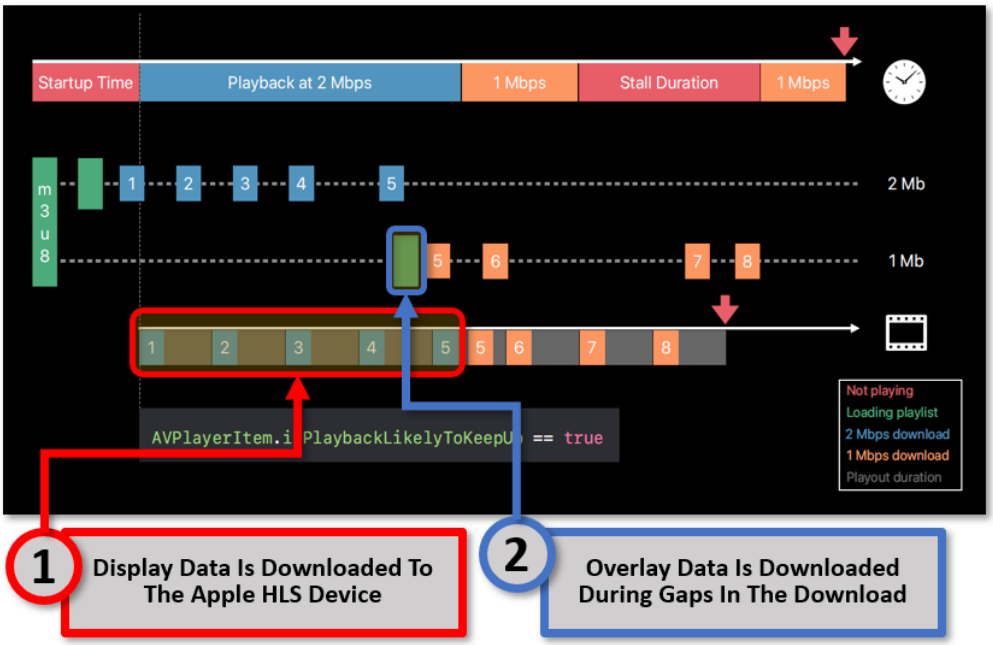
240. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '918 Products in regular business operations.

241. On information and belief, one or more of the Apple '918 Products include technology for image processing.

> HTTP Live Streaming provides a reliable, cost-effective means of delivering continuous and long-form video over the Internet. It allows a receiver to adapt the bit rate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality. It supports interstitial content boundaries.

R. Pantos, HTTP LIVE STREAM PROTOCOL SPECIFICATION 2ND EDITION at 4 (June 20, 2018).

242. On information and belief, the Apple '918 Products download display data. The downloading of this data contains gaps wherein the on-screen display ("OSD") data is downloaded. This data (e.g., captions, subtitles, etc.) is then rendered on the screen of the Apple '918 Products.



Emil Andriescu, *Measuring and Optimizing HLS Performance*, APPLE WORLD WIDE DEVELOPERS CONFERENCE 2018 (WWDC18) at 26 (2018) (annotations added).

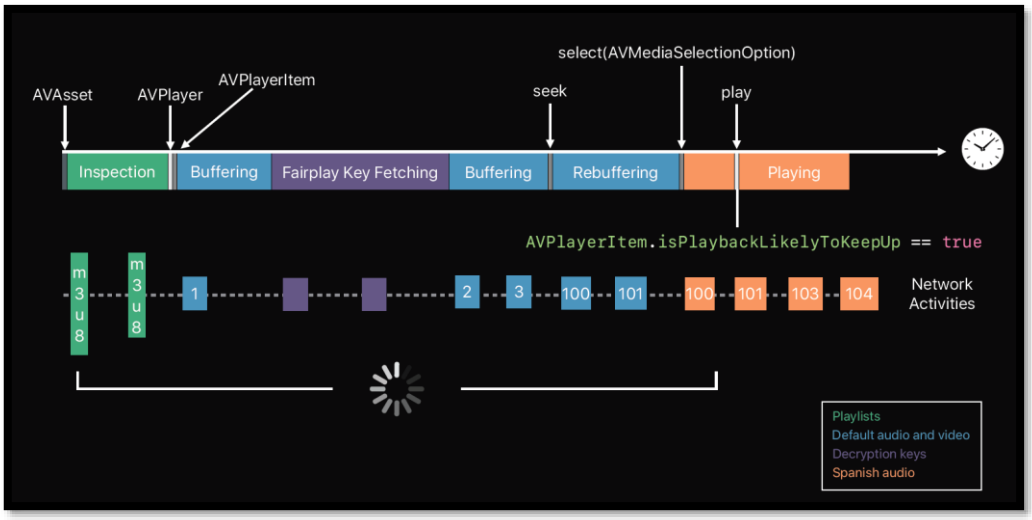
243. On information and belief, the Apple '918 Products implement HTTP Live Streaming and contain functionality wherein each transport stream comprising video/audio/on screen display content (captions) stream is downloaded. Each stream that is downloaded is delayed pending the downloading of an earlier transport stream.

> Every time a Media Playlist is loaded or reloaded from a Playlist URI, the client MUST determine the next Media Segment to load, as described in Section 6.3.5, if it intends to play the presentation normally (i.e., in Playlist order at the nominal playback rate).
>
> If the Media Playlist contains the EXT-X-MEDIA-SEQUENCE tag, the client SHOULD assume that each Media Segment in it will become unavailable at the time that the Playlist file was loaded plus the duration of the Playlist file.
>
> A client MAY use the segment Media Sequence Number to track the location of a Media Segment within a Playlist when the Playlist is reloaded.

R. Pantos, HTTP LIVE STREAM PROTOCOL SPECIFICATION 2ND EDITION at 47 (June 20, 2018).

244. On information and belief, the Apple '918 Products download the onscreen display data (which is delivered in as a separate file) until the cap in downloading the video display file.

The below excerpt from a 2018 presentation at Apple's Worldwide Developer Conference shows the downloading of data packets during gaps in downloading the video stream.



Emil Andriescu, *Measuring and Optimizing HLS Performance*, APPLE WORLD WIDE DEVELOPERS CONFERENCE 2018 (WWDC18) at 97 (2018).

245. On information and belief, the Apple '918 Products are available to businesses and individuals throughout the United States.

246. On information and belief, the Apple '918 Products are provided to businesses and individuals located in the Eastern District of Texas.

247. On information and belief, Apple has directly infringed and continues to directly infringe the '918 patent by, among other things, making, using, offering for sale, and/or selling video processing technology, including but not limited to the Apple '918 Products.

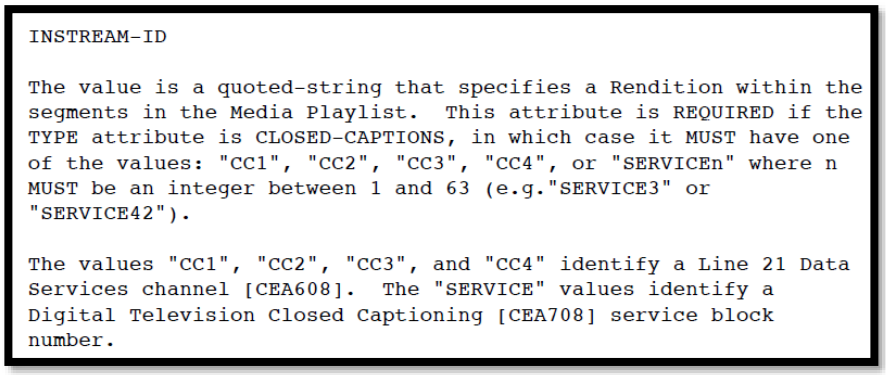
248. On information and belief, one or more of the Apple '918 Products provide an overlay such as a cursor, closed captions, or subtitles in an on-screen display in a consumer electronic device. Subtitles are treated as a variant playlist and there must be one file for each piece of content (audio, video, subtitle, caption) in the HLS presentation. For example, in the below listing of content in a master playlist, the underlined item is the separate file that contains

the subtitles that are downloaded during the caps between the downloading of the other content files.

> #EXT-X-STREAM-INF:AVERAGE-BANDWIDTH=8052613,BANDWIDTH=9873268,CODECS="avc1.64002a,mp4a.40.2", RESOLUTION=1920x1080,FRAME-RATE=60.000,CLOSED-CAPTIONS="cc",AUDIO="a1",SUBTITLES**="sub1"v9/prog_index.m3u8**

249. On information and belief, one or more of the Apple '918 Products enable downloading on-screen display (OSD) data for generating an image on a display device.

250. On information and belief, the Apple '918 Products require an IDSTREAM-ID for a rendition within the segments of playlist where the attribute is "Closed Captions."



INSTREAM-ID

The value is a quoted-string that specifies a Rendition within the segments in the Media Playlist. This attribute is REQUIRED if the TYPE attribute is CLOSED-CAPTIONS, in which case it MUST have one of the values: "CC1", "CC2", "CC3", "CC4", or "SERVICEn" where n MUST be an integer between 1 and 63 (e.g."SERVICE3" or "SERVICE42").

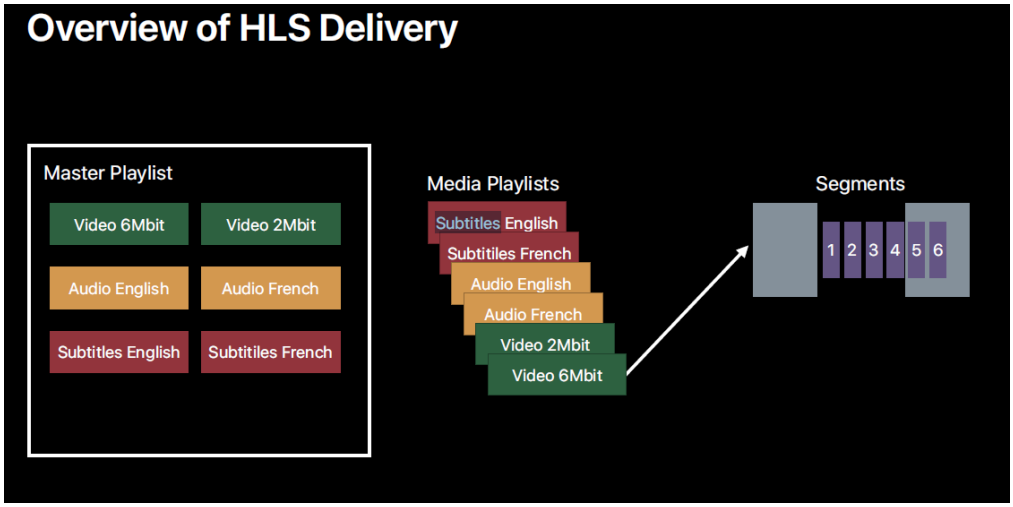
The values "CC1", "CC2", "CC3", and "CC4" identify a Line 21 Data Services channel [CEA608]. The "SERVICE" values identify a Digital Television Closed Captioning [CEA708] service block number.

R. Pantos, HTTP LIVE STREAM PROTOCOL SPECIFICATION 2ND EDITION at 27 (June 20, 2018).

251. On information and belief, one or more of the Apple '918 Products download the on-screen display (OSD) data in segments separated by gaps.

252. On information and belief, one or more of the Apple '918 Products download, during a gap in downloading the on-screen display data, an amount of overlay data for generating an overlay on the image generated on a display device.

253. On information and belief, the Apple '918 Products contain functionality wherein subtitle content is referenced in a master playlist and downloaded as a segment for an overlay display of the image displayed on a display device.



Shravya Kunamalla, *Error Handling Best Practices for HTTP Live Streaming*, APPLE WWDC 2017 PRESENTATION at 16 (2017).

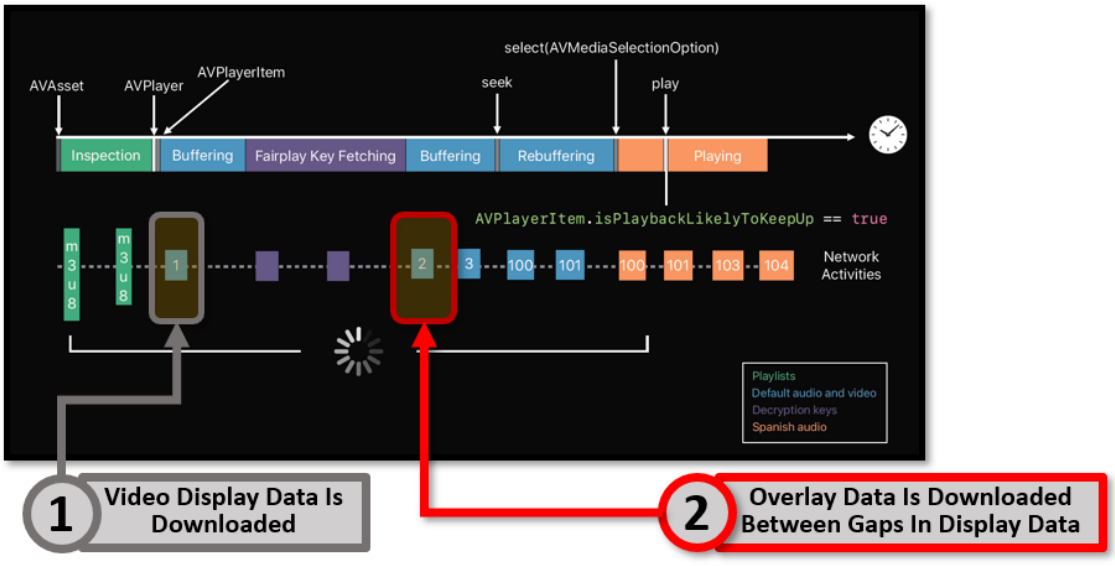
254. On information and belief, one or more of the Apple '918 Products contain overlay data downloaded during a gap that comprises a portion of the overlay data.

255. On information and belief, by complying with the HLS standard, the Apple devices – such as the Apple '918 Products - necessarily infringe the '918 patent. The mandatory sections of the HLS standard require the elements required by certain claims of the '918 patent, including but not limited to claim 18 of the '918 patent. For example, subtitle and WebVTT content that can be displayed as an overlay on a device have separate content types.

Base Sample Type	Description
ac-3	AC-3 audio
avc1	H.264 (Advanced Video Coding)
dvh1	Dolby Vision (based on hvc1)
ec-3	Enchanced AC-3 audio
hvc1	HEVC (High Efficiency Video Coding)
mp4a	MPEG-4 audio
stpp	Subtitles (Timed Text)
wvtt	WebVTT data

HLS Authoring Specification for Apple Devices, APPLE DEVELOPER DOCUMENTATION, *available at*: https://developer.apple.com/documentation/http_live_streaming/.

256. On information and belief, the Apple '918 Products comprise a computer-usable medium having computer-readable program code embodied therein for causing a video processor to download on-screen display (OSD) data for generating an image on a display device, with said downloading occurring in segments separated by gaps.



Emil Andriescu, *Measuring and Optimizing HLS Performance*, APPLE WORLD WIDE DEVELOPERS CONFERENCE 2018 (WWDC18) at 26 (2018) (annotations added).

257. On information and belief, the Apple '918 Products comprise a computer-usable medium having computer-readable program code embodied therein for causing a video processor to download an amount of overlay data for generating an overlay on an image during a gap in downloading the on-screen display (OSD) data, wherein the amount of overlay data comprises a portion of said overlay.

258. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the Apple '918 Products, Apple has injured Dynamic Data and is liable for directly infringing one or more claims of the '918 patent, including at least claim 18, pursuant to 35 U.S.C. § 271(a).

259. On information and belief, Apple also indirectly infringes the '918 patent by actively inducing infringement under 35 USC § 271(b).

260. On information and belief, Apple has had knowledge of the '918 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '918 patent and knew of its infringement, including by way of this lawsuit.

261. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '918 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '918 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '918 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '918 Products that have the capability of operating in a manner that infringe

one or more of the claims of the '918 patent, including at least claim 18, and Apple further provides documentation and training materials that cause customers and end users of the Apple '918 Products to utilize the products in a manner that directly infringe one or more claims of the '918 patent.[31] By providing instruction and training to customers and end-users on how to use the Apple '918 Products in a manner that directly infringes one or more claims of the '918 patent, including at least claim 18, Apple specifically intended to induce infringement of the '918 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '918 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '918 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '918 patent, knowing that such use constitutes infringement of the '918 patent.

262. The '918 patent is well-known within the industry as demonstrated by multiple citations to the '918 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '918 patent without paying a reasonable royalty. Apple is infringing the '918 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

[31] *See, e.g.*, *iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018); *Apple TV User Guide*, APPLE SUPPORT WEBSITE, *available at*: https://support.apple.com/guide/tv/welcome/tvos (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

263. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '918 patent.

264. As a result of Apple's infringement of the '918 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT V
INFRINGEMENT OF U.S. PATENT NO. 8,184,689

265. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

266. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for encoding and decoding video data.

267. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products and services that encode/decode video data by simultaneous encoding/decoding of more than one image of the video stream by access sharing to at least one image. By way of illustrative example, the Accused Products include, but are not limited to, Apple's devices that implement iOS 10.3 and later versions of iOS and tvOS 10.2 and later versions of tvOS, including: iPhone, iPad, and Apple TV (collectively, the "Apple '689 Product(s)").

268. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '689 Products in regular business operations.

269. On information and belief, one or more of the Apple '689 Products include technology for encoding and decoding video data.

> The usage of big.LITTLE architecture enables the A11 processor in such a way that it could handle the task using asymmetric

> multiprocessing. The GPU in the chip is three core Apple design which gives faster performance and uses less energy compared to other competitors in the mobile universe. The dual core Neural processor plays another important role by incorporating machine learning into the chip which is capable of 600 billion ops/second and appears to be pipelined through new ISP, which apparently has hardware noise reduction and faster face detection. It may also be linked with slow sync flash which can capture background details of the photo taken with flash in low light. Also, there is a new M11 motion coprocessor which features improved gyroscopes and inertial motion detection. There is also new video processor which segments the image into 2 million tiles and does motion and edge detection in conjunction with the hardware HEIF and HEVC encoder/decoder.

Debrath Banerjee, *A Microarchitecture Study on Apple's A11 Bionic Processor*, RESEARCHGATE PUBLICATION (May 2018) (emphasis added), *available at*: https://www.researchgate.net/publication/325053646_A_Microarchitectural_Study_on_Apple's_A11_Bionic_Processor.

270. On information and belief, Apple has directly infringed and continues to directly infringe the '689 patent by, among other things, making, using, offering for sale, and/or selling technology for encoding and decoding video data, including but not limited to the Apple '689 Products.

271. On information and belief, one or more of the Apple '689 Products reduce processing time and power consumption associated with encoding and decoding video stream data by reducing off-chip memory accesses through using simultaneous encoded/decoded images as a reference image for encoding/decoding at least one of the other simultaneously encoded/decoded images.

272. On information and belief, the Apple '689 Products contain AVAssetExportSession, which will simultaneously decode and encode video data. Further, AVAssetExportSession allows the Apple '689 Products to initialize an export session with the asset that contains the source media, the export preset name (presetName), and the output file type (outputFileType). The process of encoding and decoding is started by invoking exportAsynchronously(completionHandler:).

273. On information and belief, one or more of the Apple '689 Products perform a method for encoding and decoding a video stream, including a plurality of images in a video processing apparatus having a processing unit coupled to a first memory, further comprising a second memory.

274. On information and belief, the Apple '986 Products enable encoding and decoding using a first and second memory. Apple documentation states that "To convert existing movie files to a format that makes them compatible with other devices, you must generate a new movie file based on the contents of the existing file." Export Video to Alternative Formats, APPLE DEVELOPER DOCUMENTATION (2019), *available at*: https://developer.apple.com/documentation/avfoundation/media_assets_playback_and_editing/

275. On information and belief, one or more of the Apple '689 Products perform a method for encoding and decoding a video stream comprising providing a subset of image data stored in the second memory in the first memory.

TechInsights Apple iPhone 8 Plus Teardown, TECHINSIGHTS ARTICLE (January 11, 2017), *available at*: https://techinsights.com/about-techinsights/overview/blog/apple-iphone-8-teardown/ ("The iPhone 8 Plus A1897 model we examined initially is confirmed to contain the A11 Bionic AP with a die mark TMHS09.").

276. On information and belief, one or more of the Apple '689 Products perform a method for encoding and decoding a video stream comprising simultaneous encoding/decoding of more than one image of the video stream, by accessing said subset, wherein the simultaneously encoding/decoding is performed by access sharing to at least one image.

277. On information and belief, the Apple '689 Products are available to businesses and individuals throughout the United States.

278. On information and belief, the Apple '689 Products are provided to businesses and individuals located in the Eastern District of Texas.

279. By making, using, testing, offering for sale, and/or selling products and services for encoding and decoding video data, including but not limited to the Apple '689 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '689 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

280. On information and belief, Apple also indirectly infringes the '689 patent by actively inducing infringement under 35 USC § 271(b).

281. Apple has had knowledge of the '689 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '689 patent and knew of its infringement, including by way of this lawsuit.

282. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '689 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '689 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '689 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '689 Products that have the capability of operating in a manner that infringe one or more of the claims of the '689 patent, including at least claim 1, and Apple further provides documentation and training materials that cause customers and end users of the Apple '689 Products to utilize the products in a manner that directly infringe one or more claims of the '689 patent.[32] By providing instruction and training to customers and end-users on how to use the Apple

[32] *See, e.g.*, *iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018).

‘689 Products in a manner that directly infringes one or more claims of the ‘689 patent, including at least claim 1, Apple specifically intended to induce infringement of the ‘689 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple ‘689 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the ‘689 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the ‘689 patent, knowing that such use constitutes infringement of the ‘689 patent.

283. The ‘689 patent is well-known within the industry as demonstrated by multiple citations to the ‘689 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the ‘689 patent without paying a reasonable royalty. Apple is infringing the ‘689 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

284. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘689 patent.

285. As a result of Apple’s infringement of the ‘689 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT VI
INFRINGEMENT OF U.S. PATENT NO. 6,996,177

286. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

287. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for motion estimation.

288. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products that comply with the H.265 video encoding standard. By way of example, the following Apple Products perform encoding pursuant to the H.265 standard: iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS Max, iPhone XS, iPad (6th generation), iPad Pro 11-inch (3rd generation), and the iPad Pro 12.9-inch (3rd generation) (collectively, the "Apple '177 Product(s)"). [33]

289. The Apple '177 Products contain a hardware-based HEVC encoder on the Apple A11 Bionic, Apple A12 Bionic, and Apple A12X Bionic system on chip ("SoC") processors.

> Apple A9 first introduced with hardware based HEVC decoder enabling devices to efficiently playback H.265/High Efficiency video content. A11 introduced a hardware encoder, enabling iPhone's Biopic generations to create and save content in the high efficiency formats. This feature optimizes the storage space while saving high definition photos and videos.

Debrath Banerjee, *A Microarchitecture Study on Apple's A11 Bionic Processor,* RESEARCHGATE PUBLICATION at 3 (May 2018) (emphasis added), *available at*: https://www.researchgate.net/publication/325053646_A_Microarchitectural_Study_on_Apple's_A11_Bionic_Processor.

290. The following excerpt from Apple documentation relating to the Apple '177 Products identifies the accused devices as encoding video image data using motion estimation.

> Sometimes you don't always land in a pixel's boundary. For example, you know, something could have moved five pixels over

[33] *See iOS Device Compatibility Reference,* APPLE DEVELOPER WEBSITE (October 30, 2017), *available at*: https://developer.apple.com/library/archive/documentation/DeviceInformation/Reference/iOSDeviceCompatibility/HardwareGPUInformation/HardwareGPUInformation.html.

> but it could have moved five-and-a-half pixels over or five-and-a-quarter pixels over. When you need to do motion estimation at that half pixel or quarter pixel boundary, you need to be able to generate those pixels with accuracy and precision because those don't exist. You just have to pixels at the boundaries. And so as you can see, HEVC has advanced filtering which can be used to generate those sub-pel and quarter-pel pixels with much more accuracy and precision. And that leads to better motion estimation compensation and, hence, better compression.

Gavin Thomson and Athar Shah, *Introducing HEIF and HEVC,* APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 503 Transcript (2017) (emphasis added), *available at*: https://developer.apple.com/videos/play/wwdc2017/503/ (showing that that when encoding a video stream the Apple '782 Products perform "Motion Estimation").

291. Further, the Apple '177 Products contain a video encoder that functions to encode video using motion estimation values in addition to motion vectors. The following excerpt from Apple documentation identifies that the video coding engine incorporated in the Apple '177 Products uses High Efficiency Video Coding ("HEVC").[34]

> Video captured on iPhone 8, iPhone 8 Plus, and iPhone X, and running iOS 11 or later, uses the HEVC format by default. When you use AVFoundation to capture videos, you can change the default format if you know in advance that you need a different format. If your app shares the captured video using a system share sheet, the video is automatically converted to a format compatible with the destination device, and no more work is needed.

Capturing Video in Alternative Formats, APPLE DEVELOPER DOCUMENTATION (2018) (emphasis added), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/capturing_video_in_alternative_formats.

292. The following excerpt from a book that describes the HEVC motion estimation process describes that it is done through a Prediction Unit matching method and that the MV represents the displacement between the current Prediction Unit in the current frame and the matching Prediction Unit in the reference frame.

> Motion estimation compares the current prediction unit (PU) with the spatially neighboring PUs in the reference frames, and chooses the one with the least difference

[34] High Efficiency Video Coding ("HEVC") is also called H.265 and MPEG-H Part 2.

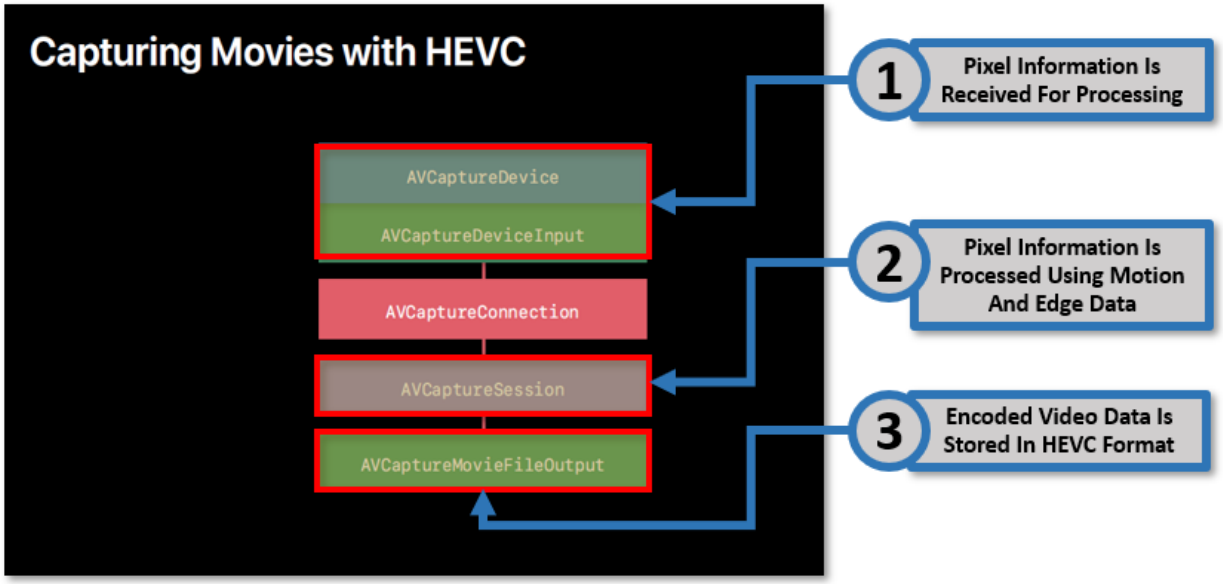
> to the current PU. The displacement between the current PU and the matching PU in the reference frames is signaled using a motion vector.

Sung-Fang Tsai, *et al.*, *Encoder Hardware Architecture for HEVC*, High Efficiency Video Coding (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 347 (September 2014) (emphasis added).

293. On information and belief, by complying with the HEVC standard, the Apple devices – such as the Apple '177 Products - necessarily infringe the '177 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '177 patent, including but not limited to claim 1. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018). The following sections of the HEVC Standard are relevant to Apple's infringement of the '177 patent: "7.3.4 Scaling list data syntax;" 7.3.6.1 General slice segment header syntax;" "7.3.6.3 Weighted prediction parameters syntax;" "7.3.8.14 Delta QP syntax;" "7.4.4 Profile, tier and level semantics;" and "7.4.7.3 Weighted prediction parameters semantics."

294. The following excerpt from a presentation at Apple's Worldwide Developers Conference shows that the Apple products encode video data that can be received in pixel format from a camera on the Apple device. In the below excerpt from an Apple presentation, the block identified as "AVCaptureDeviceInput" shows the pixel data that is received for processing via the "AVCaptureConnection."[35] The pixel data is then processed by the Apple SoC processing unit in the Apple '177 Product.

[35] *See Setting Up a Capture Session*, APPLE DEVELOPER DOCUMENTATION (last visited December 2018), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/setting_up_a_capture_session ("An AVCaptureSession is the basis for all media capture in iOS and macOS. It manages your app's exclusive access to the OS capture infrastructure and capture devices, as well as the flow of data from input devices to media outputs.").



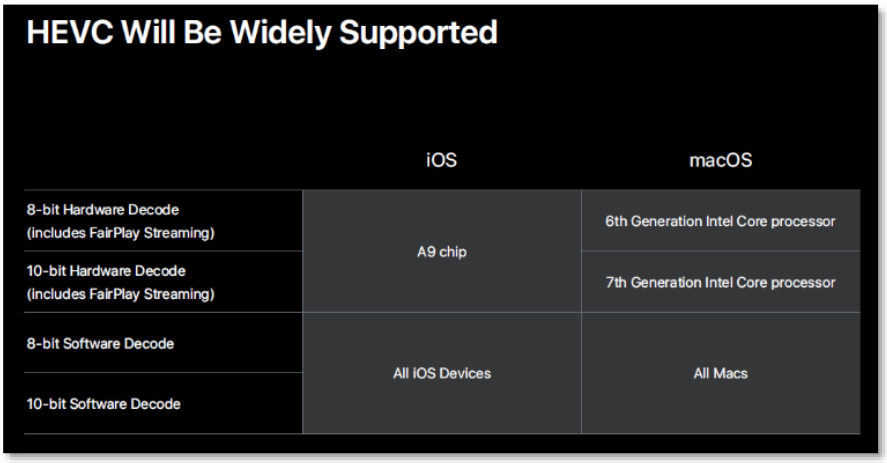
Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 29 (2017) (annotations added).

295. The following excerpts from Apple's documentation shows the Apple Products capture video using "AVCaptureSession" and then encode the video using High Efficiency Video Coding ("HEVC").

> Video captured on iPhone 8, iPhone 8 Plus, and iPhone X, and running iOS 11 or later, uses the HEVC format by default. When you use AVFoundation to capture videos, you can change the default format if you know in advance that you need a different format. If your app shares the captured video using a system share sheet, the video is automatically converted to a format compatible with the destination device, and no more work is needed.

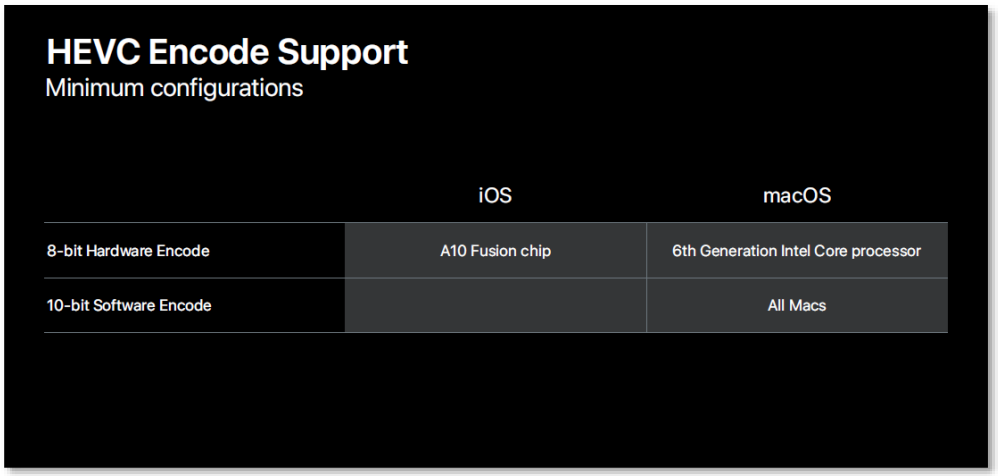
Capturing Video in Alternative Formats, APPLE DEVELOPER DOCUMENTATION (2018) (emphasis added), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/capturing_video_in_alternative_formats.

296. On information and belief, one or more of the Apple '177 Products include technology for motion estimation and motion-compensated picture signal processing. Apple's incorporation of H.265/HEVC encoding in the Apple '177 Products has been identified by Apple as being "widely supported."



Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 9 (2017).

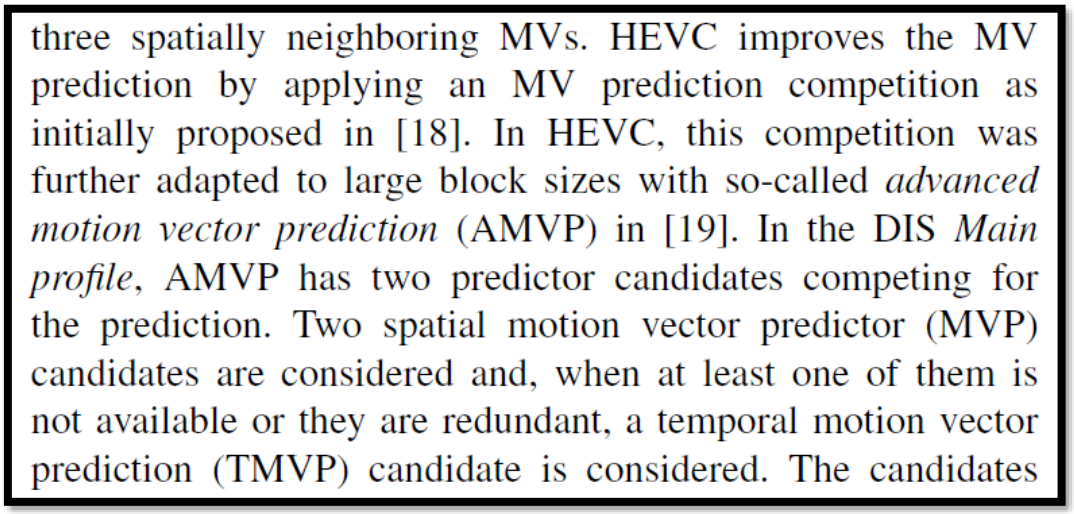
297. On information and belief, one or more of the Apple '177 Products include technology for estimating a current motion vector for a group of pixels of an image. Further, HEVC encoding support has been incorporated into the Apple '177 Products as shown in the below excerpt from an Apple presentation at its Worldwide Developer Conference in 2017.



Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 52 (2017).

298. Further, the Apple '177 Products carry out a block-based motion vector estimation process that involves comparing a plurality of candidate vectors to determine block-based motion vectors. The Apple '177 Products generate two predictor candidate motion vectors (a spatial

motion vector and temporal motion vector). The first predictor candidate motion vector is drawn from a list of spatial motion vector candidates.



three spatially neighboring MVs. HEVC improves the MV prediction by applying an MV prediction competition as initially proposed in [18]. In HEVC, this competition was further adapted to large block sizes with so-called *advanced motion vector prediction* (AMVP) in [19]. In the DIS *Main profile*, AMVP has two predictor candidates competing for the prediction. Two spatial motion vector predictor (MVP) candidates are considered and, when at least one of them is not available or they are redundant, a temporal motion vector prediction (TMVP) candidate is considered. The candidates

Philipp Helle, Simon Oudin, Benjamin Bross, Detlev Marpe, M. Oguz Bici, Kemal Ugur, Joel Jung, Gordon Clare, and Thomas Wiegand, *Block Merging for Quadtree-Based Partitioning in HEVC*, IEEE TRANS. CIR. AND SYS. FOR VIDEO TECHNOLOGY, Vol. *22* No. 12 (December 2012) ("AMVP has two predictor candidates competing for the prediction. Two spatial motion vector predictor (MVP) candidates are considered and, when at least one of them is not available or they are redundant, a temporal motion vector prediction (TMVP) candidate is considered.").

299. In AMVP, the motion vector selection process is composed by two steps wherein the candidate motion vectors are constructed into an index and then the motion vectors are compared. "In AMVP, the motion vector selection process is composed by two steps in encoder implementation. The first step is the motion vector candidate set construction process and the second step is the best motion vector selection step. In the first step, the motion vector candidate set is organized by selecting the motion vectors spatially and temporally." Gwo-Long Li, Chuen-Ching Wang, and Kuang-Hung Chiang, *An Efficient Motion Vector Prediction Method for Avoiding AMVP Data Dependency For HEVC*, 2014 IEEE INTERNATIONAL CONFERENCE ON ACOUSTIC, SPEECH AND SIGNAL PROCESSING (ICASSP) at 7412-13 (2014).

300. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '177 Products in regular business operations.

301. On information and belief, the Apple '177 Products are available to businesses and individuals throughout the United States.

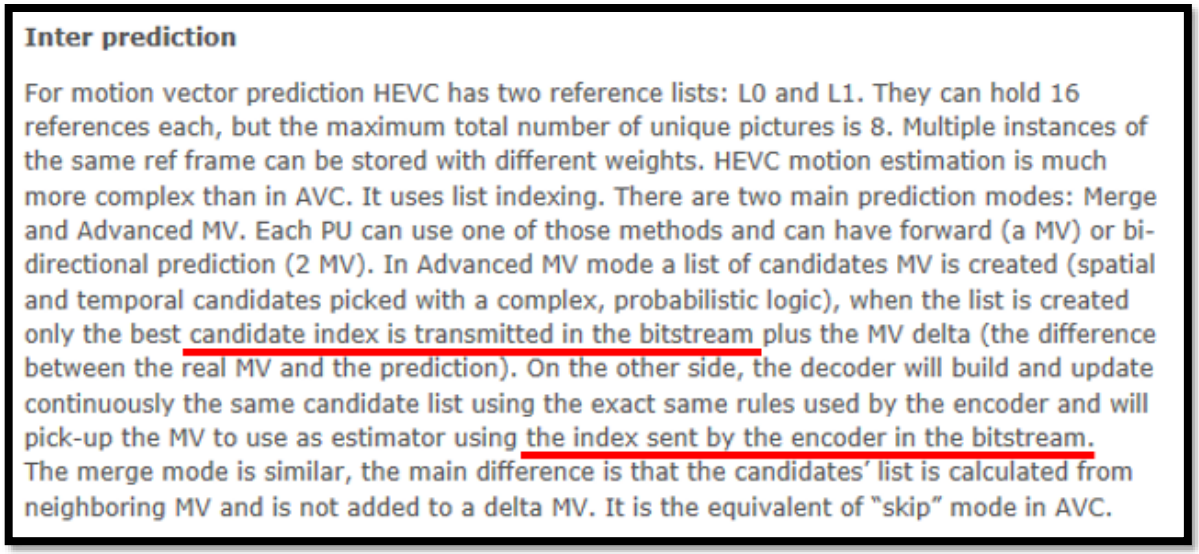
302. On information and belief, the Apple '177 Products are provided to businesses and individuals located in the Eastern District of Texas.

303. The HEVC Standard provides details regarding what would be required for a compliant HEVC encoder—*e.g.*, the standard uses terms such as "encoding," "coding," "compressing," and other similar terms to describe the encoding process.

304. On information and belief, Apple has directly infringed and continues to directly infringe the '177 patent by, among other things, making, using, offering for sale, and/or selling products and services for motion estimation and motion-compensated picture signal processing.

305. Apple '177 Products use a block-based motion vector estimation process that compares a plurality of candidate vectors to determine block-based motion vectors. The Apple '177 Products contain a video encoder that selects an image segment of a second video image corresponding to an image segment of a first video image.

306. The Apple '177 Products determine at least a most frequently occurring block-based motion vector. Further, the Apple '177 Products contain functionality wherein the motion vector prediction performed includes the ability to transmit in the bitstream the candidate index of motion vectors. Documentation of the encoding process states that the encoder will "pick up the MV [motion vector] to use as an estimator using the index sent by the encoder in the bitstream."



Inter prediction

For motion vector prediction HEVC has two reference lists: L0 and L1. They can hold 16 references each, but the maximum total number of unique pictures is 8. Multiple instances of the same ref frame can be stored with different weights. HEVC motion estimation is much more complex than in AVC. It uses list indexing. There are two main prediction modes: Merge and Advanced MV. Each PU can use one of those methods and can have forward (a MV) or bi-directional prediction (2 MV). In Advanced MV mode a list of candidates MV is created (spatial and temporal candidates picked with a complex, probabilistic logic), when the list is created only the best candidate index is transmitted in the bitstream plus the MV delta (the difference between the real MV and the prediction). On the other side, the decoder will build and update continuously the same candidate list using the exact same rules used by the encoder and will pick-up the MV to use as estimator using the index sent by the encoder in the bitstream. The merge mode is similar, the main difference is that the candidates' list is calculated from neighboring MV and is not added to a delta MV. It is the equivalent of "skip" mode in AVC.

Fabio Sonnati, *H265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

307. On information and belief, any implementation of the HEVC standard would infringe the '177 patent as every possible implementation of the standard requires: compliant devices to carry out a global motion vector estimation process using the most frequently occurring block-based motion vectors. This process of vector candidate selection allows the Apple '177 Products to obtain a global motion vector. Specifically, the HEVC standard generates a set of candidate motion vectors for the group of pixels, with the candidate motion vectors being extracted from a set of previously estimated motion vectors. After the candidate motion vectors are generated, if there are two spatial motion vectors that are identical, that is determined to be the most frequently occurring block-based motion vector and the frequently occurring spatial motion vector and temporal motion vector candidate are used to generate the global motion vector. "In HEVC, this competition was further adapted to large block sizes with so-called advanced motion vector prediction (AMVP). In the DIS Main profile, AMVP has two predictor candidates competing for the prediction. Two spatial motion vector predictor (MVP) candidates are considered and, when at least one of them is not available or they are redundant, a temporal motion

vector prediction (TMVP) candidate is considered." Kemal Ugur, Joel Jung, Gordon Clare, and Thomas Wiegand, *Block Merging for Quadtree-Based Partitioning in HEVC, IEEE TRANS. CIR. AND SYS. FOR VIDEO TECHNOLOGY, Vol. 22* No. 12 (December 2012).

308. The Apple '177 Products apply the global motion vector as a candidate vector to the block-based motion vector estimation process. Specially, the Apple '177 Products calculate the global motion vector by calculating a difference between the second motion vector and the first motion vector. The further candidate motion vector is calculated at the end of the process diagram below (as shown in the below figure) and applied to the block-based motion vector estimation process.

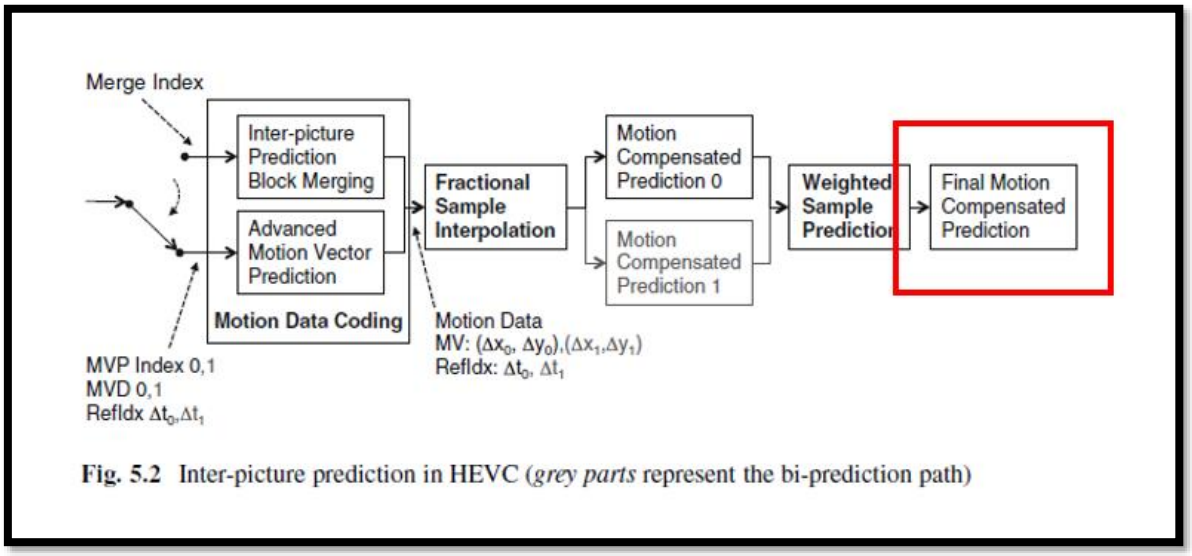


Fig. 5.2 Inter-picture prediction in HEVC (*grey parts* represent the bi-prediction path)

Gary J. Sullivan, *et al*., HEVC, HIGH EFFICIENCY VIDEO CODING (HEVC) at 115 (September 2014) (emphasis added).

309. Further, the Apple '177 Products enable AMVP wherein several of the most probable candidate vectors based on data from adjacent prediction blocks are used to create a global estimation vector and that vector is applied to the block-based motion estimation functionality.

> Motion vector signaling: Advanced motion vector prediction (AMVP) is used, including derivation of several most probable candidates based on data from

> adjacent PBs and the reference picture. A "merge" mode for MV coding can be also used, allowing the inheritance of MVs from neighboring PBs. Moreover, compared to H.264/MPEG-4 AVC, improved "skipped" and "direct" motion inference are also specified.

Gary J. Sullivan, *et al.*, *Overview of the High Efficiency Video Coding (HEVC) Standard*, PRE-PUBLICATION DRAFT, TO APPEAR IN IEEE TRANS. ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY at 3 (December 2012) (emphasis added).

310. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the Apple '177 Products, Apple has injured Dynamic Data and is liable for directly infringing one or more claims of the '177 patent, including at least claim 1, pursuant to 35 U.S.C. § 271(a).

311. On information and belief, Apple also indirectly infringes the '177 patent by actively inducing infringement under 35 USC § 271(b).

312. On information and belief, Apple has had knowledge of the '177 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '177 patent and knew of its infringement, including by way of this lawsuit.

313. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '177 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '177 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '177 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '177 Products that have the capability of operating in a manner that infringe one or more of the claims of the '177 patent, including at least claim 1, and Apple further provides documentation and training materials that cause customers and end users of the Apple '177

Products to utilize the products in a manner that directly infringe one or more claims of the '177 patent.[36] By providing instruction and training to customers and end-users on how to use the Apple '177 Products in a manner that directly infringes one or more claims of the '177 patent, including at least claim 1, Apple specifically intended to induce infringement of the '177 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '177 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '177 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '177 patent, knowing that such use constitutes infringement of the '177 patent.

314. The '177 patent is well-known within the industry as demonstrated by multiple citations to the '177 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '177 patent without paying a reasonable royalty. Apple is infringing the '177 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

315. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '177 patent.

316. As a result of Apple's infringement of the '177 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's

[36] *See, e.g.*, *iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT VII
INFRINGEMENT OF U.S. PATENT NO. 8,311,112

317. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

318. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for video compression based on the H.265 standard.

319. By way of example, the following Apple Products perform encoding pursuant to the H.265 standard: iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS Max, iPhone XS, iPad (6th generation), iPad Pro 11-inch (3rd generation), and the iPad Pro 12.9-inch (3rd generation) (collectively, the "Apple '112 Product(s)").

320. The Apple '112 Products contain a hardware-based HEVC encoder on the Apple A11 Bionic, Apple A12 Bionic, and Apple A12X Bionic system on chip ("SoC") processors.

> Apple A9 first introduced with hardware based HEVC decoder enabling devices to efficiently playback H.265/High Efficiency video content. A11 introduced a hardware encoder, enabling iPhone's Biopic generations to create and save content in the high efficiency formats. This feature optimizes the storage space while saving high definition photos and videos.

Debrath Banerjee, *A Microarchitecture Study on Apple's A11 Bionic Processor,* RESEARCHGATE PUBLICATION at 3 (May 2018) (emphasis added), *available at*: https://www.researchgate.net/publication/325053646_A_Microarchitectural_Study_on_Apple's_A11_Bionic_Processor.

321. On information and belief, the Apple devices by complying with the HEVC standard – such as the Apple '112 Products - necessarily infringe the '112 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '122 patent, including but not limited to claim 11. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND

Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018). The following sections of the HEVC Standard are relevant to Apple's infringement of the '112 patent: "3.110 Prediction Unit Definition;" "6.3.2 Block and quadtree structures;" "6.3.3 Spatial or component-wise partitioning;" "6.4.2 Derivation process for prediction block availability;" "7.3.8.5 Coding unit syntax;" "7.3.8.6 Prediction unit syntax;" "7.4.3.3.1 General picture parameter set RBSP semantics;" and "7.4.7.3 Weighted prediction parameters semantics."

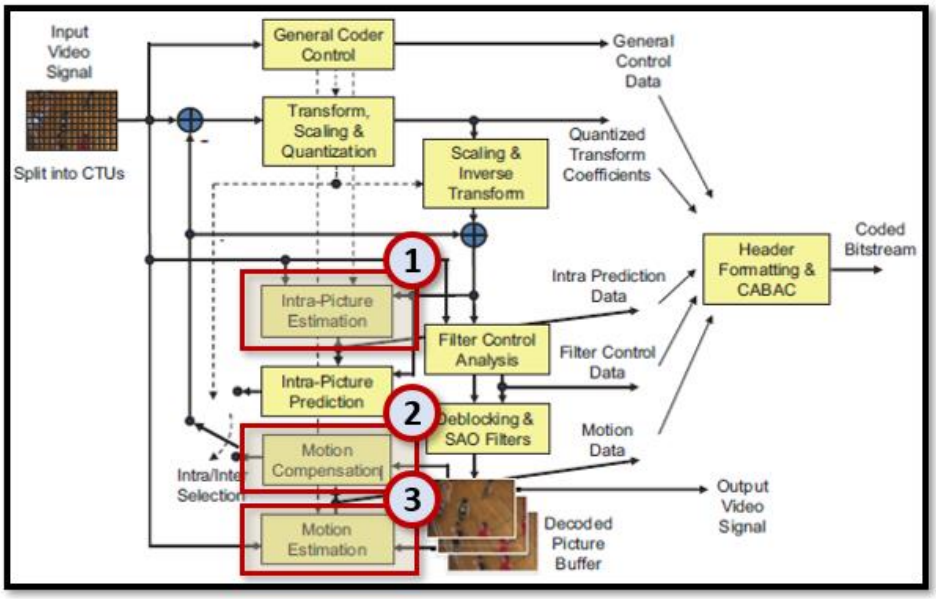
322. The Apple '112 Products perform encoding using motion compensation, specifically, inter-picture prediction wherein the Apple '112 Product makes use of the temporal correlation between pictures in order to derive a motion-compensated prediction for a block of image samples. Each image is divided into blocks (prediction units) and the Apple '112 Products compare the prediction unit in a first image with the spatially neighboring prediction units in a second image (reference image). The displacement between the current prediction unit and the matching prediction unit in the second image (reference image) is signaled using a motion vector. Further, the Apple '112 Products contain functionality wherein during the motion estimation process the block size used for prediction units can range from 4 × 8/8 × 4 to 64 × 64.

> A block-wise prediction residual ***is computed from corresponding regions of previously decoded pictures (inter-picture motion compensated prediction) or neighboring previously decoded samples from the same picture (intra-picture spatial prediction***). The residual is then processed by a block transform, and the transform coefficients are quantized and entropy coded. Side information data such as motion vectors and mode switching parameters are also encoded and transmitted.

Standardized Extensions of High Efficiency Video Coding (HEVC), IEEE JOURNAL OF SELECTED TOPICS IN SIGNAL PROCESSING, Vol. 7, No. 6 at 1002 (December 2013) (emphasis added).

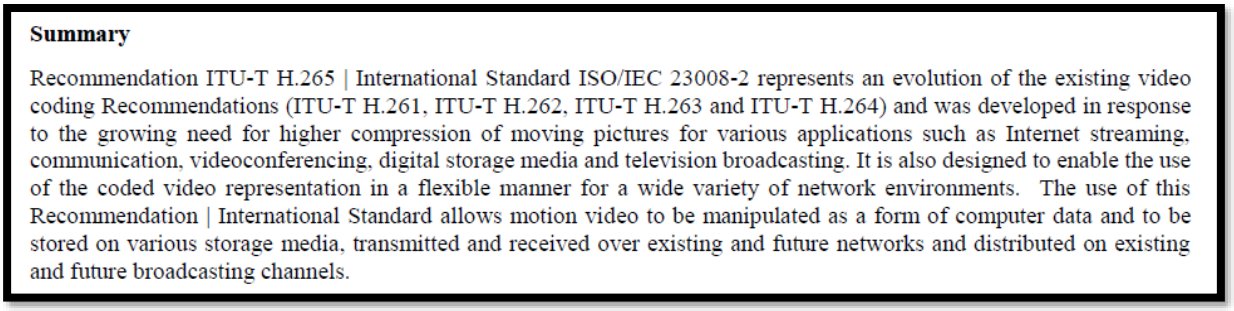
323. The Apple '112 Products also use intra-picture estimation between blocks (prediction units) within an image retrieved from memory. The frames are then processed using both motion compensation and motion estimation. The motion compensation functionality used

by the Apple '112 Products include quarter-sample precision for the motion vectors and 7-tap or 8-tap filters that are used for interpolation of fractional-sample positions.



Standardized Extensions of High Efficiency Video Coding (HEVC), IEEE JOURNAL OF SELECTED TOPICS IN SIGNAL PROCESSING, VOL. 7, NO. 6 at 1002 (December 2013) (emphasis added) (the annotations showing (1) intra-picture prediction, (2) motion compensation, and (3) motion estimation).

324. The Apple '112 Products contain functionality for motion compensation where two or more motion vectors can be applied. Further, one or two motion vectors can be applied to the image processing process. The application of the motion vectors leads to uni-predictive or bi-predictive coding, respectively, where bi-predictive coding uses an averaged result of two predictions to form the final prediction.



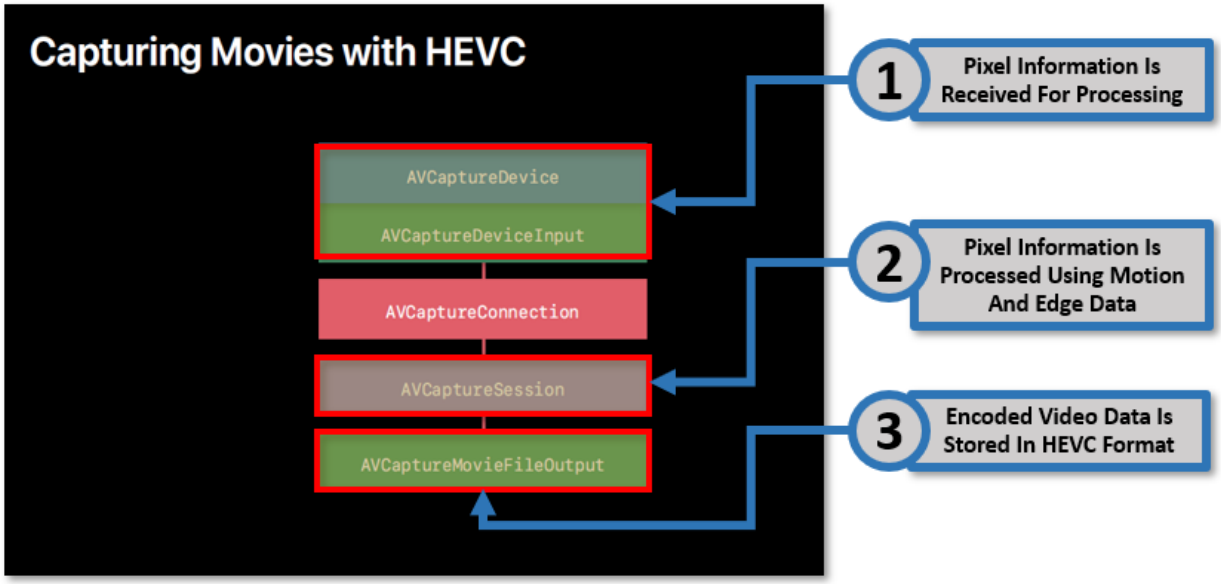
Summary

Recommendation ITU-T H.265 | International Standard ISO/IEC 23008-2 represents an evolution of the existing video coding Recommendations (ITU-T H.261, ITU-T H.262, ITU-T H.263 and ITU-T H.264) and was developed in response to the growing need for higher compression of moving pictures for various applications such as Internet streaming, communication, videoconferencing, digital storage media and television broadcasting. It is also designed to enable the use of the coded video representation in a flexible manner for a wide variety of network environments. The use of this Recommendation | International Standard allows motion video to be manipulated as a form of computer data and to be stored on various storage media, transmitted and received over existing and future networks and distributed on existing and future broadcasting channels.

Series H: Audiovisual and Multimedia Systems- Infrastructure of Audiovisual Services – Coding of Moving Video, INTERNATIONAL TELECOMMUNICATIONS UNIONS - TU-T H.265, V.5 at I (February 2018).

325. The following excerpt from a presentation at Apple's Worldwide Developers Conference shows that the Apple products encode video data that can be received in pixel format from a camera on the Apple device. In the below excerpt from an Apple presentation, the block identified as "AVCaptureDeviceInput" shows the pixel data that is received for processing via the "AVCaptureConnection."[37] The pixel data is then processed by the Apple SoC processing unit in the Apple '112 Products.

[37] *See Setting Up a Capture Session*, APPLE DEVELOPER DOCUMENTATION (last visited December 2018), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/setting_up_a_capture_session ("An `AVCaptureSession` is the basis for all media capture in iOS and macOS. It manages your app's exclusive access to the OS capture infrastructure and capture devices, as well as the flow of data from input devices to media outputs.")



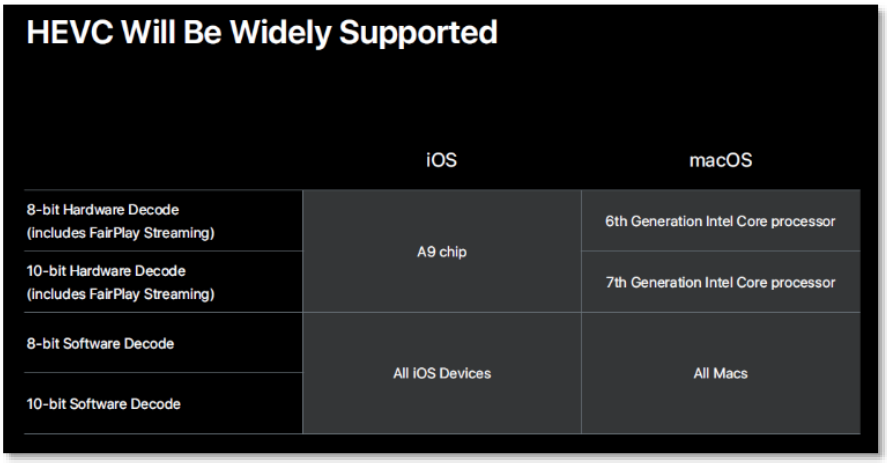
Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 29 (2017) (annotations added).

326. The following excerpts from Apple's documentation show the Apple Products capture video using "AVCaptureSession" and then encode the video using High Efficiency Video Coding ("HEVC").

> Video captured on iPhone 8, iPhone 8 Plus, and iPhone X, and running iOS 11 or later, uses the HEVC format by default. When you use AVFoundation to capture videos, you can change the default format if you know in advance that you need a different format. If your app shares the captured video using a system share sheet, the video is automatically converted to a format compatible with the destination device, and no more work is needed.

Capturing Video in Alternative Formats, APPLE DEVELOPER DOCUMENTATION (2018) (emphasis added), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/capturing_video_in_alternative_formats.

327. Apple's incorporation of H.265/HEVC encoding in the Apple '112 Products has been identified by Apple as being "widely supported."



Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 9 (2017).

328. On information and belief, one or more of the Apple '112 Products include technology for estimating a current motion vector for a group of pixels of an image. Further, HEVC encoding support has been incorporated into the Apple '112 Products as shown in the below excerpt from an Apple presentation at its Worldwide Developer Conference in 2017.

329. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '112 Products in regular business operations.

330. On information and belief, one or more of the Apple '112 Products include technology for video compression.

331. On information and belief, Apple has directly infringed and continues to directly infringe the '112 patent by, among other things, making, using, offering for sale, and/or selling technology for video compression, including but not limited to the Apple '112 Products.

332. The Apple '112 Products comprise systems wherein a frame coding unit is configured to perform predictive coding on a set of pixels of a macroblock of pixels. Further, the predictive coding functionality uses a first group of reference pixels and a macroblock of pixels from the video frame. Specifically, the Apple '112 Products, when selecting a temporal candidate

for HEVC intrra-frame encoding, default to the right bottom position just outside of the collocated prediction unit.

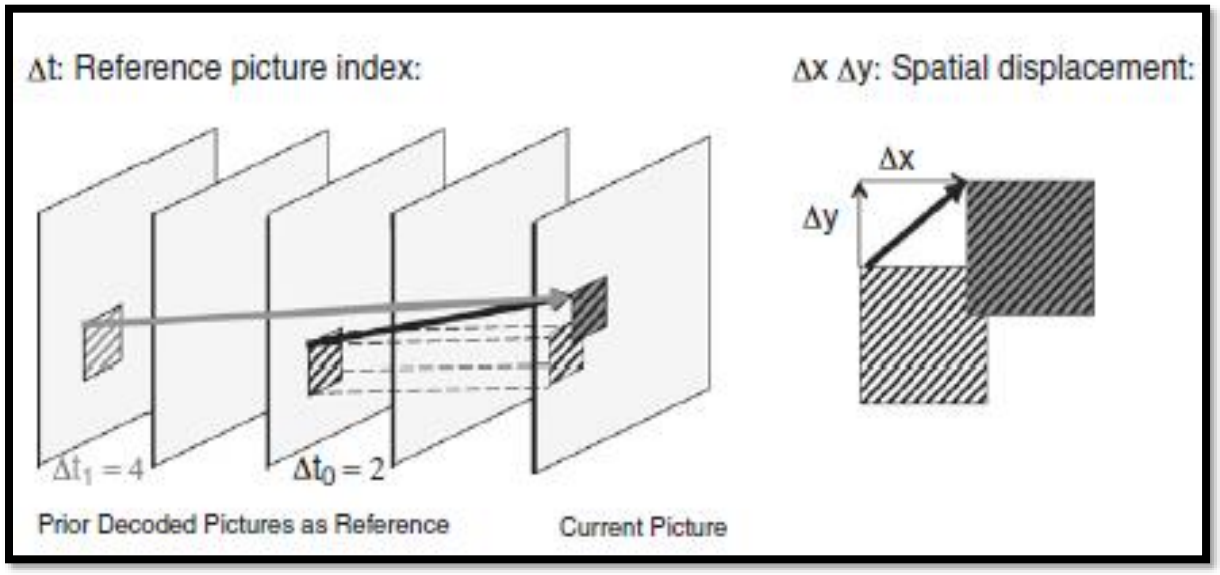
> It can be seen from Fig. 5.4b that only motion vectors from spatial neighboring blocks to the left and above the current block are considered as spatial MVP candidates. This can be explained by the fact that the blocks to the right and below the current block are not yet decoded and hence, their motion data is not available. Since the co-located picture is a reference picture which is already decoded, it is possible to also consider motion data from the block at the same position, from blocks to the right of the co-located block or from the blocks below**.** In HEVC, the block to the bottom right and at the center of the current block have been determined to be the most suitable to provide a good temporal motion vector predictor (TMVP).

Benjamin Bross, *et al., Inter-picture prediction in HEVC,* in HIGH EFFICIENCY VIDEO CODING (HEVC) at 119 (2014) (emphasis added).

333. On information and belief, one or more of the Apple '112 Products perform predictive coding on a macroblock of a video frame such that a set of pixels of the macroblock is coded using some of the pixels from the same video frame as reference pixels and the rest of the macroblock is coded using reference pixels from at least one other video frame.

334. On information and belief, the Apple '112 Products comprise an inter-frame coding unit that is configured to perform predictive coding on the rest of the macroblock of pixels using a second group of reference pixels. The second group of reference pixels that are used to perform inter-frame coding are drawn from at least one other video frame. The image data processed by the Apple '112 Products is encoded using inter-picture prediction that makes use of the temporal correlation between pictures to derive a motion-compensated prediction (MCP) for a block of image samples. For this block-based motion-compensated prediction, an image is divided into rectangular blocks. Assuming homogeneous motion inside one block, and that moving objects are larger than one block, for each block, a corresponding block in a previously decoded picture can be found that serves as a predictor (a second image). Both the first and second images are retrieved by the Apple '112 Products from storage such as on chip memory. The general concept of inter-

frame-based encoding using motion-compensated prediction based on a translational motion model is illustrated below.



Benjamin Bross, *Inter-Picture Prediction In HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 114 (September 2014).

335. On information and belief, one or more of the Apple '112 Products include a system for video compression comprising an intra-frame coding unit configured to perform predictive coding on a set of pixels of a macroblock of pixels using a first group of reference pixels, the macroblock of pixels and the first group of reference pixels being from a video frame.

336. On information and belief, the Apple '112 Products are available to businesses and individuals throughout the United States.

337. On information and belief, the Apple '112 Products are provided to businesses and individuals located in the Eastern District of Texas.

338. By making, using, testing, offering for sale, and/or selling products and services for interpolating a pixel during the interlacing of a video signal, including but not limited to the Apple '112 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '112 patent, including at least claim 11 pursuant to 35 U.S.C. § 271(a).

339. On information and belief, Apple also indirectly infringes the '112 patent by actively inducing infringement under 35 USC § 271(b).

340. Apple has had knowledge of the '112 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '112 patent and knew of its infringement, including by way of this lawsuit.

341. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '112 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '112 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '112 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '112 Products that have the capability of operating in a manner that infringe one or more of the claims of the '112 patent, including at least claim 11, and Apple further provides documentation and training materials that cause customers and end users of the Apple '112 Products to utilize the products in a manner that directly infringe one or more claims of the '112 patent.[38] By providing instruction and training to customers and end-users on how to use the Apple '112 Products in a manner that directly infringes one or more claims of the '112 patent, including at least claim 11, Apple specifically intended to induce infringement of the '112 patent. On

[38] *See, e.g., iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018); *Apple TV User Guide*, APPLE SUPPORT WEBSITE, *available at*: https://support.apple.com/guide/tv/welcome/tvos (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

information and belief, Apple engaged in such inducement to promote the sales of the Apple '112 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '112 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '112 patent, knowing that such use constitutes infringement of the '112 patent.

342. The '112 patent is well-known within the industry as demonstrated by multiple citations to the '112 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '112 patent without paying a reasonable royalty. Apple is infringing the '112 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

343. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '112 patent.

344. As a result of Apple's infringement of the '112 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT VIII
INFRINGEMENT OF U.S. PATENT NO. 6,646,688

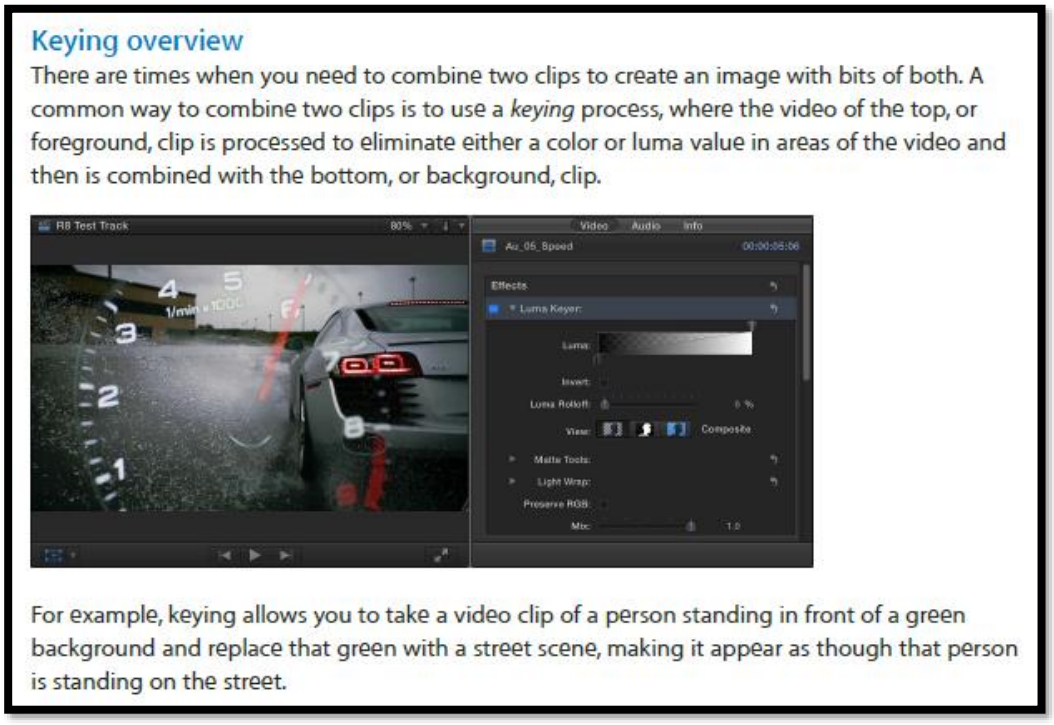
345. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

346. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for processing video and graphics data.

347. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products with chroma key capabilities. The Accused Products include, but are not limited to, Apple Final Cut Pro X (collectively, the "Apple '688 Product(s)").

348. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '688 Products in regular business operations.

349. On information and belief, one or more of the Apple '688 Products include technology for processing video and/or graphics data. The "keying functionality" in documentation for the Apple '688 Products describes the technology as processing and video content.



APPLE FINAL CUT PRO X USER GUIDE at 340 (2013) ("A common way to combine two clips is to use a keying process, where the video of the top, or foreground, clip is processed to eliminate either a color or luma value in areas of the video and then is combined with the bottom or background clip.").

350. On information and belief, the Apple '688 Products are available to businesses and individuals throughout the United States.

351. On information and belief, the Apple '688 Products are provided to businesses and individuals located in the Eastern District of Texas.

352. On information and belief, Apple has directly infringed and continues to directly infringe the '688 patent by, among other things, making, using, offering for sale, and/or selling technology for processing video and/or graphics data, including but not limited to the Apple '688 Products. For example, the Apple '688 Products enable image processing by "changing the chroma key color showing."

APPLE FINAL CUT PRO X USER GUIDE at 343 (2013).

353. On information and belief, the Apple '688 Products pre-process a stream of digital video or graphics data to output pre-processed data.

354. On information and belief, the Apple '688 Products process a color key from the pre-processed data to output resulting data.

> Quite often your foreground image has objects that you don't want to appear in the composited output. These could be production items like microphone booms and light stands or the edges of the chroma key backdrop. Additionally, you might need to resize or reposition the foreground object to better fit with the background. As a final step, you can use the color corrector to adjust the foreground so that it matches the look of the background.

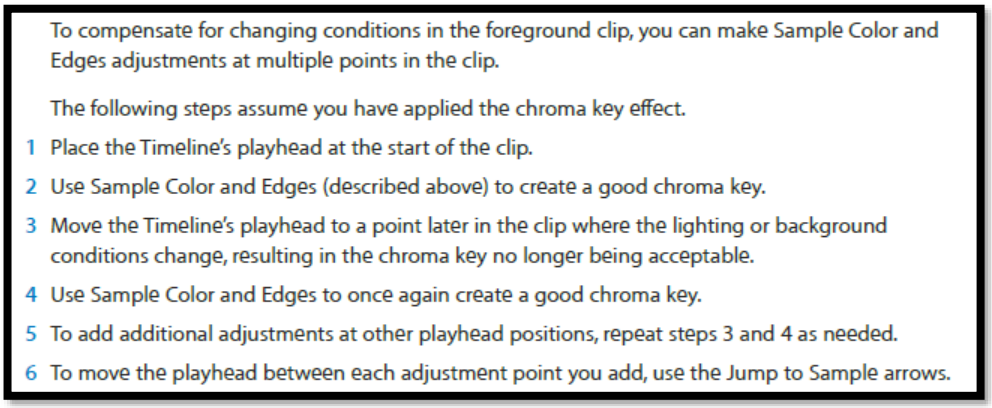
Final Cut Pro X: Finalize The Key, APPLE SUPPORT WEBSITE (last visited January 2018), *available at*: https://support.apple.com/kb/PH12667 (emphasis added).

355. On information and belief, the Apple '688 Products substitute the color key with a pre-selected color. Apple documentation describes this as color selection and a user has the option of having the Apple '688 Product automatically select a "Sample Color" or "create a key in Manual mode."

> Color Selection: These controls are meant to be used after you begin creating a key using automatic sampling or the Sample Color and Edges tools. (However, you can skip those tools and create a key using Manual mode, described below.) The graphical Chroma and Luma controls provide a detailed way of refining the range of hue, saturation, and image lightness that define the keyed matte.

APPLE FINAL CUT PRO X USER GUIDE at 345 (2013).

356. On information and belief, the Apple '688 Products process and transform the data resulting from the processing a color key from the pre-processed data.



To compensate for changing conditions in the foreground clip, you can make Sample Color and Edges adjustments at multiple points in the clip.

The following steps assume you have applied the chroma key effect.

1. Place the Timeline's playhead at the start of the clip.
2. Use Sample Color and Edges (described above) to create a good chroma key.
3. Move the Timeline's playhead to a point later in the clip where the lighting or background conditions change, resulting in the chroma key no longer being acceptable.
4. Use Sample Color and Edges to once again create a good chroma key.
5. To add additional adjustments at other playhead positions, repeat steps 3 and 4 as needed.
6. To move the playhead between each adjustment point you add, use the Jump to Sample arrows.

APPLE FINAL CUT PRO X USER GUIDE at 350 (2013) ("To compensate for changing conditions in the foreground clip, you can make Sample Color and Edges adjustments at multiple points in the clip.").

357. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the Apple '688 Products, Apple has injured Dynamic Data and is liable for directly infringing one or more claims of the '688 patent, including at least claim 6, pursuant to 35 U.S.C. § 271(a).

358. On information and belief, Apple also indirectly infringes the '688 patent by actively inducing infringement under 35 USC § 271(b).

359. On information and belief, Apple has had knowledge of the '688 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '688 patent and knew of its infringement, including by way of this lawsuit.

360. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '688 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '688 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '688 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '688 Products that have the capability of operating in a manner that infringe one or more of the claims of the '688 patent, including at least claim 6, and Apple further provides documentation and training materials that cause customers and end users of the Apple '688 Products to utilize the products in a manner that directly infringe one or more claims of the '688

patent.[39] By providing instruction and training to customers and end-users on how to use the Apple '688 Products in a manner that directly infringes one or more claims of the '688 patent, including at least claim 6, Apple specifically intended to induce infringement of the '688 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '688 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '688 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '688 patent, knowing that such use constitutes infringement of the '688 patent.

361. The '688 patent is well-known within the industry as demonstrated by multiple citations to the '688 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '688 patent without paying a reasonable royalty. Apple is infringing the '688 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

362. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '688 patent.

363. As a result of Apple's infringement of the '688 patent, Dynamic Data has suffered monetary damages, and seek recovery in an amount adequate to compensate for Apple's

[39] *See, e.g.*, *Final Cut Pro X: Use chroma keys*, APPLE SUPPORT WEBSITE, *available at*: https://support.apple.com/kb/PH12665?locale=en_US&viewlocale=en_US (April 12, 2018); *Final Cut Pro X*, APPLE USER GUIDE (2014); *Final Cut Pro X*, LOGIC EFFECTS REFERENCE GUIDE (2012).

infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT IX
INFRINGEMENT OF U.S. PATENT NO. 7,894,529

364. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

365. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for determining motion vectors that are each assigned to individual image regions.

366. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products that process video data compliance with the H.265 standard. The Accused Products include, but are not limited to, Apple's iPhone, iPad, and Apple TV, and any other Apple products capable of performing decoding of video data using the H.265 standard. By way of example, the following Apple Products perform decoding pursuant to the H.265 standard: iPhone 6s, iPhone 6s Plus, iPhone SE, iPhone 7, iPhone 7 Plus, iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS Max, iPhone XS, iPad (5th generation), iPad Pro (12.9-inch), iPad Pro (9.7-inch), iPad (6th generation), iPad Pro (10.5-inch), iPad Pro 12.9-inch (2nd generation), iPad Pro 11-inch, and the iPad Pro 12.9-inch (3rd generation) (collectively, the "Apple '529 Product(s)").

367. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '529 Products in regular business operations.

368. On information and belief, one or more of the Apple '529 Products include technology for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation.

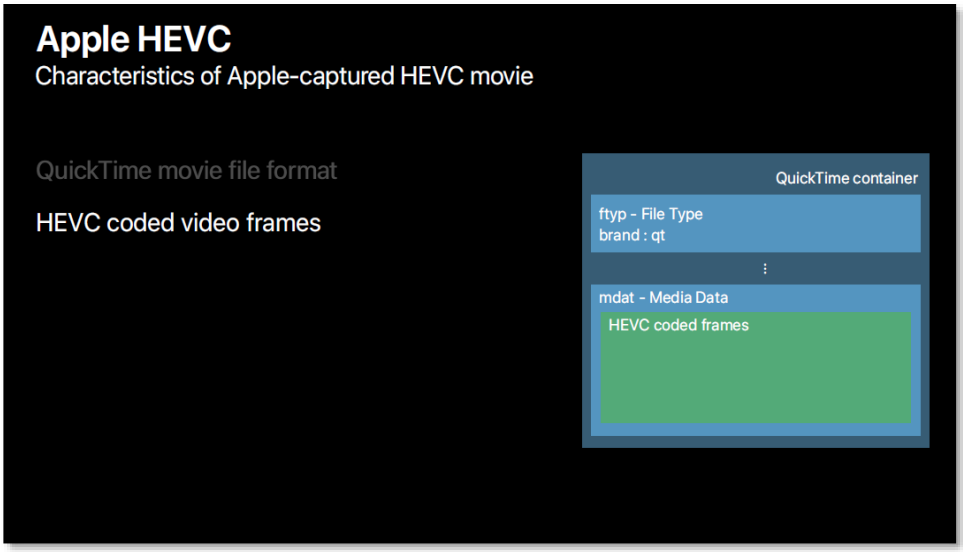
369. The Apple '529 Products contain hardware-based codecs that meet the requirements of the HEVC standard. The System-on-Chip ("SoC") processors that are included in the Apple '529 products include: Apple A9, Apple A9X, Apple A10, Fusion, Apple A10X Fusion, Apple A11 Bionic, Apple A12 Bionic, and Apple A12X Bionic system on chip processors.[40]

> Apple A9 first introduced with hardware based HEVC decoder enabling devices to efficiently playback H.265/High Efficiency video content. A11 introduced a hardware encoder, enabling iPhone's Biopic generations to create and save content in the high efficiency formats. This feature optimizes the storage space while saving high definition photos and videos.

Debrath Banerjee, *A Microarchitecture Study on Apple's A11 Bionic Processor,* RESEARCHGATE PUBLICATION at 3 (May 2018) (emphasis added), *available at*: https://www.researchgate.net/publication/325053646_A_Microarchitectural_Study_on_Apple's_A11_Bionic_Processor.

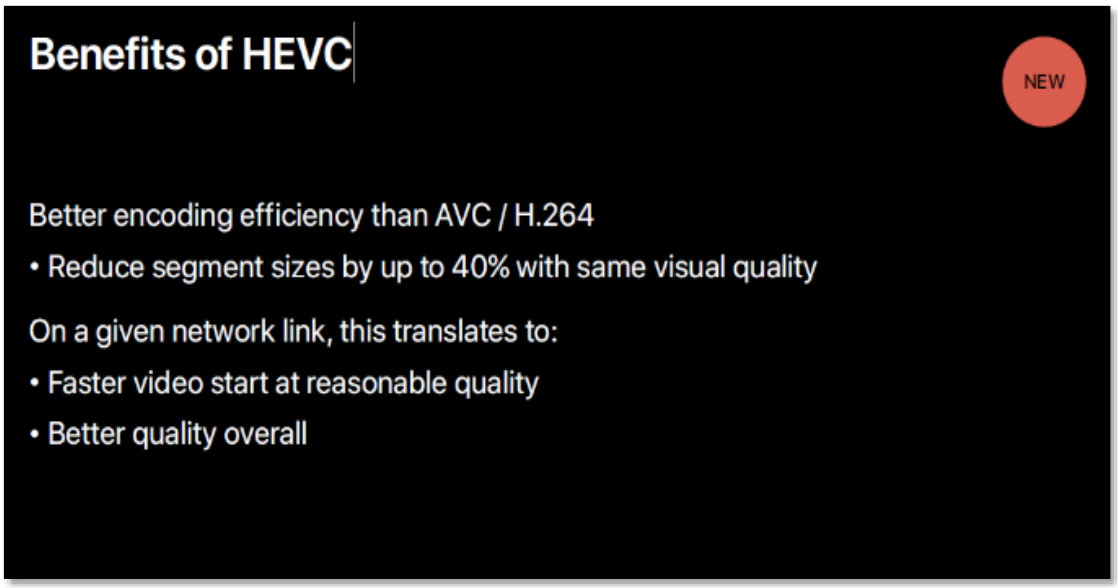
370. Further, documentation from Apple provides additional evidence that the Apple '529 Products contain "architecture [] updated to include H.265 encode and decoding acceleration."

[40] *See iOS Device Compatibility Reference*, APPLE DEVELOPER WEBSITE (October 30, 2017), *available at*: https://developer.apple.com/library/archive/documentation/DeviceInformation/Reference/iOSDeviceCompatibility/HardwareGPUInformation/HardwareGPUInformation.html



Gavin Thomson and Athar Shah, *Introducing HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 503 at 68 (2017).

371. Apple has identified that the inclusion of HEVC decoding and encoding in the Apple '529 Products is a critical "value proposition." The below excerpt from an Apple Worldwide Developer Conference presentation describes the importance of HEVC in the Apple '529 Products.



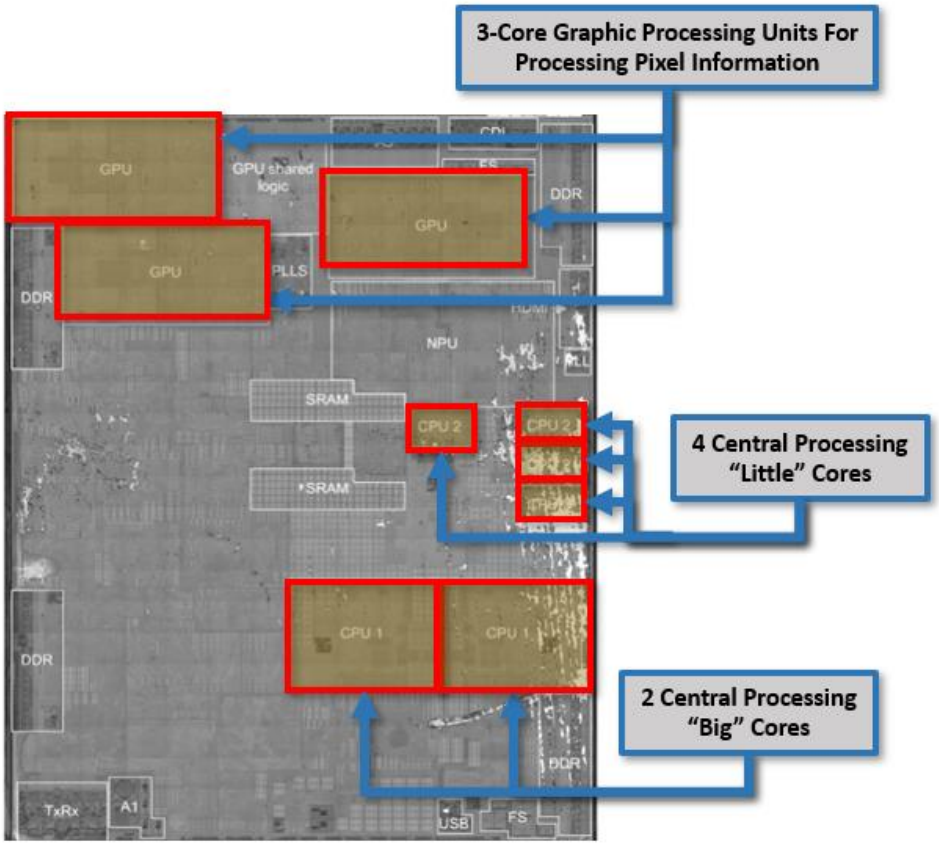
Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 8 (2017).

372. On information and belief, Apple has directly infringed and continues to directly infringe the '529 patent by, among other things, making, using, offering for sale, and/or selling technology for determining motion vectors that are each assigned to individual image regions, including but not limited to the Apple '529 Products.

373. On information and belief, the Apple '529 Products are available to businesses and individuals throughout the United States.

374. On information and belief, the Apple '529 Products are provided to businesses and individuals located in the Eastern District of Texas.

375. The following image of the Apple A11 Bionic chip in the iPhone 8 Plus shows two central processing units and six core graphics processing units that process pixel information by receiving a video data that comprises a first and second image block.

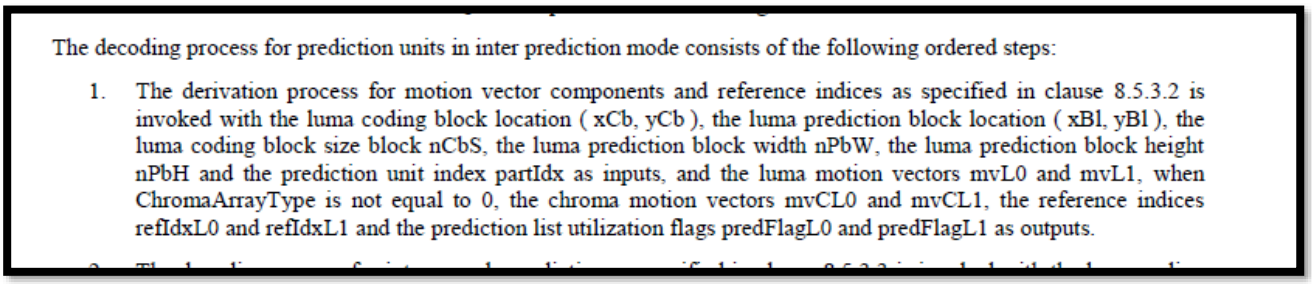


TechInsights Apple iPhone 8 Plus Teardown, TECHINSIGHTS ARTICLE (January 11, 2017) (annotations added), *available at*: https://techinsights.com/about-techinsights/overview/blog/apple-iphone-8-teardown/ ("The iPhone 8 Plus A1897 model we examined initially is confirmed to contain the A11 Bionic AP with a die mark TMHS09.").

376. On information and belief, by complying with the HEVC standard, the Apple devices – such as the Apple '529 Products - necessarily infringe the '529 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '529 patent, including but not limited to claim 1. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018). The following sections of the HEVC Standard are relevant to Apple's infringement of the '529 patent: "3.110 Prediction Unit Definition;" "6.3.2 Block and quadtree structures;" "6.3.3 Spatial or component-wise partitioning;" "6.4.2 Derivation process for prediction block availability;" "7.3.8.5 Coding unit syntax;" "7.3.8.6 Prediction unit syntax;"

"8.3.2 Decoding process for reference picture set;" "8.5.4 Decoding process for the residual signal of coding units coded in inter prediction mode;" "8.6 Scaling, transformation and array construction process prior to deblocking filter process;" "8.5.2 Inter prediction process;" "8.5.3 Decoding process for prediction units in inter prediction mode;" and "8.7.2 Deblocking filter process."

377. On information and belief, the Apple '529 Products comply with the HEVC standard, which requires determining motion vectors assigned to individual image regions of an image.



The decoding process for prediction units in inter prediction mode consists of the following ordered steps:

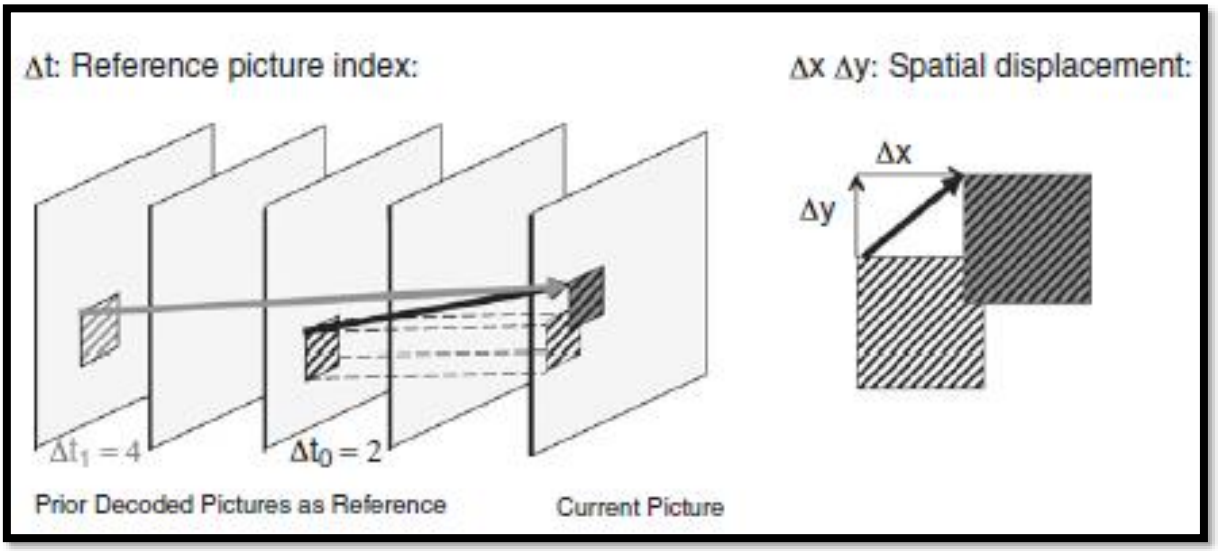
1. The derivation process for motion vector components and reference indices as specified in clause 8.5.3.2 is invoked with the luma coding block location (xCb, yCb), the luma prediction block location (xBl, yBl), the luma coding block size block nCbS, the luma prediction block width nPbW, the luma prediction block height nPbH and the prediction unit index partIdx as inputs, and the luma motion vectors mvL0 and mvL1, when ChromaArrayType is not equal to 0, the chroma motion vectors mvCL0 and mvCL1, the reference indices refIdxL0 and refIdxL1 and the prediction list utilization flags predFlagL0 and predFlagL1 as outputs.

High Efficiency Video Coding, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 at § 8.5.3.1 (February 2018).

378. On information and belief, Apple has directly infringed and continues to directly infringe the '529 patent by, among other things, making, using, offering for sale, and/or selling technology for implementing a motion estimation technique that assigns at least one motion vector to each of the image blocks and generating a modification motion vector for at least the first image block.

379. On information and belief, the encoded video stream received by the Apple '529 Products is encoded using inter-picture prediction that makes use of the temporal correlation between pictures to derive a motion-compensated prediction (MCP) for a block of image samples. For this block-based motion compensated prediction, a video picture is divided into rectangular blocks. Assuming homogeneous motion inside one block, and that moving objects are larger than

one block, for each block, a corresponding block in a previously decoded picture can be found that serves as a predictor. The general concept of inter-frame-based encoding using motion-compensated prediction based on a translational motion model is illustrated below.



Benjamin Bross, *Inter-Picture Prediction In HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 114 (September 2014).

380. On information and belief, the Apple '529 Products perform the step of selecting a second image block where the motion vector that is assigned to the first image block passes. Specifically, the Apple '529 Products, in the use of inter-picture prediction, look at two or more blocks in different frames wherein the vector passes through both the first and second image block. The following excerpts from documentation relating the video estimation technique used by the Apple '529 Products explains how HEVC uses motion estimation to determine a temporal intermediate position between two images wherein two image blocks are selected that have a motion vector passing in both the first and second image block.

> One way of achieving high video compression is to predict pixel values for a frame based on prior and succeeding pictures in the video. Like its predecessors, H.265 features the ability to predict pixel values between pictures, and in particular, to specify in which order pictures are coded and which pictures are predicted from which. The coding order is specified for Groups Of Pictures (GOP), where a number of pictures are grouped together and predicted from each other in a

> specified order. The pictures available to predict from, called reference pictures, are specified for every individual picture.

Johan Bartelmess, *Compression Efficiency of Different Picture Coding Structures in High Efficiency Video Coding (HEVC)*, UPTEC STS 16006 at 4 (March 2016) (emphasis added).

381. On information and belief, the Apple '529 Products receive encoded video data that is encoded using inter-frame coding. Specifically, the encoded video stream received by the Apple '529 Products is coded using its predecessor frame. Inter-prediction used in the encoded video data received by the Apple '529 Products allows a transform block to span across multiple prediction blocks for inter-picture predicted coding units to maximize the potential coding efficiency benefits of the quadtree-structured transform block partitioning.

> The basic source-coding algorithm is a hybrid of interpicture prediction to exploit temporal statistical dependences, intrapicture prediction to exploit spatial statistical dependences, and transform coding of the prediction residual signals to further exploit spatial statistical dependences.

G. J. Sullivan, J.-R. Ohm, W.-J. Han, and T. Wiegand, *Overview of the High Efficiency Video Coding (HEVC) standard*, IEEE TRANS. CIRCUITS SYST. VIDEO TECHNOL., Vol. 22, No. 12, p. 1654 (December 2012) (emphasis added).

382. The following excerpt from an article describing the architecture of the video stream received by the Apple '529 Products describes the functionality wherein the second encoded frame of the video data is dependent on the encoding of a first frame. "HEVC inter prediction uses motion vectors pointing to one reference frame . . . to predict a block of pixels."

> HEVC inter prediction uses motion vectors pointing to one reference frame (uni-prediction) or two reference frames (bi-prediction) to predict a block of pixels. The size of the predicted block, called Prediction Unit (PU), is determined by the Coding Unit (CU) size and its partitioning mode. For example, a 32×32 CU with 2N×N partitioning is split into two PUs of size 32×16, or a 16×16 CU with nL×2N partitioning is split into 4×16 and 12×16 PUs.

Mehul Tikekar, *et al., Decoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) (September 2014).

383. Further, the following diagram shows how the Apple Products receive video data encoded using inter-frame prediction. Specifically, interframe prediction generates a motion vector based on the motion estimation across a first and second frame. The Overview of Design Characteristics for HEVC encoded video data describes the use of "motion vectors for block-based inter prediction to exploit temporal statistical dependencies between frames."

compression. Encoding algorithms (not specified in this Recommendation | International Standard) may select between inter and intra coding for block-shaped regions of each picture. Inter coding uses motion vectors for block-based inter prediction to exploit temporal statistical dependencies between different pictures. Intra coding uses various spatial prediction modes to exploit spatial statistical dependencies in the source signal for a single picture. Motion vectors and intra prediction modes may be specified for a variety of block sizes in the picture. The prediction residual may then be further compressed using a transform to remove spatial correlation inside the transform block before it is quantized, producing a possibly irreversible process that typically discards less important visual information while forming a close approximation to the source samples. Finally, the motion vectors or intra prediction modes may also be further compressed using a variety of prediction mechanisms, and, after prediction, are combined with the quantized transform coefficient information and encoded using arithmetic coding.

High Efficiency Video Coding, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 at § 0.7 (April 2015) (annotation added).

384. On information and belief, any implementation of the HEVC standard infringes the '529 patent as every possible implementation of the standard requires: determining at least a second image block through which the motion vector assigned to the first image block at least partially passes; generating the modified motion vector as a function of a motion vector assigned to at least the second image block; and assigning the modified motion vector as the motion vector to the first image block. Further, the functionality of the motion estimation process in HEVC uses "motion vector[s]: A two-dimensional vector used for *inter prediction* that provides an offset from the coordinates in the decoded picture to the coordinates in a reference picture," as defined in definition 3.83 of the *ITU-T H.265 Series H: Audiovisual and Multimedia Systems* (2018) (emphasis added); *see also, e.g.,* Gary J. Sullivan, Jens-Rainer Ohm, Woo-Jin Han, and Thomas Wiegand, *Overview of the High Efficiency Video Coding (HEVC) Standard*, published in IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, Vol. 22, No. 12 at 1650

(December 2012) ("The encoder and decoder generate identical inter picture prediction signals by applying motion compensation (MC) using the MV and mode decision data.").

385. The following excerpt from a book describes that the motion estimation is done through PU matching method and that the MV represents the displacement between the current PU in the current frame and the matching PU in the reference frame.

> Motion estimation compares the current prediction unit (PU) with the spatially neighboring PUs in the reference frames, and chooses the one with the least difference to the current PU. The displacement between the current PU and the matching PU in the reference frames is signaled using a motion vector.

Sung-Fang Tsai, *et al.*, *Encoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 347 (September 2014) (emphasis added).

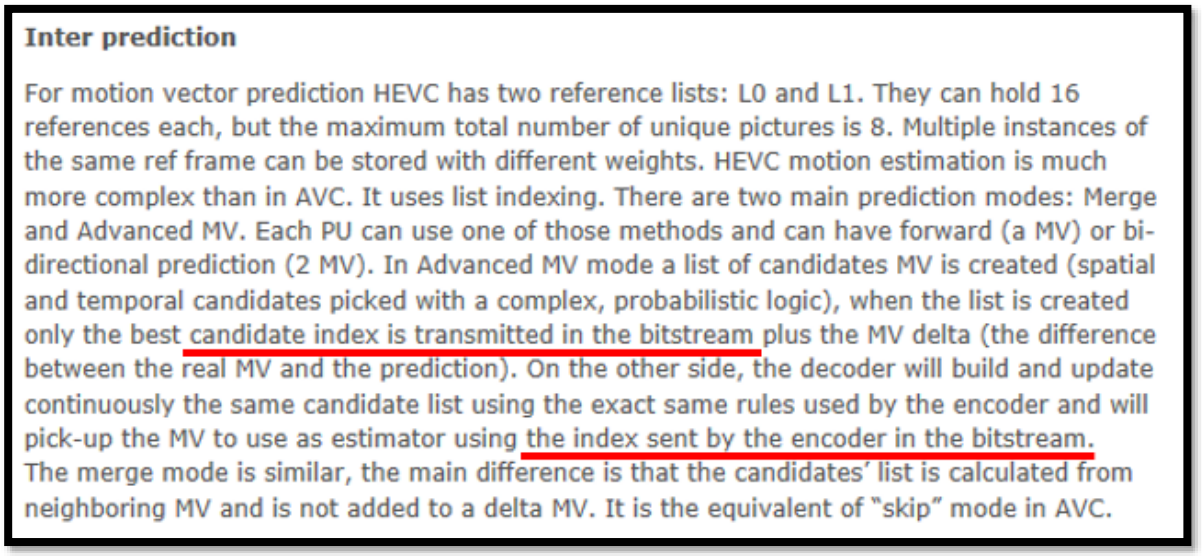
386. On information and belief, the Apple '529 Products perform the step of assigning the modified motion vector as the motion vector to the first image block. Specifically, the Apple '529 Products, through the use of AMVP and Merge Mode, select the modified motion vector and assign it to a first block. The displacement between the current prediction unit and the matching prediction unit in the second image (reference image) is signaled using a motion vector. Further, the Apple '529 Products take the modified motion vector "computed from corresponding regions of previously decoded pictures" and transmit the residual.

> A block-wise prediction residual ***is computed from corresponding regions of previously decoded pictures (inter-picture motion compensated prediction) or neighboring previously decoded samples from the same picture (intra-picture spatial prediction***). The residual is then processed by a block transform, and the transform coefficients are quantized and entropy coded. Side information data such as motion vectors and mode switching parameters are also encoded and transmitted.

Standardized Extensions of High Efficiency Video Coding (HEVC), IEEE JOURNAL OF SELECTED TOPICS IN SIGNAL PROCESSING, Vol. 7, No. 6 at 1002 (December 2013) (emphasis added).

387. On information and belief, the Apple '529 Products transmit into the bitstream the candidate index of motion vectors. HEVC documentation states that the coding process will "pick

up the MV [motion vector] to use as an estimator using the index sent by the encoder in the bitstream."



Inter prediction

For motion vector prediction HEVC has two reference lists: L0 and L1. They can hold 16 references each, but the maximum total number of unique pictures is 8. Multiple instances of the same ref frame can be stored with different weights. HEVC motion estimation is much more complex than in AVC. It uses list indexing. There are two main prediction modes: Merge and Advanced MV. Each PU can use one of those methods and can have forward (a MV) or bi-directional prediction (2 MV). In Advanced MV mode a list of candidates MV is created (spatial and temporal candidates picked with a complex, probabilistic logic), when the list is created only the best candidate index is transmitted in the bitstream plus the MV delta (the difference between the real MV and the prediction). On the other side, the decoder will build and update continuously the same candidate list using the exact same rules used by the encoder and will pick-up the MV to use as estimator using the index sent by the encoder in the bitstream. The merge mode is similar, the main difference is that the candidates' list is calculated from neighboring MV and is not added to a delta MV. It is the equivalent of "skip" mode in AVC.

Fabio Sonnati, *H265 – Part I: Technical Overview,* VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

388. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '529 Products in regular business operations.

389. On information and belief, one or more of the Apple '529 Products include technology for determining motion vectors that are each assigned to individual image regions.

390. By making, using, testing, offering for sale, and/or selling products and services for interpolating a pixel during the interlacing of a video signal, including but not limited to the Apple '529 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '529 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

391. On information and belief, Apple also indirectly infringes the '529 patent by actively inducing infringement under 35 USC § 271(b).

392. Apple has had knowledge of the '529 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Apple knew of the '529 patent and knew of its infringement, including by way of this lawsuit.

393. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '529 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '529 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '529 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '529 Products that have the capability of operating in a manner that infringe one or more of the claims of the '529 patent, including at least claim 1, and Apple further provides documentation and training materials that cause customers and end users of the Apple '529 Products to utilize the products in a manner that directly infringe one or more claims of the '529 patent.[41] By providing instruction and training to customers and end-users on how to use the Apple '529 Products in a manner that directly infringes one or more claims of the '529 patent, including at least claim 1, Apple specifically intended to induce infringement of the '529 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '529 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '529 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '529 patent, knowing that such use constitutes infringement of the '529 patent.

[41] *See, e.g.*, *iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

394. The ‘529 patent is well-known within the industry as demonstrated by multiple citations to the ‘529 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the ‘529 patent without paying a reasonable royalty. Apple is infringing the ‘529 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

395. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘529 patent.

396. As a result of Apple’s infringement of the ‘529 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT X
INFRINGEMENT OF U.S. PATENT NO. 7,542,041

397. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

398. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for dynamically configuring a multi-pipe pipeline system.

399. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products and services that dynamically configure a multi-pipe pipeline system to sequentially process data as it traverses the pipeline. By way of illustrative example, these infringing products include, without limitation, Apple’s devices that implement iOS 10.3 and later versions of iOS and tvOS 10.2 and later versions of tvOS, including: iPhone, iPad, and Apple TV (collectively, the “Apple ‘041 Product(s)”).

400. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '041 Products in regular business operations.

401. On information and belief, one or more of the Apple '041 Products include technology for dynamically configuring a multi-pipe pipeline system.

402. On information and belief, Apple has directly infringed and continues to directly infringe the '041 patent by, among other things, making, using, offering for sale, and/or selling technology for dynamically configuring a multi-pipe pipeline system, including but not limited to the Apple '041 Products.

403. On information and belief, one or more of the Apple '041 Products enable a multiple-pipeline system that is dynamically configurable to effect various combinations of functions for each pipeline.

404. On information and belief, one or more of the Apple '041 Products include a multiple pipeline system that includes a pool of auxiliary function blocks that are provided as required to select pipelines.

405. On information and belief, one or more of the Apple '041 Products consist of a multiple-pipeline system wherein each pipeline is configured to include a homogenous set of core functions.

406. On information and belief, one or more of the Apple '041 Products include a pool of auxiliary functions is provided for selective insertion of auxiliary functions between core functions of select pipelines.

407. On information and belief, one or more of the Apple '041 Products includes auxiliary functions wherein each auxiliary function includes a multiplexer that allows it to be selectively coupled within each pipeline.

408. On information and belief, the Apple '041 Products enable the use of indirect buffers that represent draw of dispatch call arguments.

> With an indirect buffer, the CPU doesn't need to wait for any values and can immediately issue a draw call that references an indirect buffer. After the CPU completes all of its work, the GPU can then generate the arguments, write them to the indirect buffer in one pass, and execute the call associated with them in another pass. This improved sequence is shown in Figure 12-2.

Indirect Buffers, Metal Best Practices Guide, APPLE DEVELOPER DOCUMENTATION (2018), *available at*: https://developer.apple.com/library/archive/documentation/3DDrawing/Conceptual/MTLBestPracticesGuide/.

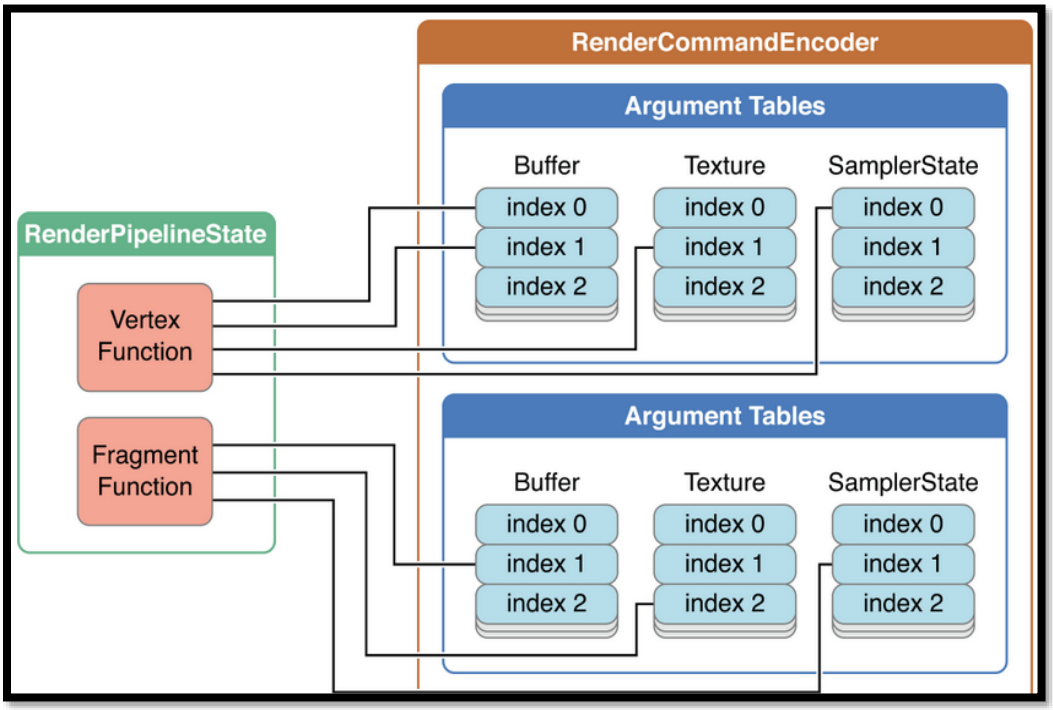
409. On information and belief, the Apple '041 Products allow multiple render or compute pipelines which enable parallelism. The below excerpt from Apple's developer documentation shows how to enable multiple render pipelines asynchronously.

```
1  const uint32_t pipelineCount;
2  dispatch_queue_t dispatch_queue =
     dispatch_get_global_queue(DISPATCH_QUEUE_PRIORITY_DEFAULT, 0);
3
4  // Dispatch the render pipeline build
5  __block NSMutableArray<id<MTLRenderPipelineState>> *pipelineStates = [[NSMutableArray
     alloc] initWithCapacity:pipelineCount];
6
7  dispatch_group_t pipelineGroup = dispatch_group_create();
8  for(uint32_t pipelineIndex = 0; pipelineIndex < pipelineCount; pipelineIndex++)
9  {
10     id <MTLFunction> vertexFunction = [_defaultLibrary
     newFunctionWithName:vertexFunctionNames[pipelineIndex]];
11     id <MTLFunction> fragmentFunction = [_defaultLibrary
     newFunctionWithName:fragmentFunctionNames[pipelineIndex]];
```

Pipelines, Metal Best Practices Guide, APPLE DEVELOPER DOCUMENTATION (2018), *available at*: https://developer.apple.com/library/archive/documentation/3DDrawing/Conceptual/MTLBestPracticesGuide/.

410. On Information and belief, the Apple '041 Products use a Render Command Encoder that manages subordinate MTLRenderCommandEncoder objects that share the same

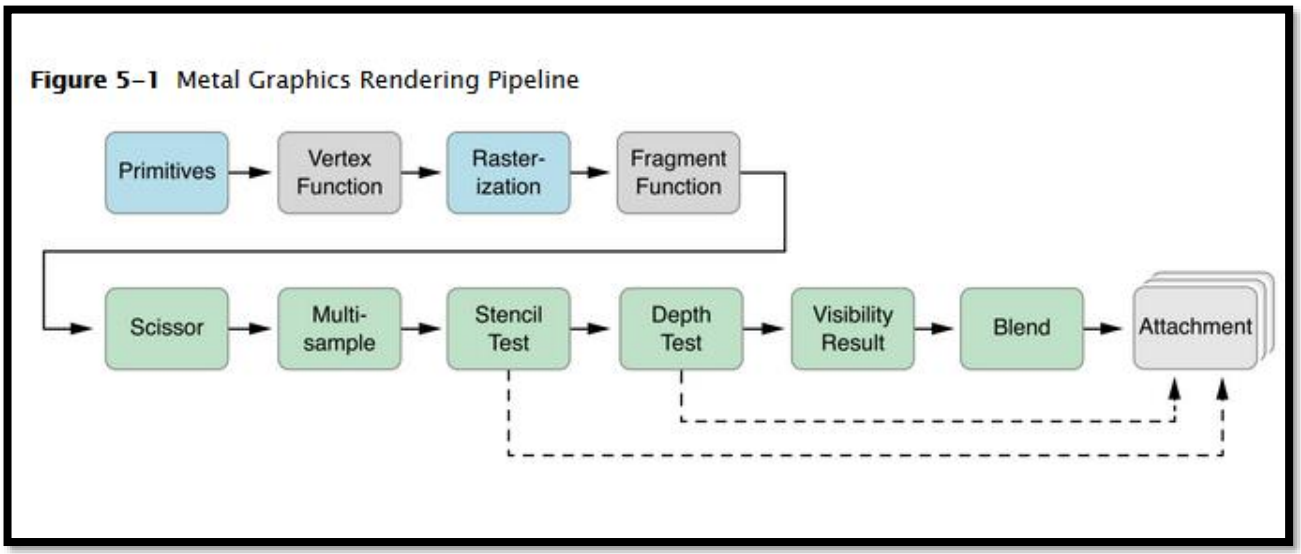
command buffer and render pass descriptor. The parallel render command encoder functions to ensure that the attachment load and store actions occur only at the start and end of the entire rendering pass. The below diagram shows the functionality wherein the argument tables are assigned to the render command encoder. The arguments that are assigned include buffers, textures and samplers. The methods assigned to the Render Command Encoder include buffers, textures, and samplers.



Graphics Rendering: Render Command Encoder, *Metal Best Practices Guide*, APPLE DEVELOPER DOCUMENTATION (2018), *available at*: https://developer.apple.com/library/archive/documentation/3DDrawing/Conceptual/MTLBestPracticesGuide/.

411. On information and belief, the Apple '041 Products enable rendering pipelines. The rendering pipelines consist of custom functions to provide graphics commands to the GPU in the Apple '041 Products. The pipeline elements in the Apple '041 Products are configured to sequentially process data as it traverses the pipeline. The below diagram shows an example of the Metal Graphics Rendering Pipelines in which signals are selectively coupled to a core pipeline element to process data as it traverses between the pair of core elements.

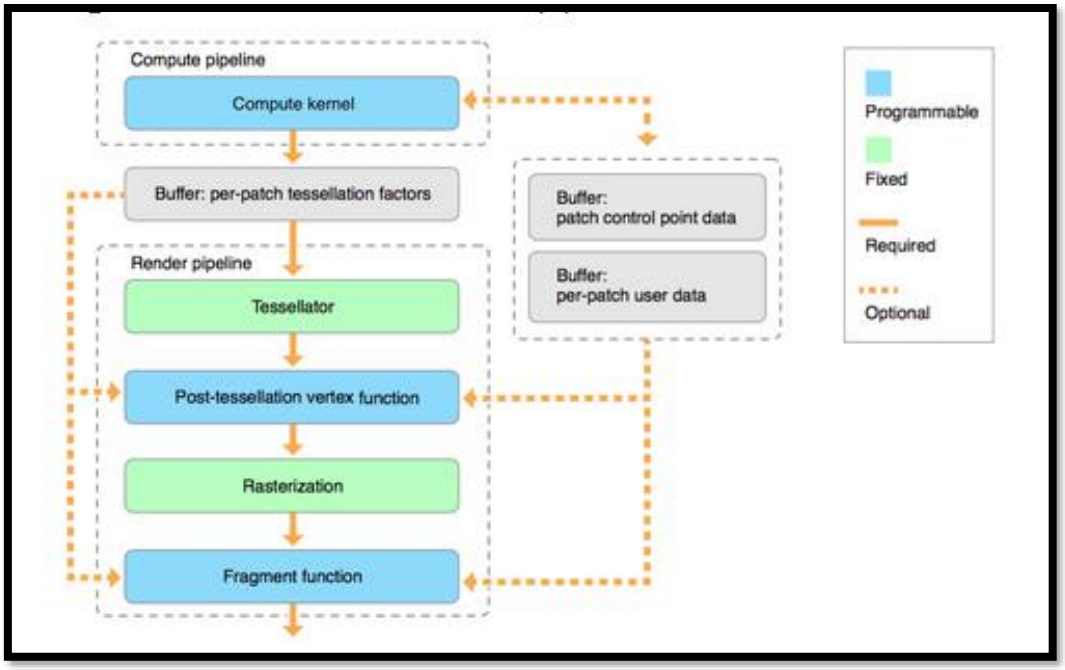
412. On information and belief, one or more of the Apple '041 Products contain a processing system wherein a plurality of auxiliary elements are within a selected pipeline of the multiple pipelines, between a pair of core pipeline elements of the plurality of core pipeline elements to process the data as it traverses between the pair of core elements.



Graphics Rendering: Render Command Encoder, Metal Best Practices Guide, APPLE DEVELOPER DOCUMENTATION (2018), *available at*: https://developer.apple.com/library/archive/documentation/3DDrawing/Conceptual/MTLBestPracticesGuide/.

413. On information and belief, the Apple '041 Products contain multiple pipelines (e.g., Graphics Rendering Pipelines) that are configured to sequentially process data as it traverses the pipeline. The below diagram shows a tessellation pipeline on the Apple '041 Products. The tessellation pipeline is used to calculate a detailed surface from a prior surface. To approximate the detailed surface, the Apple '041 Products' GPUs use per-patch tessellation factors to subdivide each patch into triangles.

414. On information and belief, one or more of the Apple '041 Products contain a processing system that includes a plurality of pipelines, with each pipeline of the plurality including a plurality of core pipeline elements that are configured to sequentially process data as it traverses the pipeline.



Graphics Rendering: Render Command Encoder, Metal Best Practices Guide, APPLE DEVELOPER DOCUMENTATION (2018), *available at*: https://developer.apple.com/library/archive/documentation/3DDrawing/Conceptual/MTLBestPracticesGuide/.

415. On information and belief, the Apple '041 Products contain functionality for compilation pipelines. At build time, the pipeline is stored in a Metal Library. When the pipeline is loaded, an optimization is run that eliminates any code that is not used. In addition, the Apple '041 Products enable the creation of intermediate constants. The optional constants enabled by the Apple '041 Products are constants that do not need to have a provided value when one specializes the function.

416. On information and belief, one or more of the Apple '041 Products contain a processing system that includes a plurality of auxiliary elements, each auxiliary element of the plurality of auxiliary elements being configured to be selectively coupled to multiple pipelines of the plurality of pipelines.

417. On information and belief, one or more of the Apple '041 Products contain a processing system wherein the auxiliary elements are responsive to external coupling-select signals.

418. On information and belief, the Apple '041 Products are available to businesses and individuals throughout the United States.

419. On information and belief, the Apple '041 Products are provided to businesses and individuals located in the Eastern District of Texas.

420. By making, using, testing, offering for sale, and/or selling products and services for dynamically configuring a multi-pipe pipeline system, including but not limited to the Apple '041 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '041 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

421. On information and belief, Apple also indirectly infringes the '041 patent by actively inducing infringement under 35 USC § 271(b).

422. Apple has had knowledge of the '041 patent since at least service of the Original Complaint in this matter or shortly thereafter, and on information and belief, Apple knew of the '041 patent and knew of its infringement, including by way of this lawsuit.

423. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '041 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '041 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '041 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple

provides the Apple '041 Products that have the capability of operating in a manner that infringe one or more of the claims of the '041 patent, including at least claim 1, and Apple further provides documentation and training materials that cause customers and end users of the Apple '041 Products to utilize the products in a manner that directly infringe one or more claims of the '041 patent.[42] By providing instruction and training to customers and end-users on how to use the Apple '041 Products in a manner that directly infringes one or more claims of the '041 patent, including at least claim 1, Apple specifically intended to induce infringement of the '041 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '041 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '041 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '041 patent, knowing that such use constitutes infringement of the '041 patent.

424. The '041 patent is well-known within the industry as demonstrated by multiple citations to the '041 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '041 patent without paying a reasonable royalty. Apple is infringing the '041 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

[42] *See, e.g., iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018); *Apple TV User Guide*, APPLE SUPPORT WEBSITE, *available at*: https://support.apple.com/guide/tv/welcome/tvos (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

425. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '041 patent.

426. As a result of Apple's infringement of the '041 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT XI
INFRINGEMENT OF U.S. PATENT NO. 7,571,450

427. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

428. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for displaying information.

429. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products that implement HTTP Live Streaming ("HLS"). The Accused Products include, but are not limited to, Apple's iPhone, iPad, and Apple TV, and any other products capable of implementing HLS (collectively, the "Apple '450 Product(s)").

430. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '450 Products in regular business operations.

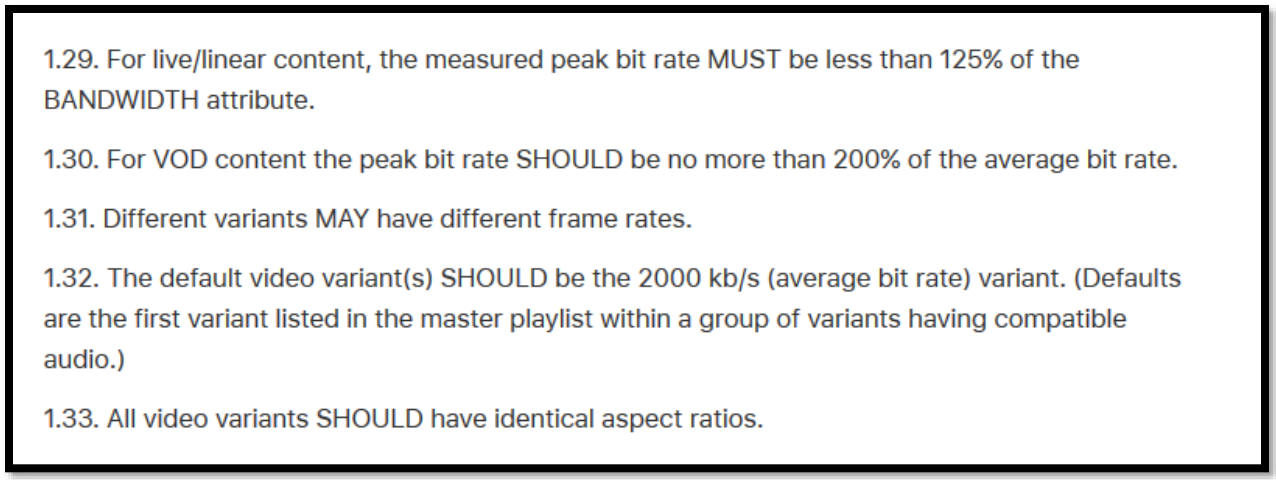
431. On information and belief, one or more of the Apple '450 Products include technology for displaying information.

> HTTP Live Streaming provides a reliable, cost-effective means of delivering continuous and long-form video over the Internet. It allows a receiver to adapt the bit rate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality. It supports interstitial content boundaries.

R. Pantos, HTTP LIVE STREAM PROTOCOL SPECIFICATION 2ND EDITION at 4 (June 20, 2018).

432. On information and belief, Apple has directly infringed and continues to directly infringe the '450 patent by, among other things, making, using, offering for sale, and/or selling technology for displaying information, including but not limited to the Apple '450 Products.

433. On information and belief, one or more of the Apple '450 Products enable methods and systems wherein a user does not need to make a new selection after being switched from one service to a second service.



1.29. For live/linear content, the measured peak bit rate MUST be less than 125% of the BANDWIDTH attribute.

1.30. For VOD content the peak bit rate SHOULD be no more than 200% of the average bit rate.

1.31. Different variants MAY have different frame rates.

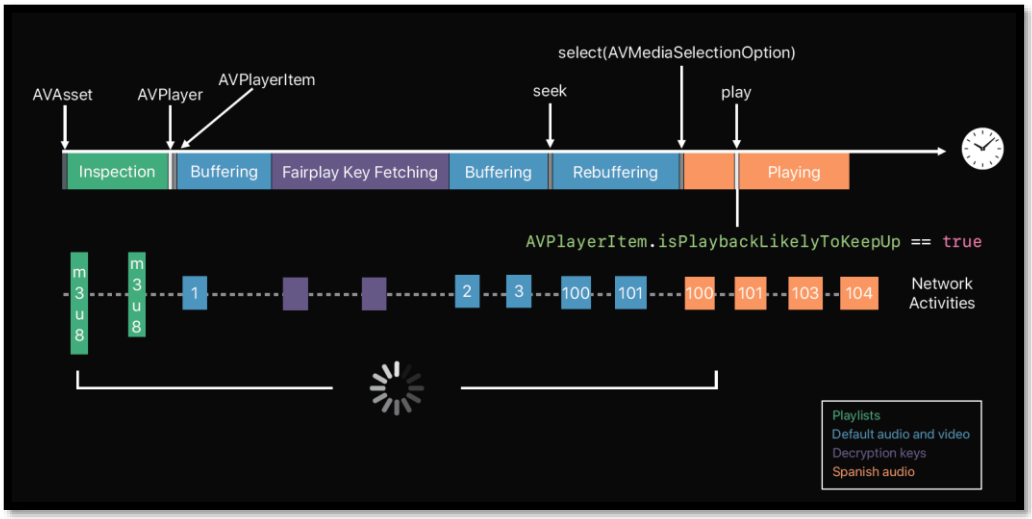
1.32. The default video variant(s) SHOULD be the 2000 kb/s (average bit rate) variant. (Defaults are the first variant listed in the master playlist within a group of variants having compatible audio.)

1.33. All video variants SHOULD have identical aspect ratios.

HLS Authoring Specification for Apple Devices, APPLE DEVELOPER DOCUMENTATION (2018), *available at*: https://developer.apple.com/documentation/http_live_streaming/hls_authoring_specification_for_apple_devices (describing that variant content can have a default value or automatically switch).

434. On information and belief, one or more of the Apple '450 Products permit a user of an information display system to have selections made on a first service also presented when the user switches to a second service without requiring the user to browse through the menus to define the type of information to be displayed a second time.

435. On information and belief, one or more of the Apple '450 Products enable a user to make a selection on the basis of the provided options while the first service selected is used to select the appropriate data elements of the stream of the second service.

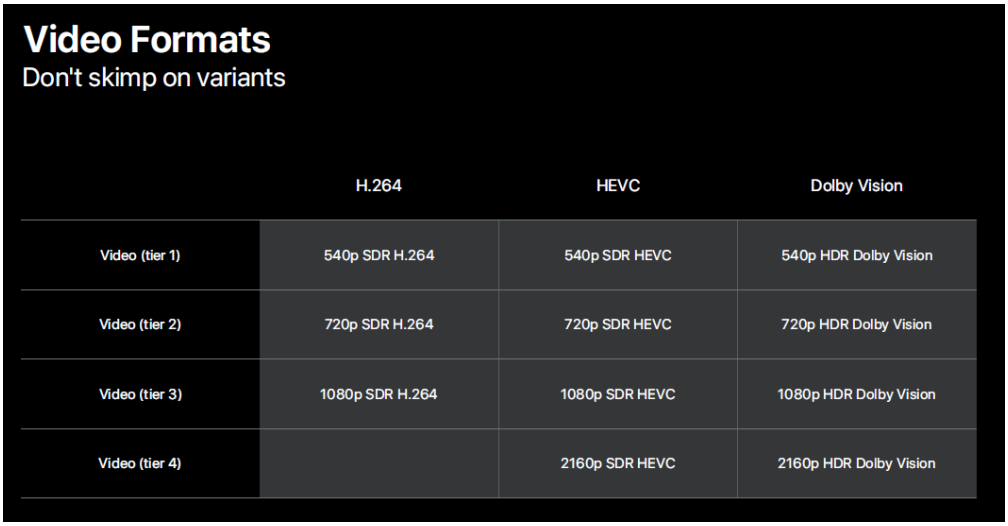


Emil Andriescu, *Measuring and Optimizing HLS Performance*, APPLE WORLD WIDE DEVELOPERS CONFERENCE 2018 (WWDC18) at 97 (2018) (showing that a user can select between different variant content that can be called from a master playlist but come from different services).

436. On information and belief, one or more of the Apple '450 Products enable various content sources to share similar information models.

437. On information and belief, by complying with the HLS standard, the Apple devices – such as the Apple '450 Products - necessarily infringe the '450 patent. The mandatory sections of the HLS standard require the elements required by certain claims of the '450 patent, including but not limited to claim 8 of the '450 patent. *See* HLS AUTHORING SPECIFICATION FOR APPLE DEVICES (October 21, 2015) ("1.2 Video Encoding Requirements;" "4.1 Accessibility Requirements;" "7.0 Media Segmentation Requirements;" "9.0 Master Playlist Requirements;" "Delivery Requirements;" "9.9 You Must Provide Multiple Bit Rate (Variants).").

438. On information and belief, one or more of the Apple '450 Products perform a method of displaying information on a display device wherein receiving a transport stream comprises services, with the services having elementary streams of video and of data elements.

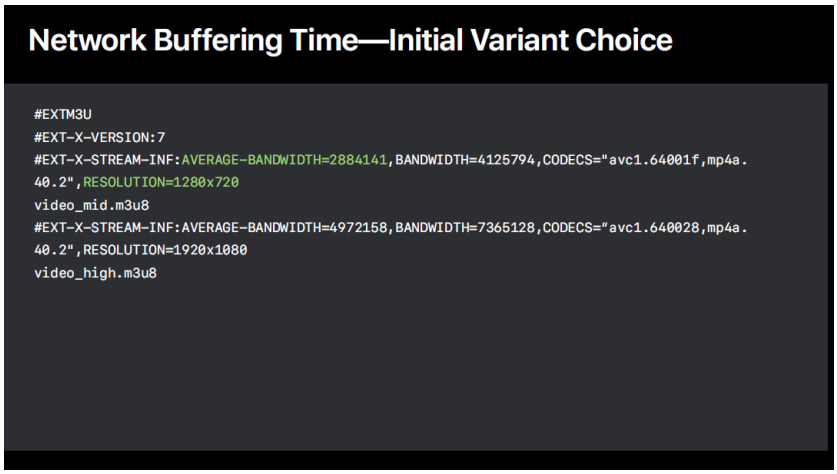


Emil Andriescu, *Measuring and Optimizing HLS Performance*, APPLE WORLD WIDE DEVELOPERS CONFERENCE 2018 (WWDC18) at 252 (2018) (showing that a service can provide variant streams comprised of data and video as well as different resolutions and quality levels).

439. On information and belief, one or more of the Apple '450 Products perform a method of displaying information on a display device wherein user actions of making a user selection of a type of information to be displayed on the device are received.

440. On information and belief, one or more of the Apple '450 Products perform a method of displaying information on a display device wherein filtering to select a data element of a first one of the services on the basis of the user selection is performed.

441. On information and belief, one or more of the Apple '450 Products perform a method of displaying information on a display device wherein rendering to calculate an output image to be displayed on the display device on the basis of the first data element selected is performed.



Emil Andriescu, *Measuring and Optimizing HLS Performance*, APPLE WORLD WIDE DEVELOPERS CONFERENCE 2018 (WWDC18) at 252 (2018) (showing that an initial variant choice can determine the subsequent content).

442. On information and belief, one or more of the Apple '450 Products perform a method of displaying information on a display device wherein switching from the first one of the services to a second one of the services comprises a second step of filtering to select a second data-element of the second one of the services on basis of the user selection.

443. On information and belief, one or more of the Apple '450 Products perform a method of displaying information on a display device wherein being switched from the first one of the services to the second one of the services, with the data-element and the second data-element being mutually semantically related and a second step of rendering to calculate the output image to be displayed on the display device, on basis of the second data-element selected by the filter is performed.

444. On information and belief, the Apple '450 Products are available to businesses and individuals throughout the United States.

445. On information and belief, the Apple '450 Products are provided to businesses and individuals located in the Eastern District of Texas.

446. By making, using, testing, offering for sale, and/or selling products and services for displaying information, including but not limited to the Apple '450 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '450 patent, including at least claim 8 pursuant to 35 U.S.C. § 271(a).

447. On information and belief, Apple also indirectly infringes the '450 patent by actively inducing infringement under 35 USC § 271(b).

448. Apple has had knowledge of the '450 patent since at least service of the original Complaint in this matter, or shortly thereafter, and on information and belief, Apple knew of the '450 patent and knew of its infringement, including by way of this lawsuit.

449. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '450 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '450 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '450 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '450 Products that have the capability of operating in a manner that infringe one or more of the claims of the '450 patent, including at least claim 8, and Apple further provides documentation and training materials that cause customers and end users of the Apple '450 Products to utilize the products in a manner that directly infringe one or more claims of the '450 patent.[43] By providing instruction and training to customers and end-users on how to use the Apple

[43] *See, e.g.*, *iPhone User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/iphone/12/#/iph344652def (last visited Nov. 2018); *iPad User Guide*, APPLE HELP WEBSITE, *available at*: https://help.apple.com/ipad/12/ (last visited Nov. 2018);

‘450 Products in a manner that directly infringes one or more claims of the ‘450 patent, including at least claim 8, Apple specifically intended to induce infringement of the ‘450 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple ‘450 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the ‘450 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the ‘450 patent, knowing that such use constitutes infringement of the ‘450 patent.

450. The ‘450 patent is well-known within the industry as demonstrated by multiple citations to the ‘450 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the ‘450 patent without paying a reasonable royalty. Apple is infringing the ‘450 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

451. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘450 patent.

452. As a result of Apple’s infringement of the ‘450 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

Apple TV User Guide, APPLE SUPPORT WEBSITE, *available at*: https://support.apple.com/guide/tv/welcome/tvos (last visited Nov. 2018); *Installing Apple Beta Software*, APPLE DEVELOPER SUPPORT WEBSITE, *available at*: https://developer.apple.com/support/beta-software/install-beta/ (last visited Nov. 2018).

COUNT XII
INFRINGEMENT OF U.S. PATENT NO. 6,996,175

453. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

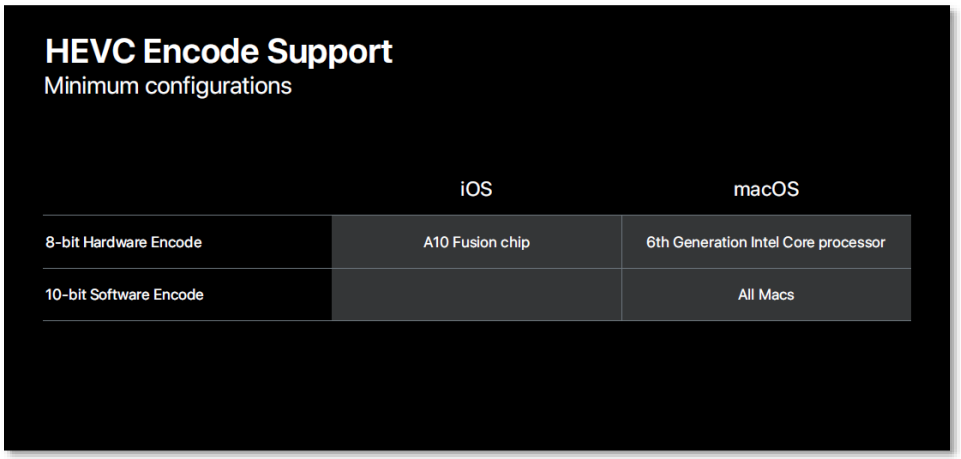
454. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for recursive motion vector estimation.

455. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products that comply with the H.265 standard. By way of example, the following Apple Products perform encoding pursuant to the H.265 standard: iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS Max, iPhone XS, iPad (6th generation), iPad Pro 11-inch (3rd generation), and the iPad Pro 12.9-inch (3rd generation) (collectively, the "Apple '175 Product(s)").

456. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '175 Products in regular business operations.

457. On information and belief, one or more of the Apple '175 Products include technology for generating for a block a plurality of candidate vectors from stored vectors.

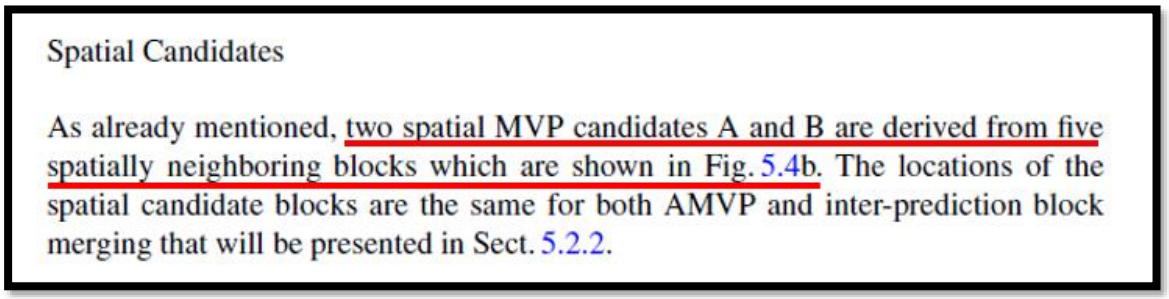
458. On information and belief, one or more of the Apple '175 Products include technology for estimating a current motion vector for a group of pixels of an image. Further, HEVC encoding support has been incorporated into the Apple '175 Products as shown in the below excerpt from an Apple presentation at its Worldwide Developer Conference in 2017.



Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 52 (2017).

459. On information and belief, by complying with the HEVC standard, Apple's devices – such as the Apple '175 Products - necessarily infringe the '175 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '175 patent, including but not limited to claim 1. *High Efficiency Video Coding*, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 (February 2018) (The following sections of the HEVC Standard are relevant to Apple's infringement of the '175 patent: "3.110 Prediction Unit Definition;" "6.3.2 Block and quadtree structures;" "6.3.3 Spatial or component-wise partitioning;" "6.4.2 Derivation process for prediction block availability;" "7.3.4 Scaling list data syntax;" 7.3.6.1 General slice segment header syntax;" "7.3.6.3 Weighted prediction parameters syntax;" "7.3.8.14 Delta QP syntax;" "7.4.4 Profile, tier and level semantics;" and "7.4.7.3 Weighted prediction parameters semantics."

460. On information and belief, one or more of the Apple '175 Products include technology for selecting one of these candidate vectors (that was generated from a stored vector) to generate a selected vector.

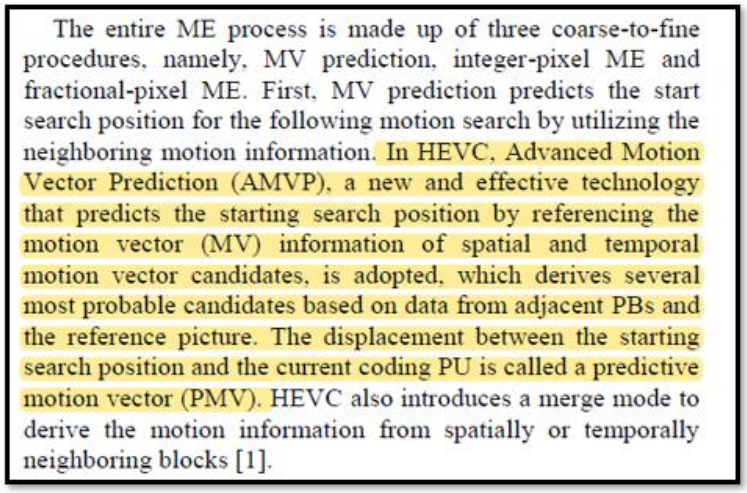


Spatial Candidates

As already mentioned, two spatial MVP candidates A and B are derived from five spatially neighboring blocks which are shown in Fig. 5.4b. The locations of the spatial candidate blocks are the same for both AMVP and inter-prediction block merging that will be presented in Sect. 5.2.2.

Gary Sullivan, *et al*., HIGH EFFICIENCY VIDEO CODING (HEVC) ALGORITHMS AND ARCHITECTURES at 117 (2014) (emphasis added).

461. On information and belief, one or more of the Apple '175 Products include technology for generating a plurality of test vectors from the selected vector.



The entire ME process is made up of three coarse-to-fine procedures, namely, MV prediction, integer-pixel ME and fractional-pixel ME. First, MV prediction predicts the start search position for the following motion search by utilizing the neighboring motion information. In HEVC, Advanced Motion Vector Prediction (AMVP), a new and effective technology that predicts the starting search position by referencing the motion vector (MV) information of spatial and temporal motion vector candidates, is adopted, which derives several most probable candidates based on data from adjacent PBs and the reference picture. The displacement between the starting search position and the current coding PU is called a predictive motion vector (PMV). HEVC also introduces a merge mode to derive the motion information from spatially or temporally neighboring blocks [1].

Yongfei Zhang, Chao Zhang, and Rui Fan, *Fast Motion Estimation in HEVC Inter Coding: An Overview of Recent Advances*, PROCEEDINGS, APSIPA ANNUAL SUMMIT AND CONFERENCE 2018 at 1 (November 2018) (emphasis added).

462. On information and belief, one or more of the Apple '175 Products include technology for selecting one of the test vectors to generate an output vector.

463. Specifically, the HEVC standard arranges to calculate the further candidate motion vector by calculating a difference between the second motion vector and the first motion vector. The further candidate motion vector is calculated at the end of the process diagram below (see the red box).

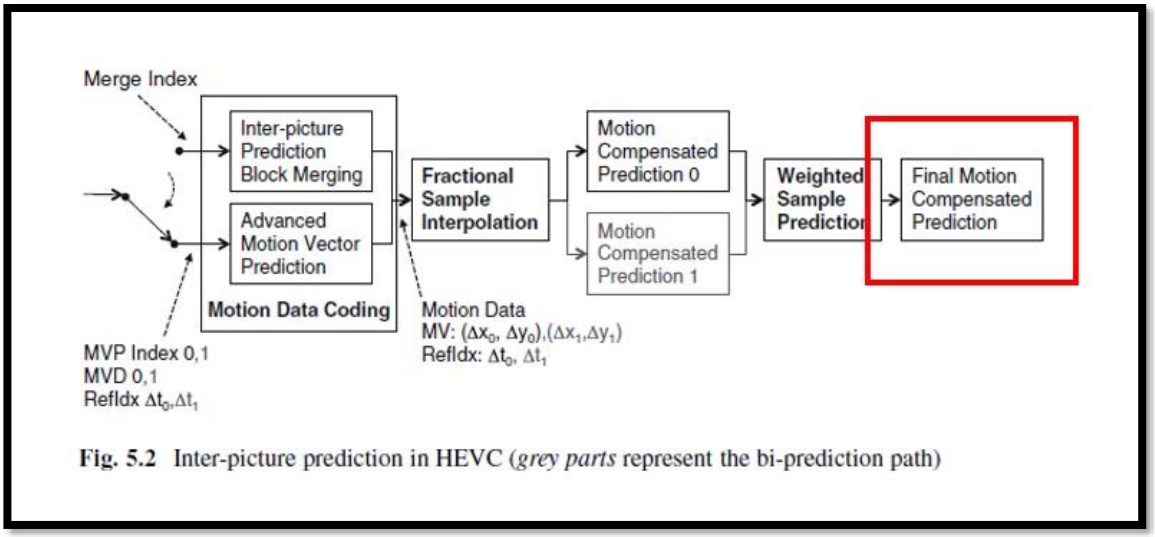


Fig. 5.2 Inter-picture prediction in HEVC (*grey parts* represent the bi-prediction path)

Gary J. Sullivan, *et al.*, HEVC, HIGH EFFICIENCY VIDEO CODING (HEVC) at 115 (September 2014) (emphasis added).

464. On information and belief, one or more of the Apple '175 Products comprise functionality wherein blocks in a picture are further divided into a plurality of blocks.

465. On information and belief, one or more of the Apple '175 Products comprises functionality wherein the vectors generate in the recursive estimation process are generated based on a difference between the output vector and the selected vector.

> It can be seen from Fig. 5.4b that only motion vectors from spatial neighboring blocks to the left and above the current block are considered as spatial MVP candidates. This can be explained by the fact that the blocks to the right and below the current block are not yet decoded and hence, their motion data is not available. Since the co-located picture is a reference picture which is already decoded, it is possible to also consider motion data from the block at the same position, from blocks to the right of the co-located block or from the blocks below**.** In HEVC, the block to the bottom right and at the center of the current block have been determined to be the most suitable to provide a good temporal motion vector predictor (TMVP).

Benjamin Bross, *et al.*, *Inter-picture prediction in HEVC*, in HIGH EFFICIENCY VIDEO CODING (HEVC) at 119 (2014) (emphasis added).

466. On information and belief, one or more of the Apple '175 Products include technology for storing the output vector as one of the stored vectors for possible use in a next block.

467. On information and belief, Apple has directly infringed and continues to directly infringe the ‘175 patent by, among other things, making, using, offering for sale, and/or selling technology for recursive motion vector estimation, including but not limited to the Apple ‘175 Products.

468. On information and belief, the Apple ‘175 Products are available to businesses and individuals throughout the United States.

469. On information and belief, the Apple ‘175 Products are provided to businesses and individuals located in the Eastern District of Texas.

470. By making, using, testing, offering for sale, and/or selling products and services for recursive motion vector estimation, including but not limited to the Apple ‘175 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the ‘175 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

471. On information and belief, Apple also indirectly infringes the ‘175 patent by actively inducing infringement under 35 USC § 271(b).

472. Apple has had knowledge of the ‘175 patent since at least service of this First Amended Complaint or shortly thereafter, and on information and belief, Apple knew of the ‘175 patent and knew of its infringement, including by way of this lawsuit.

473. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple ‘175 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘175 patent. Apple performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘175 patent

and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '175 Products that have the capability of operating in a manner that infringe one or more of the claims of the '175 patent, including at least claim 1, and Apple further provides documentation and training materials that cause customers and end users of the Apple '175 Products to utilize the products in a manner that directly infringe one or more claims of the '175 patent.[44] By providing instruction and training to customers and end-users on how to use the Apple '175 Products in a manner that directly infringes one or more claims of the '175 patent, including at least claim 1, Apple specifically intended to induce infringement of the '175 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '175 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '175 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '175 patent, knowing that such use constitutes infringement of the '175 patent.

474. The '175 patent is well-known within the industry as demonstrated by multiple citations to the '175 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '175 patent without paying a reasonable royalty. Apple is infringing the '175 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

[44] *See, e.g.*, Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 29 (2017); *Capturing Video in Alternative Formats*, APPLE DEVELOPER DOCUMENTATION (2018) (emphasis added), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/capturing_video_in_alternative_formats; Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 9 (2017).

475. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '175 patent.

476. As a result of Apple's infringement of the '175 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

COUNT XIII
INFRINGEMENT OF U.S. PATENT NO. 7,982,799

477. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

478. Apple designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for interpolating an image information value for a pixel of an interline situated between two original image lines in an image.

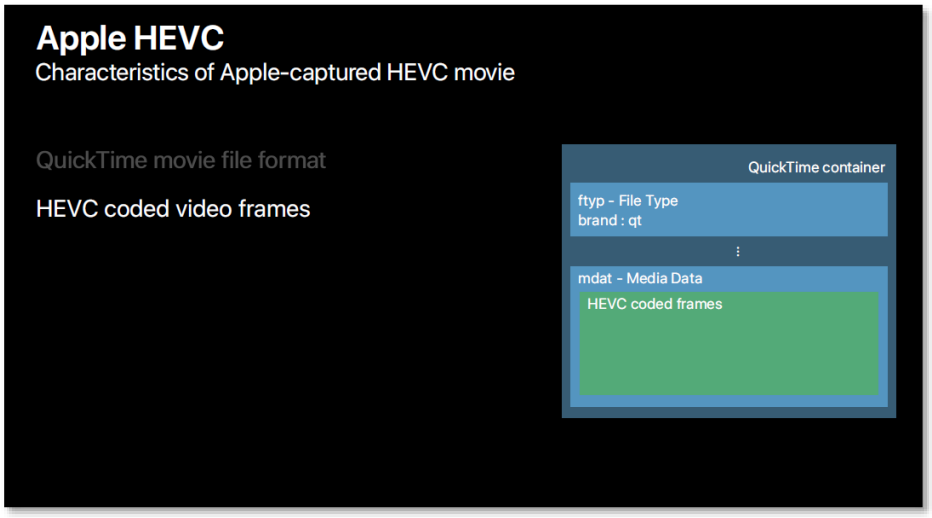
479. Apple designs, makes, sells, offers to sell, imports, and/or uses Apple products that contain functionality for interpolating image information capable of decoding video data in compliance with the H.265 standard. The Accused Products include, but are not limited to, Apple's iPhone, iPad, and Apple TV, and any other Apple products capable of performing decoding of video data using the H.265 standard. By way of example, the following Apple Products perform decoding pursuant to the H.265 standard: iPhone 6s, iPhone 6s Plus, iPhone SE, iPhone 7, iPhone 7 Plus, iPhone 8, iPhone 8 Plus, iPhone X, iPhone XR, iPhone XS Max, iPhone XS, iPad (5th generation), iPad Pro (12.9-inch), iPad Pro (9.7-inch), iPad (6th generation), iPad Pro (10.5-inch), iPad Pro 12.9-inch (2nd generation), iPad Pro 11-inch, and the iPad Pro 12.9-inch (3rd generation) (collectively, the "Apple '799 Product(s)").

480. The Apple '799 Products contain hardware-based decoders on the Apple A9, Apple A9X, Apple A10, Fusion, Apple A10X Fusion, Apple A11 Bionic, Apple A12 Bionic, and Apple A12X Bionic system on chip ("SoC") processors.[45]

> Apple A9 first introduced with hardware based HEVC decoder enabling devices to efficiently playback H.265/High Efficiency video content. A11 introduced a hardware encoder, enabling iPhone's Biopic generations to create and save content in the high efficiency formats. This feature optimizes the storage space while saving high definition photos and videos.

Debrath Banerjee, *A Microarchitecture Study on Apple's A11 Bionic Processor,* RESEARCHGATE PUBLICATION at 3 (May 2018) (emphasis added), *available at*: https://www.researchgate.net/publication/325053646_A_Microarchitectural_Study_on_Apple's_A11_Bionic_Processor.

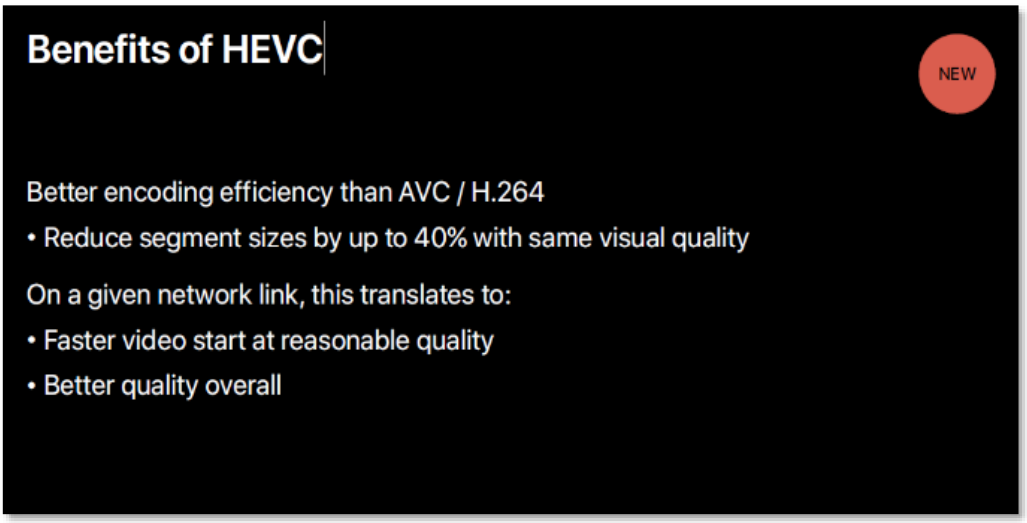
481. Further, documentation from Apple provides additional evidence that the Apple '799 Products contain "architecture [] updated to include H.265 encode and decoding acceleration."



Gavin Thomson and Athar Shah, *Introducing HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 503 at 68 (2017).

[45] *See iOS Device Compatibility Reference*, APPLE DEVELOPER WEBSITE (October 30, 2017), *available at*: https://developer.apple.com/library/archive/documentation/DeviceInformation/Reference/iOSDeviceCompatibility/HardwareGPUInformation/HardwareGPUInformation.html (describing the

482. Apple has identified that the inclusion of HEVC decoding and encoding in the Apple '799 Products is a critical "value proposition." The below excerpt from an Apple Worldwide Developer Conference presentation describes the importance of HEVC in the Apple '799 Products.



Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 8 (2017).

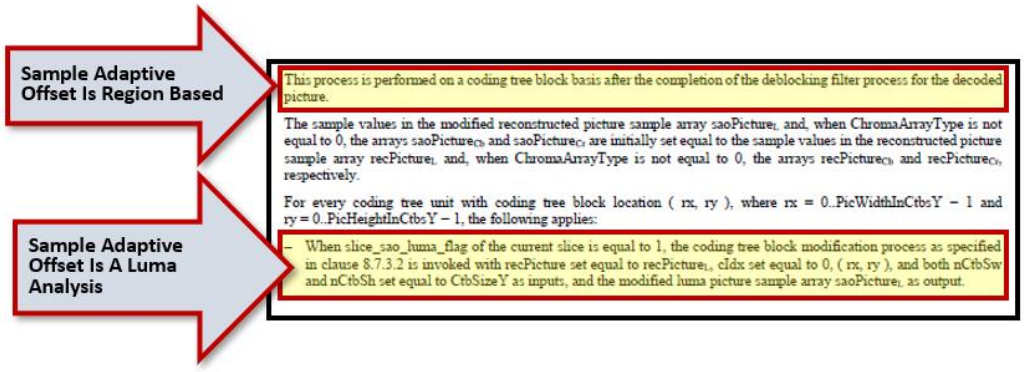
483. On information and belief, by complying with the HEVC standard, the Apple devices – such as the Apple '799 Products - necessarily infringe the '799 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '799 patent, including but not limited to claim 1 of the '799 patent. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018) (The following sections of the HEVC Standard are relevant to Apple's infringement of the '799 patent: "8.6.7 Picture construction process prior to in-loop filter process;" "8.7.2 Deblocking filter process;" "8.7.3 Sample adaptive offset process;" "F.8.7 In-loop filter process;" "8.3.2 Decoding process for reference picture set;" "8.5.4 Decoding process for the residual signal of coding units coded in inter prediction mode;" "8.6 Scaling, transformation and array construction process prior to deblocking filter process;"

"8.5.2 Inter prediction process;" and "8.5.3 Decoding process for prediction units in inter prediction mode.").

484. On information and belief, one or more Apple subsidiaries and/or affiliates use the Apple '799 Products in regular business operations.

485. On information and belief, one or more of the Apple '799 Products contain functionality for a direction quality value for an image direction.

486. On information and belief, one or more of the Apple '799 Products include technology selecting from a number of image directions, to each of which a direction quality value is assigned, a direction of interpolation by comparing these direction quality values.



High Efficiency Video Coding, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 at § 8.7.3.1 (April 2015) (annotations added).

487. On information and belief, Apple has directly infringed and continues to directly infringe the '799 patent by, among other things, making, using, offering for sale, and/or selling technology for interpolating an image information value for a pixel of an interline situated between two original image lines in an image, including but not limited to the Apple '799 Products.

> Using a translational motion model, the position of the block in a previously decoded picture is indicated by a motion vector: Δx; Δy where Δx specifies the horizontal and Δy the vertical displacement relative to the position of the current block. The motion vectors: Δx; Δy could be of fractional sample accuracy to more accurately capture the movement of the underlying object. Interpolation is applied on the reference pictures to derive the prediction signal when the corresponding

> motion vector has fractional sample accuracy. The previously decoded picture is referred to as the reference picture and indicated by a reference index Δt to a reference picture list. These translational motion model parameters, i.e. motion vectors and reference indices, are further referred to as motion data.

Benjamin Bross, *Inter-Picture Prediction In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 114 (September 2014) (emphasis added).

488. On information and belief, one or more of the Apple '799 Products reduce or prevent ambiguities in the determination of an optimal image direction by adding a single direction values of several adjacent pixels.

489. On information and belief, the Apple '799 Products contain functionality for determining the image information value being interposed in dependence on image information values assigned to pixels lying adjacent to the pixel being interpolated (in the direction of interpolation).

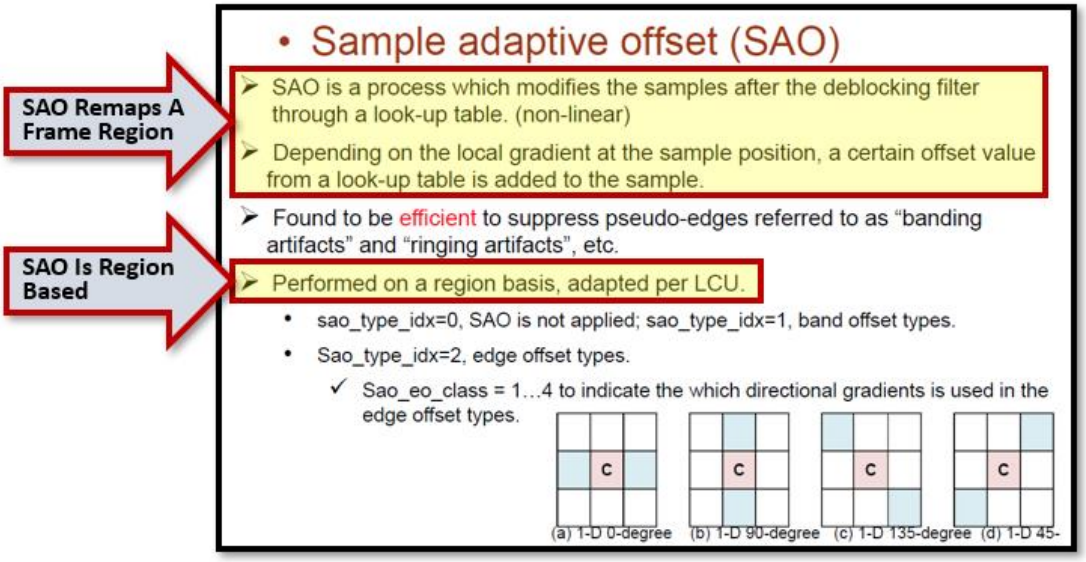
490. On information and belief, one or more of the Apple '799 Products contain functionality for selecting a pixel group with two or more pixels as part of ascertaining a directional quality value.

> SAO classifies each pixel into one of four bands or one of four edge types and adds an offset to it. For band offsets, the band of each pixel depends on its value and the position of the four bands. For edge offsets, the edge of each pixel depends on the whether its value is larger or smaller than two of its neighbors. The selection between band offsets and edge offsets, position of bands, choice of neighbors for edge offsets, and values of the offsets are signaled at the CTU level for luma and chroma separately.

Mehul Tikekar, *et al., Decoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 335 (September 2014) (emphasis added).

491. On information and belief, one or more of the Apple '799 Products enable a method for interpolation of an image information value for a pixel of an interline that includes selecting from a number of image directions, to each of which a direction quality value is assigned, a direction of interpolation by comparing the direction quality values. "[A]fter the deblocking filter

through a look-up table . . . [and applying] a certain offset value from a look-up-table is added to the sample."[46]



Oscar C. Au, HIGH EFFICIENCY VIDEO CODING (HEVC) PRESENTATION at 43 (October 2013) (annotations added).

492. On information and belief, one or more of the Apple '799 Products enable a method for interpolation of an image information value for a pixel of an interline that includes determining the image information value being interpolated in dependence on image information values assigned to pixels lying adjacent to the pixel being interpolated in the direction of interpolation.

493. On information and belief, one or more of the Apple '799 Products enable a method for interpolation of an image information value for a pixel of an interline that includes ascertaining a direction quality value for an image direction by determining a single direction quality value for each pixel of the pixel group, the single direction quality value being dependent on image information values assigned to image regions lying adjacent to the particular pixel of the group in the image direction.

[46] Oscar C. Au, HIGH EFFICIENCY VIDEO CODING (HEVC) PRESENTATION at 43 (October 2013).

> The second in-loop filter, SAO, is applied to the output of the deblocking filter and further improves the quality of the decoded picture by attenuating ringing artifacts and changes in sample intensity of some areas of a picture. The most important advantage of the in-loop filters is improved subjective quality of reconstructed pictures. In addition, using the filters in the decoding loop also increases the quality of the reference pictures and hence also the compression efficiency.

Andrey Norkin, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei, *In-Loop Filters In HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 171 (September 2014) (annotations added).

494. On information and belief, the Apple '799 Products are available to businesses and individuals throughout the United States.

495. On information and belief, the Apple '799 Products are provided to businesses and individuals located in the Eastern District of Texas.

496. By making, using, testing, offering for sale, and/or selling products and services for interpolating an image information value for a pixel of an interline situated between two original image lines in an image, including but not limited to the Apple '799 Products, Apple has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '799 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

497. On information and belief, Apple also indirectly infringes the '799 patent by actively inducing infringement under 35 USC § 271(b).

498. Apple has had knowledge of the '799 patent since at least service of this First Amended Complaint or shortly thereafter, and on information and belief, Apple knew of the '799 patent and knew of its infringement, including by way of this lawsuit.

499. On information and belief, Apple intended to induce patent infringement by third-party customers and users of the Apple '799 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Apple specifically intended and was aware that the normal and customary use of the accused products would infringe the '799 patent. Apple performed the acts that constitute

induced infringement, and would induce actual infringement, with knowledge of the '799 patent and with the knowledge that the induced acts would constitute infringement. For example, Apple provides the Apple '799 Products that have the capability of operating in a manner that infringe one or more of the claims of the '799 patent, including at least claim 1, and Apple further provides documentation and training materials that cause customers and end users of the Apple '799 Products to utilize the products in a manner that directly infringe one or more claims of the '799 patent.[47] By providing instruction and training to customers and end-users on how to use the Apple '799 Products in a manner that directly infringes one or more claims of the '799 patent, including at least claim 1, Apple specifically intended to induce infringement of the '799 patent. On information and belief, Apple engaged in such inducement to promote the sales of the Apple '799 Products, e.g., through Apple user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '799 patent. Accordingly, Apple has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '799 patent, knowing that such use constitutes infringement of the '799 patent.

500. The '799 patent is well-known within the industry as demonstrated by multiple citations to the '799 patent in published patents and patent applications assigned to technology companies and academic institutions. Apple is utilizing the technology claimed in the '799 patent without paying a reasonable royalty. Apple is infringing the '799 patent in a manner best described

[47] *See e.g.*, Roger Pantos and Anil Katti, *Advances in HTTP Live Streaming*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 504 at 8 (2017); Gavin Thomson and Athar Shah, *Introducing HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 503 at 68 (2017); *Setting Up a Capture Session*, APPLE DEVELOPER DOCUMENTATION (last visited December 2018), *available at*: https://developer.apple.com/documentation/avfoundation/cameras_and_media_capture/setting_up_a_capture_session; Erik Turnquist and Brad Ford, *Working with HEIF and HEVC*, APPLE WORLDWIDE DEVELOPER CONFERENCE 2017: SESSION 511 at 52 (2017).

as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

501. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '799 patent.

502. As a result of Apple's infringement of the '799 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Apple's infringement, but in no event less than a reasonable royalty for the use made of the invention by Apple together with interest and costs as fixed by the Court.

PRAYER FOR RELIEF

WHEREFORE, Dynamic Data respectfully requests that this Court enter:

A. A judgment in favor of Dynamic Data that Apple has infringed, either literally and/or under the doctrine of equivalents, the '073, '257, '054, '918, '689, '177, '112, '688, '529, '041, '450, 175, and '799 patents;

B. An award of damages resulting from Apple's acts of infringement in accordance with 35 U.S.C. § 284;

C. A judgment and order finding that Apple's infringement was willful, wanton, malicious, bad-faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate within the meaning of 35 U.S.C. § 284 and awarding to Dynamic Data enhanced damages.

D. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Dynamic Data its reasonable attorneys' fees against Apple.

E. Any and all other relief to which Dynamic Data may show themselves to be entitled.

JURY TRIAL DEMANDED

Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Dynamic Data Technologies, LLC requests a trial by jury of any issues so triable by right.

Dated: January 25, 2019

Respectfully submitted,

/s/ Daniel P. Hipskind

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Attorneys for Dynamic Data Technologies, LLC

CERTIFICATE OF SERVICE

I hereby certify that counsel of record who are deemed to have consented to electronic service are being served this 25th of January, 2019 with a copy of this document via the Court's CM/ECF System per Local Rule CV-5(a)(3). Any other counsel of record will be served by electronic mail, facsimile transmission and/or first class mail on this same date.

/s/ Daniel P. Hipskind
Daniel P. Hipskind