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UNITED STATES DISTRICT COURT
SOUTHERN DISTRICT OF NEW YORK

DYNAMIC DATA TECHNOLOGIES, LLC Plaintiff, v. HTC CORPORATION AND HTC AMERICA, INC. Defendants.	Civil Action No. 1:18-cv-10180-GHW **COMPLAINT** **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"); 7,010,039 (the "'039 patent"); 8,311,112 (the "'112 patent"); 6,646,688 (the "'688 patent"); 7,894,529 (the "'529 patent"); and 7,571,450 (the "'450 patent") (collectively, the "patents-in-suit"). Defendants HTC

Corporation and HTC America, Inc. (collectively, "HTC" or "Defendant") infringe 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*.

INTRODUCTION

1. Dynamic Data's portfolio of over 1,200 patent assets encompasses core technologies in the field of image and video processing. 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.

2. To facilitate the licensing of Philips' foundational technology, Dynamic Data is pursuing remedies for infringement of its patents in venues throughout the world. Contemporaneous to the filing of this Complaint and complaints against other companies selling the technologies claimed by Dynamic Data's patent portfolio, Dynamic Data has filed patent enforcement actions against Apple Retail Germany B.V. & Co. KG, Apple Distribution International, and Apple, Inc. in Düsseldorf, Germany.[1] In the People's Republic of China, Dynamic Data has filed patent enforcement actions against Advanced Micro Devices (China) Co., Ltd.,[2] Apple Electronic Products Trading (Beijing) Co., Ltd.,[3] and Microsoft (China) Co., Ltd.[4]

3. Dynamic Data has continued to expand its portfolio of motion estimation and motion compensation patents since the Original Complaint in this matter was filed. 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.

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

[2] Asserting Patent No. ZL02817458.5.

[3] *See* Case Nos. (2019) Jing 73 Min Chu No. 235; (2019) Jing 73 Min Chu No. 234.

[4] *See* Case Nos. (2018) Su 01 Minchu 3500 ((2018)苏01民初3500号), (2018) Su 01 Minchu 3501 ((2018)苏01民初3501号), and (2018) Su 01 Minchu 3502 ((2018) 苏01民初3502号).

4. Dynamic Data's patent portfolio is well known within the consumer electrics industry. Over 3,300 U.S. and foreign patents and patent applications have cited Dynamic Data's patent portfolio. HTC has cited the intellectual property assets in Dynamic Data's patent portfolio in patents assigned to HTC.[5]

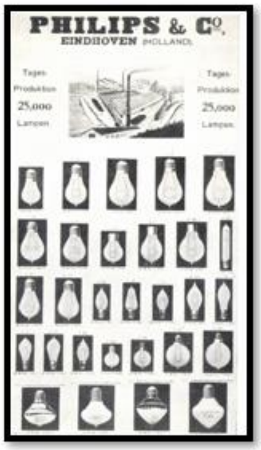
<u>DYNAMIC DATA'S LANDMARK INVENTIONS</u>

5. 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.[6] 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).

[5] *See e.g.*, U.S. Patent No. 6,803,968, European Patent No. 3451127.
[6] Gerard O'Regan, A BRIEF HISTORY OF COMPUTING at 99 (2012).

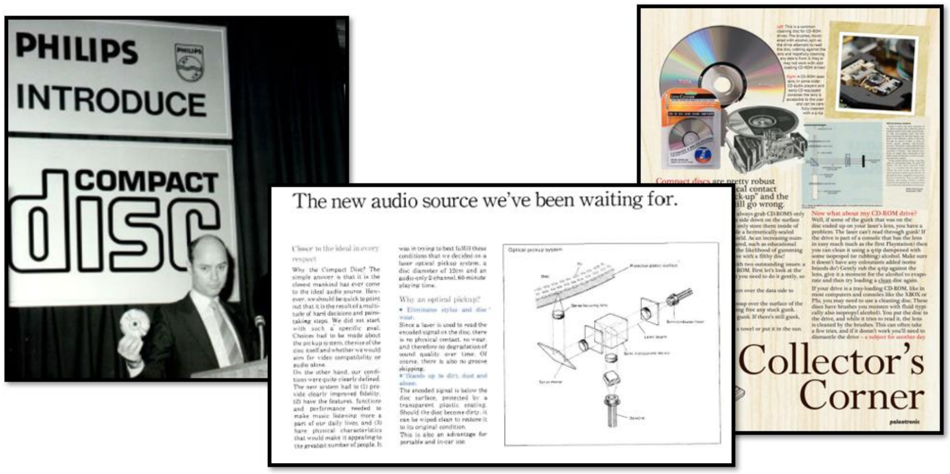
6. In 1962, Philips introduced the first audio cassette tape.[7] A year later, Philips launched a small battery-powered audio tape recorder that used a cassette instead of a loose spool.[8] Philips C-cassette was later used as the first mass storage device for early personal computers in the 1970s and 1980s.



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").

7. 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.

[7] 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.")
[8] Anthony Pollard, GRAMOPHONE: THE FIRST 75 YEARS at 231 (1998).



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).

8. 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.[9] 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.

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

[9] *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.[10] 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.[11]

10. 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.

DYNAMIC DATA'S PATENT PORTFOLIO

11. 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,[12] the European Patent Office,[13] the German Patent and Trademark Office,[14] the Japan Patent Office,[15] and many other national patent offices.

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[10] 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.").

[11] *Id.* at 191.

[12] *See, e.g.*, CN100504925C; CN100438609C; CN1679052B; CN1333373C; CN1329870C; CN1303818C.

[13] *See, e.g.*, European Patent Nos. EP1032921B1; EP1650978B1; EP1213700B1; EP1520409B1.

[14] *See, e.g.*, German Patent Nos. DE60120762; DE50110537; DE60126151; DE60348978; DE602004049357.

[15] *See, e.g.*, Japanese Patent Nos. JP4583924B2; JP5059855B2; JP5153336B2; JP4637585B2.

12. 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 technologies. Dynamic Data is the owner by assignment of the over 1,200 patent assets in the Dynamic Data patent portfolio.

13. Philips has a long history of research and development in the Southern District of New York. Philips's North American research headquarters during the time the inventions disclosed in the patents-in-suit were developed was in Briarcliff Manor, New York. Philips research maintained a 100-acre research and development center in Briarcliff Manor from 1965 to 2015. The research and development work of Philip's Briarcliff Manor center was responsible for contributions to the Grand Alliance (ATSC) Digital TV standards, UHP (Ultra High Performance) lamp technology for large-screen TVs, and ghost canceling in TV reception. Among other innovations, Briarcliff research also made possible the industry's first readily-available, large-scale, single-panel liquid crystal-on-silicon (LCoS) display.

14. Philips researchers in Briarcliff Manor, New York are the named inventors of numerous patents in the Dynamic Data patent portfolio.

15. Philips Intellectual Property and Standards ("Philips IP&S") is located in Valhalla, New York. Philips IP&S is responsible for licensing of Philips patents and handles licensing relating to video encoding, cross licensing, and agreements with HEVC advance and MPEG LA.

16. Highlighting the importance of the patents-in-suit is the fact that the eleven 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:

- MediaTek Inc.[16]
- Samsung Electronics Co., Ltd.[17]
- Qualcomm Inc.[18]
- Google LLC[19]
- Intel Corporation[20]
- Broadcom Corporation[21]
- Microsoft Corporation[22]
- Sony Corporation[23]
- Fujitsu Ltd.[24]
- Panasonic Corporation[25]
- Matsushita Electric Industrial Company Limited[26]

THE PARTIES

DYNAMIC DATA TECHNOLOGIES, LLC

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

18. 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.

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[16] *See, e.g.*, U.S. Patent Nos. 7,397,973; 7,605,872; 8,179,984; 9,563,960; 9,917,988; and 9,641,861.

[17] *See, e.g.*, U.S. Patent Nos. 6,930,729; 7,911,537; 7,532,764; 8,605,790; and 8,095,887.

[18] *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.

[19] *See, e.g.*, U.S. Patent No. 8,787,454 and U.S. Patent Appl. No. 10/003,793.

[20] *See, e.g.*, U.S. Patent Nos. 7,554,559; 7,362,377; and 8,462,164.

[21] *See, e.g.*, U.S. Patent Nos. 8,325,273 and 9,377,987.

[22] *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.

[23] *See, e.g.*, U.S. Patent Nos. 7,218,354 and 8,174,615.

[24] *See, e.g.*, U.S. Patent Nos. 7,092,032 and 8,290,308.

[25] *See, e.g.*, U.S. Patent Nos. 8,164,687 and 8,432,495.

[26] *See, e.g.*, U.S. Patent Nos. 7,362,378 and 7,423,961.

19. Dynamic Data pursues the reasonable royalties owed for HTC'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.

HTC CORPORATION AND HTC AMERICA, INC.

20. HTC Corporation is incorporated under the laws of Taiwan with its principal place of business at 23 Xinghau Road, Taoyuan City, Taoyuan 330, Taiwan, R.O.C. HTC Corporation does business in the State of New York and in the Southern District of New York. HTC Corporation may be served with process at its principal place of business at 23 Xinghau Road, Taoyuan City, Taoyuan 330, Taiwan, R.O.C.

21. HTC America, Inc. is Washington state corporation with its principal place of business at 308 Occidental Ave. S., Suite 300, Seattle, WA 98104. HTC America, Inc. may be served with process via its registered agent for service of process: National Corporate Research, Ltd., 10 East 40th Street, 10th Floor, New York, New York 10016. On information and belief, HTC America, Inc. is registered to do business in the State of New York, and has been since at least December 31, 2010. HTC America, Inc. is a wholly-owned United States subsidiary of HTC Corporation. HTC Corporation and HTC America, Inc. are collectively referred to herein as "HTC."

22. HTC operates its business and sells, develops, and/or markets its products in the Southern District of New York.

23. HTC partners with several Southern District of New York-located businesses to sell and service HTC products, including, for example, Microsoft Corporation and GameStop Corporation.

JURISDICTION AND VENUE

24. 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).

25. Upon information and belief, this Court has personal jurisdiction over HTC in this action because HTC has committed acts within the Southern District of New York giving rise to this action and has established minimum contacts with this forum such that the exercise of jurisdiction over HTC would not offend traditional notions of fair play and substantial justice. Defendant HTC, 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, HTC is registered to do business in the State of New York, actively conducts business within this District, and actively directs its activities to customers located in the Southern District of New York.

26. Venue is proper in this district under 28 U.S.C. §§ 1391(b)-(d) and 1400(b). On information and belief, HTC maintains a regular and established place of business within the Southern District of New York.

27. HTC is registered to do business in the State of New York, has actively managed its business from within the Southern District of New York, and upon information and belief, has transacted business in the Southern District of New York and has committed acts of direct and indirect infringement in the Southern District of New York.

28. On information and belief, among other business activities in the Southern District of New York, HTC actively manages and runs its operations relating to the marketing of its VIVE Arts program from within the Southern District of New York. Further, on information and belief,

HTC has contracted with third-party partners located within the Southern District of New York to demonstrate to the public and market HTC's VIVE Virtual Reality System from retail locations within New York City, including but not limited to: the Microsoft Store, 677 Fifth Avenue, New York, NY 10022 and GameStop, 2322 Broadway, New York, NY 10024.

THE ASSERTED PATENTS

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

29. U.S. Patent No. 8,135,073 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.

30. 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.

31. 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.

32. 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.

33. 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.

34. 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.

35. 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.

36. 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.

37. Richard Chi-Te Shen of Leonia, New Jersey is the sole named inventor of the ’073 patent and would likely be able to provide relevant testimony regarding the ‘073 patent.

38. The ‘073 patent was prosecuted by David L. Barnes of Briarcliff Manor, New York and Michael E. Marion of Tarrytown, New York.

39. The ‘073 Patent Family has been cited by 36 patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to the following companies have cited the ‘073 Patent Family 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

40. U.S. Patent No. 6,714,257 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.

41. 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.

42. The '257 Patent discloses additional improvements to scaling and filtering color-keyed images.

43. 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.

44. 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.

45. 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.

46. The '257 Patent family 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 Family as relevant prior art.

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

47. U.S. Patent No. 8,073,054 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.

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

49. 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.

50. 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.

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

52. The '054 Patent discloses a motion estimation unit comprising a selector for selecting 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 the basis of a first motion vector and a second motion vector, both belonging to the set of previously estimated motion vectors.

53. The '054 Patent discloses a motion estimation unit that calculates the further candidate motion vector on the 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.

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

55. Mr. Edward Goodman of Valhalla, New York assisted in the prosecution of the '054 patent and is likely to be a relevant witness regarding any claims arising from the '054 patent.

56. The '054 Patent Family has been cited by 14 patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to the following companies have cited the '054 Patent Family 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

57. U.S. Patent No. 6,774,918 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.

58. 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.

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

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

61. 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.

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

63. The inventions disclosed in the '918 Patent improves 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.

64. The '918 Patent claims a technical solution to a problem unique to video processing.

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

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

66. 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.

67. The '689 Patent discloses novel methods and apparatuses for encoding and decoding video data.

68. 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.

69. 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.

70. 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.

71. 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.

72. Mr. John Rehberg of Orefield, Pennsylvania assisted in the prosecution of the ‘689 Patent before the United State Patent and Trademark Office. Mr. Rehberg would likely be able to offer relevant testimony regarding the ‘689 patent.

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

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

74. U.S. Patent No. 6,996,177 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.

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

76. 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.

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

78. 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.

79. 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.

80. 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.

81. Prosecution counsel for the '177 patent include Edward W. Goodman of Valhalla, New York and Algy Tamoshunas of Tarrytown, New York. It is likely that Mr. Goodman and Mr. Tamoshunas would be relevant witnesses in any claims arising from the '177 patent.

82. The '177 Patent Family has been cited by 16 United States and international patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to the following companies have cited the '177 Patent Family as relevant prior art:

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

U.S. PATENT NO. 7,010,039

83. U.S. Patent No. 7,010,039 entitled, *Motion Estimator for Reduced Halos in MC Up-Conversion*, was filed on May 15, 2001, and claims priority to May 18, 2000. The '039 Patent is subject to a 35 U.S.C. § 154(b) term extension of 768 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '039 Patent. A true and correct copy of the '039 Patent is attached hereto as Exhibit 7.

84. The '039 Patent claims specific methods and apparatuses detecting motion at a temporal intermediate position between previous and next images. The inventions disclosed in the

‘039 Patent solve a problem wherein an estimator estimating motion between two successive pictures from a video sequence cannot perform well in areas where covering or uncovering occurs.

85. The ‘039 Patent solves this problem by carrying out the optimization at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

86. The ‘039 Patent discloses a method and apparatus for detecting motion at a temporal intermediate position between previous and next images.

87. The ‘039 Patent discloses the use of a criterion function for selecting and optimizing candidate vectors.

88. The ‘039 Patent was prosecuted by Edward W. Goodman of Valhalla, New York and Michael E. Marion of Tarrytown, New York. In addition, Philips Corporate Counsel was involved in the prosecution of the ‘039 patent. Philips corporate counsel is located in Tarrytown, New York. It is likely that Mr. Goodman and Mr. Marion would be relevant witnesses in any claims arising from the ‘039 patent.

89. The ‘039 Patent further discloses a criterion function that depends on data from both previous and next images and in which the optimizing is carried out at the temporal intermediate position in non-covering and non-uncovering areas, characterized in that the optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

90. The ‘039 Patent Family has been cited by 30 United States and international patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to the following companies have cited the ‘039 Patent Family as relevant prior art:

- Qualcomm Incorporated
- Panasonic Corporation

- Samsung Electronics Co., Ltd.
- Matsushita Electric Industrial Co., Ltd.
- Sharp Kabushiki Kaisha
- Integrated Device Technology, Inc.
- Zoran Corporation

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

91. U.S. Patent No. 8,311,112 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 8.

92. The '112 Patent discloses novel methods and systems for video compression.

93. 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.

94. 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.

95. 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.

96. The '112 Patent Family has been cited by 10 patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to the following companies have cited the '112 Patent Family 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

97. 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 9.

98. The '688 patent discloses multiple embodiments for optimally processing high quality video and graphics.

99. 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.

100. 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.

101. 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.

102. The '688 patent Family 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

103. U.S. Patent No. 7,894,529 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 10.

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

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

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

107. 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.

108. 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.

109. 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.

110. The '529 Patent discloses a method that assigns the modified motion vector as the motion vector to the first image block.

111. The '529 Patent was prosecuted by Patrick J. O'Shea of Farmington, Connecticut. It is likely that Mr. O'Shea would be a relevant witness in any claims arising from the '529 patent.

112. The '529 Patent Family has been cited by multiple patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to Fujifilm Corp., and Samsung Electronics Co., Ltd. have cited the '529 Patent Family as relevant prior art.

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

113. 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.

114. 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.

115. 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.

116. 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.

117. The inventions disclosed in the '450 Patent enable various content sources to share similar information models.

118. 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.

119. 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.

120. 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.

121. 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.

122. 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.

123. 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.

The '450 Patent was prosecuted by Michael E. Marion of Tarrytown, New York and Michael Belk of Briarcliff Manor, New York. It is likely that Mr. Marion and Mr. Belk would be relevant witnesses in any claims arising from the '450 patent.

124. The '450 Patent Family has been cited by several patents and patent applications as relevant prior art. Specifically, patents and patent applications issued to AT&T Intellectual Property I LP, Nokia Oyj, Samsung Electronics Co., Ltd., and ZTE Corporation have all cited the '450 Patent Family as relevant prior art.

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

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

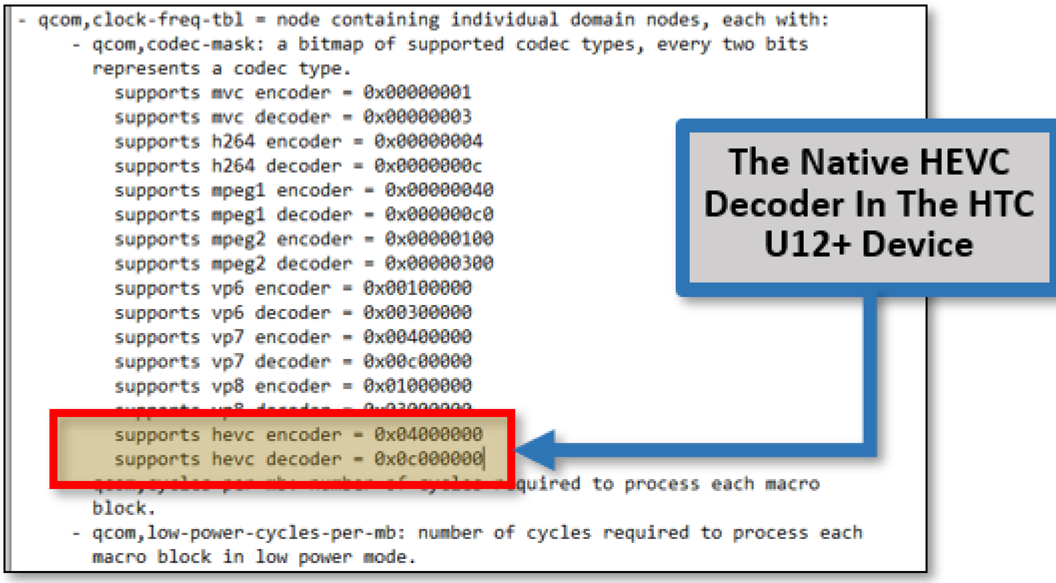
126. HTC designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation.

127. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that contain sub-pixel accurate motion vector functionality, including but not limited to HTC products that contain and/or enable H.265 decoding functionality including the HTC U12+ (the "HTC '073 Product(s)").

128. The HTC U12+ device contains a video data decoder that complies with the H.265 standard.

129. The HTC U12+ device includes software that enables decoding data that is stored in an HEVC compliant format. For example, source code files for the HTC U12+ device show that the device contains a native HEVC decoder. The following image shows documentation that

is included in the source code for the HTC U12+ device that shows the presence of a native HEVC decoder.



```
- qcom,clock-freq-tbl = node containing individual domain nodes, each with:
    - qcom,codec-mask: a bitmap of supported codec types, every two bits
      represents a codec type.
        supports mvc encoder = 0x00000001
        supports mvc decoder = 0x00000003
        supports h264 encoder = 0x00000004
        supports h264 decoder = 0x0000000c
        supports mpeg1 encoder = 0x00000040
        supports mpeg1 decoder = 0x000000c0
        supports mpeg2 encoder = 0x00000100
        supports mpeg2 decoder = 0x00000300
        supports vp6 encoder = 0x00100000
        supports vp6 decoder = 0x00300000
        supports vp7 encoder = 0x00400000
        supports vp7 decoder = 0x00c00000
        supports vp8 encoder = 0x01000000
        supports vp8 decoder = 0x03000000
        supports hevc encoder = 0x04000000
        supports hevc decoder = 0x0c000000
    - qcom,cycles-per-mb: number of cycles required to process each macro
      block.
    - qcom,low-power-cycles-per-mb: number of cycles required to process each
      macro block in low power mode.
```


HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

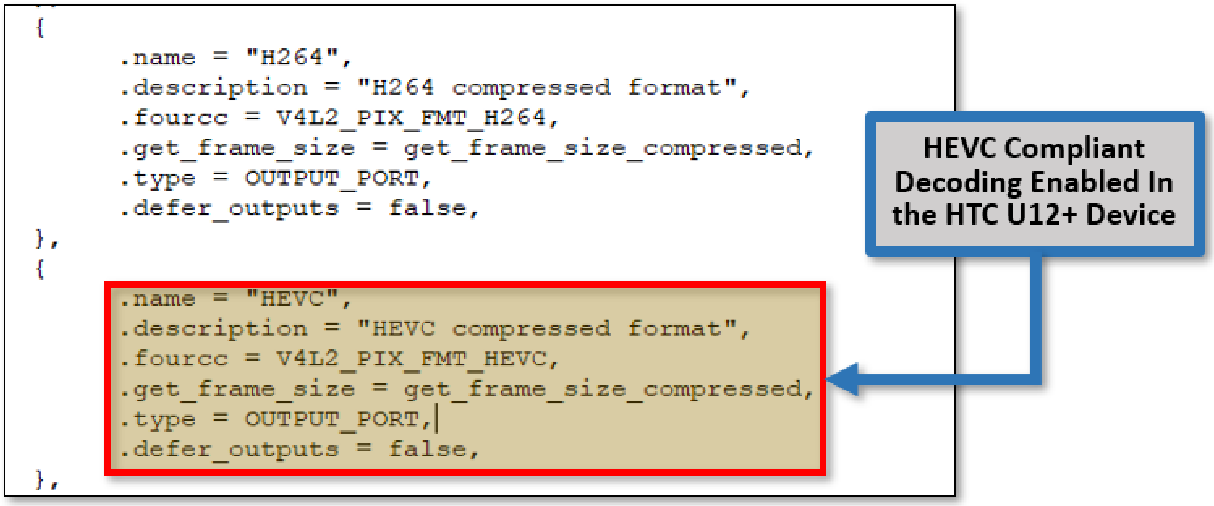
130. The HTC U12+ product contains the Android 8.0 operating system, a Qualcomm Snapdragon 845 chipset, and an Adreno 630 graphics processing unit.

Platform	
Chipset	Qualcomm Snapdragon 845
Cores	Octa Core
CPU	4x 2.8GHz Kryo 385 Gold & 4x 1.7GHz Kryo 385 Silver
GPU	Adreno 630
OS	Android 8.0 (Oreo)

HTC U12 Plus Specifications, IHS MARKIT TEARDOWN TECHNOLOGY REPORT (August 10, 2018), *available at*: https://technology.ihs.com/Teardowns/detail/?ids=603895_3368.

131. The HEVC decoder contained in the HTC U12+ device supports decoding compliant with the HEVC standard. The below excerpt from uncompiled source code for the HTC

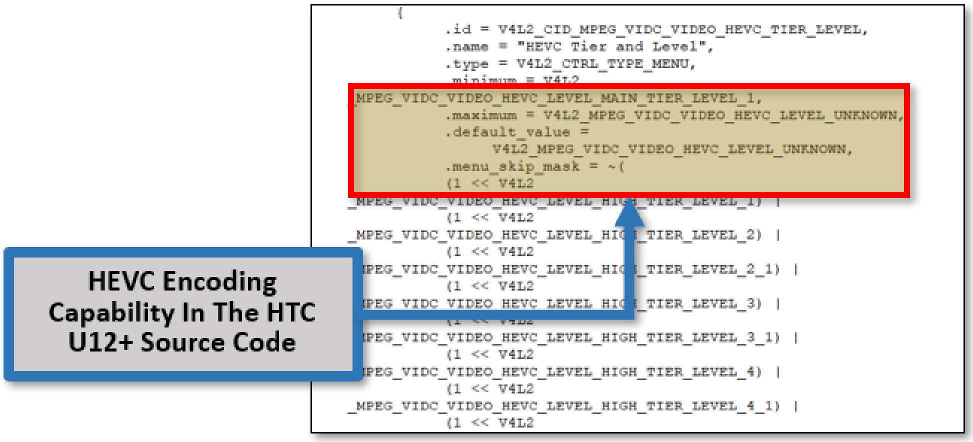
U12+ device shows that the decoding of "HEVC compressed format" data is supported by the HTC U12+ device.



```
{
        .name = "H264",
        .description = "H264 compressed format",
        .fourcc = V4L2_PIX_FMT_H264,
        .get_frame_size = get_frame_size_compressed,
        .type = OUTPUT_PORT,
        .defer_outputs = false,
},
{
        .name = "HEVC",
        .description = "HEVC compressed format",
        .fourcc = V4L2_PIX_FMT_HEVC,
        .get_frame_size = get_frame_size_compressed,
        .type = OUTPUT_PORT,
        .defer_outputs = false,
},
```

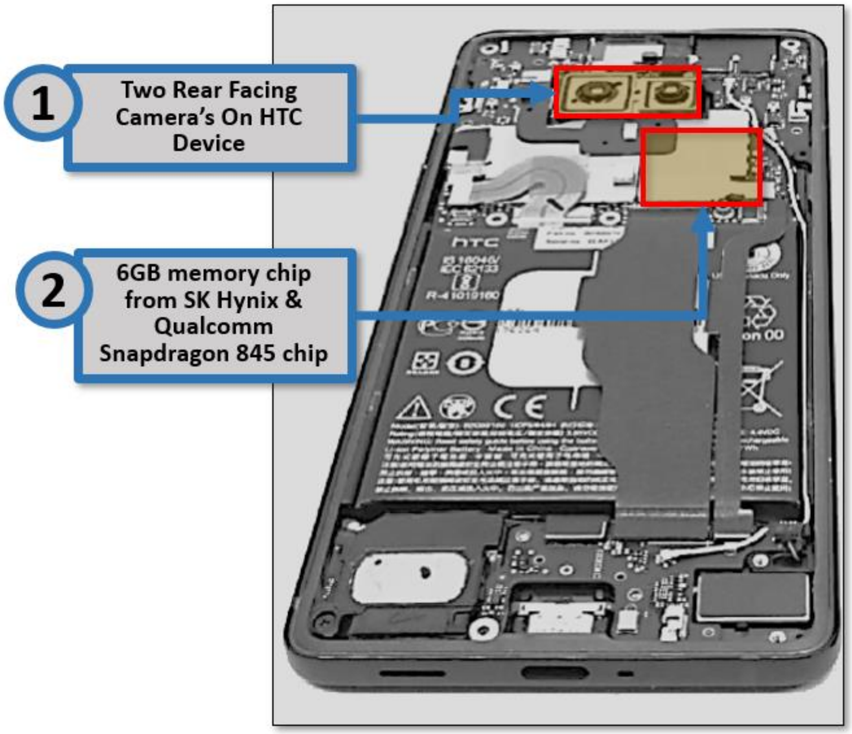

HTC U12+ Kernel Source Code File: MSM_VDEC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video decoder contained on the source code of the HTC U12+ device).

132. The HTC U12+ product supports decoding data using several HEVC Levels. The default level for the HEVC decoder in the HTC U12+ device is HEVC "Main Tier | Level 1." The following excerpt from uncompiled source code for the HTC U12+ product shows how this default value is set in the MSM_VIDC_COMMON.C file.



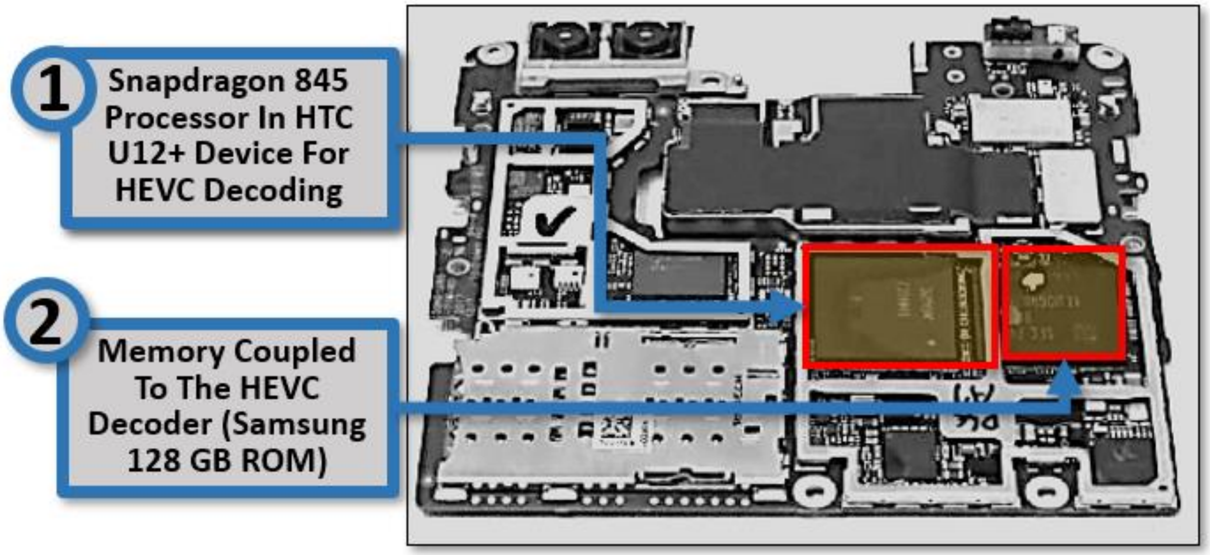
HTC U12+ Kernel Source Code File: MSM_VIDC_COMMON.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video "HEVC Tier and Level" control menu in the source code of the HTC U12+ device for HEVC decoding).

133. The HTC U12+ device contains memory chips (including a SK Hynix 6GB memory chip) and a SD845 processor. The following annotated image shows the internal components of the HTC U12+ device and identifies the memory chip and processor. These components perform the HEVC decoding compliant with the HEVC standard.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ rear facing cameras, memory chip, and processor) (annotation added).

134. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The following image of the motherboard in the HTC U12+ device shows that the processor for HEVC decoding is coupled to the memory.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor) (annotation added).

135. The HTC '073 Products contain a processor for decoding the received encoded frame-based encoded video data. Further, the HTC '073 Products apply a remapping policy to the first frame of decoded video data using a region-based luma analysis. As part of the decoding process performed by HTC '073 Products, a reference picture (first frame) is decoded and two in-loop filters (deblocking and a sample adaptive offset) are applied to the reference picture.

136. The HTC '073 Products comprise a video decoder for decoding video images. Specifically, the HTC '073 Products contain functionality for video decoding through H.265/High Efficiency Video Coding ("HEVC") decoding.

137. The HTC '073 Products contain a processor for decoding the received encoded frame-based encoded video data. Further, the HTC '073 Products apply a remapping policy to the first frame of decoded video data using a region-based luma analysis. As part of the decoding process performed by the HTC '073 Products, a reference picture (first frame) is decoded and two in-loop filters (deblocking and a sample adaptive offset) are applied to the reference picture.

138. The HTC '073 Products have an input for receiving frame-based encoded video information. Specifically, the HTC '073 Products receive frame-based encoded video information in the form of video data that is encoded in the High Efficiency Video Coding (HEVC/H.265) format set by the ITU-T Video Coding Experts Group.

139. The HTC '073 Products include inputs for receiving and decoding HEVC video data

140. The HTC '073 Products incorporate a decoding unit for decoding the frame of the received video data. The encoding and decoding process for video data received by the HTC '073 Products use inter-picture prediction wherein motion data comprises the selection of a reference frame and motion vectors to be applied in predicting the samples of each block.

141. One or more of the HTC '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.

142. By complying with the HEVC standard, the HTC devices – such as the HTC '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 HTC'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.").

143. The HTC '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).

144. HTC 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 HTC '073 Products. The following excerpt explains 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).

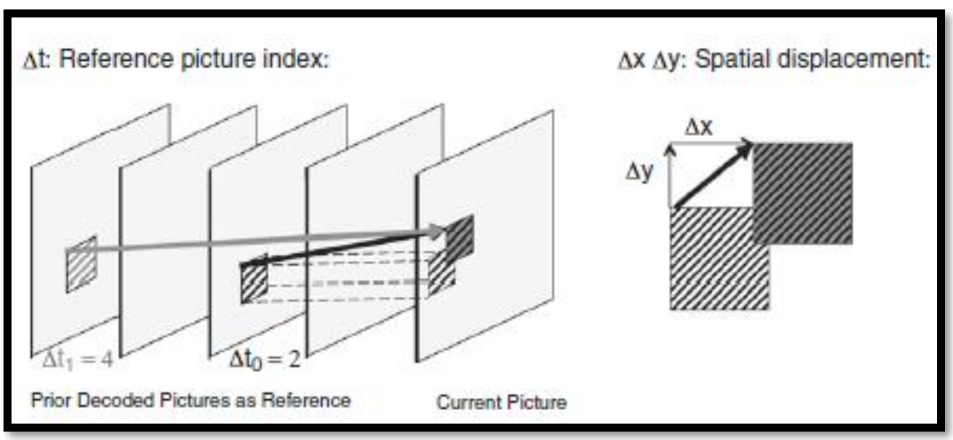
145. The HTC '073 Products receive encoded video data that is encoded using inter-frame coding. Specifically, the encoded video stream received by the HTC '073 Products is coded using its predecessor frame. Inter-prediction used in the encoded video data received by the HTC

'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).

146. The encoded video stream received by the HTC '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.



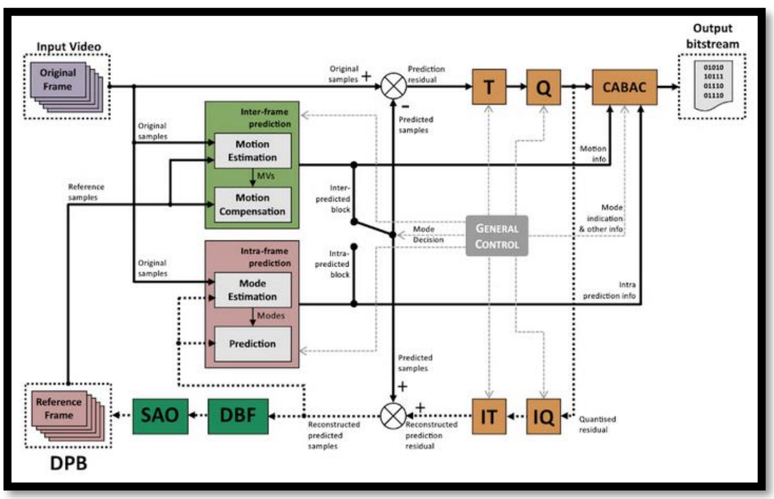
Benjamin Bross, *Inter-Picture Prediction In HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 114 (September 2014).

147. The following excerpt from an article describing the architecture of the encoded video stream received by the HTC '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) (September 2014).

148. The following diagram shows how the HTC '073 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.



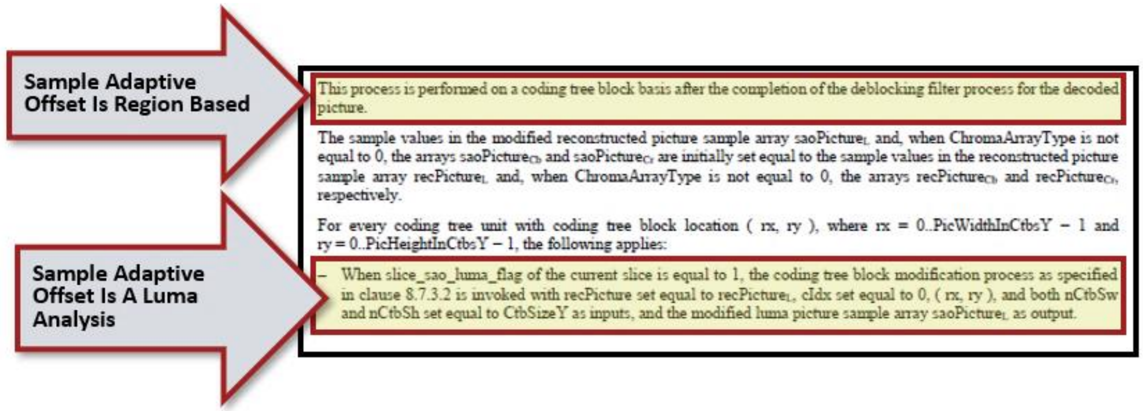
Guilherme Corrêa, *et al.*, COMPLEXITY-AWARE HIGH EFFICIENCY VIDEO CODING at 16 (2015).

149. One or more of the HTC '073 Products reduce the processing capacity required for providing video enhancements to video processing through re-mapping of previous frames for subsequent frames.

150. 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.

151. The HTC '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 <u>classifying the samples in the region</u> 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) at 185 (September 2014) (emphasis added).

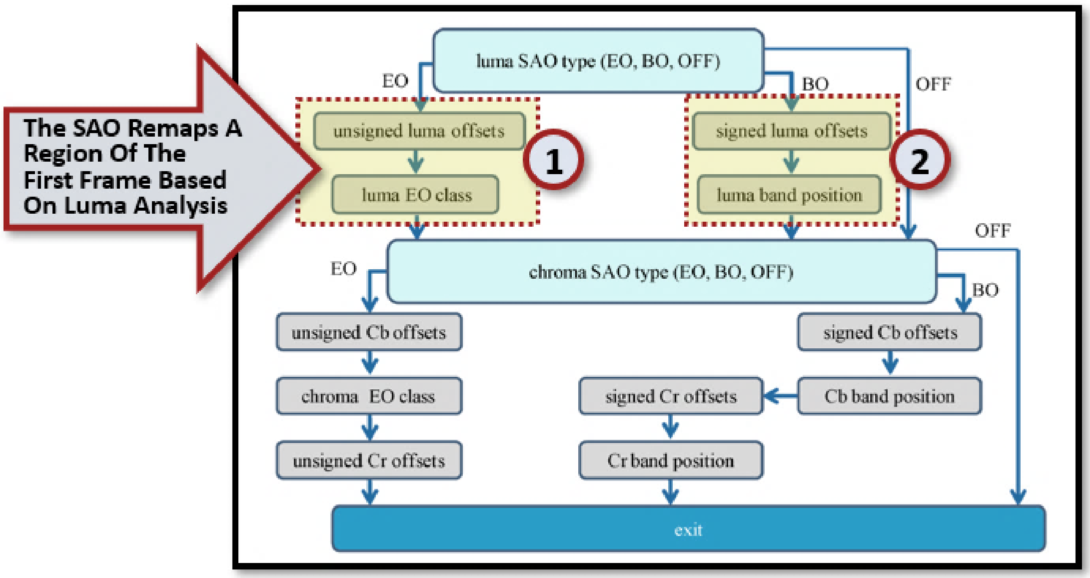
152. Further, the HEVC documentation requires that the application of a sample adaptive offset be region based (*e.g.*, applied to a coding block) ("This process is performed on a coding block basis after the completion for the deblocking filter process for the decoded picture").



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).

153. The HTC '073 Products contain functionality wherein a decoder applies sample adaptive offset to a decoded reference frame (first frame). Further, the HTC '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).

154. The HTC '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 HTC '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).

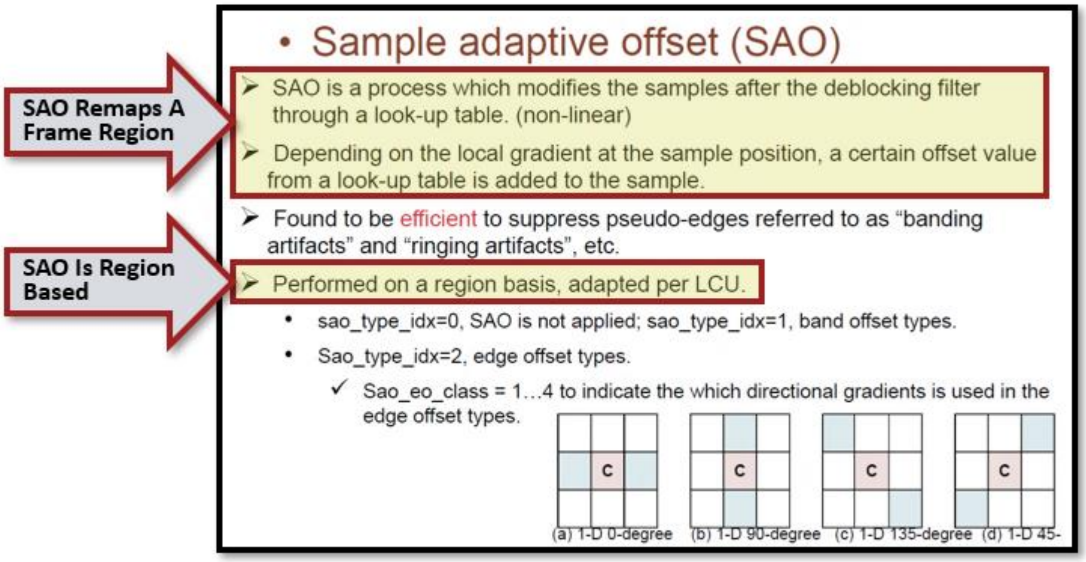
155. Further, HEVC documentation makes clear that the application of the standard adaptive offset remapping policy is based on a luminance analysis. The below shows that slices of a region have a standard adaptive offset applied based on a "luma flag."

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.").

156. 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 HTC '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."[27]



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

157. When the HTC '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).[28]

> 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

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

[28] Andrey Norkin, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei, *In-Loop Filters In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) 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.").

> pictures. In addition, using the filters in the decoding loop also increases the quality of the reference pictures and hence also the compression efficiency.

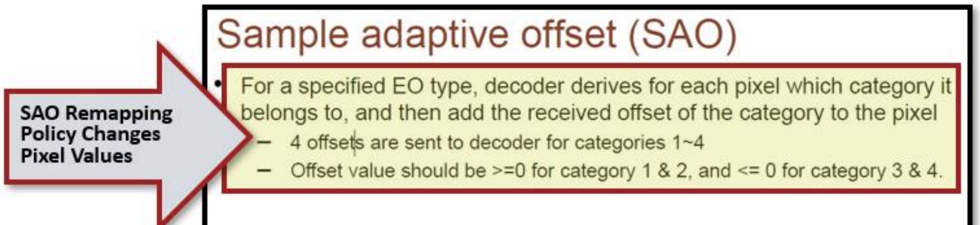
Andrey Norkin, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei, *In-Loop Filters In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 171 (September 2014) (annotations added).

158. Sample adaptive offset, as implemented by the HTC '073 Products, 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) at 335 (September 2014).

159. 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.



Category	Condition
1	c < 2 neighboring pixel values
2	c < 1 neighbor && c == 1 neighbor
3	c > 1 neighbor && c == 1 neighbor
4	c > 2 neighbors
0	None of the above

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

160. The HTC ‘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 HTC ‘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.

161. One or more of the HTC ‘073 Products enable the provision of enhanced video pictures with minimal additional hardware costs for the components required to successfully process the video data.

162. One or more of the HTC ‘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.").

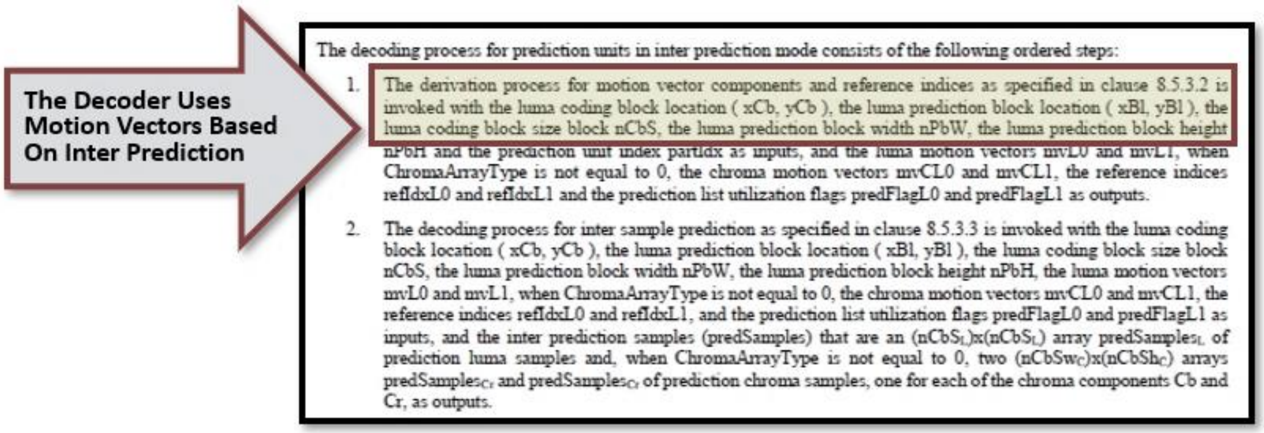
163. One or more of the HTC '073 Products include a video decoder comprising an input for receiving video information wherein the encoding of the second frame depends on the encoding of the first frame, the encoding of the second frame includes motion vectors indicating differences in positions between 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 in the HEVC Standard 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).

164. One or more of the HTC '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."



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.
2. The decoding process for inter sample prediction as specified in clause 8.5.3.3 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, 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 inputs, and the inter prediction samples (predSamples) that are an $(nCbS_L)x(nCbS_L)$ array $predSamples_L$ of prediction luma samples and, when ChromaArrayType is not equal to 0, two $(nCbSw_C)x(nCbSh_C)$ arrays $predSamples_{Cr}$ and $predSamples_{Cr}$ of prediction chroma samples, one for each of the chroma components Cb and Cr, 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 (April 2015) (annotation added).

165. One or more of the HTC '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.

166. One or more HTC subsidiaries and/or affiliates use the HTC '073 Products in regular business operations.

167. The HTC '073 Products are available to businesses and individuals throughout the United States.

168. The HTC '073 Products are provided to businesses and individuals located in the Southern District of New York.

169. 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 HTC '073 Products, HTC 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).

170. HTC also indirectly infringes the '073 patent by actively inducing infringement under 35 U.S.C. § 271(b).

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

172. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '073 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '073 Products to utilize the products in a manner that directly infringe one or more claims of the '073 patent.[29] By providing instruction and training to

[29] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-

customers and end-users on how to use the HTC '073 Products in a manner that directly infringes one or more claims of the '073 patent, including at least claim 14, HTC specifically intended to induce infringement of the '073 patent. HTC engaged in such inducement to promote the sales of the HTC '073 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '073 patent. Accordingly, HTC 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.

173. 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. HTC is utilizing the technology claimed in the '073 patent without paying a reasonable royalty. HTC 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.

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

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

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plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

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

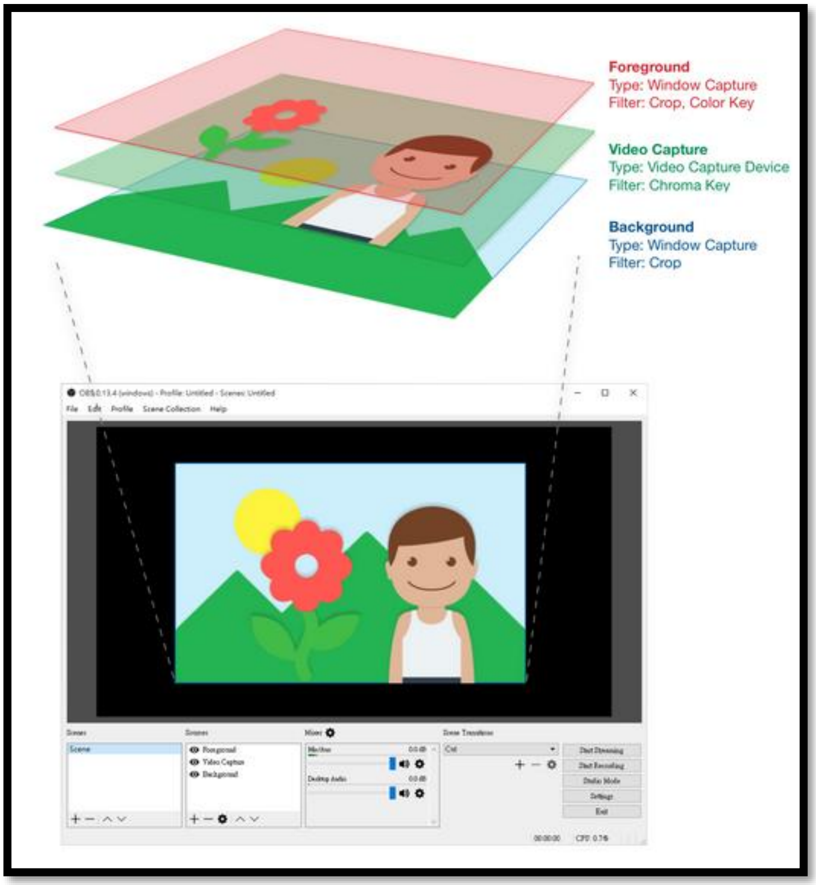
176. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

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

178. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC VIVE virtual reality products, including the HTC VIVE Pro and HTC VIVE (collectively, the "HTC '257 Product(s)").

179. In the HTC '257 Products a color key is used to generate a transparent background in the video stream and then a custom overlay image is placed into the data stream

180. The HTC '257 Products perform the step of creating a key-only image corresponding to key regions in the keyed image. Specifically, the HTC '257 Products enable the creation of a key-only image as part of its "mixed reality functionality." For example, the HTC VIVE supports using two images and applying a chroma key to them to combine them and creating a mixed reality effect. The below excerpt from HTC VIVE documentation shows this process:



How To Shoot Mixed Reality Video With HTC VIVE, HTC VIVE WEBSITE ADMINISTRATOR POSTING (August 30, 2016).

181. The HTC '257 Products support creating a key-only image corresponding to key regions in the keyed image. Specifically, in the HTC '257 Products, as part of the mixed reality functionality, perform the steps of tracking moving objects and placing them into a chroma-keyed scene. The below excerpts from the VIVE Tracker Developer Guidelines shows two use cases where moving objects are tracked using a wireless interface and then placed into an image.

182. The HTC '257 Products enable the processing of a stream of digital video data wherein a Chroma Key is used to output pre-processed data.

183. The HTC '257 Products take the key-only image corresponding to key only regions and converts the image into vector data that can then be scaled.

Use Case 4: Track moving objects using a wireless interface in VR, with the accessory passing data to a PC via USB, BT/Wi-Fi or propriety RF. This case is similar to Use Case 3, but the accessory transfers data to/from a PC directly for a specific purpose based on its design.

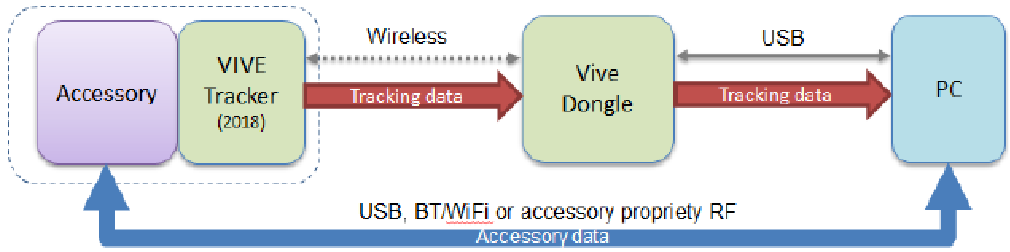
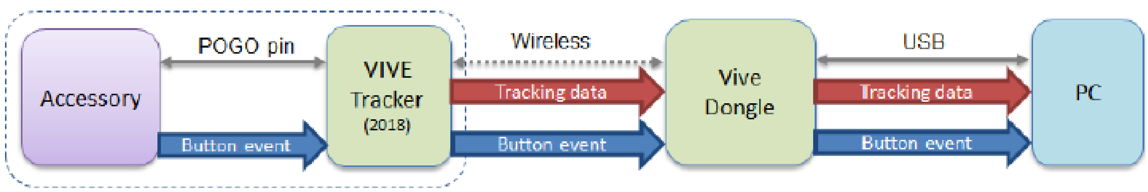


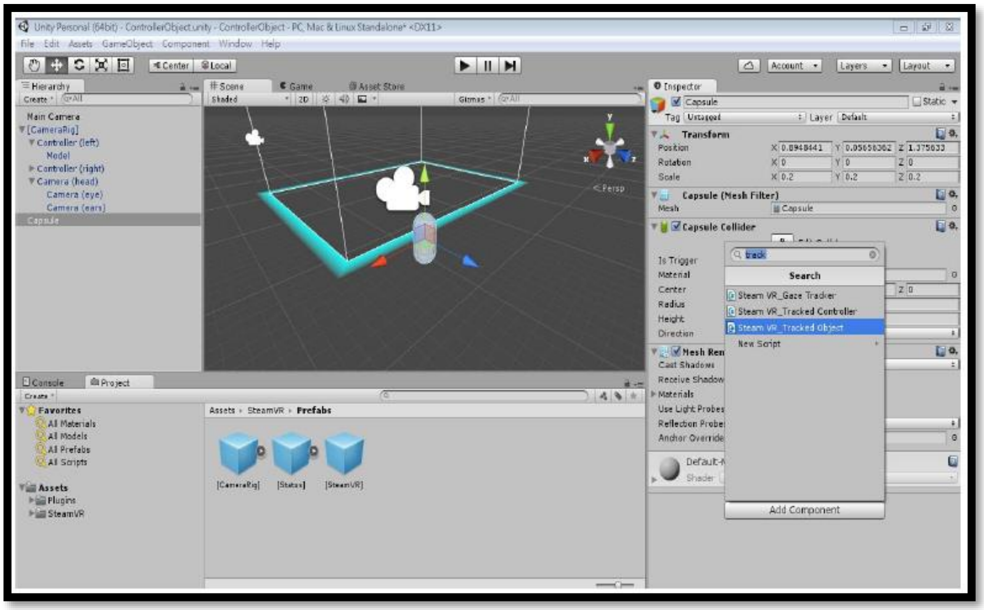
Figure: Use case 4 of VIVE Tracker (2018)

Use Case 5: Track moving objects using a wireless interface in VR, with the accessory simulating buttons of the Vive controller or passing data to a PC via the VIVE Tracker (2018). This case is similar to Use Case 3, but the accessory connects with the VIVE Tracker (2018) to transfer button event to a PC by Pogo pin.



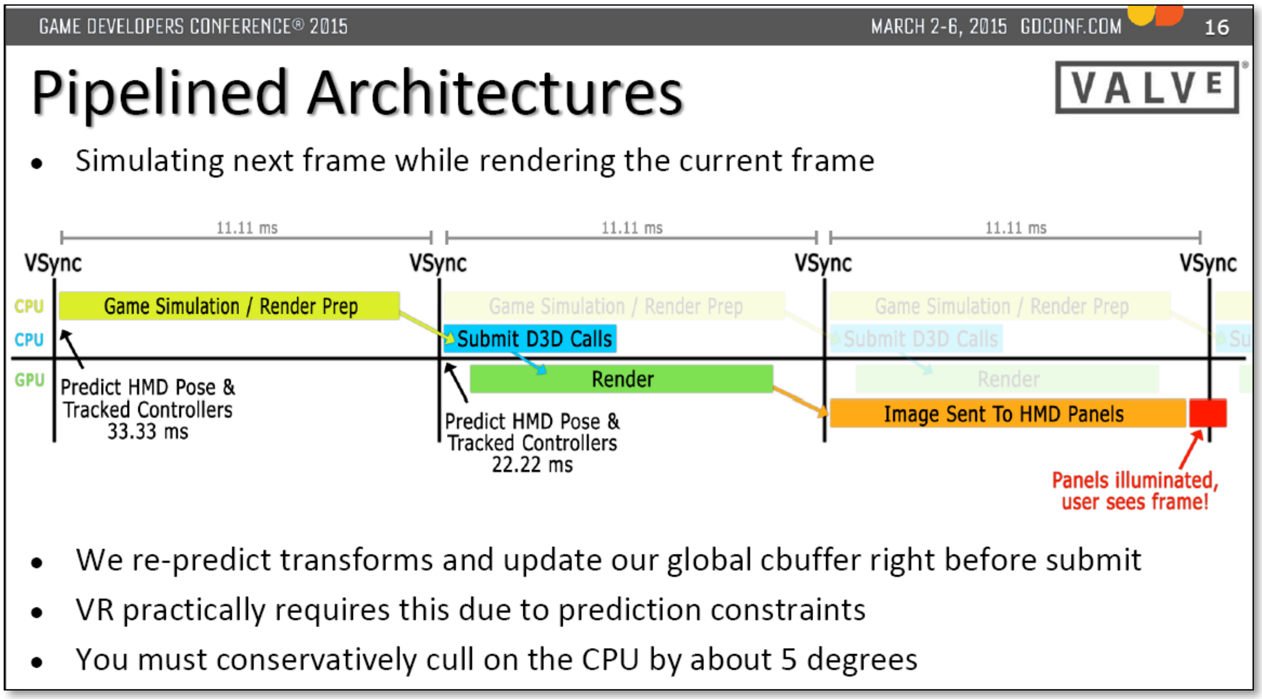
HTC VIVE TRACKER DEVELOPER (2018) GUIDELINES VER. 1.0 at 2 (2018).

184. The HTC '257 Products support the placement of an image into a chroma keyed image as a 3D object. The below excerpt from HTC documentation shows how a controller object is placed into a chroma-keyed scene. Here we can also see how the two images (in this case two scenes one being the controller and the other being the background graphics or other objects) are then scaled and combined by the HTC VIVE system. As part of this process the HTC '257 Products scale the key-only image and then scales the keyed image. Here these would be the (1) 3D object that is being placed into a scene and (2) the scene in which the 3D object is being placed.



HTC VIVE TRACKER DEVELOPER GUIDELINES VER. 1.0 AT 2 (2018).

185. The HTC '257 Products comprise a processor which is responsible for merging the scaled key-only image and the scaled keyed image. The below excerpt from a presentation at the Game Developers Conference describes the graphics pipeline architecture where the image data is merged as part of the rendering process (green box below) and then sent to the "HMD Panels."



Alex Vlachos, *Advanced VR Rendering*, GAME DEVELOPERS CONFERENCE PRESENTATION at 16 (March 2015).

186. The HTC '257 Products scale the keyed image to form a scaled keyed image. Specifically, the HTC '257 Products' graphics engine exports data from a memory where it is stored as vectors. The scaled vector image is placed in the graphics pipeline.

187. The HTC '257 Products perform the step of scaling the key-only image and the keyed image to form a "scaled key-only image" and a "scaled key image." For example, a chroma keyed image (such as a controller) is placed into an image and the image is scaled using vectors. The chroma keyed image can also be scaled using vectors when it is placed into an image. The below excerpt from HTC VIVE developer documentation shows how to transform the accessory by comparing vectors parallel to y-axis and z-axis of the Vive Tracker (AxisY_Tracker, AxisZ_Tracker) and the accessory (AxisY_Accessory, AxisZ_Accessory).

```
public class Accessory : MonoBehaviour {

  const Vector3 AxisY_Tracker = new Vectors(AxisY_Tracker_X, AxisY_Tracker_Y,
AxisY_Tracker_Z);
  const Vector3 AxisZ_Tracker = new Vectors(AxisZ_Tracker_X, AxisZ_Tracker_Y, AxisZ_Tracker_Z);

  const Vector3 AxisY_Accessory = new Vectors(AxisY_ Accessory _X, AxisY_ Accessory _Y, AxisY_
Accessory _Z);
  const Vector3 AxisZ_ Accessory = new Vectors(AxisZ_ Accessory _X, AxisZ_ Accessory _Y, AxisZ_
Accessory _Z);

  void Update () {

    //Calculate delta rotation by comparing vectors parallel to Y axes of Tracker and the accessory
    Quaternion delta_rotY = Quaternion.FromToRotation(AxisY_Tracker, AxisY_Accessory);
    AxisZ_Tracker = delta_rotY * AxisZ_Tracker;
    Quaternion delta_rotZ = Quaternion.FromToRotation(AxisZ_Tracker, AxisZ_Accessory);

    //Collect delta rotation and displacement between Tracker and Accessory
    Vector3 delta_displacement = new Vector3(dX, dY, dZ);
    Quaternion delta_rotation  = delta_rotZ * delta_rotY;

    //Get current Tracker pose
    Vector3 tracker_position   = SteamVR_Controller.Input(3).transform.pos;
    Quaternion tracker_rotation = SteamVR_Controller.Input(3).transform.rot;

    //Transform current Tracker pose to Accessory pose
    GameObject.Find("Accessory ").transform.rotation = delta_rotation * tracker_rotation;
    GameObject.Find("Accessory ").transform.position = tracker_position + (delta_rotation *
tracker_rotation) * delta_displacement;
  }
}
```

HTC VIVE TRACKER DEVELOPER GUIDELINES VER. 1.3 at 30 (January 19, 2017).

188. One or more HTC subsidiaries and/or affiliates use the HTC '257 Products in regular business operations.

189. The HTC '257 Products merge the scaled key-only image and the scaled keyed image. The merge image is then processed by the HTC VIVE and rendered to the user.

190. The HTC '257 Products are available to businesses and individuals throughout the United States.

191. The HTC '257 Products are provided to businesses and individuals located in the Southern District of New York.

192. HTC 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 HTC '257 Products.

193. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the HTC '257 Products, HTC 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).

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

195. HTC 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, HTC knew of the '257 Patent and knew of its infringement, including by way of this lawsuit.

196. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '257 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '257 Products to utilize the products in a manner that directly infringe one or more claims of the '257 patent.[30] By providing instruction and training to

[30] *See, e.g.*, VIVE PRO HMD USER GUIDE (2018); VIVE BUSINESS EDITION VR SYSTEM, QUICKSPECS (2017); *VIVEPORT Submission Guide*, VIVE DEVELOPER GUIDE (July 5, 2018); *HTC VIVE Tracker Developer Guidelines (2018) Ver. 1.0*, VIVE DEVELOPER DOCUMENTATION (2018); *VIVE Focus User Guide*, VIVE DEVELOPER DOCUMENTATION (2018); *VIVE Tracker FAQ*, VIVE DEVELOPER DOCUMENTATION (2017); Matthew Gepp, *A Crash Course In All Things Virtual Reality*, HTC VIVE BLOG (November 6, 2017), *available at*:

customers and end-users on how to use the HTC '257 Products in a manner that directly infringes one or more claims of the '257 patent, including at least claim 9, HTC specifically intended to induce infringement of the '257 patent. On information and belief, HTC engaged in such inducement to promote the sales of the HTC '257 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '257 patent. Accordingly, HTC 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.

197. 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. HTC is utilizing the technology claimed in the '257 patent without paying a reasonable royalty. HTC 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.

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

199. As a result of HTC's infringement of the '257 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for HTC's

https://blog.vive.com/us/2017/11/06/vr-101-crash-course-in-virtual-reality/; *VIVE Wave SDK Developer Guide*, VIVE DEVELOPER DOCUMENTATION (last visited March 2019), *available at*: https://hub.vive.com/storage/app/doc/en-us/index.html.

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

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

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

201. HTC 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.

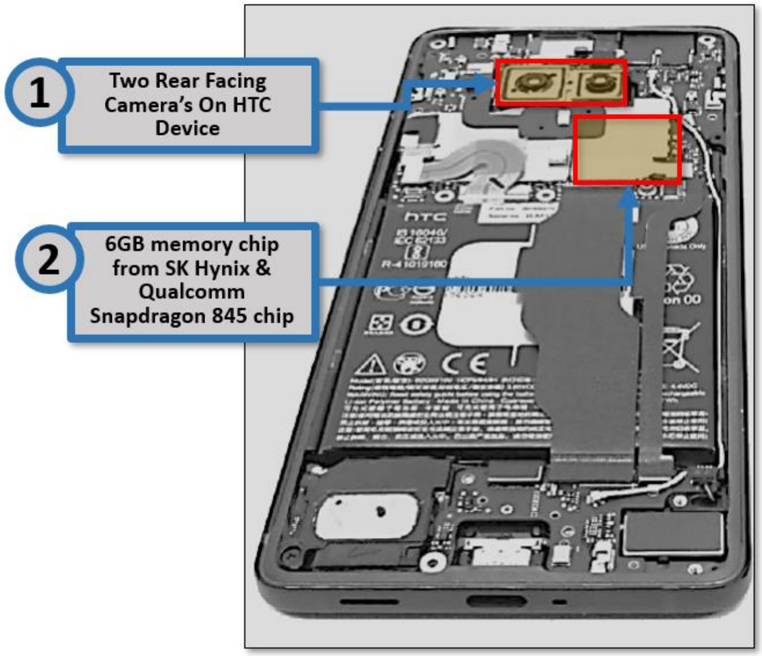
202. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that contain and/or enable H.265 encoding functionality including the HTC U12+ (the "HTC '054 Product(s)").

203. The HTC U12+ device contains a video data encoder that complies with the H.265 standard. Specifically, documentation regarding the HTC U12+ product shows that it can encode "large files using HEVC/H.265 compression."

> Technically, there are twin cameras on either side of the U12+, a first for HTC in the U.S. market. The primary rear array includes the default 12MP (f1.75, 1.4µm) with HTC's UltraPixel 4 lens, and a second 16MP (f.2.0, 1µm) with 2x optical and 10x digital zoom, HDR Boost 2, and utilizes both laser and phase detection autofocus along with optical image stabilization (OIS). On the front are dual 8MP (f.2.0, 1.2µm) UltraPixel lenses with a wide 84-degree field-of-view, HDR Boost and screen flash for face illumination. For video, the camera shoots both standard high-def and 60 frame-per-second (fps) 4K, compressing these large files using HEVC/H.265 compression. The U12+ also can capture 240fps slow motion, but only in high definition.

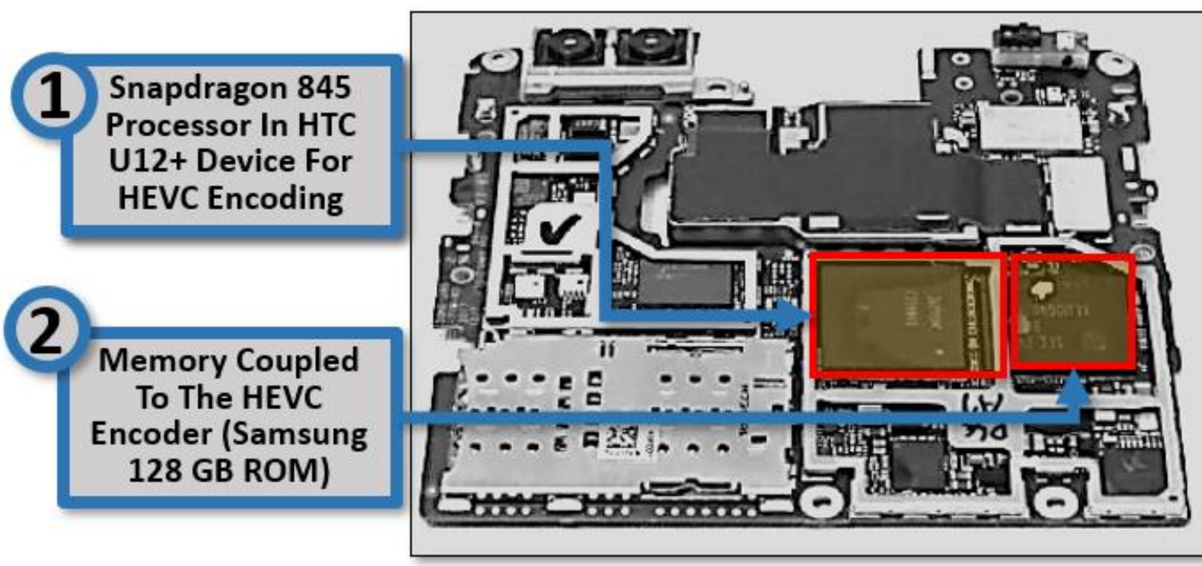
Stewart Wolpin, *HTC U12+ Launches with New Camera And Convenience Features*, TECHLICIOUS.COM WEBSITE (May 25, 2018), *available at*: https://www.techlicious.com/blog/htc-u12-plus-launch/ (emphasis added).

204. The HTC U12+ device contains memory chips (e.g., a SK Hynix 6GB memory chip) and a SD845 processor. The following annotated image shows the internal components of the HTC U12+ device and identifies the memory chip and processor.



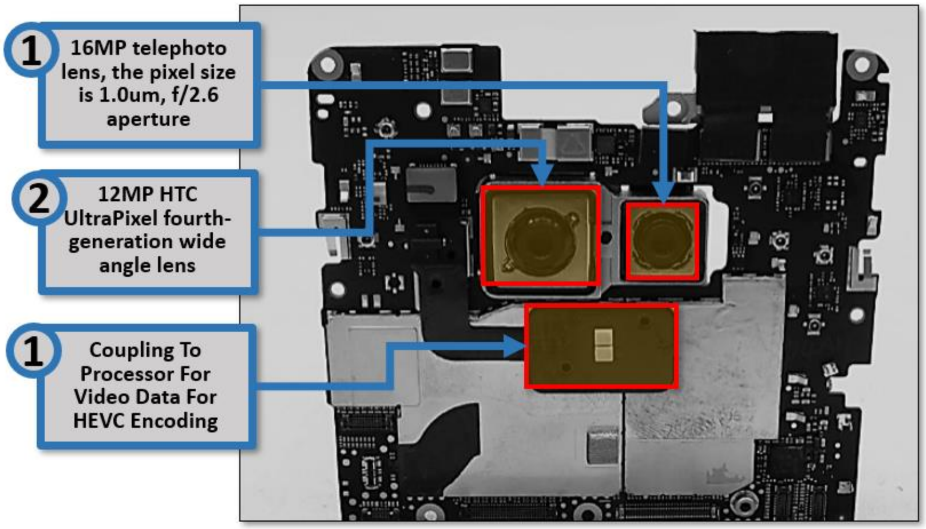
ANNOTATED IMAGE OF THE HTC U12+ DEVICE Internal Components (showing the HTC U12+ rear facing cameras, memory chip, and processor).

205. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The below image of the motherboard in the HTC U12+ device shows that the processor for HEVC encoding is coupled to the memory.



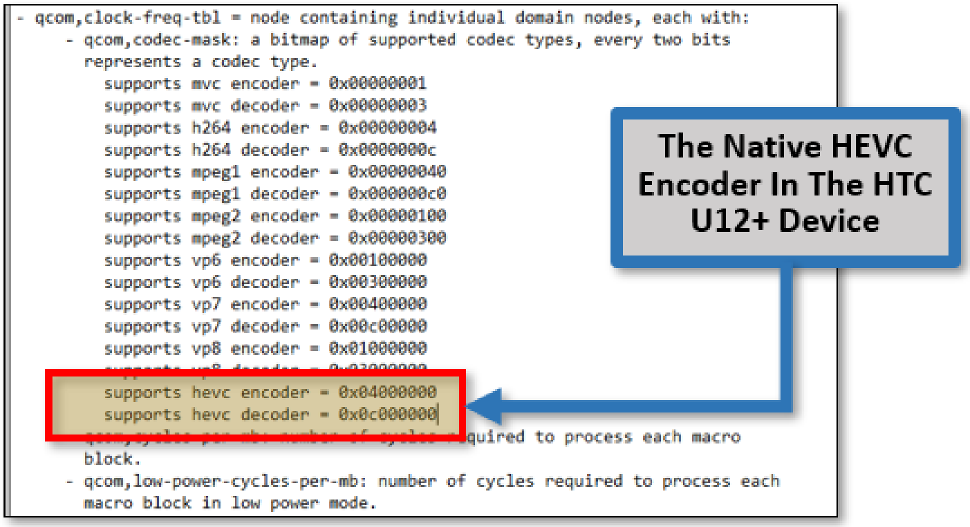
ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor).

206. The HTC U12+ device contains two cameras: (1) a 16 mega pixel camera and (2) a 12 mega pixel camera. The cameras are coupled to the processor such that data captured by the cameras can be encoded into the HEVC format using the HTC U12+ HEVC encoder. The following image of the motherboard in the HEVC U12+ device shows that connection between the cameras and the HEVC encoder.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ cameras coupled to the HEVC encoder).

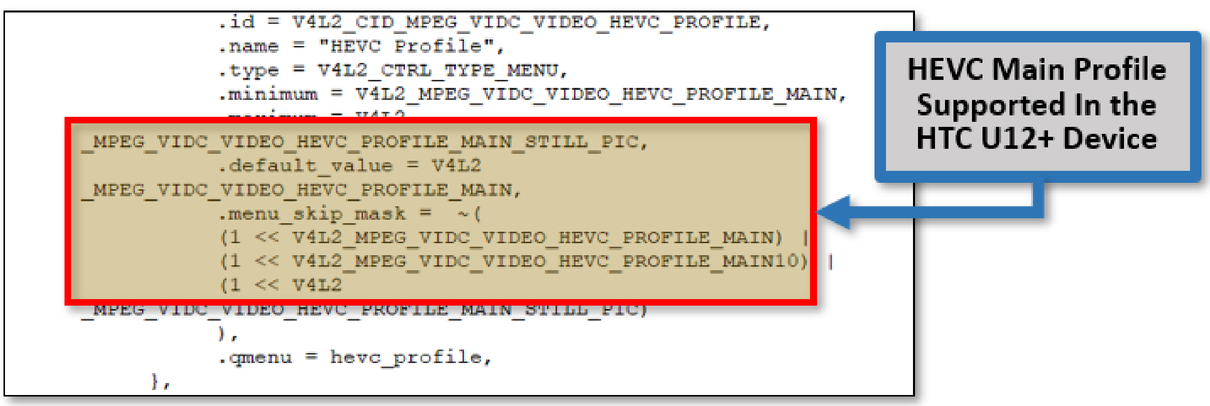
207. The HTC U12+ device includes software that enables encoding data in HEVC compliant format. For example, source code files for the HTC U12+ device show that the device contains a native HEVC encoder. The following image shows documentation that is included in the source code for the HTC U12+ device that shows the presence of a native HEVC encoder.



```
- qcom,clock-freq-tbl = node containing individual domain nodes, each with:
    - qcom,codec-mask: a bitmap of supported codec types, every two bits
      represents a codec type.
        supports mvc encoder = 0x00000001
        supports mvc decoder = 0x00000003
        supports h264 encoder = 0x00000004
        supports h264 decoder = 0x0000000c
        supports mpeg1 encoder = 0x00000040
        supports mpeg1 decoder = 0x000000c0
        supports mpeg2 encoder = 0x00000100
        supports mpeg2 decoder = 0x00000300
        supports vp6 encoder = 0x00100000
        supports vp6 decoder = 0x00300000
        supports vp7 encoder = 0x00400000
        supports vp7 decoder = 0x00c00000
        supports vp8 encoder = 0x01000000
        supports hevc encoder = 0x04000000
        supports hevc decoder = 0x0c000000
      ...quired to process each macro
      block.
    - qcom,low-power-cycles-per-mb: number of cycles required to process each
      macro block in low power mode.
```


HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

208. The HEVC encoder contained in the HTC U12+ device supports encoding compliant with the HEVC Main and Main10 profile contained in the HEVC standard. The below excerpt from uncompiled source code for the HTC U12+ device shows that the HEVC profiles that are supported by the HEVC encoder.

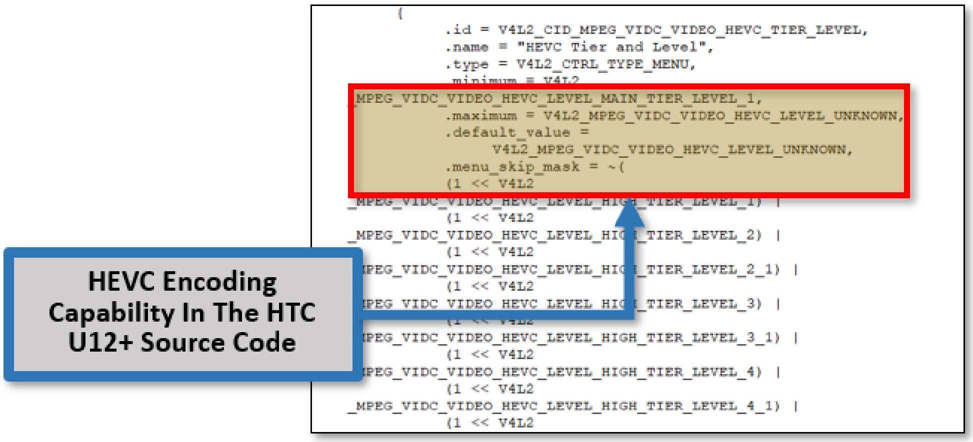


```
            .id = V4L2_CID_MPEG_VIDC_VIDEO_HEVC_PROFILE,
            .name = "HEVC Profile",
            .type = V4L2_CTRL_TYPE_MENU,
            .minimum = V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN,
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN_STILL_PIC,
            .default_value = V4L2
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN,
            .menu_skip_mask = ~(
            (1 << V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN) |
            (1 << V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN10) |
            (1 << V4L2
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN_STILL_PIC)
            ),
            .qmenu = hevc_profile,
        },
```


HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder profile contained on the source code of the HTC U12+ device).

209. The HTC U12+ product supports encoding data using several HEVC Levels. The default level for the HEVC encoder in the HTC U12+ device is “Main Tier | Level 1.” The

following excerpt from the source code loaded onto the HTC U12+ product shows how this default value is set in the MSM_VENC.C source code file.



HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder "HEVC Tier and Level" control menu on the source code of the HTC U12+ device).

210. The HEVC standard provides details regarding the requirements for an HEVC encoder. Specifically, 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.").

211. The HEVC standard describes that encoding engine as being "symmetric" with the decoding engine. The HEVC standard states:

> <u>The encoding engine is essentially symmetric with the decoding engine</u>, i.e., procedures are called in the same order. The following procedures are described in this clause: InitEncoder, EncodeDecision, EncodeBypass, EncodeTerminate, which correspond to InitDecoder, DecodeDecision, DecodeBypass and DecodeTerminate, respectively. The state of the arithmetic encoding engine is represented by a value of the variable ivlLow pointing to the lower end of a sub-interval and a value of the variable ivlCurrRange specifying the corresponding range of that sub-interval.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 9.3.5.1 (February 2018).

212. One or more HTC subsidiaries and/or affiliates use the HTC '054 Products in regular business operations.

213. HTC documentation cited in the proceeding paragraphs shows that the HTC '054 Products perform a motion vector estimation method. Specifically, the HTC '054 Products perform the method of encoding video content using High Efficiency Video Coding ("HEVC").

214. The HTC '054 Products contain a processor for decoding the received encoded frame-based encoded video data. Further, the HTC '054 Products apply a remapping policy to the first frame of decoded video data using a region-based luma analysis. As part of the decoding process performed by HTC '054 Products, a reference picture (first frame) is decoded and two in-loop filters (deblocking and a sample adaptive offset) are applied to the reference picture.

215. The HTC '054 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. The image segment has an image segment center.

216. One or more of the HTC '054 Products include technology for estimating a current motion vector for a group of pixels of an image

217. HTC 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 HTC '054 Products.

218. By complying with the HEVC standard, HTC's devices – such as the HTC '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 HTC'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."

219. The HTC '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.

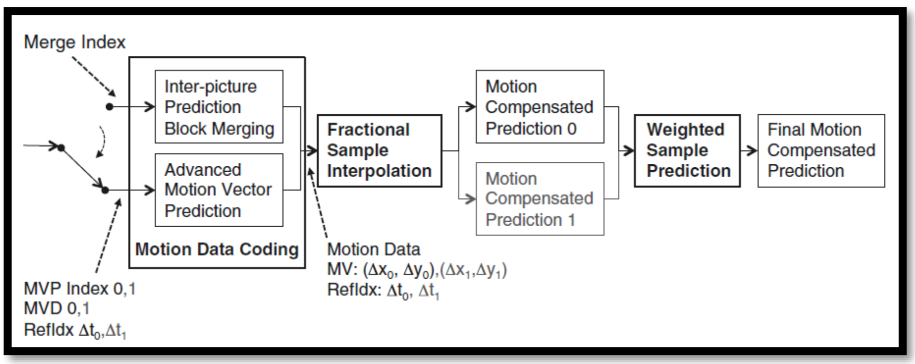
Fabio Sonnati, *H265 – Part I: Technical Overview,* VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

220. One or more of the HTC '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).

221. The following block diagram illustrates the form of encoded video data received by the HTC '054 Products. Specifically, the encoded video data received by the HTC '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 HTC '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).

222. The HTC '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 HTC '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.").

223. One or more of the HTC '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.

224. The HTC '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 referred to as the MV delta. The MV delta is the difference between the real MV and the candidate prediction.

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.

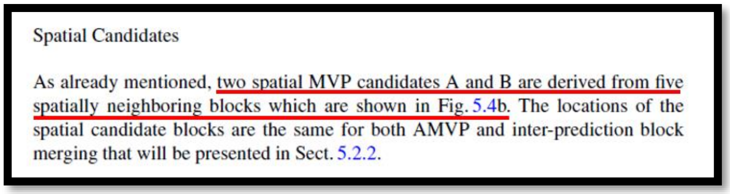
Fabio Sonnati, *H265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

225. 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 calculating a difference between the second motion vector and the first motion vector.

226. One or more of the HTC '054 Products include a motion estimation unit comprising a selector for selecting 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 the basis of a first motion vector and a second motion vector, both belonging to the set of previously estimated motion vectors.

227. The HTC '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 the 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.'

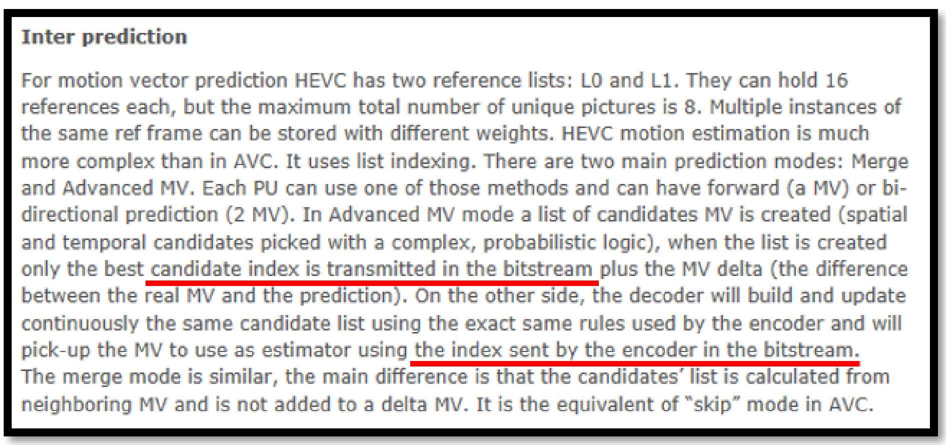


Spatial Candidates

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.

HIGH EFFICIENCY VIDEO CODING (HEVC) ALGORITHMS AND ARCHITECTURES at 117 (2014) (emphasis added).

228. Further, the HTC '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 HTC '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, *H.265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

229. The HTC '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 HTC '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).

230. One or more of the HTC '054 Products include a motion estimation unit that calculates the further candidate motion vector on the 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 (see the red box in the below diagram).

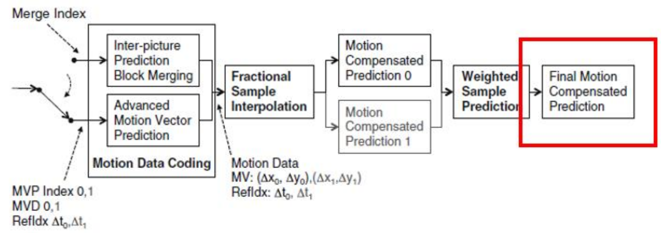


Fig. 5.2 Inter-picture prediction in HEVC (*grey parts* represent the bi-prediction path)

HEVC, HIGH EFFICIENCY VIDEO CODING (HEVC) at 115 (September 2014) (emphasis added).

231. One or more of the HTC '054 Products include a motion estimation unit that arranges to calculate the further candidate motion vector by calculating a difference between the second motion vector and the first motion vector.

232. The HTC '054 Products are available to businesses and individuals throughout the United States.

233. The HTC '054 Products are provided to businesses and individuals located in the Southern District of New York.

234. 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 HTC '054 Products, HTC 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).

235. HTC also indirectly infringes the '054 patent by actively inducing infringement under 35 U.S.C. § 271(b).

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

237. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '054 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '054 Products to utilize the products in a manner that directly infringe one or more claims of the '054 patent.[31] By providing instruction and training to customers and end-users on how to use the HTC '054 Products in a manner that directly infringes one or more claims of the '054 patent, including at least claim 1, HTC specifically intended to induce infringement of the '054 patent. HTC engaged in such inducement to promote the sales of the HTC '054 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '054 patent. Accordingly, HTC has induced and continues to induce users of the accused products to

[31] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

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.

238. 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. HTC is utilizing the technology claimed in the '054 patent without paying a reasonable royalty. HTC 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.

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

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

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

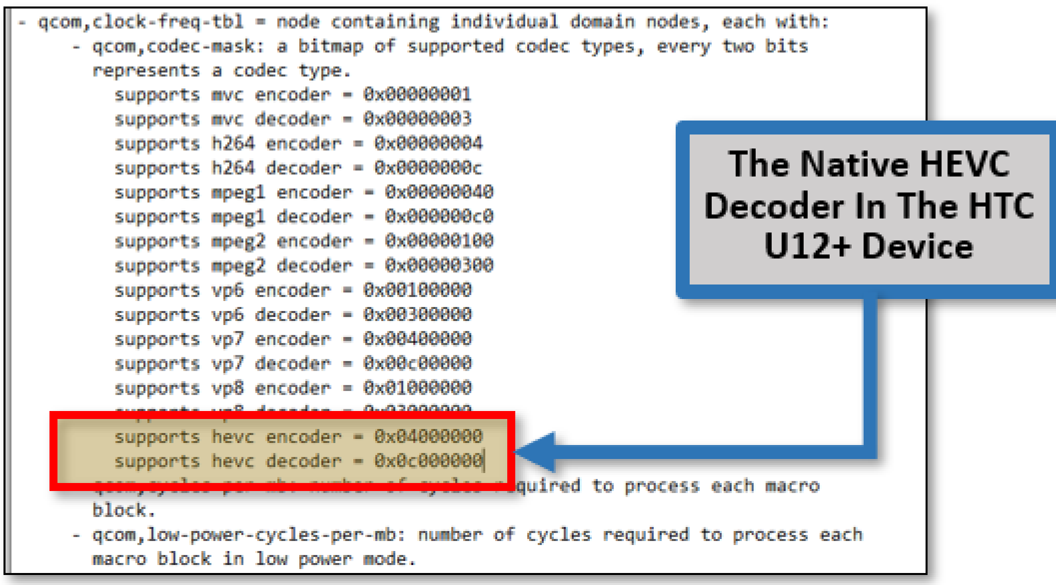
241. Dynamic Data references and incorporates by reference the preceding paragraphs of this Complaint as if fully set forth herein.

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

243. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that contain sub-pixel accurate motion vector functionality, including but not limited to HTC products

that contain and/or enable H.265 decoding functionality including the HTC U12+ (the "HTC '918 Product(s)").

244. The HTC U12+ device includes software that enables decoding data that is stored in an HEVC compliant format. For example, source code files for the HTC U12+ device shows that the device contains a native HEVC decoder. The following image shows documentation that is included in the source code for the HTC U12+ device that shows the presence of a native HEVC decoder.



```
- qcom,clock-freq-tbl = node containing individual domain nodes, each with:
    - qcom,codec-mask: a bitmap of supported codec types, every two bits
      represents a codec type.
        supports mvc encoder = 0x00000001
        supports mvc decoder = 0x00000003
        supports h264 encoder = 0x00000004
        supports h264 decoder = 0x0000000c
        supports mpeg1 encoder = 0x00000040
        supports mpeg1 decoder = 0x000000c0
        supports mpeg2 encoder = 0x00000100
        supports mpeg2 decoder = 0x00000300
        supports vp6 encoder = 0x00100000
        supports vp6 decoder = 0x00300000
        supports vp7 encoder = 0x00400000
        supports vp7 decoder = 0x00c00000
        supports vp8 encoder = 0x01000000
        supports hevc encoder = 0x04000000
        supports hevc decoder = 0x0c000000
      ...quired to process each macro
      block.
    - qcom,low-power-cycles-per-mb: number of cycles required to process each
      macro block in low power mode.
```


HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

245. The HTC U12+ product contains the Android 8.0 operating system, a SD 845 chipset, and an Adreno 630 graphics processing unit.

Platform	
Chipset	Qualcomm Snapdragon 845
Cores	Octa Core
CPU	4x 2.8GHz Kryo 385 Gold & 4x 1.7GHz Kryo 385 Silver
GPU	Adreno 630
OS	Android 8.0 (Oreo)

HTC U12 PLUS SPECIFICATIONS, IHS MARKIT TEARDOWN TECHNOLOGY REPORT (August 10, 2018), *available at*: https://technology.ihs.com/Teardowns/detail/?ids=603895_3368,

246. The HEVC decoder contained in the HTC U12+ device supports decoding compliant with the HEVC standard. The below excerpt from uncompiled source code for the HTC U12+ device shows that the decoding of "HEVC compressed format" data is supported by the HTC U12+ device.

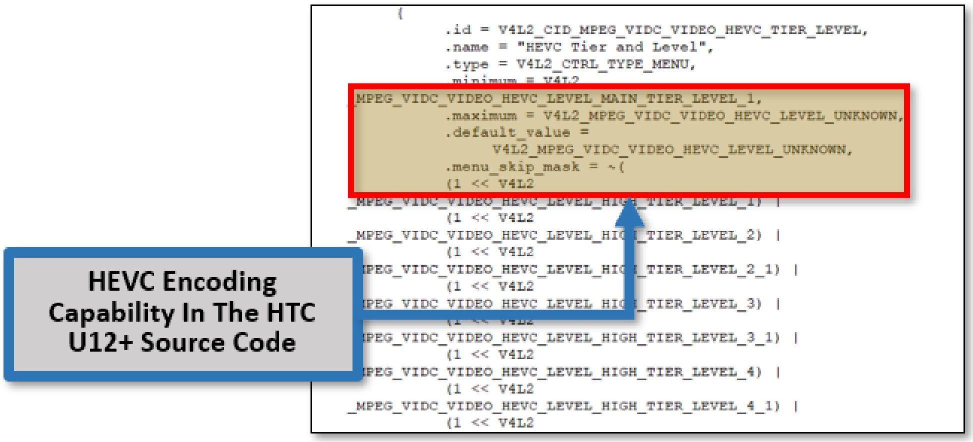
```
{
        .name = "H264",
        .description = "H264 compressed format",
        .fourcc = V4L2_PIX_FMT_H264,
        .get_frame_size = get_frame_size_compressed,
        .type = OUTPUT_PORT,
        .defer_outputs = false,
},
{
        .name = "HEVC",
        .description = "HEVC compressed format",
        .fourcc = V4L2_PIX_FMT_HEVC,
        .get_frame_size = get_frame_size_compressed,
        .type = OUTPUT_PORT,
        .defer_outputs = false,
},
```

HEVC Compliant Decoding Enabled In the HTC U12+ Device

HTC U12+ Kernel Source Code File: MSM_VDEC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video decoder contained on the source code of the HTC U12+ device).

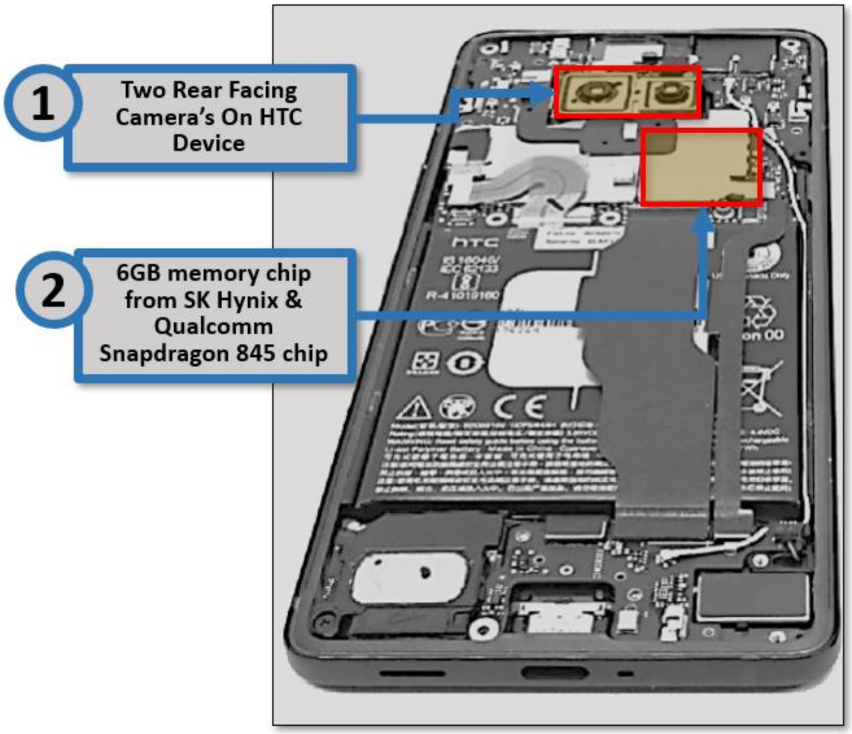
247. The HTC U12+ product supports decoding data using several HEVC Levels. The default level for the HEVC decoder in the HTC U12+ device is HEVC "Main Tier | Level 1." The

following excerpt from uncompiled source code for the HTC U12+ product shows how this default value is set in the MSM_VIDC_COMMON.C file.



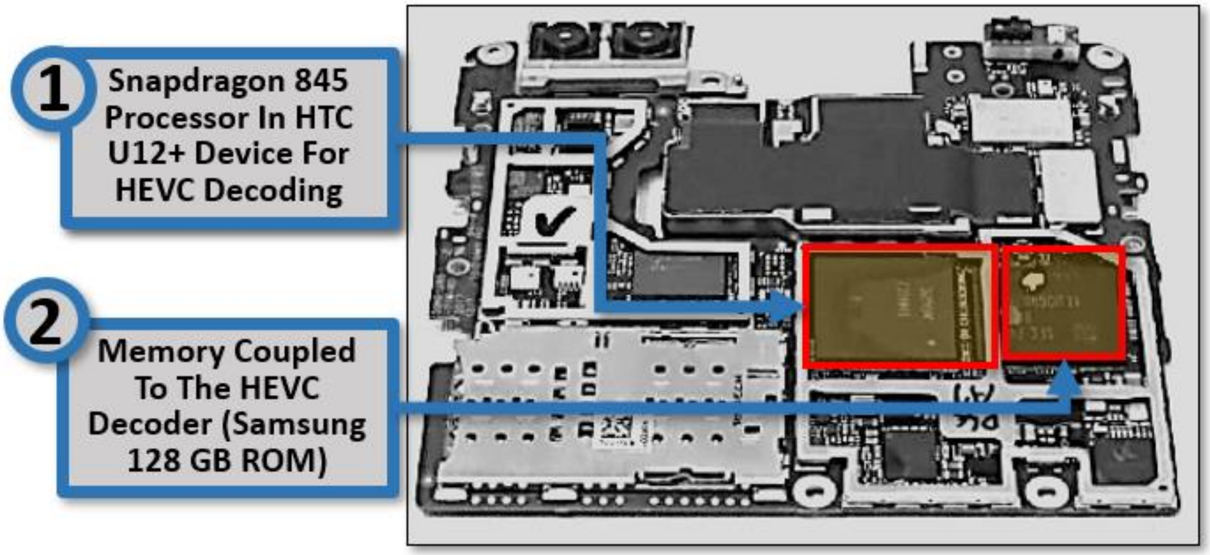
HTC U12+ Kernel Source Code File: MSM_VIDC_COMMON.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video "HEVC Tier and Level" control menu on the source code of the HTC U12+ device for HEVC decoding).

248. The HTC U12+ device contains memory (e.g., a SK Hynix 6GB memory chip) and a SD845 processor. The following annotated image shows the internal components of the HTC U12+ device and identifying the memory chip and processor. These components perform the HEVC decoding compliant with the HEVC standard.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ rear facing cameras, memory chip, and processor) (annotation added).

249. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The below image of the motherboard in the HTC U12+ device shows that the processor for HEVC decoding is coupled to the memory.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor) (annotation added).

250. The HTC '918 Products contain functionality for downloading on-screen display (OSD) data for generating an image on a display device. Specifically, the HTC '918 Products have an input for receiving frame-based encoded video information. The HTC '918 Products receive frame-based encoded video information in the form of video data that is encoded in the High Efficiency Video Coding (HEVC/H.265) format set by the ITU-T Video Coding Experts Group.

251. By complying with the HEVC standard, the HTC devices – such as the HTC '918 Products – necessarily infringe the '918 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '918 patent, including but not limited to claim 18. 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 HTC's infringement of the '918 patent: "5.3 Logical operators;" "5.10 Variables, syntax elements and tables;" "5.11 Text description of

logical operations;" "7.2 Specification of syntax functions and descriptors;" "7.3.1 NAL unit syntax;" "7.3.2 Raw byte sequence payloads, trailing bits and byte alignment syntax;" "7.3.5 Supplemental enhancement information message syntax;" "7.4.2 NAL unit semantics;" and "7.4.6 Supplemental enhancement information message semantics."

252. The HTC '918 Products receive a bitstream in which the data is segmented into Network Abstraction Layer ("NAL") Units. NAL Units are segments of data that can include video data and overlay data (such as captions and overlay images). The HTC '918 Products support the receipt of VCL and non-VCL NAL units. The VCL NAL units contain the data that represents the values of the samples in the video pictures, and the non-VCL NAL units contain any associated additional information such as parameter sets or overlay data.

> HEVC uses a NAL unit based bitstream structure. A coded bitstream is partitioned into NAL units which, when conveyed over lossy packet networks, should be smaller than the maximum transfer unit (MTU) size. <u>Each NAL unit consists of a NAL unit header followed by the NAL unit payload.</u> There are two conceptual classes of NAL units. Video coding layer (VCL) NAL units containing coded sample data, e.g., coded slice NAL units, whereas non-VCL NAL units that contain metadata typically belonging to more than one coded picture, or where the association with a single coded picture would be meaningless, such as parameter set NAL units, or where the information is not needed by the decoding process, such as SEI NAL units.

Rickard Sjöberg, et al., *Overview of HEVC High-Level Syntax and Reference Picture Management,* IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, Vol. 22, No. 12 at 1859 (December 2012) (emphasis added).

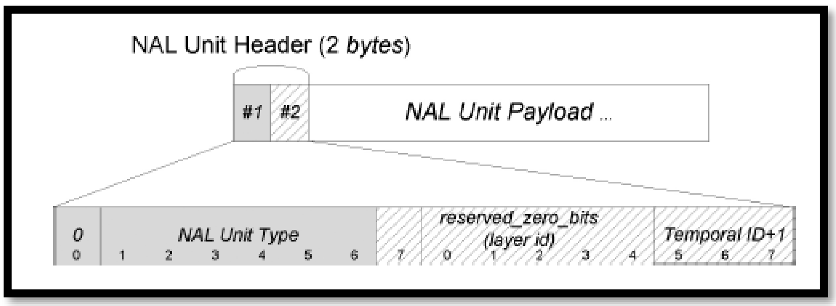
253. The VCL NAL Units contain segments of data which are used to generate an image (*e.g.*, HEVC image) on a display device. Each VCL NAL Unit comprises a discrete number of bites which make up a segment. The following excerpt from the HEVC specification describes the NAL unit as being a segment with a "demarcation" setting forth where the segment ends and begins:

> NumBytesInNalUnit specifies the size of the NAL unit in bytes. This value is required for decoding of the NAL unit. Some form of <u>demarcation of NAL unit</u>

> boundaries is necessary to enable inference of NumBytesInNalUnit. One such demarcation method is specified in Annex B for the byte stream format. Other methods of demarcation may be specified outside of this Specification.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 7.4.2.1 (February 2018) (emphasis added).

254. VCL NAL Units comprise discrete video data that ends. It is between the receipt of VCL NAL Units that the overlay data (Non-VCL NAL Unit) data is received by the HTC '918 Products.



Thomas Schierl, Miska M. Hannuksela, Ye-Kui Wang, and Stephan Wenger, System Layer Integration of High Efficiency Video Coding, *IEEE TRANS. CIR. AND SYS. FOR VIDEO TECHNOLOGY*, VOL. 22, NO. 12 at 1875 (December 2012).

255. The HEVC bitstream structure is comprised of discreet data. In the gaps between the receipt by the HTC '918 Products of VCL NAL Units, Non-VCL NAL Units are received by the HTC '918 Products' decoder.

> An HEVC bitstream consists of a number of access units, each including coded data associated with a picture that has a distinct capturing or presentation time. Each access unit is divided into NAL units, including one or more VCL NAL units (i.e., coded slice NAL units) and zero or more non-VCL NAL units, e.g., parameter set NAL units or supplemental enhancement information (SEI) NAL units. Each NAL unit includes an NAL unit header and an NAL unit payload. Information in the NAL unit header can be (conveniently) accessed by media gateways, also known as media aware network elements (MANEs), for intelligent, media aware operations on the stream, such as stream adaptation.

Thomas Schierl, Miska M. Hannuksela, Ye-Kui Wang, and Stephan Wenger, System Layer Integration of High Efficiency Video Coding, *IEEE TRANS. CIR. AND SYS. FOR VIDEO TECHNOLOGY*, VOL. 22, NO. 12 at 1873 (December 2012).

256. Non-VCL NAL unit types include data such as supplemental enhancement information that is used to create overlays for display on the device.

Table 2.2 The 32 HEVC non-VCL NAL unit types

Non-VCL NAL unit types			
Parameter sets	32	VPS_NUT	Video parameter set
	33	SPS_NUT	Sequence parameter set
	34	PPS_NUT	Picture parameter set
Delimiters	35	AUD_NUT	Access unit delimiter
	36	EOS_NUT	End of sequence
	37	EOB_NUT	End of bitstream
Filler data	38	FD_NUT	Filler data
Supplemental enhancement information (SEI)	39	PREFIX_SEI_NUT	
	40	SUFFIX_SEI_NUT	
Reserved	41–47	RSV	
Unspecified	48–63	UNSPEC	

HIGH EFFICIENCY VIDEO CODING (HEVC) at 29 (September 2014).

257. Non-VCL NAL Units include supplemental enhancement information ("SEI") messages. The SEI data that is received contains overlay information that can be combined with the image data that has already been received.

sei_message( ) {	**Descriptor**
payloadType = 0	
while(next_bits(8) = = 0xFF) {	
ff_byte /* equal to 0xFF */	f(8)
payloadType += 255	
}	
last_payload_type_byte	u(8)
payloadType += last_payload_type_byte	
payloadSize = 0	
while(next_bits(8) = = 0xFF) {	
ff_byte /* equal to 0xFF */	f(8)
payloadSize += 255	
}	
last_payload_size_byte	u(8)
payloadSize += last_payload_size_byte	
sei_payload(payloadType, payloadSize)	
}	

High Efficiency Video Coding, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 at § 7.3.5 (February 2018).

258. The HTC '918 Products combine the VCL NAL Unit and Non-VCL NAL Unit information to create images that contain overlay information.

> The NAL units are decoded by the decoder to produce the decoded pictures that are output from the decoder. Both the encoder and decoder store pictures in a decoded picture buffer (DPB). This buffer is mainly used for storing pictures so that previously coded pictures can be used to generate prediction signals to use when

> coding other pictures. These stored pictures are called reference pictures. . . . There are two classes of NAL units in HEVC—video coding layer (VCL) NAL units and non-VCL NAL units. Each VCL NAL unit carries one slice segment of coded picture data while the non-VCL NAL units contain control information that typically relates to multiple coded pictures. <u>One coded picture, together with the non-VCL NAL units that are associated with the coded picture, is called an HEVC access unit</u>.

HIGH EFFICIENCY VIDEO CODING (HEVC) at 14-15 (September 2014) (emphasis added).

259. One or more HTC subsidiaries and/or affiliates use the HTC '918 Products in regular business operations.

260. The HTC '918 Products are available to businesses and individuals throughout the United States.

261. The HTC '918 Products are provided to businesses and individuals located in the Southern District of New York.

262. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the HTC '918 Products, HTC 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).

263. HTC also indirectly infringes the '918 patent by actively inducing infringement under 35 U.S.C. § 271(b).

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

265. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe

the '918 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '918 Products to utilize the products in a manner that directly infringe one or more claims of the '918 patent.[32] By providing instruction and training to customers and end-users on how to use the HTC '918 Products in a manner that directly infringes one or more claims of the '918 patent, including at least claim 18, HTC specifically intended to induce infringement of the '918 patent. HTC engaged in such inducement to promote the sales of the HTC '918 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '918 patent. Accordingly, HTC 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.

266. 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. HTC is utilizing the technology claimed in the '918 patent

[32] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

without paying a reasonable royalty. HTC 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.

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

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

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

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

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

271. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that enable encoding and decoding of video content including the HTC U12+, HTC U11, HTC U11 Life, HTC U Ultra, and HTC 10 (collectively, the "HTC '689 Product(s)").

272. The HTC '689 Products contain functionality for encoding and decoding a video stream using a video processing unit coupled to a first and second memory. Specifically, the HTC '689 Products include a Snapdragon series system-on-chip ("SoC") processor with an Adreno graphics processing unit ("GPU"). For each of the accused HTC '689 Products, the video

processing chip is identified: the HTC U12+ (containing a Snapdragon 845 SoC[33] and an Adreno 630 GPU),[34] HTC U11(containing a Snapdragon 835 SoC[35] and an Adreno 540 GPU),[36] HTC U11 Life (containing a Snapdragon 630 SoC[37] and an Adreno 508 GPU),[38] HTC U Ultra (containing a Snapdragon 821 SoC[39] and an Adreno 530 GPU),[40] and HTC 10 (containing a Snapdragon 820 SoC[41] and an Adreno 530 GPU).[42]

273. The HTC '689 Products include a Hexagon Digital Signal Processor ("DSP"). The below figure shows a block diagram of the Snapdragon 800 series system-on-chip ("SoC") which is contained in the HTC '689 Products.[43] The SoC in the HTC '689 Products contains dedicated subsystems for camera, display, video, audio/voice, sensors, graphics, cellular modem, and Wi-Fi. Each subsystem on the HTC '689 Products contains dedicated hardware, and special purpose processing engines and customized software. The following diagram identifies that the HTC '689

[33] *HTC U12+ Specifications*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/.

[34] *Snapdragon 845 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited March 2019), *available at*: https://www.qualcomm.com/products/snapdragon-845-mobile-platform.

[35] *HTC U11 Specifications*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u11/.

[36] *Snapdragon 835 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited March 2019), *available at*: https://www.qualcomm.com/products/snapdragon-835-mobile-platform.

[37] *HTC U11 Life Specifications*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u11-life/.

[38] *Snapdragon 630 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited March 2019), *available at*: https://www.qualcomm.com/products/snapdragon-630-mobile-platform.

[39] *HTC U Ultra Specifications*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u-ultra/.

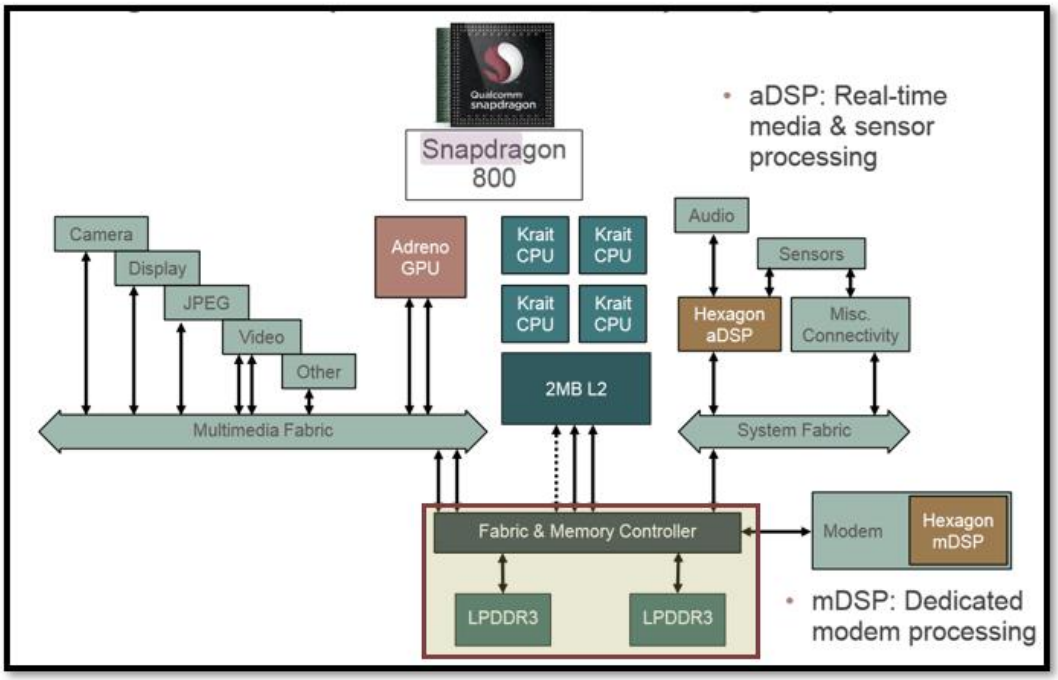
[40] *Snapdragon 821 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited March 2019), *available at*: https://www.qualcomm.com/products/snapdragon-821-mobile-platform.

[41] *HTC 10 Specifications*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/go/buy-htc-10/.

[42] *Snapdragon 820 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited March 2019), *available at*: https://www.qualcomm.com/products/snapdragon-820-mobile-platform.

[43] The Snapdragon 630 SoC contains a functionally identical Hexagon aDSP and Hexagon mDSP.

Products contain an "aDSP" for "[r]eal-time media & sensor processing" and a "mDSP" for "[d]edicated modem processing."

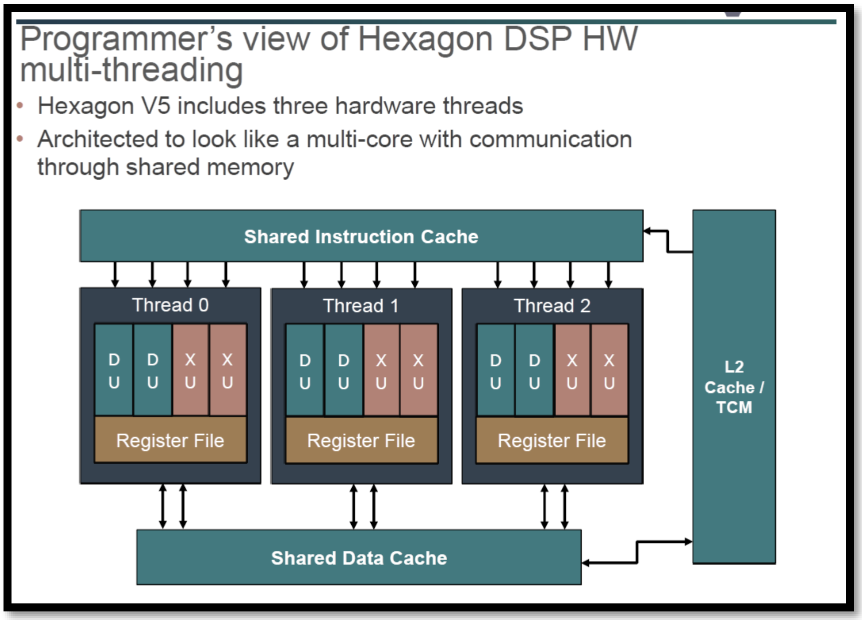


Lucian Codrescu, Qualcomm Hexagon DSP: An Architecture Optimized for Mobile Multimedia and Communications, QUALCOMM PRESENTATION at 2 (2013) (the yellow highlighted box shows the aDSP and mDSP modules described above).

274. The Hexagon DSP in the HTC '689 Products is a multithreaded very long instruction word ("VLIW") DSP. As illustrated in the following diagram, the DSP in the HTC '689 Products features a unified byte-addressable memory. This memory has a single 32-bit virtual address space that holds both instructions and data. The DSP operates in little-endian mode.

275. The HTC '689 Products contain a full-featured memory management unit ("MMU") that translates virtual to physical addresses.

276. The HTC '689 Products contain a DSP instruction unit that is coupled to a first and second memory (L2 Cache and Shared Data Cache).



Lucian Codrescu, Qualcomm Hexagon DSP: An Architecture Optimized for Mobile Multimedia and Communications, QUALCOMM PRESENTATION at 11 (2013) (depicting the L2 Cache and Shared Data Cache of the DSP in the HTC '689 Products).

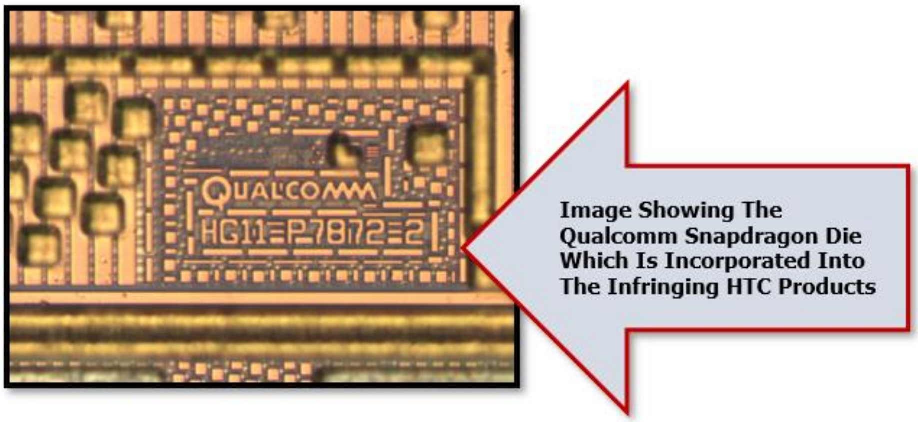
277. The HTC '689 Products contain a digital signal processor that enables the encoding and decoding of video data. "The Hexagon instruction set architecture (ISA) contains numerous special-purpose instructions designed to accelerate key multimedia kernels. Multimedia algorithms with special instruction support include: variable-length encode/decode, such as context-adaptive binary-arithmetic coding processing in H.264 video; features from accelerated segment test (FAST) corner detection image processing; FFT algorithms; sliding-window filters; linear-feedback shift."[44]

278. The HTC '689 Products contain a DSP which contains a data cache, L2 cache, and a connection of the main memory. "In the Snapdragon 800 implementation, the DSP runs up to 800 MHz. The instruction cache is 16 Kbytes, the data cache is 32 Kbytes, and the level-2 (L2)

[44] Lucian Codrescu et. al., *Hexagon DSP: An Architecture Optimized For Mobile Multimedia and Communications*, IEEE MICRO, VOL. 34, NO. 2, at 36-37 (March/April 2014) (emphasis added).

cache is 256 Kbytes. Connection to main memory is provided over a 64-bit system bus that runs at 240MHz."[45]

279. The HTC '689 Products use motion estimation and motion compensation in the encoding and decoding of video data. The below image identifies an exemplar of the image processing component in the HTC '689 Products – a Qualcomm 800 Series SoC.



QUALCOMM SNAPDRAGON 845 DIE MARKS (2017) (The Snapdragon processor incorporated in the HTC Products is a software-based machine-learning solutions based on an SDKs, distributing workload to the CPU, GPU, or DSP based on requirements such and the infringing encoding/decoding process.).

280. The central processing unit ("CPU") and DSP contained in the HTC '689 Products communicate with each other via FastRPC, a proprietary remote procedure call ("RPC") mechanism used to enable remote function calls between the CPU and DSP.

281. The HTC '689 Products contain a processing unit that is coupled to a first and second memory. "The aDSP is part of the SoC package. Therefore, various processor units (in this case, the aDSP and CPU) have access to the same hardware memory unit (such as DDR3). For better memory control, there are multiple logical divisions of the memory. Each processing

[45] *Id.*, at 40.

unit has exclusive and shared access to various memory areas. Memory protection units (MPUs) implement the access control."[46]

282. The HTC '689 Products contain functionality for providing a subset of image data stored in the second memory in the first memory.

> Data level parallelism means that the processor can take one piece of data and distribute it across different parallel computing nodes. Hexagon has four nodes, or execution units . . . Here, a shift is performed on a 64-bit piece of data, Rss, and the result is stored in Rdd. Instead of shifting the entire double word left, we want to shift four half-words each. Hexagon can do this in parallel.

MPSS Debug Manual, QUALCOMM DOCUMENTATION 80-NF515-10K at 9 (June 15, 2017) (emphasis added).

283. The HTC '689 Products include a system memory management unit ("SMMU"). The HTC '689 Product SMMU optimizes the need to allocate small chunks of memory when larger chunks are not available. Further, the SMMU layer enables actual non-continuous memory chunks to be presented in a continuous view to each processing unit.

284. The HTC '689 Products store video data during the decoding process on memory structures including the CPU Cache, L3 Cache, L2 Cache, L1 Cache, and Off Chip Ram. The following image identifies an exemplar of the video processing structure in the HTC '689 Products and the memory structures where memory image data during the encoding and decoding process can be stored.

[46] *Qualcomm FastRPC User Guide*, QUALCOMM DOCUMENTATION 80-N7039-2 at 11 (March 31, 2017).

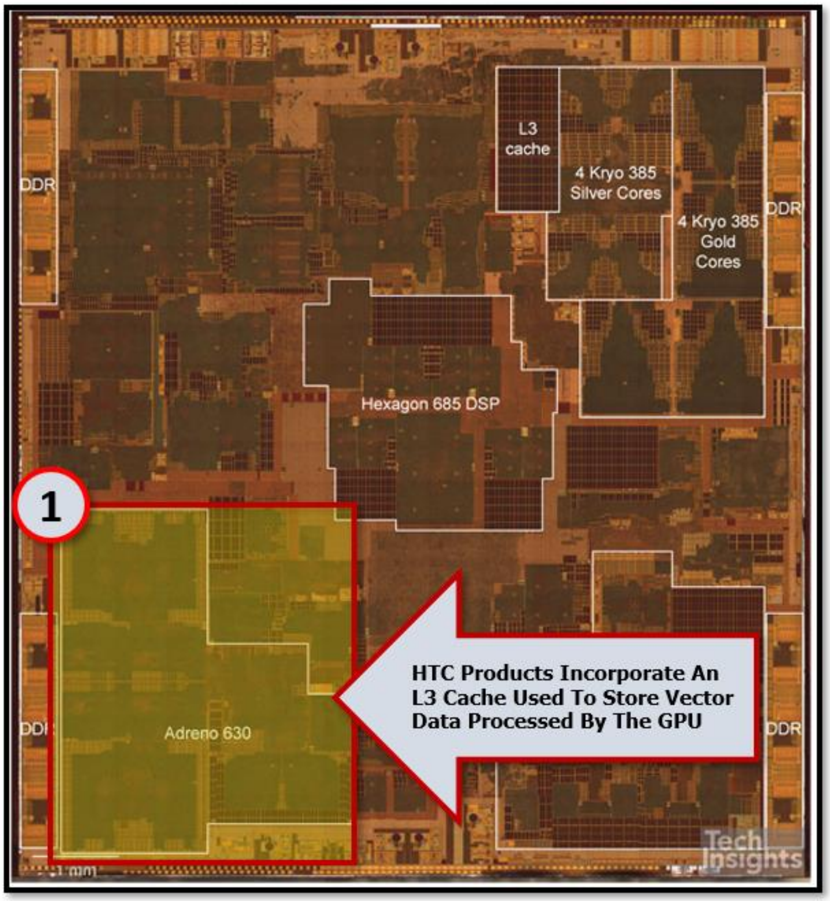


IMAGE OF AN EXEMPLAR HTC '689 PRODUCT PROCESSOR: DETAILED PRODUCT ANALYSIS (2018) (annotations added) (showing at "1" the Adreno 630 GPU).

285. The HTC '689 Products during the encoding and decoding process can write image data to the L2 Cache, L1 Cache, and System Memory. As an illustrative example, documentation regarding the processor in the HTC '689 Products shows that through the use of "latency hiding" data for video encoding is retrieved from both external memory and on chip memory.

286. The HTC '689 Products contain a DSP that exploits thread level parallelism. The hardware threads appear independent, but they share the L1 Instruction Cache, the L1 data Cache, and the L2 Unified Cache as shown in the below diagram.

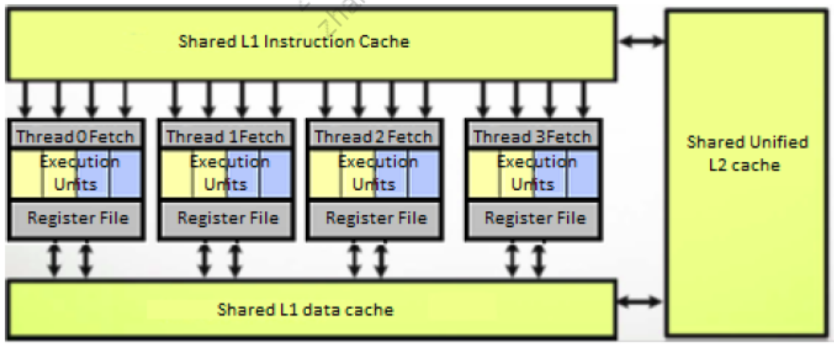
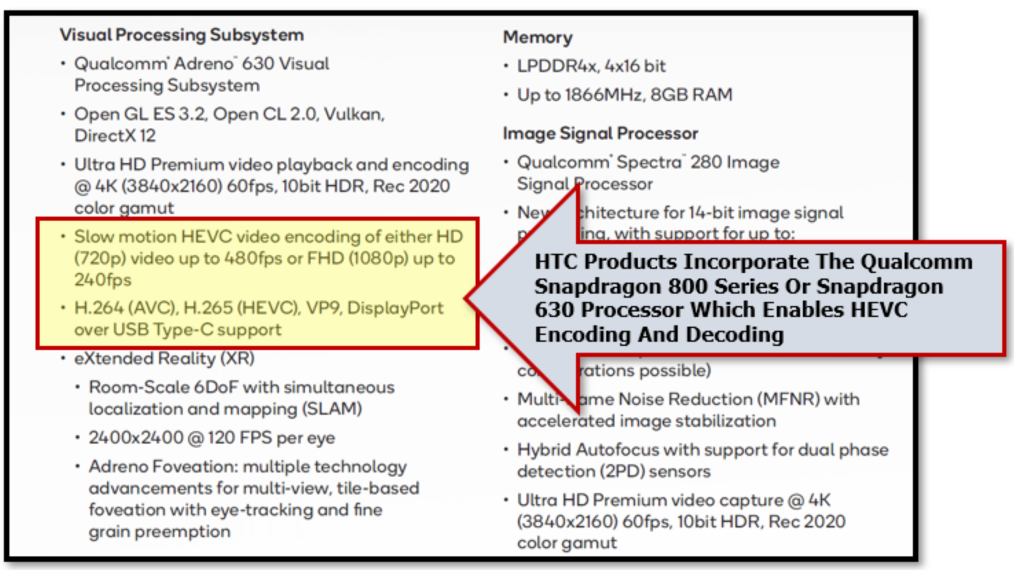


Figure 2-1 Abstraction of hexagon processor showing thread level parallelism

MPSS Debug Manual, QUALCOMM DOCUMENTATION 80-NF515-10K at 9 (June 15, 2017).

287. The HTC '689 Products contain a processor stack frame. The processor stack is used to store stack frames, which are data structures that store state information on active subroutines of a program.

288. The HTC '689 Products contain functionality for simultaneously encoding and decoding a video stream.



Qualcomm Snapdragon 845 Mobile Platform, QUALCOMM DATASHEET at 2 (2018) ("Higher quality video capture with Motion Compensated Temporal Filtering (MCTF)").

289. The HTC '689 Products contain functionality for encoding and decoding a video stream by accessing a subset of image data stored in memory.

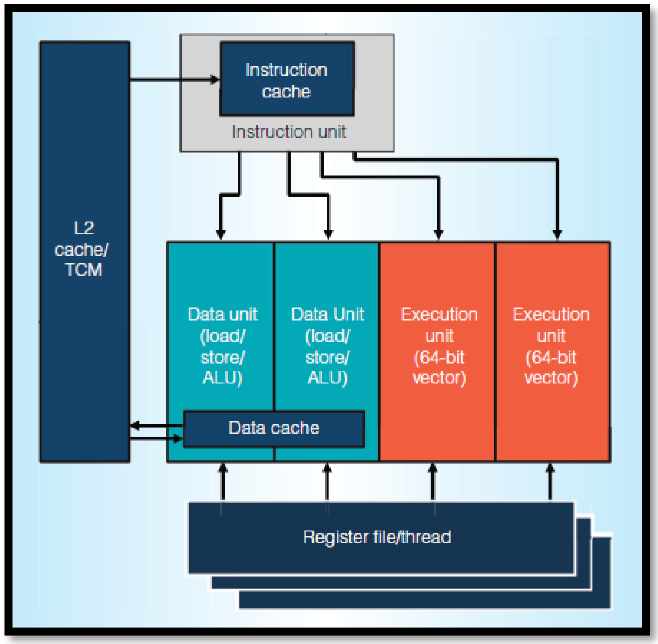
> Relying on its in-house DSP to spur new smartphone features, Qualcomm has improved the capabilities of its Hexagon architecture and is making it easier than ever for programmers to tap into. At today's Hot Chips conference, the company disclosed improvements such as floating-point support and dynamic multithreading that it implemented in the Hexagon v5 generation, which recently began shipping in the Snapdragon 800 processor. These improvements expand the DSP's range of applications to include image and video processing as well as computer vision and sensor analysis.

Linley Gwennap, *Qualcomm Extends Hexagon DSP: Hexagon v5 Adds Floating-Point Math, Dynamic Multithreading*, LINLEY GROUP MICROPROCESSOR REPORT at 1 (August 2013).

290. The HTC '689 Products contain functionality for simultaneously encoding and decoding video data by access sharing one or more images stored in memory.

291. The HTC '689 Products include multiple execution units and data units that can execute instructions in parallel. The instruction level parallelism in the HTC '689 Products "allows multiple instructions to be executed concurrently. The processor has four Execution Units which are used in the instruction pipeline."[47] The following diagram shows the shared "data cache" and "L2 Cache" that are coupled to the instruction unit in the HTC '689 Products.

[47] *MPSS Debug Manual*, QUALCOMM DOCUMENTATION 80-NF515-10K at 9 (June 15, 2017).



Lucian Codrescu, et. al., *Hexagon DSP: An Architecture Optimized for Mobile Multimedia and Communications,* IEEE MICRO, VOL. 34, NO. 2, at 36 (Mar.-Apr. 2014).

292. One or more HTC subsidiaries and/or affiliates use the HTC '689 Products in regular business operations.

293. HTC 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 HTC '689 Products.

294. The HTC '689 Products are available to businesses and individuals throughout the United States.

295. The HTC '689 Products are provided to businesses and individuals located in the Southern District of New York.

296. 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 HTC '689 Products, HTC 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).

297. HTC also indirectly infringes the '689 patent by actively inducing infringement under 35 USC § 271(b).

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

299. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '689 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '689 Products to utilize the products in a manner that directly infringe one or more claims of the '689 patent.[48] By providing instruction and training to customers and end-users on how to use the HTC '689 Products in a manner that directly infringes one or more claims of the '689 patent, including at least claim 1, HTC specifically intended to

[48] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

induce infringement of the ‘689 patent. HTC engaged in such inducement to promote the sales of the HTC ‘689 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the ‘689 patent. Accordingly, HTC 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.

300. 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. HTC is utilizing the technology claimed in the ‘689 patent without paying a reasonable royalty. HTC 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.

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

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

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

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

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

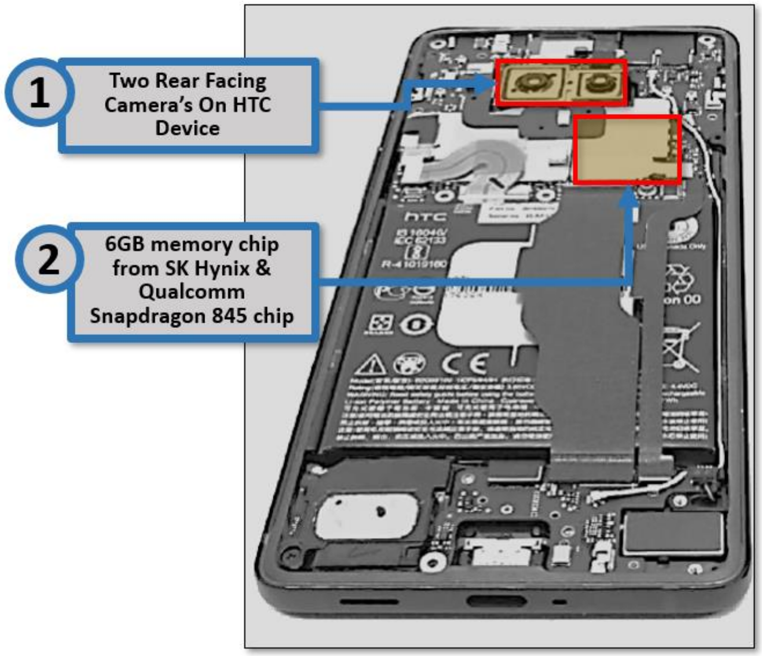
305. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that contain and/or enable H.265 encoding functionality including the HTC U12+ (the "HTC '177 Product(s)").

306. The HTC U12+ device contains a video data encoder that complies with the H.265 standard. Specifically, documentation regarding the HTC U12+ product shows that it can encode "large files using HEVC/H.265 compression."

> Technically, there are twin cameras on either side of the U12+, a first for HTC in the U.S. market. The primary rear array includes the default 12MP (f1.75, 1.4µm) with HTC's UltraPixel 4 lens, and a second 16MP (f.2.0, 1µm) with 2x optical and 10x digital zoom, HDR Boost 2, and utilizes both laser and phase detection autofocus along with optical image stabilization (OIS). On the front are dual 8MP (f.2.0, 1.2µm) UltraPixel lenses with a wide 84-degree field-of-view, HDR Boost and screen flash for face illumination. For video, the camera shoots both standard high-def and 60 frame-per-second (fps) 4K, compressing these large files using HEVC/H.265 compression. The U12+ also can capture 240fps slow motion, but only in high definition.

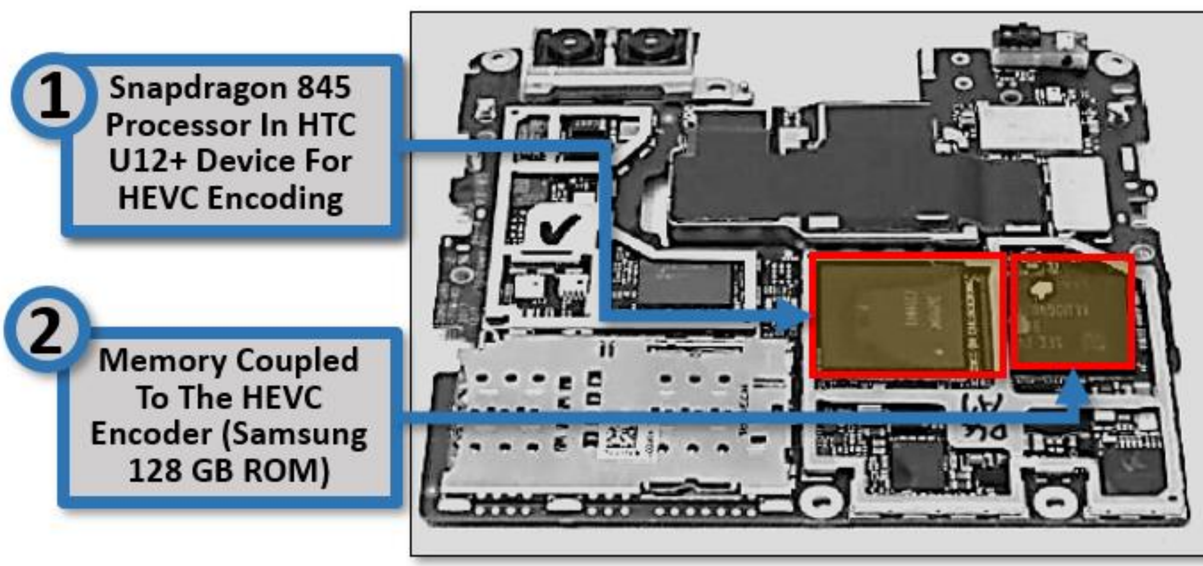
Stewart Wolpin, *HTC U12+ Launches with New Camera And Convenience Features*, TECHLICIOUS.COM WEBSITE (May 25, 2018), *available at*: https://www.techlicious.com/blog/htc-u12-plus-launch/ (emphasis added).

307. The HTC U12+ device contains memory chips (including a SK Hynix 6GB memory chip) and a Qualcomm Snapdragon 845 (or SD845) processor. The following annotated image shows the internal components of the HTC U12+ device and identifying the memory chip and processor.



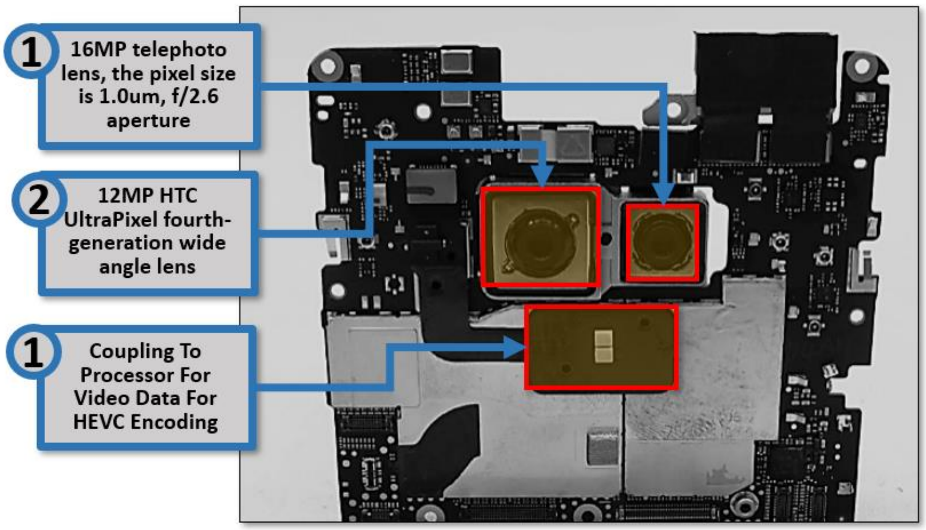
ANNOTATED IMAGE OF THE HTC U12+ DEVICE Internal Components (showing the HTC U12+ rear facing cameras, memory chip, and processor).

308. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The below image of the motherboard in the HTC U12+ device shows that the processor for HEVC encoding is coupled to the memory.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor).

309. The HTC U12+ device contains two cameras: (1) a 16 mega pixel camera and (2) a 12 mega pixel camera. The cameras are coupled to the processor such that data captured by the cameras can be encoded into the HEVC format using the HTC U12+ HEVC encoder. The following image of the motherboard in the HEVC U12+ device shows the connection between the cameras and the HEVC encoder.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ cameras coupled to the HEVC encoder).

310. The HTC U12+ device includes software that enables encoding data in HEVC compliant format. For example, source code files for the HTC U12+ device show that the device contains a native HEVC encoder. The following image shows documentation that is included in the source code for the HTC U12+ device that shows the presence of a native HEVC encoder.

```
- qcom,clock-freq-tbl = node containing individual domain nodes, each with:
    - qcom,codec-mask: a bitmap of supported codec types, every two bits
      represents a codec type.
        supports mvc encoder = 0x00000001
        supports mvc decoder = 0x00000003
        supports h264 encoder = 0x00000004
        supports h264 decoder = 0x0000000c
        supports mpeg1 encoder = 0x00000040
        supports mpeg1 decoder = 0x000000c0
        supports mpeg2 encoder = 0x00000100
        supports mpeg2 decoder = 0x00000300
        supports vp6 encoder = 0x00100000
        supports vp6 decoder = 0x00300000
        supports vp7 encoder = 0x00400000
        supports vp7 decoder = 0x00c00000
        supports vp8 encoder = 0x01000000
        supports vp8 decoder = 0x03000000
        supports hevc encoder = 0x04000000
        supports hevc decoder = 0x0c000000
    - qcom,cycles-per-mb: number of cycles required to process each macro
      block.
    - qcom,low-power-cycles-per-mb: number of cycles required to process each
      macro block in low power mode.
```

The Native HEVC Encoder In The HTC U12+ Device

HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

311. The HEVC encoder contained in the HTC U12+ device supports encoding compliant with the HEVC Main and Main10 profile contained in the HEVC standard. The below excerpt from uncompiled source code for the HTC U12+ device shows that the HEVC profiles are supported by the HEVC encoder.

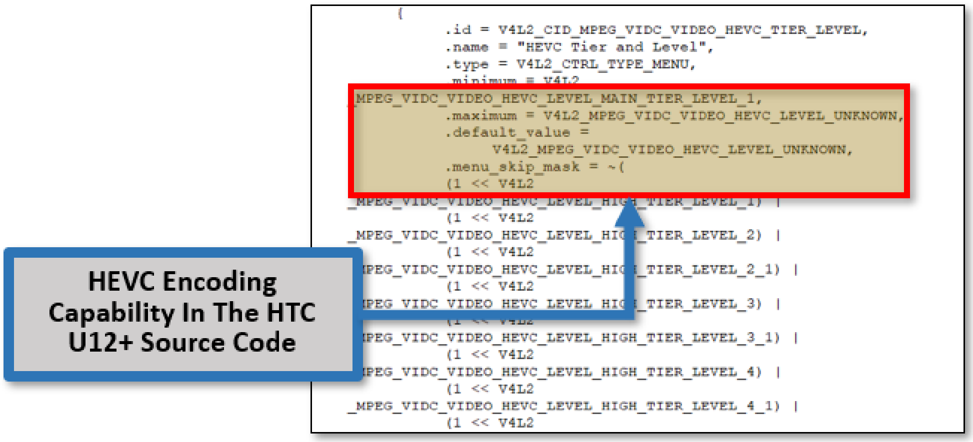
```
        .id = V4L2_CID_MPEG_VIDC_VIDEO_HEVC_PROFILE,
        .name = "HEVC Profile",
        .type = V4L2_CTRL_TYPE_MENU,
        .minimum = V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN,
        .maximum = V4L2
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN_STILL_PIC,
        .default_value = V4L2
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN,
        .menu_skip_mask = ~(
        (1 << V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN) |
        (1 << V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN10) |
        (1 << V4L2
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN_STILL_PIC)
        ),
        .qmenu = hevc_profile,
    },
```

HEVC Main Profile Supported In the HTC U12+ Device

HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder profile contained on the source code of the HTC U12+ device).

312. The HTC U12+ product supports encoding data using several HEVC Levels. The default level for the HEVC encoder in the HTC U12+ device is "Main Tier | Level 1." The

following excerpt from the source code loaded onto the HTC U12+ product shows how this default value is set in the MSM_VENC.C source code file.



HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder "HEVC Tier and Level" control menu on the source code of the HTC U12+ device).

313. The HEVC standard provides details regarding the requirements for an HEVC encoder. Specifically, 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.").

314. The HEVC standard describes that encoding engine as being "symmetric" with the decoding engine. The HEVC standard states:

> <u>The encoding engine is essentially symmetric with the decoding engine</u>, i.e., procedures are called in the same order. The following procedures are described in this clause: InitEncoder, EncodeDecision, EncodeBypass, EncodeTerminate, which correspond to InitDecoder, DecodeDecision, DecodeBypass and DecodeTerminate, respectively. The state of the arithmetic encoding engine is represented by a value of the variable ivlLow pointing to the lower end of a sub-interval and a value of the variable ivlCurrRange specifying the corresponding range of that sub-interval.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 9.3.5.1 (February 2018).

315. One or more HTC subsidiaries and/or affiliates use the HTC '177 Products in regular business operations.

316. One or more of the HTC '177 Products include technology for motion estimation and motion-compensated picture signal processing.

317. The HTC '177 Products use a block-based motion vector estimation process that compares a plurality of candidate vectors to the determine block-based motion vectors.

318. The HTC '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. The image segment has an image segment center.

319. Documentation from HTC provides additional evidence that the HTC '177 products contain H.265 encoding.

320. The HTC '177 Products use a Prediction Unit matching method wherein the motion vector 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 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) at 347 (September 2014) (emphasis added).

321. By complying with the HEVC standard, the HTC devices – such as the HTC '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 HTC'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."

322. One or more of the HTC '177 Products include technology for motion estimation and motion-compensated picture signal processing.

323. One or more of the HTC '177 Products include technology for estimating a current motion vector for a group of pixels of an image.

324. The HTC '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 HTC '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.").

325. The HTC '177 Products utilize a motion vector selection process 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 13 (2014).

326. One or more HTC subsidiaries and/or affiliates use the HTC '177 Products in regular business operations.

327. The HTC '177 Products are available to businesses and individuals throughout the United States.

328. The HTC '177 Products are provided to businesses and individuals located in the Southern District of New York.

329. The HTC '177 Products use a block-based motion vector estimation process that compares a plurality of candidate vectors to determine block-based motion vectors. The HTC '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.

330. The HTC '177 Products determine at least a most frequently occurring block-based motion vector. The HTC '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).

331. 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 HTC '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).

332. The HTC '177 Products apply a global motion vector as a candidate vector to the block-based motion vector estimation process. Specially, the HTC '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.

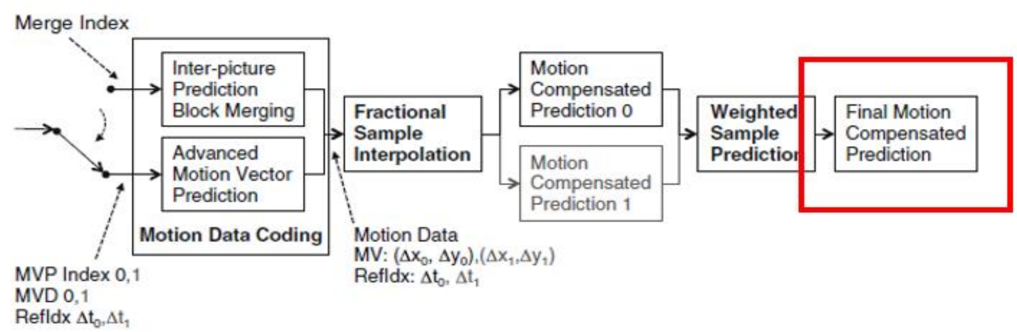


Fig. 5.2 Inter-picture prediction in HEVC (*grey parts* represent the bi-prediction path)

HEVC, HIGH EFFICIENCY VIDEO CODING (HEVC) at 115 (September 2014) (emphasis added).

333. Further, the HTC '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.

G. J. Sullivan, J.-R. Ohm, W.-J. Han, and T. Wiegand, *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).

334. HTC 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.

335. The HTC '177 Products comprise methods and devices for motion estimation and motion-compensated picture signal processing.

336. The HTC '177 Products incorporate 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.

337. The HTC '177 Products determine at least a most frequently occurring block-based motion vector.

338. The HTC '177 Products carry out a global motion vector estimation process using at least the most frequently occurring block-based motion vector to obtain a global motion vector.

339. The HTC '177 Products applies the global motion vector as a candidate vector to the block-based motion vector estimation process.

340. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the HTC '177 Products, HTC 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).

341. HTC also indirectly infringes the '177 patent by actively inducing infringement under 35 U.S.C. § 271(b).

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

343. Alternatively, HTC has had knowledge of the '177 patent since at least March 29, 2010, when Korean Patent No. KR100949980B1, which is owned by HTC and cites the '177 patent family as relevant prior art, was issued. Alternatively, HTC has had knowledge of the '177 patent since at least July 1, 2015, when European Patent No. EP2030450B1, which is owned by HTC and cites the '177 patent family as relevant prior art, was issued.

344. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '177 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '177 Products to utilize the products in a manner that directly infringe one or more claims of the '177 patent.[49] By providing instruction and training to

[49] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-

customers and end-users on how to use the HTC '177 Products in a manner that directly infringes one or more claims of the '177 patent, including at least claim 1, HTC specifically intended to induce infringement of the '177 patent. HTC engaged in such inducement to promote the sales of the HTC '177 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '177 patent. Accordingly, HTC 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.

345. 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. HTC is utilizing the technology claimed in the '177 patent without paying a reasonable royalty. HTC 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.

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

347. As a result of HTC's infringement of the '177 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for HTC's infringement, but in no event less than a reasonable royalty for the use made of the invention by HTC together with interest and costs as fixed by the Court.

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plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

COUNT VII
INFRINGEMENT OF U.S. PATENT NO. 7,010,039

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

349. HTC designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for detecting motion.

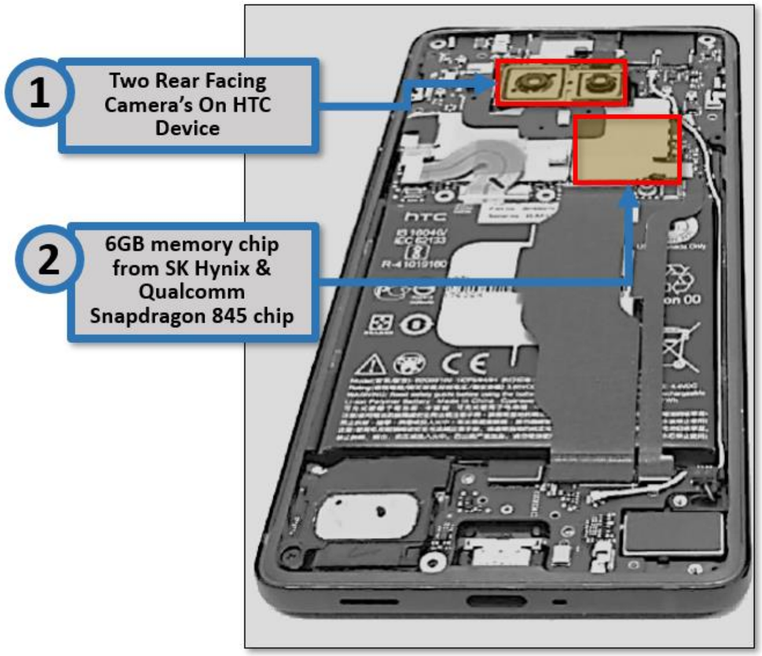
350. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that contain and/or enable H.265 encoding functionality including the HTC U12+ (the "HTC '039 Product(s)").

351. The HTC U12+ device contains a video data encoder that complies with the H.265 standard. Specifically, documentation regarding the HTC U12+ product shows that it can encode "large files using HEVC/H.265 compression."

> Technically, there are twin cameras on either side of the U12+, a first for HTC in the U.S. market. The primary rear array includes the default 12MP (f1.75, 1.4µm) with HTC's UltraPixel 4 lens, and a second 16MP (f.2.0, 1µm) with 2x optical and 10x digital zoom, HDR Boost 2, and utilizes both laser and phase detection autofocus along with optical image stabilization (OIS). On the front are dual 8MP (f.2.0, 1.2µm) UltraPixel lenses with a wide 84-degree field-of-view, HDR Boost and screen flash for face illumination. <u>For video, the camera shoots both standard high-def and 60 frame-per-second (fps) 4K, compressing these large files using HEVC/H.265 compression.</u> The U12+ also can capture 240fps slow motion, but only in high definition.

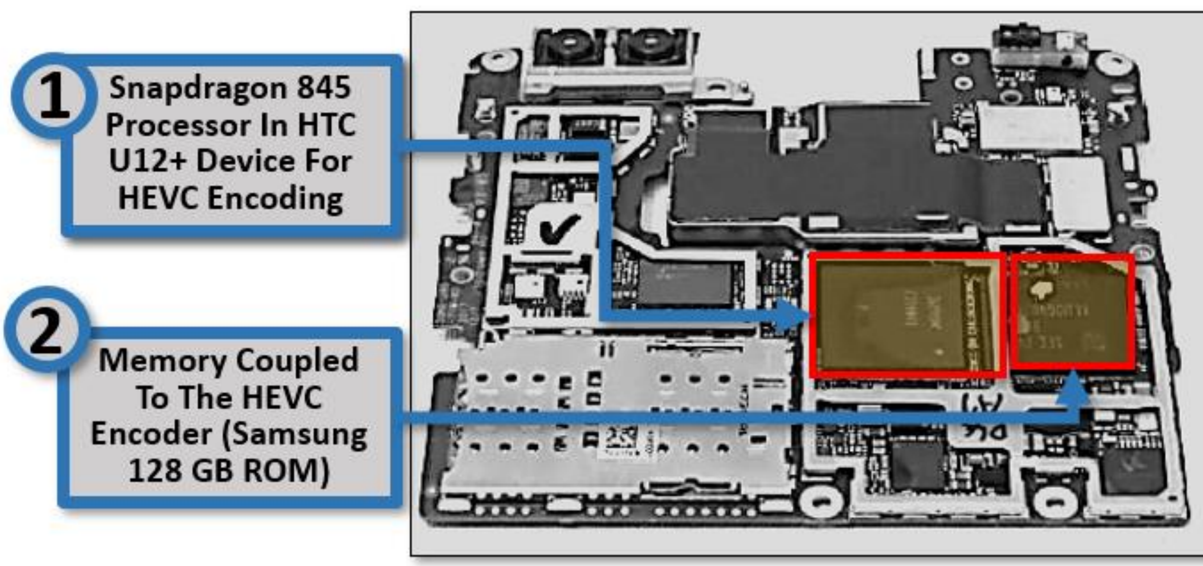
Stewart Wolpin, *HTC U12+ Launches with New Camera And Convenience Features*, TECHLICIOUS.COM WEBSITE (May 25, 2018), *available at*: https://www.techlicious.com/blog/htc-u12-plus-launch/ (emphasis added).

352. The HTC U12+ device contains memory (e.g., SK Hynix 6GB memory chip) and a SD845 processor. The following annotated image shows the internal components of the HTC U12+ device and identifying the memory chip and processor.



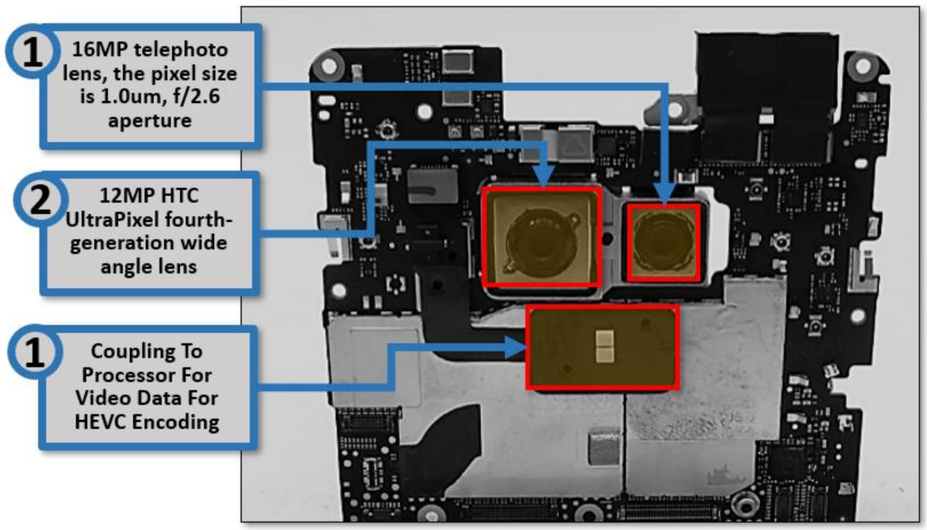
ANNOTATED IMAGE OF THE HTC U12+ DEVICE Internal Components (showing the HTC U12+ rear facing cameras, memory chip, and processor).

353. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The below image of the motherboard in the HTC U12+ device shows that the processor for HEVC encoding is coupled to the memory.



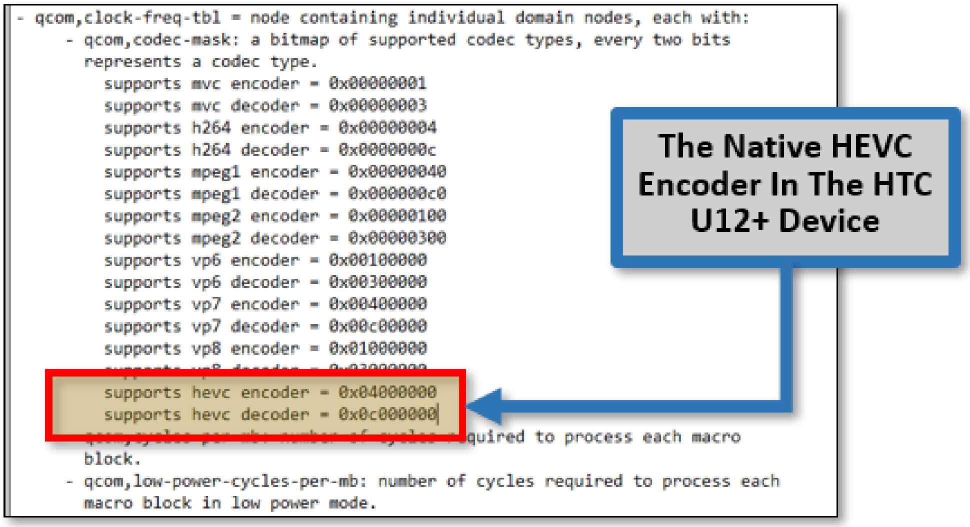
ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor).

354. The HTC U12+ device contains two cameras: (1) a 16 mega pixel camera and (2) a 12 mega pixel camera. The cameras are coupled to the processor such that data captured by the cameras can be encoded into the HEVC format using the HTC U12+ HEVC encoder. The following image of the motherboard in the HEVC U12+ device shows that connection between the cameras and the HEVC encoder.



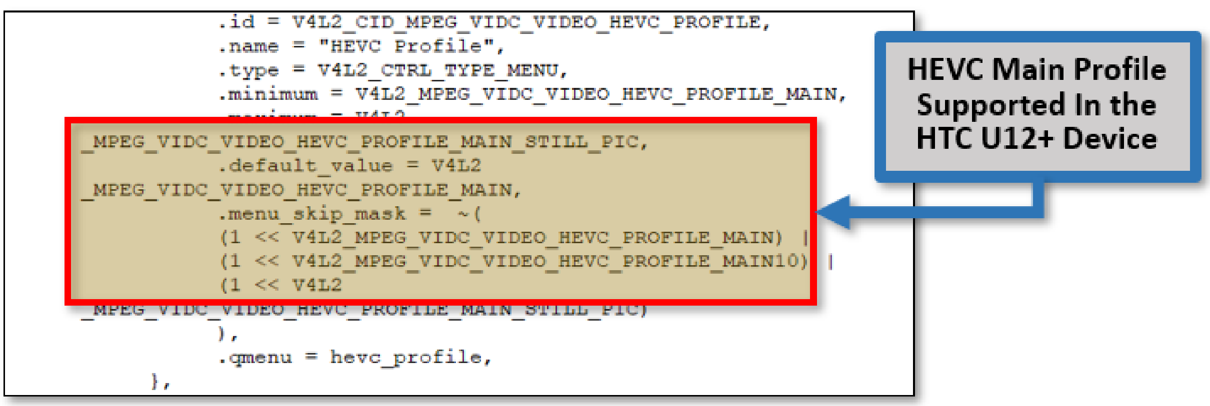
ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ cameras coupled to the HEVC encoder).

355. The HTC U12+ device includes software that enables encoding data in HEVC compliant format. For example, source code files for the HTC U12+ device show that the device contains a native HEVC encoder. The following image shows documentation that is included in the source code for the HTC U12+ device that shows the presence of a native HEVC encoder.


```
- qcom,clock-freq-tbl = node containing individual domain nodes, each with:
    - qcom,codec-mask: a bitmap of supported codec types, every two bits
      represents a codec type.
        supports mvc encoder = 0x00000001
        supports mvc decoder = 0x00000003
        supports h264 encoder = 0x00000004
        supports h264 decoder = 0x0000000c
        supports mpeg1 encoder = 0x00000040
        supports mpeg1 decoder = 0x000000c0
        supports mpeg2 encoder = 0x00000100
        supports mpeg2 decoder = 0x00000300
        supports vp6 encoder = 0x00100000
        supports vp6 decoder = 0x00300000
        supports vp7 encoder = 0x00400000
        supports vp7 decoder = 0x00c00000
        supports vp8 encoder = 0x01000000
        supports hevc encoder = 0x04000000
        supports hevc decoder = 0x0c000000
    ... quired to process each macro
      block.
    - qcom,low-power-cycles-per-mb: number of cycles required to process each
      macro block in low power mode.
```


HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

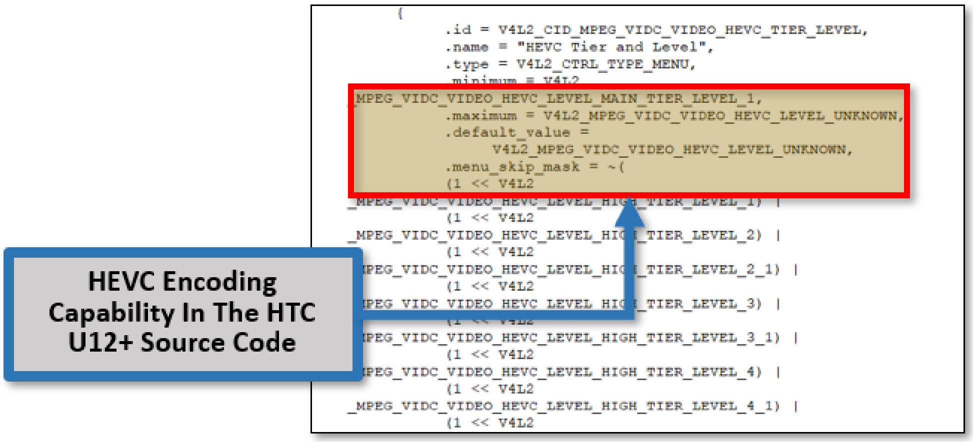
356. The HEVC encoder contained in the HTC U12+ device supports encoding compliant with the HEVC Main and Main10 profile contained in the HEVC standard. The below excerpt from uncompiled source code for the HTC U12+ device shows that the HEVC profiles that are supported by the HEVC encoder.


```
        .id = V4L2_CID_MPEG_VIDC_VIDEO_HEVC_PROFILE,
        .name = "HEVC Profile",
        .type = V4L2_CTRL_TYPE_MENU,
        .minimum = V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN,
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN_STILL_PIC,
        .default_value = V4L2
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN,
        .menu_skip_mask = ~(
        (1 << V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN) |
        (1 << V4L2_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN10) |
        (1 << V4L2
_MPEG_VIDC_VIDEO_HEVC_PROFILE_MAIN_STILL_PIC)
        ),
        .qmenu = hevc_profile,
    },
```


HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder profile contained on the source code of the HTC U12+ device).

357. The HTC U12+ product supports encoding data using several HEVC Levels. The default level for the HEVC encoder in the HTC U12+ device is "Main Tier | Level 1." The

following excerpt from the source code loaded onto the HTC U12+ product shows how this default value is set in the MSM_VENC.C source code file.



HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder "HEVC Tier and Level" control menu on the source code of the HTC U12+ device).

358. The HEVC standard provides details regarding the requirements for an HEVC encoder. Specifically, 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.").

359. The HEVC standard describes that encoding engine as being "symmetric" with the decoding engine. The HEVC standard states:

> The encoding engine is essentially symmetric with the decoding engine, i.e., procedures are called in the same order. The following procedures are described in this clause: InitEncoder, EncodeDecision, EncodeBypass, EncodeTerminate, which correspond to InitDecoder, DecodeDecision, DecodeBypass and DecodeTerminate, respectively. The state of the arithmetic encoding engine is represented by a value of the variable ivlLow pointing to the lower end of a sub-interval and a value of the variable ivlCurrRange specifying the corresponding range of that sub-interval.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 9.3.5.1 (February 2018).

360. One or more HTC subsidiaries and/or affiliates use the HTC '039 Products in regular business operations.

361. The HTC '039 Products contain functionality wherein a criterion function for candidate vectors is optimized. The criterion function depends on data obtained from the previous and next images in the video data stream. The optimizing is carried out at a temporal intermediate position in non-covered and covered areas. The following excerpts explain how HEVC is a form of encoding video information using a temporal intermediate position between previous and next images.

> 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).

> HEVC features both low- and high-level methods for dependency removal which can be used to leverage multi-core processors [13]. Only the three high-level mechanisms slices, tiles and WPP are of interest for this work. It is important to note that all of them subdivide individual video frames based on CTUs which are HEVC's basic processing unit. CTUs have a maximum size of 64×64 luma pixels and are recursively split into square-shaped Coding Units (CUs), which contain Prediction Units (PUs) and Transform Units (TUs) [14].

Stefan Radicke, *et al*., *Many-Core HEVC Encoding Based on Wavefront Parallel Processing and GPU -accelerated Motion Estimation*, E-BUSINESS AND TELECOMMUNICATIONS: 11TH INTERNATIONAL JOINT CONFERENCE at 296 (2015) ("HEVC feature both low- and high-level methods for dependency removal which can be used to leverage multi-core processors. . . It is important to note that all of them subdivide individual video frames based on CTUs which are HEVC' basic processing unit.").

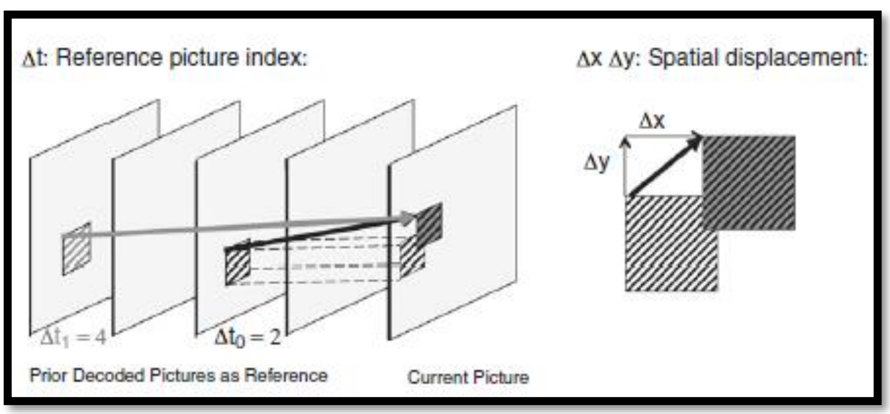
362. The HTC '039 Products receive encoded video data that is encoded using inter-frame coding. The encoded video stream received by the HTC '039 Products are coded using its predecessor frame and subsequent frame. Inter-prediction used in the encoded video data received

by the HTC '039 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).

363. The encoded video stream received by the HTC '039 Products are 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.



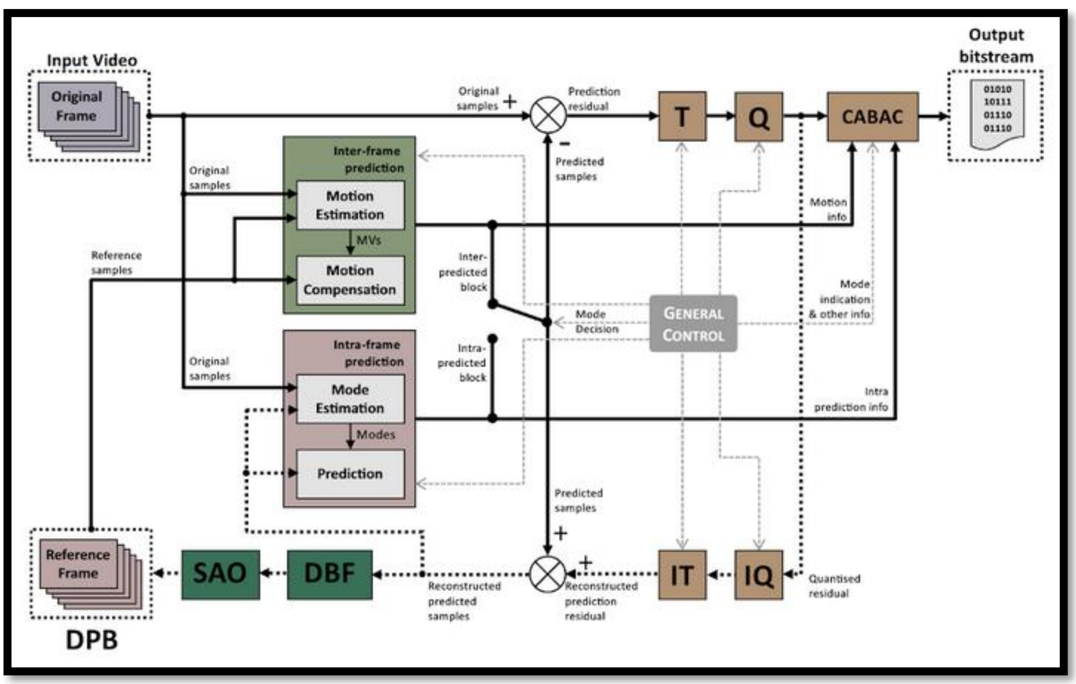
Benjamin Bross, *Inter-Picture Prediction In HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 114 (September 2014).

364. The following excerpt from an article describing the architecture of the encoded video stream received by the HTC ’039 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 . . . or two reference frames (bi-prediction) 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) (September 2014).

365. The following diagram shows how the HTC ‘039 Products receive video data encoded using inter-frame prediction. Specifically, interframe prediction generates a motion vector based on the motion estimation across frames.



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

366. The HTC ‘039 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 HTC ‘039 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; 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.

367. The HTC ’039 Products optimize the selection of candidate vectors by calculation a temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas. Specifically, the encoding process for video data received by the HTC ‘039 Products use inter-picture prediction wherein motion data comprises the selection of a reference frame and motion vectors to be applied in predicting the samples of each block.

368. The “Overview of Design Characteristics” in the HEVC specification 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).

369. By complying with the HEVC standard, the HTC devices – such as the HTC '039 Products – necessarily infringe the '039 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '039 patent, including but not limited to claim 13. *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 HTC's infringement of the '039 patent: "5.3 Logical operators;" "5.10 Variables, syntax elements and tables;" "5.11 Text description of logical operations;" "7.2 Specification of syntax functions and descriptors;" "7.3.1 NAL unit syntax;" "7.3.2 Raw byte sequence payloads, trailing bits and byte alignment syntax;" "7.3.5 Supplemental enhancement information message syntax;" "7.4.2 NAL unit semantics;" and "7.4.6 Supplemental enhancement information message semantics."

370. The HTC '039 Products are available to businesses and individuals throughout the United States.

371. The HTC '039 Products are provided to businesses and individuals located in the Southern District of New York.

372. HTC has directly infringed and continues to directly infringe the '039 patent by, among other things, making, using, offering for sale, and/or selling technology for detecting motion, including but not limited to the HTC '039 Products.

373. The HTC '039 Products detect motion at a temporal intermediate position between previous and next images.

374. The HTC '039 Products carry out the optimization at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

375. The HTC '039 Products detect motion at a temporal intermediate position between previous and next images.

376. The HTC '039 Products utilize a criterion function for candidate vectors that is optimized.

377. The HTC '039 Products utilize a criterion function that depends on data from both previous and next images and in which the optimizing is carried out at the temporal intermediate position in non-covering and non-uncovering areas, characterized in that the optimizing is carried out at the temporal position of the next image in covering areas and at the temporal position of the previous image in uncovering areas.

378. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the HTC '039 Products, HTC has injured Dynamic Data and is liable for directly infringing one or more claims of the '039 patent, including at least claim 13, pursuant to 35 U.S.C. § 271(a).

379. HTC also indirectly infringes the '039 patent by actively inducing infringement under 35 U.S.C. § 271(b).

380. HTC has had knowledge of the '039 patent since at least service of the Original Complaint in this case or shortly thereafter, and on information and belief, HTC knew of the '039 patent and knew of its infringement, including by way of this lawsuit.

381. HTC intended to induce patent infringement by third-party customers and users of the HTC '039 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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '039 patent. HTC performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '039 patent and with the knowledge that the induced acts would constitute infringement. For example, HTC provides the HTC '039 Products that have the capability of operating in a manner that infringe one or more of the claims of the '039 patent, including at least claim 13, and HTC further provides documentation and training materials that cause customers and end users of the HTC '039 Products to utilize the products in a manner that directly infringe one or more claims of the '039 patent.[50] By providing instruction and training to customers and end-users on how to use the HTC '039 Products in a manner that directly infringes one or more claims of the '039 patent, including at least claim 13, HTC specifically intended to induce infringement of the '039 patent. HTC engaged in such inducement to promote the sales of the HTC '039 Products, e.g., through HTC user manuals, product support, marketing materials,

[50] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

and training materials to actively induce the users of the accused products to infringe the '039 patent. Accordingly, HTC 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 '039 patent, knowing that such use constitutes infringement of the '039 patent.

382. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '039 patent.

383. As a result of HTC's infringement of the '039 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for HTC's infringement, but in no event less than a reasonable royalty for the use made of the invention by HTC together with interest and costs as fixed by the Court.

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

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

385. HTC designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for video compression.

386. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that contain and/or enable H.265 encoding functionality including the HTC U12+ (the "HTC '112 Product(s)").

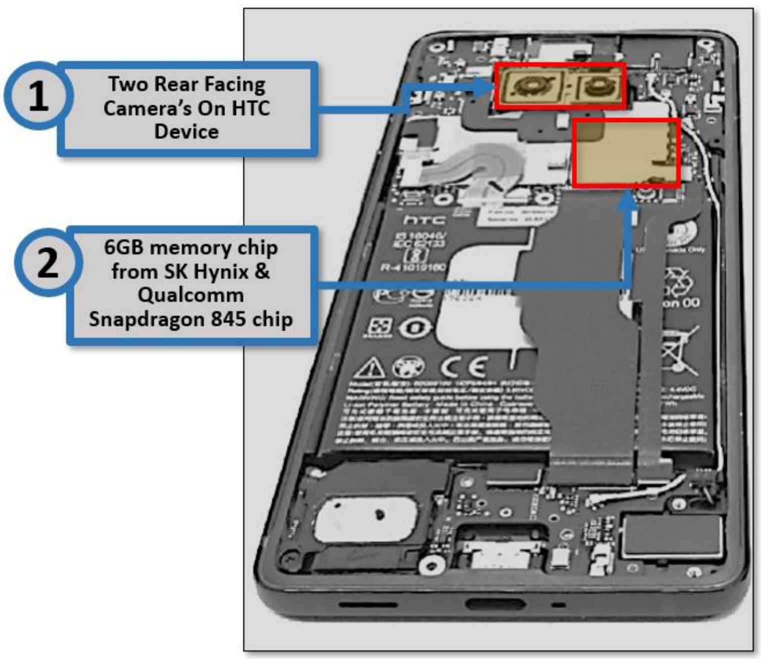
387. The HTC U12+ device contains a video data encoder that complies with the H.265 standard. Specifically, documentation regarding the HTC U12+ product shows that it can encode "large files using HEVC/H.265 compression."

> Technically, there are twin cameras on either side of the U12+, a first for HTC in the U.S. market. The primary rear array includes the default 12MP (f1.75, 1.4μm)

> with HTC's UltraPixel 4 lens, and a second 16MP (f.2.0, 1µm) with 2x optical and 10x digital zoom, HDR Boost 2, and utilizes both laser and phase detection autofocus along with optical image stabilization (OIS). On the front are dual 8MP (f.2.0, 1.2µm) UltraPixel lenses with a wide 84-degree field-of-view, HDR Boost and screen flash for face illumination. For video, the camera shoots both standard high-def and 60 frame-per-second (fps) 4K, compressing these large files using HEVC/H.265 compression. The U12+ also can capture 240fps slow motion, but only in high definition.

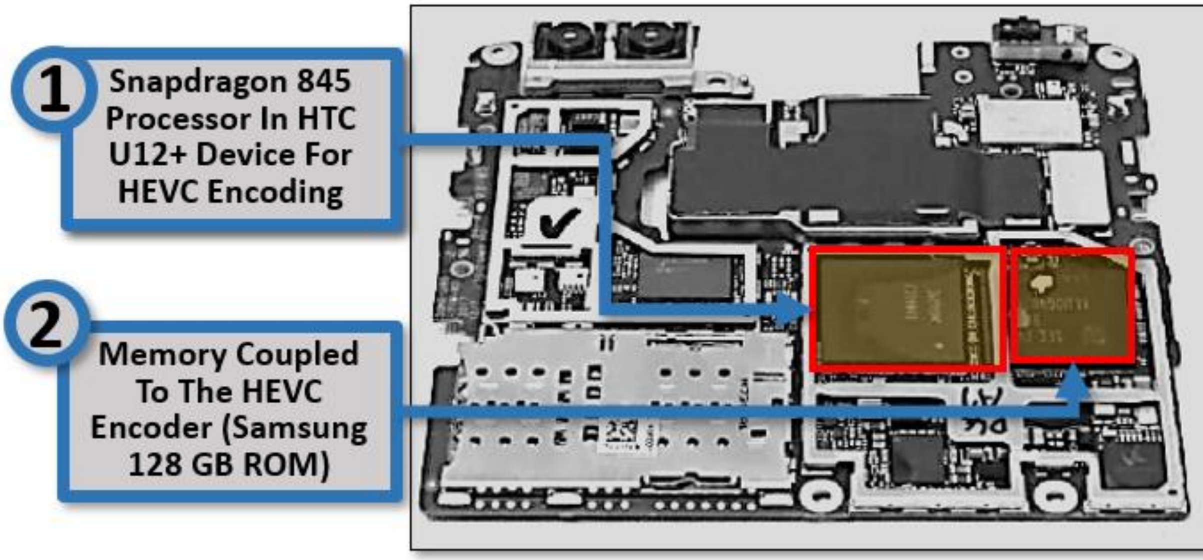
Stewart Wolpin, *HTC U12+ Launches with New Camera And Convenience Features,* TECHLICIOUS.COM WEBSITE (May 25, 2018), *available at*: https://www.techlicious.com/blog/htc-u12-plus-launch/ (emphasis added).

388. The HTC U12+ device contains memory (e.g., SK Hynix 6GB memory chip) and a SD845 processor. The following annotated image shows the internal components of the HTC U12+ device and identifying the memory chip and processor.



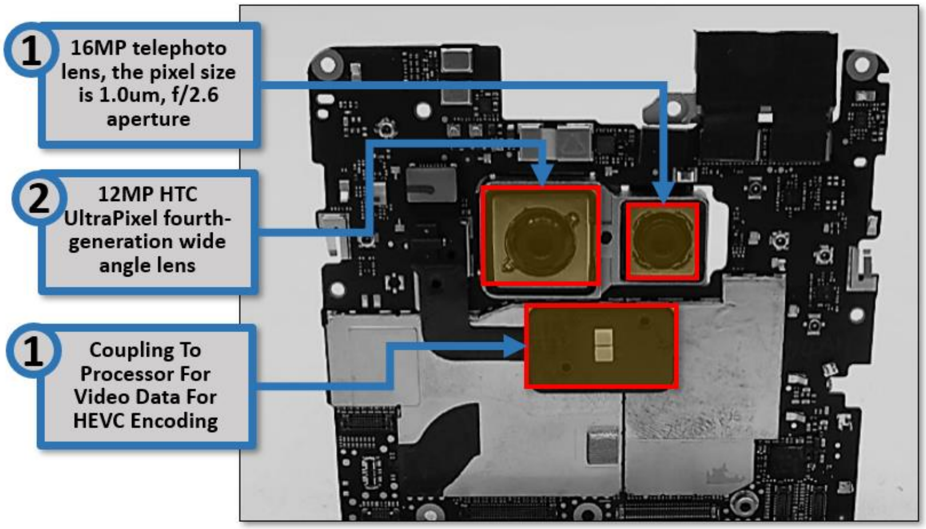
ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ rear facing cameras, memory chip, and processor).

389. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The below image of the motherboard in the HTC U12+ device shows that the processor for HEVC encoding is coupled to the memory.



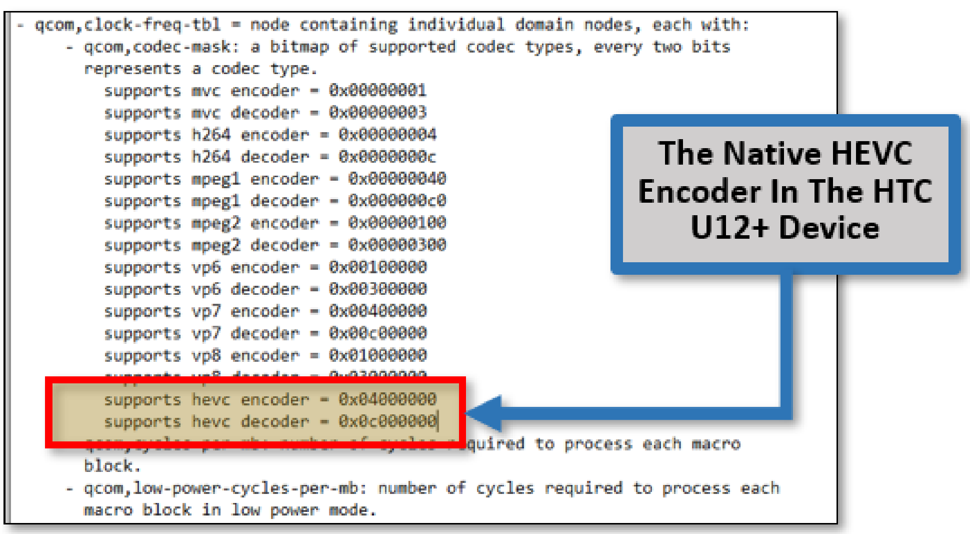
ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor).

390. The HTC U12+ device contains two cameras: (1) a 16 mega pixel camera and (2) a 12 mega pixel camera. The cameras are coupled to the processor such that data captured by the cameras can be encoded into the HEVC format using the HTC U12+ HEVC encoder. The following image of the motherboard in the HEVC U12+ device shows that connection between the cameras and the HEVC encoder.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ cameras coupled to the HEVC encoder).

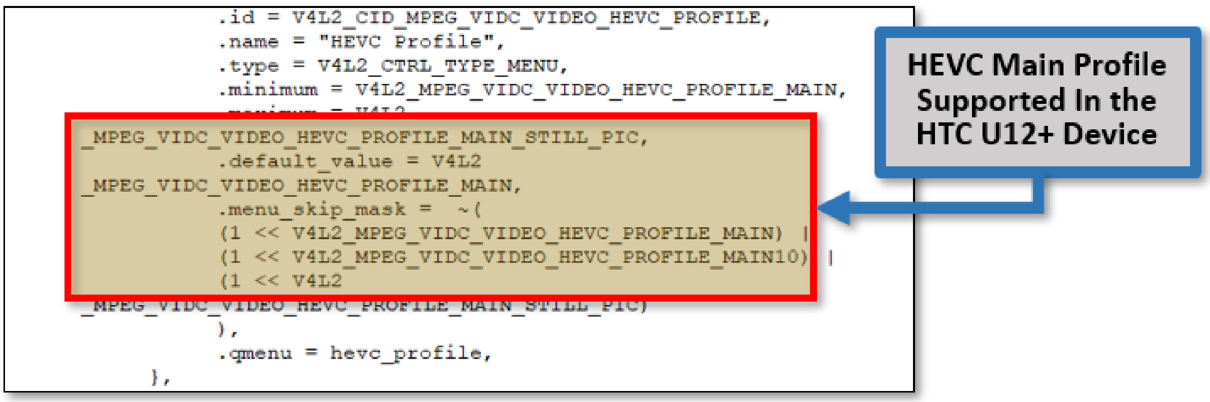
391. The HTC U12+ device includes software that enables encoding data in HEVC compliant format. For example, source code files for the HTC U12+ device show that the device contains a native HEVC encoder. The following image shows documentation that is included in the source code for the HTC U12+ device that shows the presence of a native HEVC encoder.



```
- qcom,clock-freq-tbl = node containing individual domain nodes, each with:
   - qcom,codec-mask: a bitmap of supported codec types, every two bits
     represents a codec type.
       supports mvc encoder = 0x00000001
       supports mvc decoder = 0x00000003
       supports h264 encoder = 0x00000004
       supports h264 decoder = 0x0000000c
       supports mpeg1 encoder = 0x00000040
       supports mpeg1 decoder = 0x000000c0
       supports mpeg2 encoder = 0x00000100
       supports mpeg2 decoder = 0x00000300
       supports vp6 encoder = 0x00100000
       supports vp6 decoder = 0x00300000
       supports vp7 encoder = 0x00400000
       supports vp7 decoder = 0x00c00000
       supports vp8 encoder = 0x01000000
       supports hevc encoder = 0x04000000
       supports hevc decoder = 0x0c000000
     quired to process each macro
     block.
   - qcom,low-power-cycles-per-mb: number of cycles required to process each
     macro block in low power mode.
```

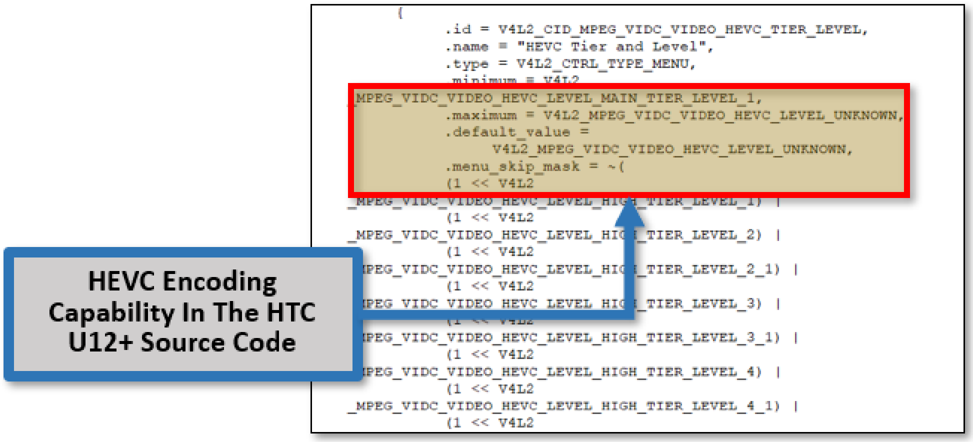

HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

392. The HEVC encoder contained in the HTC U12+ device supports encoding compliant with the HEVC Main and Main10 profile contained in the HEVC standard. The below excerpt from uncompiled source code for the HTC U12+ device shows that the HEVC profiles that are supported by the HEVC encoder.



HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder profile contained on the source code of the HTC U12+ device).

393. The HTC U12+ product supports encoding data using several HEVC Levels. The default level for the HEVC encoder in the HTC U12+ device is "Main Tier | Level 1." The following excerpt from the source code loaded onto the HTC U12+ product shows how this default value is set in the MSM_VENC.C source code file.



HTC U12+ Kernel Source Code File: MSM_VENC.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video encoder "HEVC Tier and Level" control menu on the source code of the HTC U12+ device).

394. The HEVC standard provides details regarding the requirements for an HEVC encoder. Specifically, 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.").

395. The HEVC standard describes that encoding engine as being "symmetric" with the decoding engine. The HEVC standard states:

> The encoding engine is essentially symmetric with the decoding engine, i.e., procedures are called in the same order. The following procedures are described in this clause: InitEncoder, EncodeDecision, EncodeBypass, EncodeTerminate, which correspond to InitDecoder, DecodeDecision, DecodeBypass and DecodeTerminate, respectively. The state of the arithmetic encoding engine is represented by a value of the variable ivlLow pointing to the lower end of a sub-interval and a value of the variable ivlCurrRange specifying the corresponding range of that sub-interval.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 9.3.5.1 (February 2018).

396. One or more HTC subsidiaries and/or affiliates use the HTC '112 Products in regular business operations.

397. The HTC '112 Products select the selected image selection area based on a range of possible motion vectors in the selected image search area. Further, the search area of the selected image segment has a center. Specifically, the HTC '112 Products contain functionality for selecting a coding unit. The coding unit comprises a selected image segment.

398. The H.265/HEVC encoding performed by the HTC '112 Products enables the selection of an image segment of a given image corresponding to an image segment of a first video image. The selected image segment has a center and a search area is defined around the image segment.

399. The HTC '112 Products contain an image processing unit that receives, at a minimum, two frames of a video from memory. These frames are then processed by the video compensation unit of the HTC '112 Products. Further, the HTC '112 Products contain an encoder for motion estimation. "[T]he encoder needs to perform motion estimation, which is one of the most computationally expensive operations in the encoder, and complexity is reduced by allowing less candidates."[51]

400. The HTC '112 Products perform encoding using motion compensation, specifically, inter-picture prediction wherein the HTC '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 HTC '112 Product compares 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.

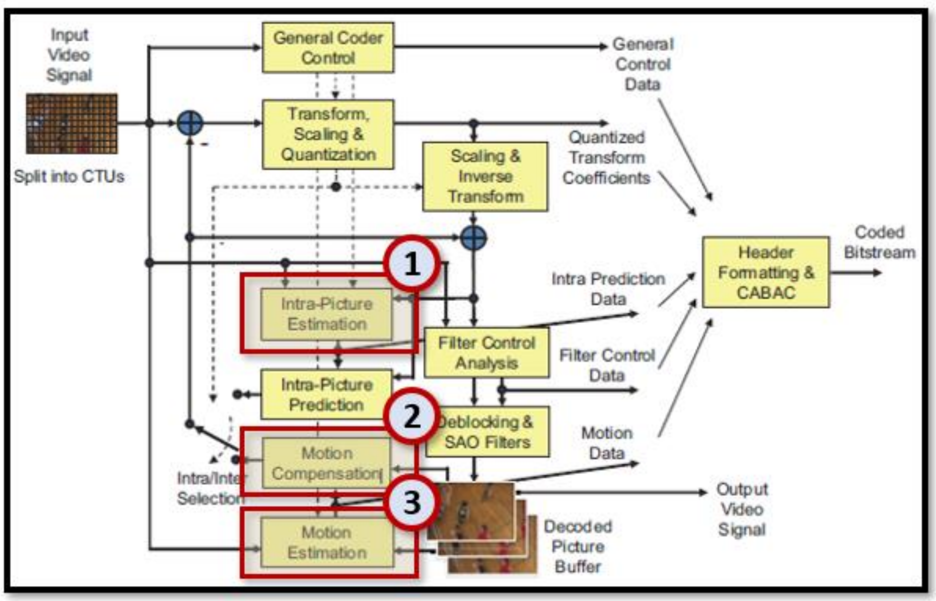
[51] Gary J. Sullivan, *et al.*, *Overview of the High Efficiency Video Coding (HEVC) Standard*, PRE-PUBLICATION DRAFT, TO APPEAR IN IEEE TRANS. ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY at 13 (December 2012) (emphasis added).

401. The HTC '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).

402. The HTC '112 Products 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 HTC '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).

403. The HTC '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).

404. The HTC '112 Products comprise a system wherein an intra-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 HTC '112 Products, when selecting a temporal candidate for HEVC intra-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);

405. Descriptions of the HEVC encoding process, which are implemented by the HTC '112 Products, state "for the temporal candidate, the right bottom position just outside of the collocated PU of the reference picture is used if it is available. Otherwise, the center position is

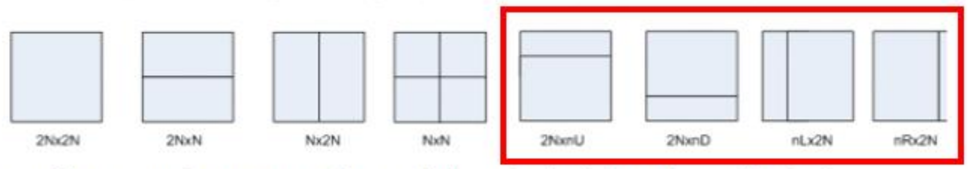
used instead." G. J. Sullivan, J.-R. Ohm, W.-J. Han, and T. Wiegand, *Overview of the High Efficiency Video Coding (HEVC) Standard*, IEEE TRANS. ON CIRCUIT AND SYSTEMS FOR VIDEO TECHNOLOGY at 13 (December 2012).

406. The HTC video encoder in the HTC '112 Products selects an image segment of a second video image corresponding to an image segment of a first video image. The image segment further has an image segment center.

407. The HTC '112 Products encode video data such that a predetermined search area (S) center is offset from the center of the image segment. The predetermined search area is called a partition and there are eight different partition modes in the H.265 standard, these partition modes are shown in the figure below. The last four partition modes are asymmetric, meaning their center is offset from the overall CU center.

Prediction Units

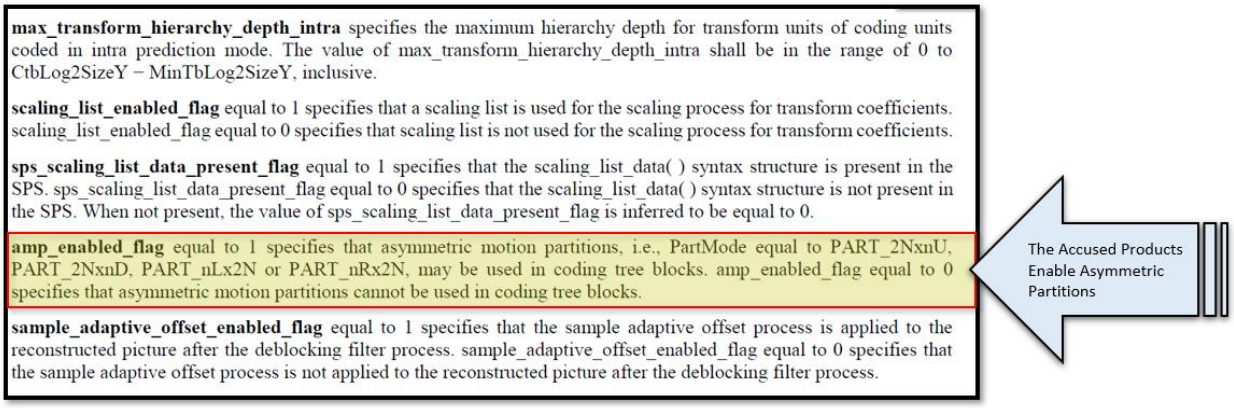
We have introduced the new transform sizes just after the picture partitioning to exploit the analogy between CU and TU trees, but before transform and quantization there's the prediction phase (inter or intra).
A CU can be predicted using one of eight partition modes (see picture below).



Even if a CU contains one, two or four prediction units (PUs), it can be predicted using exclusively inter-frame or intra-frame prediction technique, furthermore Intra-coded CUs can use only the square partitions 2Nx2N or NxN. Inter-coded CUs can use both square and asymmetric partitions. A number of other limitations are applied to simplify signaling. For example, no 4×4 prediction is allowed in inter-prediction and 4×8 and 8×4 are allowed only in forward prediction (so not in b-frames). Tendentially inter-prediction stops at 8×8 level.

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

408. The figure below shows the syntax as well as the instructions for enabling the asymmetric partitions within the H.265 standard, which is used by the HTC '112 Products.



max_transform_hierarchy_depth_intra specifies the maximum hierarchy depth for transform units of coding units coded in intra prediction mode. The value of max_transform_hierarchy_depth_intra shall be in the range of 0 to CtbLog2SizeY − MinTbLog2SizeY, inclusive.

scaling_list_enabled_flag equal to 1 specifies that a scaling list is used for the scaling process for transform coefficients. scaling_list_enabled_flag equal to 0 specifies that scaling list is not used for the scaling process for transform coefficients.

sps_scaling_list_data_present_flag equal to 1 specifies that the scaling_list_data( ) syntax structure is present in the SPS. sps_scaling_list_data_present_flag equal to 0 specifies that the scaling_list_data( ) syntax structure is not present in the SPS. When not present, the value of sps_scaling_list_data_present_flag is inferred to be equal to 0.

amp_enabled_flag equal to 1 specifies that asymmetric motion partitions, i.e., PartMode equal to PART_2NxnU, PART_2NxnD, PART_nLx2N or PART_nRx2N, may be used in coding tree blocks. amp_enabled_flag equal to 0 specifies that asymmetric motion partitions cannot be used in coding tree blocks.

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. sample_adaptive_offset_enabled_flag equal to 0 specifies that the sample adaptive offset process is not applied to the reconstructed picture after the deblocking filter process.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at 76 (April 2015) (annotation added).

409. The HTC '112 Products receive encoded video data that is encoded using intra-frame coding. Specifically, the encoded video stream received by the HTC '112 Products is coded using a reference group of pixels in the video frame. Intra-frame prediction used in the encoded video data received by the HTC '112 Products allows a transform block to span across multiple prediction blocks for intra-frame-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).

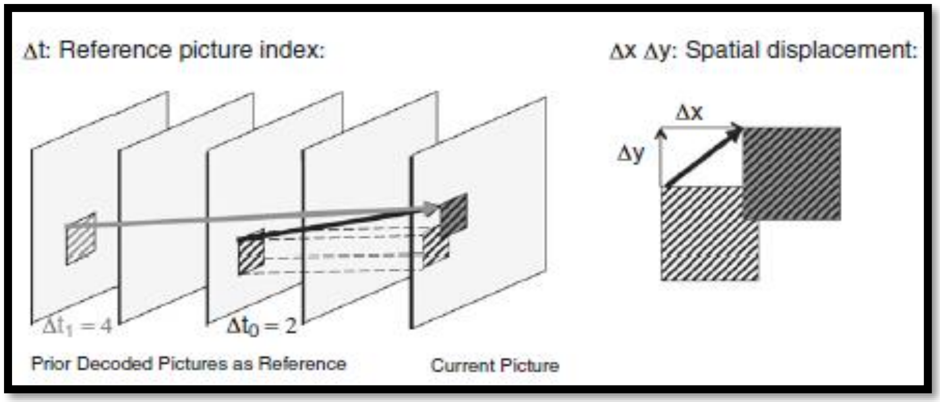
410. The HTC '112 Products comprise functionality for retrieving image motion data related to the search area. Specifically, the HTC '112 Products retrieve data relating to the motion search area. The data, which includes the motion vector index, is sent from the encoder and retrieved by the decoder.

> Since inter-picture prediction typically compensates for the motion of real-world objects between pictures of a video sequence, it is also referred to as motion-

> compensated prediction. While intra-picture prediction exploits the spatial redundancy between neighboring blocks inside a picture, motion-compensated prediction utilizes the large amount of temporal redundancy between pictures. In either case, the resulting prediction error, which is formed by taking the difference between the original block and its prediction, is transmitted using transform coding, which exploits the spatial redundancy inside a block and consists of a decorrelating linear transform, scalar quantization of the transform coefficients and entropy coding of the resulting transform coefficient levels.

Heiko Schwarz, Thomas Schierl, Detlev Marpe, *Block Structures and Parallelism Features in HEVC*, in HEVC, HIGH EFFICIENCY VIDEO CODING (HEVC) at 49 (September 2014) (emphasis added).

411. The HTC '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 HTC '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 HTC '112 Product 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) at 114 (September 2014).

412. By complying with the HEVC standard, the HTC devices – such as the HTC '112 Products – necessarily infringe the '112 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '112 patent, including but not limited to claim 11 of the '112 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 HTC's infringement of the '112 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.").

413. One or more HTC subsidiaries and/or affiliates use the HTC '112 Products in regular business operations.

414. One or more of the HTC '112 Products include technology for video compression.

415. HTC 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 HTC ‘112 Products.

416. One or more of the HTC ‘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.

417. One or more of the HTC ‘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.

418. One or more of the HTC ‘112 Products include 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.

419. The HTC ‘112 Products are available to businesses and individuals throughout the United States.

420. The HTC ‘112 Products are provided to businesses and individuals located in the Southern District of New York.

421. 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 HTC ‘112 Products, HTC 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).

422. HTC also indirectly infringes the '112 patent by actively inducing infringement under 35 U.S.C. § 271(b).

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

424. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '112 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '112 Products to utilize the products in a manner that directly infringe one or more claims of the '112 patent.[52] By providing instruction and training to customers and end-users on how to use the HTC '112 Products in a manner that directly infringes one or more claims of the '112 patent, including at least claim 11, HTC specifically intended to

[52] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

induce infringement of the '112 patent. HTC engaged in such inducement to promote the sales of the HTC '112 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '112 patent. Accordingly, HTC 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.

425. 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. HTC is utilizing the technology claimed in the '112 patent without paying a reasonable royalty. HTC 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.

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

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

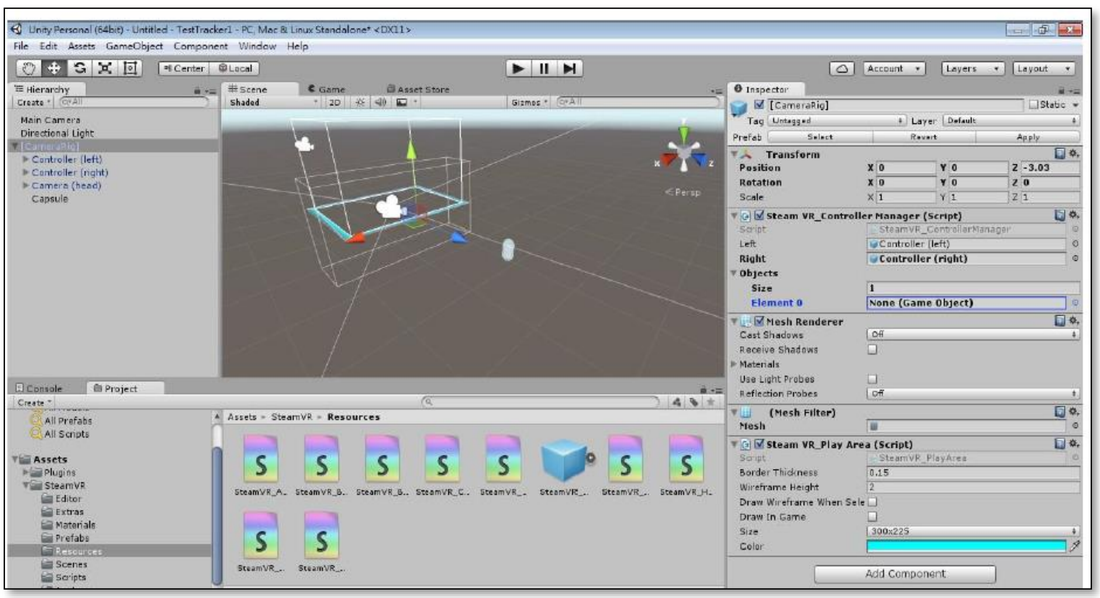
COUNT IX
INFRINGEMENT OF U.S. PATENT NO. 6,646,688

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

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

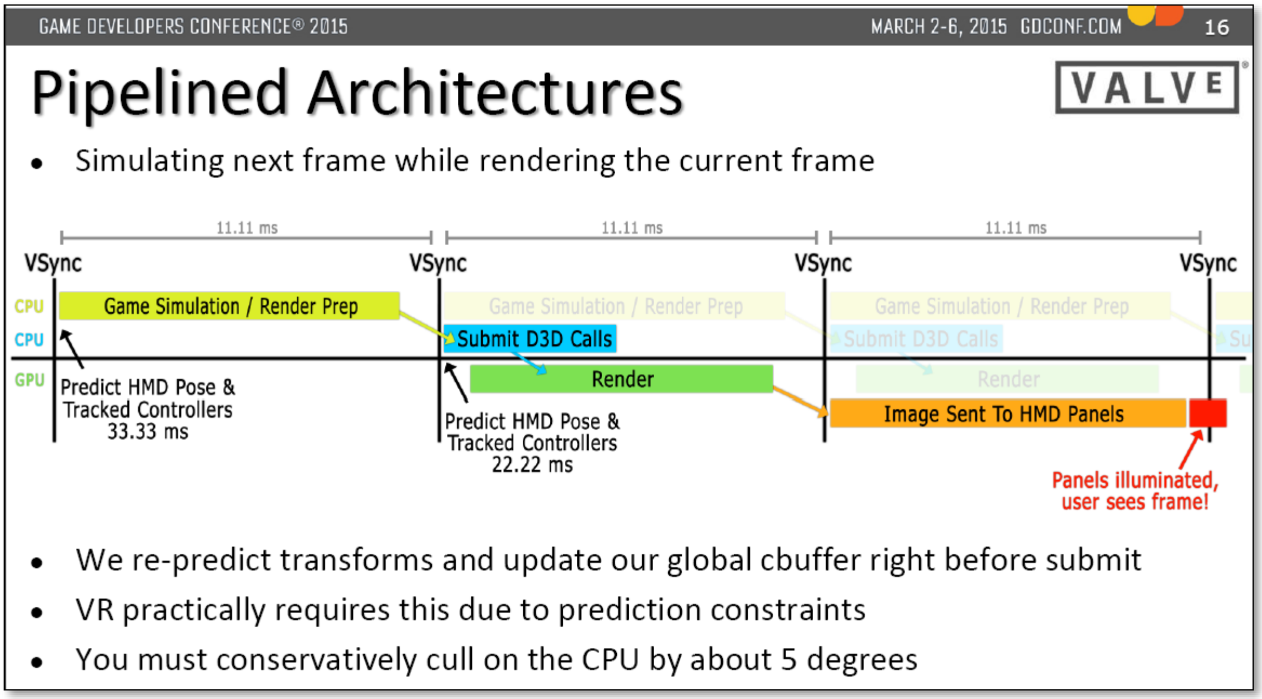
430. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC VIVE virtual reality products, including the HTC VIVE Pro and HTC VIVE (collectively, the "HTC '688 Product(s)").

431. The HTC '688 Products comprise a video/graphics data processing method that enables the processing of an image using a color key (aka chroma key). The following excerpt from HTC documentation identifies the ability to process image data using a color key. An example of a color key that is enabled by the HTC '688 Products is shown in the lower right of the below image.



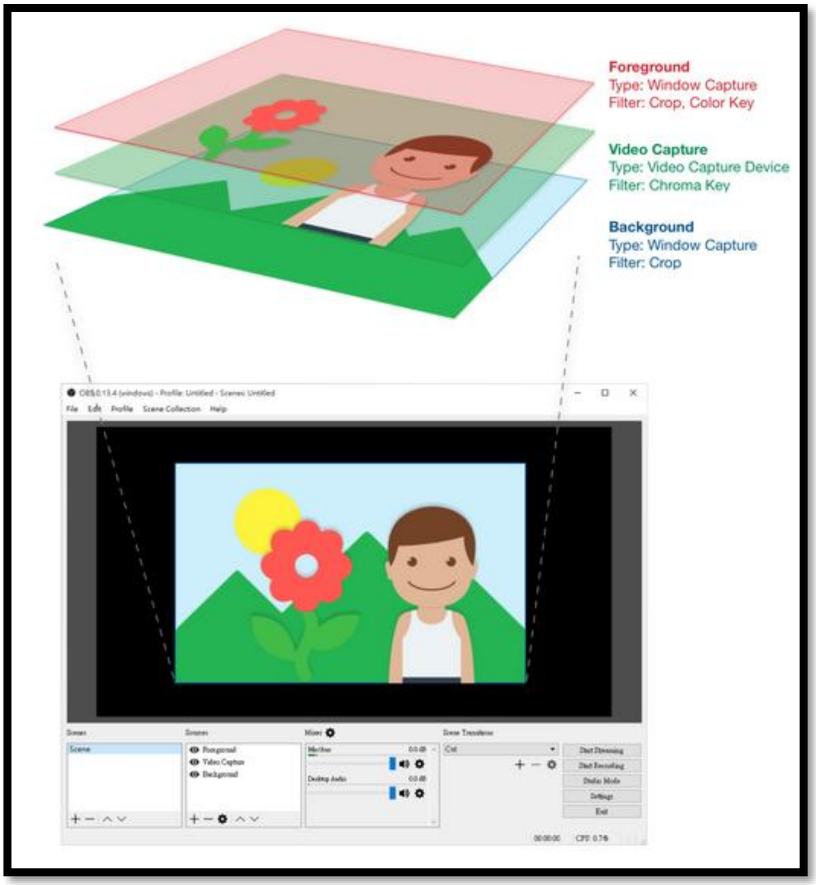
HTC '688 HTC VIVE TRACKER (2018) DEVELOPER GUIDELINES VER. 1.0 at 41 (2018).

432. The HTC '688 Products enable pre-processing a stream of digital video data that will output pre-processed data. The below excerpt from a presentation at the Game Developers Conference describes the graphics pipeline architecture where the image data is merged as part of the rendering process (green box below) and then sent to the "HMD Panels."



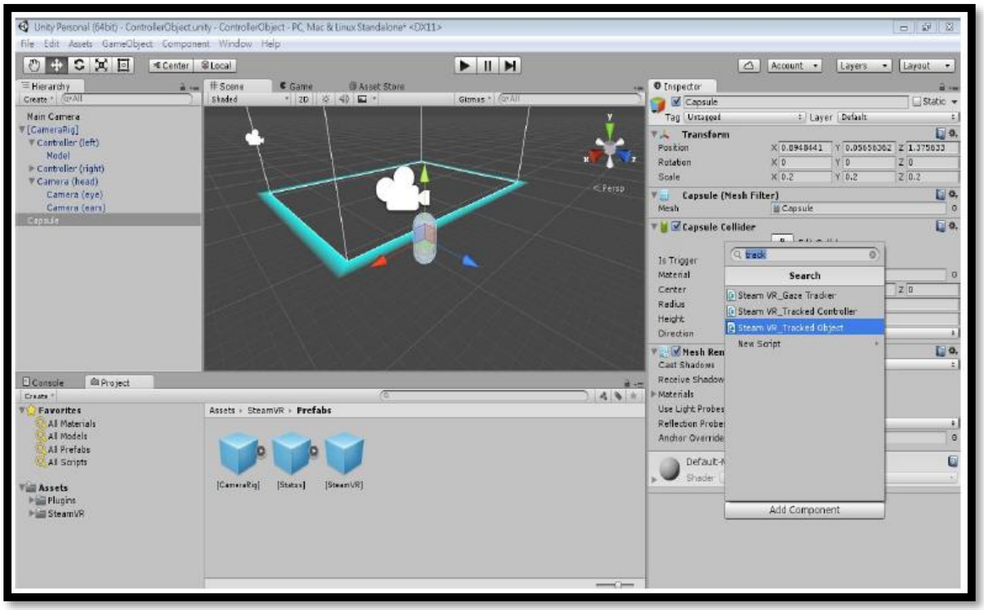
Alex Vlachos, *Advanced VR Rendering*, GAME DEVELOPERS CONFERENCE PRESENTATION at 16 (March 2015).

433. The HTC '688 Products perform the step of processing a color key from the pre-processed data to output resulting data. For example, the HTC VIVE processes a color key such that it is applied to a video stream of data and a processed video stream is outputted where the color is applied to the video stream. Specifically, the HTC '688 Products graphics engine will process both a color key and a video data stream.



How To Shoot Mixed Reality Video With HTC VIVE, HTC VIVE WEBSITE ADMINISTRATOR POSTING (August 30, 2016).

434. The HTC ’688 Products perform the step of taking the resulting data and substituting the color key with a pre-selected color. For example, the resulting data can be processed with a different color key (e.g., blue) as part of the mixed reality functionality in the HTC VIVE. The below image shows the functionality in the authoring system to process the video data with a pre-selected color key.



HTC VIVE Tracker Developer Guidelines Ver. 1.0 at 2 (2018).

435. The HTC '688 Products comprise a system for pre-processing a stream of digital video/graphics data to output pre-processed data. Specifically, the HTC '688 Products are described in the below excerpt from HTC documentation as enabling the steps of tracking moving objects and placing them into a chroma-keyed scene. The below excerpts from the VIVE Tracker Developer Guidelines shows two use cases where moving objects are tracked using a wireless interface and then placed into an image.

Use Case 4: Track moving objects using a wireless interface in VR, with the accessory passing data to a PC via USB, BT/Wi-Fi or propriety RF. This case is similar to Use Case 3, but the accessory transfers data to/from a PC directly for a specific purpose based on its design.

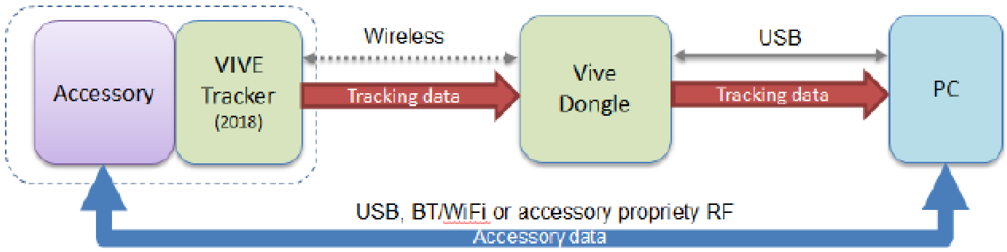
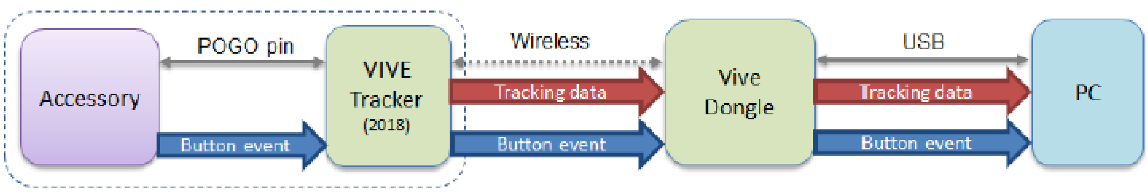


Figure: Use case 4 of VIVE Tracker (2018)

Use Case 5: Track moving objects using a wireless interface in VR, with the accessory simulating buttons of the Vive controller or passing data to a PC via the VIVE Tracker (2018). This case is similar to Use Case 3, but the accessory connects with the VIVE Tracker (2018) to transfer button event to a PC by Pogo pin.



HTC VIVE TRACKER DEVELOPER (2018) GUIDELINES VER. 1.0 at 2 (2018).

436. The HTC '688 Products comprise a system wherein the data is transformed by substituting the color key with a preselected color. Specifically, Chroma Key can be preset to four different colors which are then used to substitute the color key with a preselected color. For example, a chroma keyed image (such as a controller) is placed into an image and the image is scaled using vectors. The chroma keyed image can also be scaled using vectors when it is placed into an image. The below excerpt from HTC VIVE developer documentation show how to transform the accessory by comparing vectors parallel to y-axis and z-axis of the Vive Tracker (AxisY_Tracker, AxisZ_Tracker) and the accessory (AxisY_Accessory, AxisZ_Accessory).

```
public class Accessory : MonoBehaviour {

   const Vector3 AxisY_Tracker = new Vectors(AxisY_Tracker_X, AxisY_Tracker_Y,
AxisY_Tracker_Z);
   const Vector3 AxisZ_Tracker = new Vectors(AxisZ_Tracker_X, AxisZ_Tracker_Y, AxisZ_Tracker_Z);

   const Vector3 AxisY_Accessory = new Vectors(AxisY_ Accessory _X, AxisY_ Accessory _Y, AxisY_
Accessory _Z);
   const Vector3 AxisZ_ Accessory = new Vectors(AxisZ_ Accessory _X, AxisZ_ Accessory _Y, AxisZ_
Accessory _Z);

   void Update () {

      //Calculate delta rotation by comparing vectors parallel to Y axes of Tracker and the accessory
      Quaternion delta_rotY = Quaternion.FromToRotation(AxisY_Tracker, AxisY_Accessory);
      AxisZ_Tracker = delta_rotY * AxisZ_Tracker;
      Quaternion delta_rotZ = Quaternion.FromToRotation(AxisZ_Tracker, AxisZ_Accessory);

      //Collect delta rotation and displacement between Tracker and Accessory
      Vector3 delta_displacement = new Vector3(dX, dY, dZ);
      Quaternion delta_rotation  = delta_rotZ * delta_rotY;

      //Get current Tracker pose
      Vector3 tracker_position    = SteamVR_Controller.Input(3).transform.pos;
      Quaternion tracker_rotation = SteamVR_Controller.Input(3).transform.rot;

      //Transform current Tracker pose to Accessory pose
      GameObject.Find("Accessory ").transform.rotation = delta_rotation * tracker_rotation;
      GameObject.Find("Accessory ").transform.position = tracker_position + (delta_rotation *
tracker_rotation) * delta_displacement;
   }
}
```

HTC VIVE TRACKER DEVELOPER GUIDELINES VER. 1.3 at 30 (January 19, 2017).

437. One or more HTC subsidiaries and/or affiliates use the HTC '688 Products in regular business operations.

438. The HTC '688 Products are available to businesses and individuals throughout the United States.

439. The HTC '688 Products are provided to businesses and individuals located in the Southern District of New York.

440. HTC 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 HTC '688 Products.

441. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the HTC '688 Products, HTC 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).

442. HTC also indirectly infringes the '688 patent by actively inducing infringement under 35 USC § 271(b).

443. HTC 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, HTC knew of the '688 patent and knew of its infringement, including by way of this lawsuit.

444. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '688 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '688 Products to utilize the products in a manner that directly infringe one or more claims of the '688 patent.[53] By providing instruction and training to

[53] *See, e.g.*, VIVE PRO HMD USER GUIDE (2018); VIVE BUSINESS EDITION VR SYSTEM, QUICKSPECS (2017); *VIVEPORT Submission Guide*, VIVE DEVELOPER GUIDE (July 5, 2018); *HTC VIVE Tracker Developer Guidelines (2018) Ver. 1.0*, VIVE DEVELOPER DOCUMENTATION (2018); *VIVE Focus User Guide*, VIVE DEVELOPER DOCUMENTATION (2018); *VIVE Tracker FAQ*, VIVE DEVELOPER DOCUMENTATION (2017); Matthew Gepp, *A Crash Course In All Things Virtual Reality*, HTC VIVE BLOG (November 6, 2017), *available at*: https://blog.vive.com/us/2017/11/06/vr-101-crash-course-in-virtual-reality/; *VIVE Wave SDK Developer Guide*, VIVE DEVELOPER DOCUMENTATION (last visited March 2019), *available at*: https://hub.vive.com/storage/app/doc/en-us/index.html.

customers and end-users on how to use the HTC '688 Products in a manner that directly infringes one or more claims of the '688 patent, including at least claim 6, HTC specifically intended to induce infringement of the '688 patent. On information and belief, HTC engaged in such inducement to promote the sales of the HTC '688 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '688 patent. Accordingly, HTC 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.

445. 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. HTC is utilizing the technology claimed in the '688 patent without paying a reasonable royalty. HTC 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.

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

447. As a result of HTC's infringement of the '688 patent, Dynamic Data has suffered monetary damages, and seek recovery in an amount adequate to compensate for HTC's infringement, but in no event less than a reasonable royalty for the use made of the invention by HTC together with interest and costs as fixed by the Court.

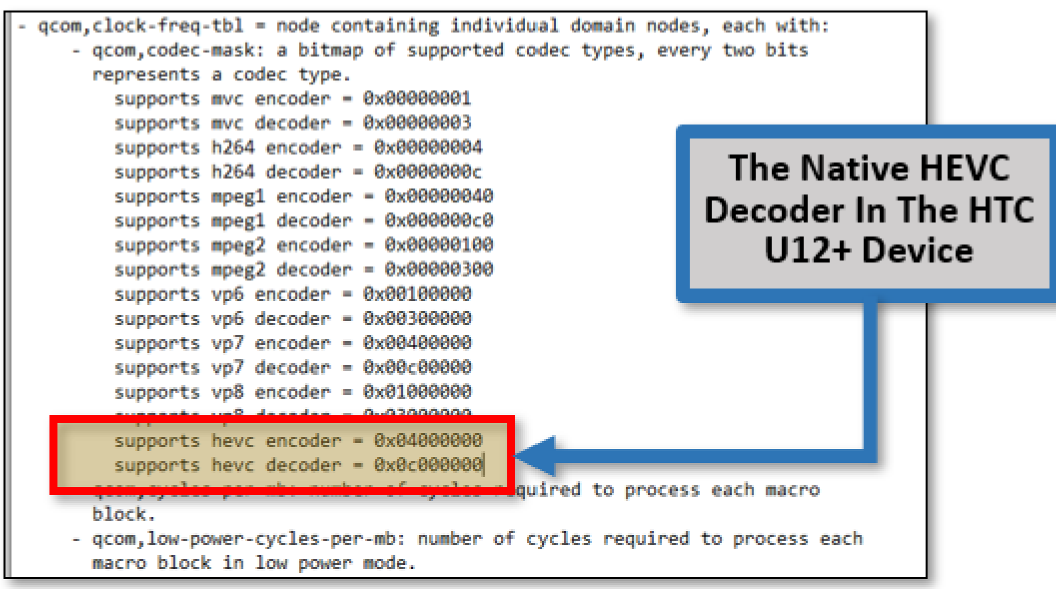
COUNT X
INFRINGEMENT OF U.S. PATENT NO. 7,894,529

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

449. HTC 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.

450. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC products that contain sub-pixel accurate motion vector functionality, including but not limited to HTC products that contain and/or enable H.265 decoding functionality including the HTC U12+ (the "HTC '529 Product(s)").

451. The HTC U12+ device includes software that enables decoding data that is stored in an HEVC compliant format. For example, source code files for the HTC U12+ device shows that the device contains a native HEVC decoder. The following image shows documentation that is included in the source code for the HTC U12+ device that shows the presence of a native HEVC decoder.



HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

452. The HTC U12+ product contains the Android 8.0 operating system, a SD845 chipset, and an Adreno 630 graphics processing unit.

Platform	
Chipset	Qualcomm Snapdragon 845
Cores	Octa Core
CPU	4x 2.8GHz Kryo 385 Gold & 4x 1.7GHz Kryo 385 Silver
GPU	Adreno 630
OS	Android 8.0 (Oreo)

HTC U12 PLUS SPECIFICATIONS, IHS MARKIT TEARDOWN TECHNOLOGY REPORT (August 10, 2018), *available at*: https://technology.ihs.com/Teardowns/detail/?ids=603895_3368,

453. The HEVC decoder contained in the HTC U12+ device supports decoding compliant with the HEVC standard. The below excerpt from uncompiled source code for the HTC U12+ device shows that the decoding of "HEVC compressed format" data is supported by the HTC U12+ device.

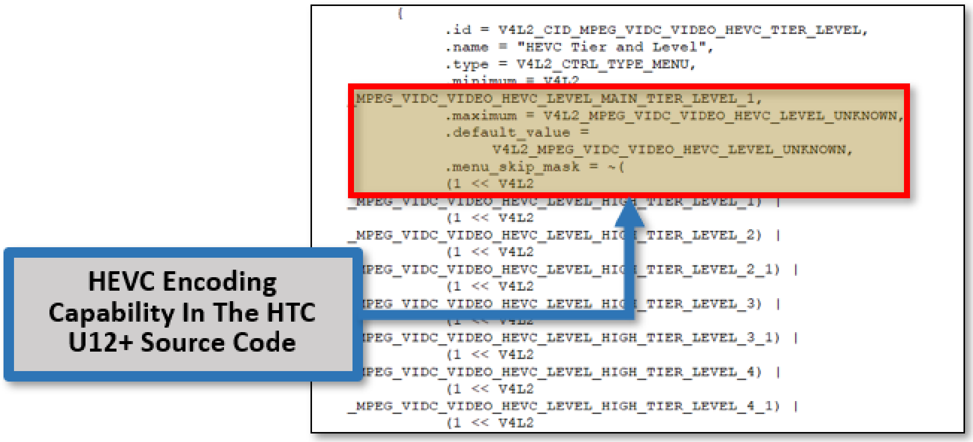
```
{
        .name = "H264",
        .description = "H264 compressed format",
        .fourcc = V4L2_PIX_FMT_H264,
        .get_frame_size = get_frame_size_compressed,
        .type = OUTPUT_PORT,
        .defer_outputs = false,
},
{
        .name = "HEVC",
        .description = "HEVC compressed format",
        .fourcc = V4L2_PIX_FMT_HEVC,
        .get_frame_size = get_frame_size_compressed,
        .type = OUTPUT_PORT,
        .defer_outputs = false,
},
```

HEVC Compliant Decoding Enabled In the HTC U12+ Device

HTC U12+ Kernel Source Code File: MSM_VDEC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video decoder contained on the source code of the HTC U12+ device).

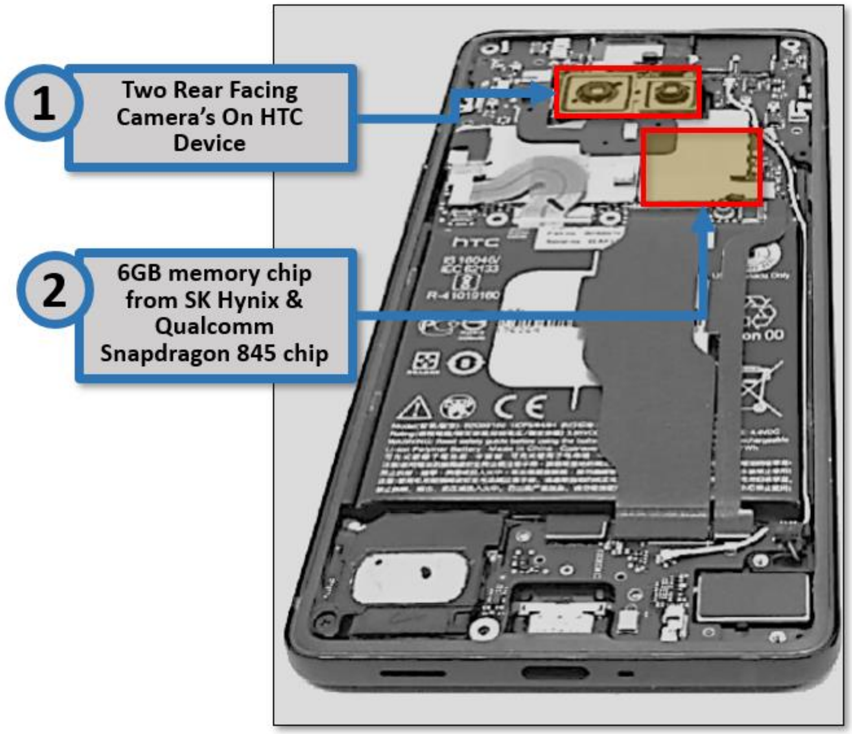
454. The HTC U12+ product supports decoding data using several HEVC Levels. The default level for the HEVC decoder in the HTC U12+ device is HEVC "Main Tier | Level 1." The

following excerpt from uncompiled source code for the HTC U12+ product shows how this default value is set in the MSM_VIDC_COMMON.C file.



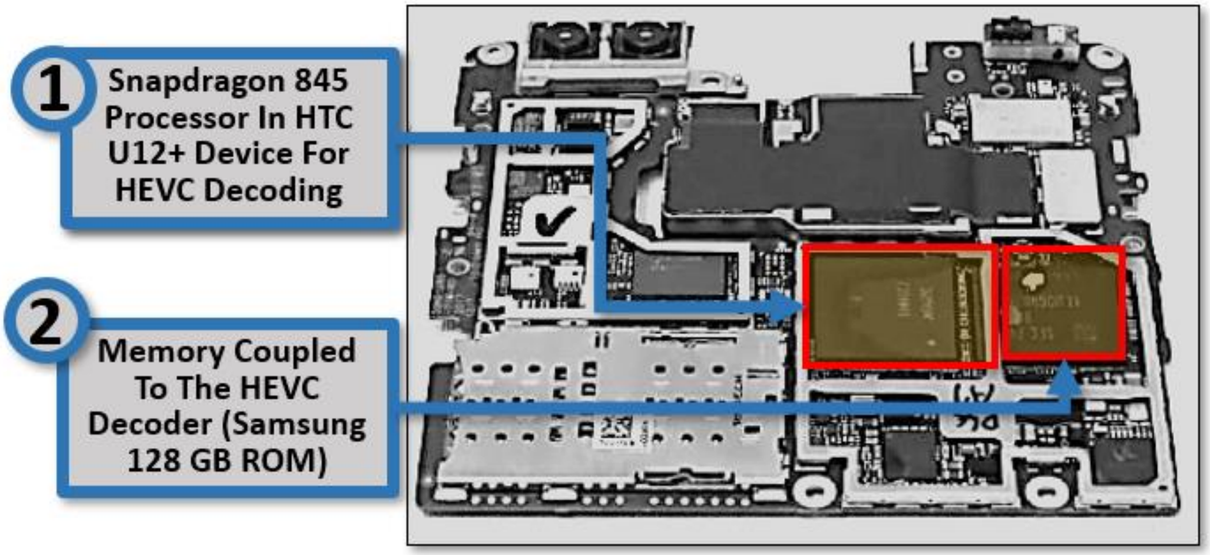
HTC U12+ Kernel Source Code File: MSM_VIDC_COMMON.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video "HEVC Tier and Level" control menu on the source code of the HTC U12+ device for HEVC decoding).

455. The HTC U12+ device contains memory (*e.g.*, a SK Hynix 6GB memory chip) and a SD845 processor. The following annotated image shows the internal components of the HTC U12+ device and identifying the memory chip and processor. These components perform the HEVC decoding compliant with the HEVC standard.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ rear facing cameras, memory chip, and processor) (annotation added).

456. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The below image of the motherboard in the HTC U12+ device shows that the processor for HEVC decoding is coupled to the memory.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor) (annotation added).

457. The HTC '529 Products incorporate a decoding unit for decoding the frame of the received video data. The decoding utilizes a second frame recovery unit that is a decoding motion vector. Specifically, the encoding and decoding process for video data received by the HTC '529 Products use inter-picture prediction wherein motion data comprises the selection of a reference frame and motion vectors to be applied in predicting the samples of each block.

458. By complying with the HEVC standard, the HTC devices – such as the HTC '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 HTC'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."

459. The HTC '529 Products comply with the HEVC standard, which requires determining motion vectors assigned to individual image regions of an image.

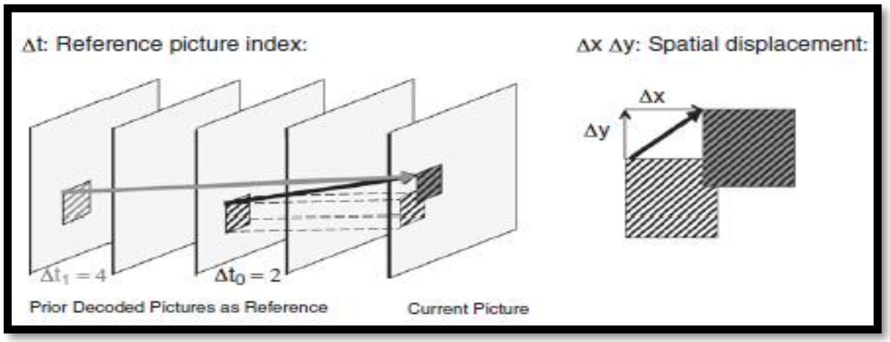
> The decoding process for prediction units in inter prediction mode consists of the following ordered steps:
>
> 1. The derivation process for motion vector components and reference indices as specified in clause 8.5.3.2 is invoked with the luma coding block location (xCb, yCb), the luma prediction 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).

460. HTC 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.

461. The encoded video stream received by the HTC '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) at 114 (September 2014).

462. The HTC '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 HTC '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 HTC '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.

> <u>One way of achieving high video compression is to predict pixel values for a frame based on prior and succeeding pictures in the video.</u> 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).

463. The HTC '529 Products receive encoded video data that is encoded using inter-frame coding. Specifically, the encoded video stream received by the HTC '529 Products is coded using its predecessor frame. Inter-prediction used in the encoded video data received by the HTC '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 <u>temporal statistical dependences,</u> 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).

464. The following excerpt from an article describing the architecture of the video stream received by the HTC '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) (September 2014).

465. 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.").

466. The motion estimation done by the HTC '529 Products is done through a PU matching method where the motion vector 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) at 347 (September 2014) (emphasis added).

467. The HTC '529 Products perform the step of assigning the modified motion vector as the motion vector to the first image block. Specifically, the HTC '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 HTC '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).

468. The HTC '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).

469. One or more HTC subsidiaries and/or affiliates use the HTC '529 Products in regular business operations.

470. HTC 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 HTC '529 Products.

471. One or more of the HTC '529 Products include technology for determining motion vectors that are each assigned to individual image regions.

472. One or more of the HTC '529 Products enable an increase in the resolution of video and image signals during the motion estimation process.

473. One or more of the HTC '529 Products perform a method for determining motion vectors which are assigned to individual image regions of an image.

474. One or more of the HTC '529 Products perform 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.

475. One or more of the HTC '529 Products perform 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.

476. One or more of the HTC '529 Products perform a method that generates the modified motion vector as a function of a motion vector assigned to at least the second image block.

477. One or more of the HTC '529 Products perform a method that assigns the modified motion vector as the motion vector to the first image block.

478. The HTC '529 Products are available to businesses and individuals throughout the United States.

479. The HTC '529 Products are provided to businesses and individuals located in the Southern District of New York.

480. 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 HTC

'529 Products, HTC 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).

481. HTC also indirectly infringes the '529 patent by actively inducing infringement under 35 U.S.C. § 271(b).

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

483. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically intended and was aware that the normal and customary use of the accused products would infringe the '529 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '529 Products to utilize the products in a manner that directly infringe one or more claims of the '529 patent.[54] By providing instruction and training to

[54] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

customers and end-users on how to use the HTC '529 Products in a manner that directly infringes one or more claims of the '529 patent, including at least claim 1, HTC specifically intended to induce infringement of the '529 patent. HTC engaged in such inducement to promote the sales of the HTC '529 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '529 patent. Accordingly, HTC 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.

484. 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. HTC is utilizing the technology claimed in the '529 patent without paying a reasonable royalty. HTC 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.

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

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

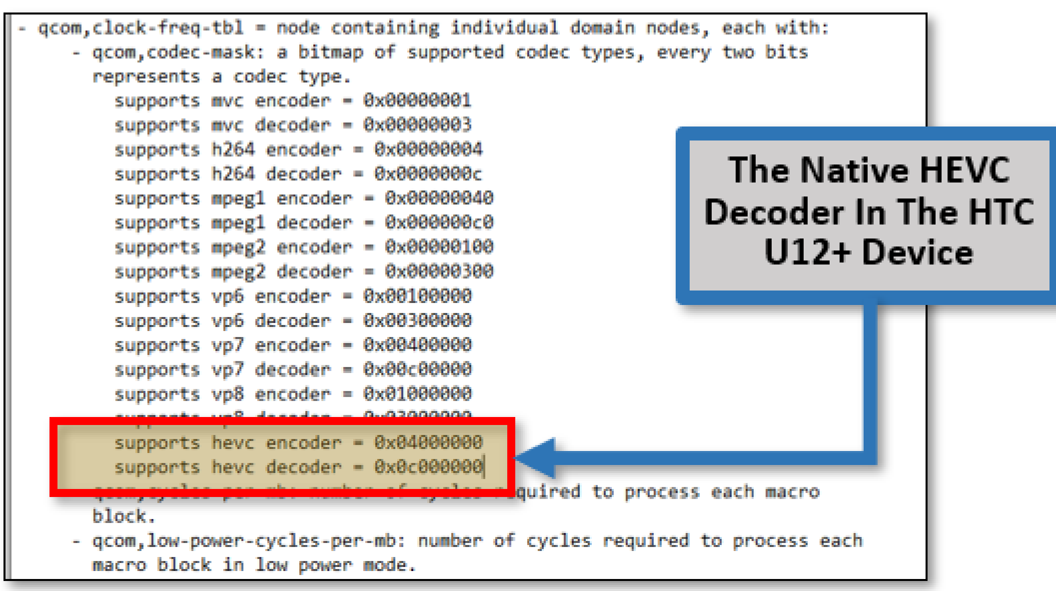
<u>COUNT XI</u>
<u>INFRINGEMENT OF U.S. PATENT NO. 7,571,450</u>

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

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

489. HTC designs, makes, sells, offers to sell, imports, and/or uses HTC devices that contain H.265 decoding functionality including the HTC U12+ (the "HTC '450 Product(s)").

490. The HTC U12+ device includes software that enables decoding data that is stored in an HEVC compliant format. For example, source code files for the HTC U12+ device shows that the device contains a native HEVC decoder. The following image shows documentation that is included in the source code for the HTC U12+ device that shows the presence of a native HEVC decoder.


```
- qcom,clock-freq-tbl = node containing individual domain nodes, each with:
    - qcom,codec-mask: a bitmap of supported codec types, every two bits
      represents a codec type.
        supports mvc encoder = 0x00000001
        supports mvc decoder = 0x00000003
        supports h264 encoder = 0x00000004
        supports h264 decoder = 0x0000000c
        supports mpeg1 encoder = 0x00000040
        supports mpeg1 decoder = 0x000000c0
        supports mpeg2 encoder = 0x00000100
        supports mpeg2 decoder = 0x00000300
        supports vp6 encoder = 0x00100000
        supports vp6 decoder = 0x00300000
        supports vp7 encoder = 0x00400000
        supports vp7 decoder = 0x00c00000
        supports vp8 encoder = 0x01000000
        supports hevc encoder = 0x04000000
        supports hevc decoder = 0x0c000000
                                           quired to process each macro
      block.
    - qcom,low-power-cycles-per-mb: number of cycles required to process each
      macro block in low power mode.
```


HTC U12+ Kernel Source Code File: MSM-VIDC.TXT, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (annotations added).

491. The HTC U12+ product contains the Android 8.0 operating system, a SD845 chipset, and an Adreno 630 graphics processing unit.

Platform	
Chipset	Qualcomm Snapdragon 845
Cores	Octa Core
CPU	4x 2.8GHz Kryo 385 Gold & 4x 1.7GHz Kryo 385 Silver
GPU	Adreno 630
OS	Android 8.0 (Oreo)

HTC U12 PLUS SPECIFICATIONS, IHS MARKIT TEARDOWN TECHNOLOGY REPORT (August 10, 2018), *available at*: https://technology.ihs.com/Teardowns/detail/?ids=603895_3368,

492. The HEVC decoder contained in the HTC U12+ device supports decoding compliant with the HEVC standard. The below excerpt from uncompiled source code for the HTC U12+ device shows that the decoding of "HEVC compressed format" data is supported by the HTC U12+ device.

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        .fourcc = V4L2_PIX_FMT_H264,
        .get_frame_size = get_frame_size_compressed,
        .type = OUTPUT_PORT,
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},
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        .name = "HEVC",
        .description = "HEVC compressed format",
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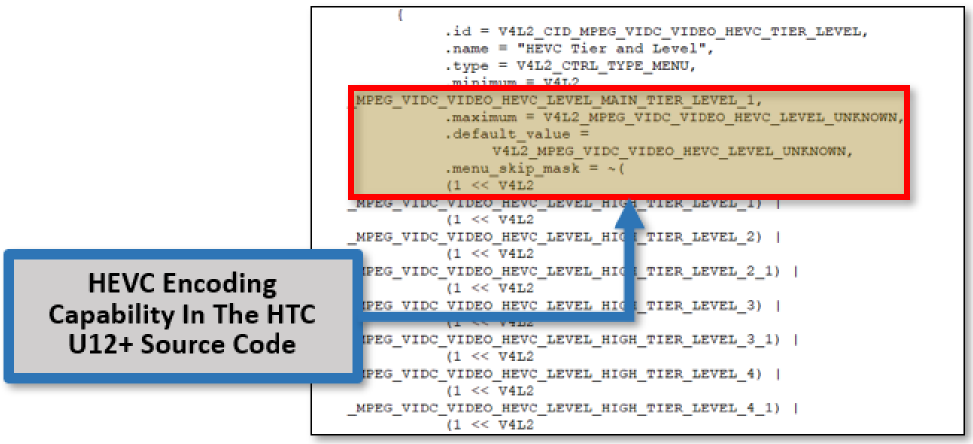
```

HEVC Compliant Decoding Enabled In the HTC U12+ Device

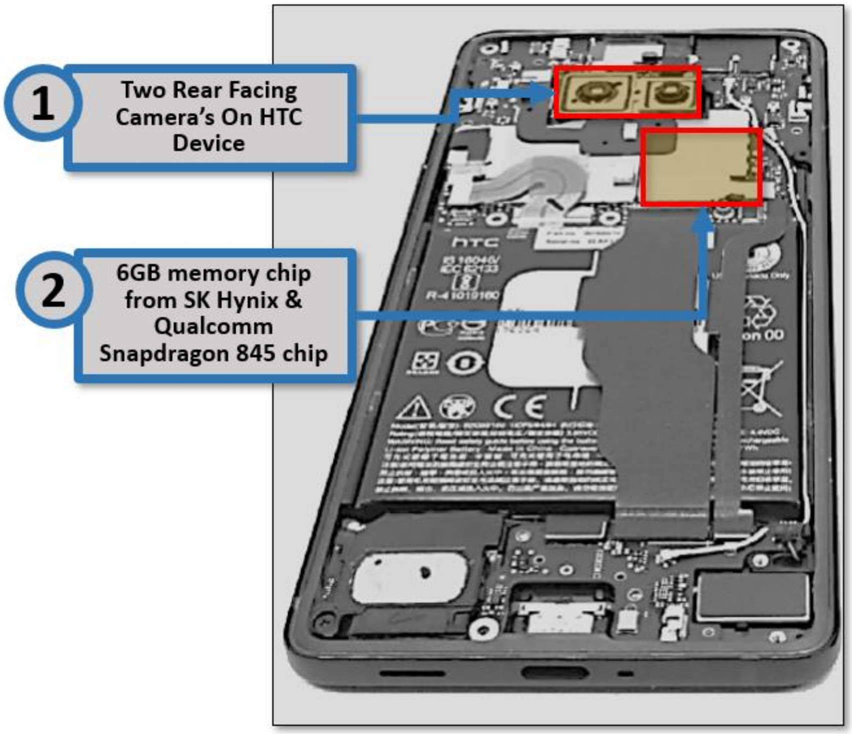
HTC U12+ Kernel Source Code File: MSM_VDEC.C, HTC U12+ KERNEL (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video decoder contained on the source code of the HTC U12+ device).

493. The HTC U12+ product supports decoding data using several HEVC Levels. The default level for the HEVC decoder in the HTC U12+ device is HEVC "Main Tier | Level 1." The following excerpt from uncompiled source code for the HTC U12+ product shows how this default value is set in the MSM_VIDC_COMMON.C file.



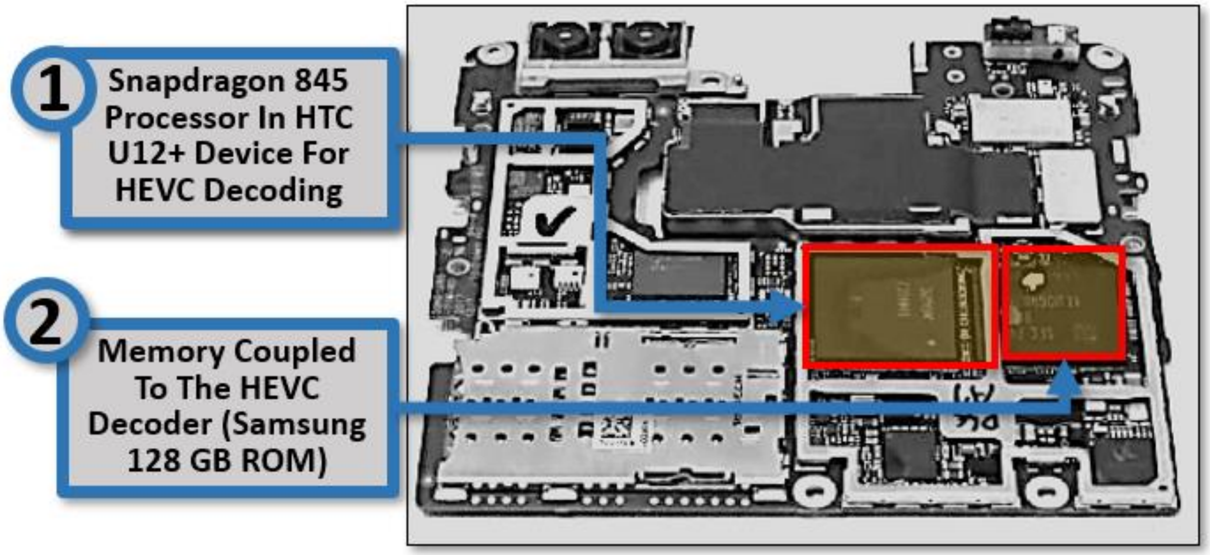
HTC U12+ Kernel Source Code File: MSM_VIDC_COMMON.C, HTC U12+ Kernel (2018), *available at*: https://www.htcdev.com/devcenter/downloads (identifying the video "HEVC Tier and Level" control menu on the source code of the HTC U12+ device for HEVC decoding).

494. The HTC U12+ device contains memory (*e.g.* SK Hynix 6GB memory chip) and a SD845 processor. The following annotated image shows the internal components of the HTC U12+ device and identifying the memory chip and processor. These components perform the HEVC decoding compliant with the HEVC standard.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ rear facing cameras, memory chip, and processor) (annotation added).

495. The HTC U12+ device contains memory chips including a SK Hynix 6GB memory chip and a 128 GB Samsung ROM memory chip. The below image of the motherboard in the HTC U12+ device shows that the processor for HEVC decoding is coupled to the memory.



ANNOTATED IMAGE OF THE HTC U12+ DEVICE INTERNAL COMPONENTS (showing the HTC U12+ memory chip coupled to the processor) (annotation added).

496. By complying with the HEVC standard, the HTC devices – such as the HTC '450 Products – necessarily infringe the '450 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '450 patent, including but not limited to claim 8. *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 HTC's infringement of the '450 patent: "5.3 Logical operators;" "5.10 Variables, syntax elements and tables;" "5.11 Text description of logical operations;" "7.2 Specification of syntax functions and descriptors;" "7.3.1 NAL unit syntax;" "7.3.2 Raw byte sequence payloads, trailing bits and byte alignment syntax;" "7.3.5 Supplemental enhancement information message syntax;" "7.4.2 NAL unit semantics;" and "7.4.6 Supplemental enhancement information message semantics."

497. The HTC '450 Products receive data that is segmented into Network Abstraction Layer ("NAL") Units. NAL Units are segments of data that can include video data and overlay

data (such as captions and overlay images). The HTC '450 Products support the receipt of VCL and non-VCL NAL units. The VCL NAL units contain the data that represents the values of the samples in the video pictures, and the non-VCL NAL units contain any associated additional information such as parameter sets or overlay data.

> HEVC uses a NAL unit based bitstream structure. A coded bitstream is partitioned into NAL units which, when conveyed over lossy packet networks, should be smaller than the maximum transfer unit (MTU) size. Each NAL unit consists of a NAL unit header followed by the NAL unit payload. There are two conceptual classes of NAL units. Video coding layer (VCL) NAL units containing coded sample data, e.g., coded slice NAL units, whereas non-VCL NAL units that contain metadata typically belonging to more than one coded picture, or where the association with a single coded picture would be meaningless, such as parameter set NAL units, or where the information is not needed by the decoding process, such as SEI NAL units.

Rickard Sjöberg et al, *Overview of HEVC High-Level Syntax and Reference Picture Management*, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, Vol. 22, No. 12 at 1859 (December 2012) (emphasis added).

498. The HTC '450 Products process data in the form of VCL NAL Units that contain segments of data which are used to generate an image (e.g., HEVC image) on a display device. Each VCL NAL Unit comprises a discrete number of bites which make up a segment. The following excerpt from the HEVC specification describes a NAL unit as being a segment with a "demarcation" setting forth where the segment ends and begins.

> NumBytesInNalUnit specifies the size of the NAL unit in bytes. This value is required for decoding of the NAL unit. Some form of demarcation of NAL unit boundaries is necessary to enable inference of NumBytesInNalUnit. One such demarcation method is specified in Annex B for the byte stream format. Other methods of demarcation may be specified outside of this Specification.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 7.4.2.1 (February 2018) (emphasis added).

499. The HTC '450 Products receive VCL NAL units that contain the data that represents the values of the samples in the video pictures, and non-VCL NAL units that contain associated additional information such as parameter sets or overlay data.

> HEVC uses a NAL unit based bitstream structure. A coded bitstream is partitioned into NAL units which, when conveyed over lossy packet networks, should be smaller than the maximum transfer unit (MTU) size. Each NAL unit consists of a NAL unit header followed by the NAL unit payload. There are two conceptual classes of NAL units. Video coding layer (VCL) NAL units containing coded sample data, e.g., coded slice NAL units, whereas non-VCL NAL units that contain metadata typically belonging to more than one coded picture, or where the association with a single coded picture would be meaningless, such as parameter set NAL units, or where the information is not needed by the decoding process, such as SEI NAL units.

Rickard Sjöberg et al, *Overview of HEVC High-Level Syntax and Reference Picture Management,* IEEE Transactions on Circuits and Systems for Video Technology, Vol. 22, No. 12 at 1859 (December 2012) (emphasis added).

500. The HTC'450 Products perform filtering, wherein the filtering enables a user to select a data element based on the user's selection. Specifically, a user can select the display of Non-VCL NAL Unit data which can include closed captions or other overlay information that is selected based on the user interaction. The data that is selected by the user is parsed by the system and filtered. The Non-VCL NAL Units include supplemental enhancement information ("SEI") messages. The SEI data that is received contains overlay information that can be combined with the image data that has already been received.

sei_message( ) {	**Descriptor**
payloadType = 0	
while(next_bits(8) = = 0xFF) {	
ff_byte /* equal to 0xFF */	f(8)
payloadType += 255	
}	
last_payload_type_byte	u(8)
payloadType += last_payload_type_byte	
payloadSize = 0	
while(next_bits(8) = = 0xFF) {	
ff_byte /* equal to 0xFF */	f(8)
payloadSize += 255	
}	
last_payload_size_byte	u(8)
payloadSize += last_payload_size_byte	
sei_payload(payloadType, payloadSize)	
}	

High Efficiency Video Coding, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 at § 7.3.5 (February 2018).

501. The HTC '450 Products perform rendering of an output image to be displayed on a display device on the basis of the first data-element selected by the filter. The overlay data is used to render overlays of the display data. The amount of overlay data that is downloaded in the form of Non-VCL data comprises a portion of the overlay that is displayed.

502. HTC 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 HTC '450 Products.

503. One or more of the HTC '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.

504. One or more of the HTC '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.

505. One or more of the HTC '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.

506. One or more of the HTC '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.

507. One or more of the HTC '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 by the filer is performed.

508. One or more of the HTC '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, characterized in comprising a second step of filtering to select a second data-element of the second one of the services, on the basis of the user selection is performed.

509. One or more of the HTC '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 the basis of the second data-element selected by the filter is performed.

510. The HTC '450 Products are available to businesses and individuals throughout the United States.

511. The HTC '450 Products are provided to businesses and individuals located in the Southern District of New York.

512. By making, using, testing, offering for sale, and/or selling products and services for displaying information, including but not limited to the HTC '450 Products, HTC 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).

513. HTC also indirectly infringes the '450 patent by actively inducing infringement under 35 U.S.C. § 271(b).

514. HTC has had knowledge of the '450 patent since at least service of the Original Complaint in this case or shortly thereafter, and on information and belief, HTC knew of the '450 patent and knew of its infringement, including by way of this lawsuit.

515. HTC intended to induce patent infringement by third-party customers and users of the HTC '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. HTC specifically

intended and was aware that the normal and customary use of the accused products would infringe the '450 patent. HTC 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, HTC provides the HTC '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 HTC further provides documentation and training materials that cause customers and end users of the HTC '450 Products to utilize the products in a manner that directly infringe one or more claims of the '450 patent.[55] By providing instruction and training to customers and end-users on how to use the HTC '450 Products in a manner that directly infringes one or more claims of the '450 patent, including at least claim 8, HTC specifically intended to induce infringement of the '450 patent. HTC engaged in such inducement to promote the sales of the HTC '450 Products, e.g., through HTC user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '450 patent. Accordingly, HTC 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.

516. 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

[55] *See, e.g.*, *HTC U12+ Technical Specification*, HTC WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/smartphones/htc-u12-plus-spec/; *HTC U12+ User Guide*, HTC SUPPORT DOCUMENTATION (2018); *HTC Video: Bigger, Bolder and Edgier. Introducing the HTC U12+*, HTC VIDEO TUTORIAL (May 23, 2018), *available at*: https://www.youtube.com/watch?v=QyjPcwiarmc; *HTC U12+ Frequently Asked Questions*, HTC SUPPORT WEBSITE (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/faq; *Unlocked HTC U12+ Software Update Instructions 10.8.2018*, HTC SUPPORT CENTER (last visited March 2019), *available at*: https://www.htc.com/us/support/htc-u12-plus/news/; *HTC Kernel Source Code, Binaries and Update For HTC U12+ Android*, HTC DEV CENTER (last visited March 2019), *available at*: https://www.htcdev.com/devcenter/downloads.

companies and academic institutions. HTC is utilizing the technology claimed in the '450 patent without paying a reasonable royalty. HTC 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.

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

518. As a result of HTC's infringement of the '450 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for HTC's infringement, but in no event less than a reasonable royalty for the use made of the invention by HTC 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 HTC has infringed, either literally and/or under the doctrine of equivalents, the '073, '257, '054, '918, '689, '177, '039, '112, '688, '529, and '450 patents;

B. An award of damages resulting from HTC's acts of infringement in accordance with 35 U.S.C. § 284;

C. A judgment and order finding that HTC'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 HTC.

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: March 22, 2019

Respectfully submitted,

/s/ Daniel P. Hipskind

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CERTIFICATE OF SERVICE

I hereby certify that counsel of record who are deemed to have consented to electronic service are being served this 22nd of March, 2019 with a copy of this document via the Court's CM/ECF System.

/s/ Daniel P. Hipskind
Daniel P. Hipskind