IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

DYNAMIC DATA TECHNOLOGIES, LLC, *Plaintiff,* v. QUALCOMM INC., QUALCOMM TECHNOLOGIES, INC., LENOVO HOLDING COMPANY, INC., LENOVO (UNITED STATES) INC., AND MOTOROLA MOBILITY LLC, *Defendants*.	Civil Action No._________ **JURY TRIAL DEMANDED**

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.: 7,058,227 (the "'227 patent"); 6,639,944 (the "'944 patent"); 6,760,376 (the "'376 patent"); 6,782,054 (the "'054 patent"); and 7,039,109 (the "'109 patent") (collectively, the "patents-in-suit"). Defendants Qualcomm Inc.; Qualcomm Technologies, Inc.; Lenovo Holding Company, Inc.; Lenovo (United States) Inc.; and Motorola Mobility LLC (collectively, the "Defendants") 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 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 groundbreaking technologies, including compact audio cassettes, magnetic resonance imaging (MRI) machines, and compact discs.

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

2. 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.

3. In 1891, Philips, then known as Philips & Company, was founded in Eindhoven, Netherlands to manufacture carbon-filament lamps.[1] 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).

4. In 1962, Philips introduced the first audio cassette tape.[2] A year later, Philips launched a small battery-powered audio tape recorder that used a cassette instead of a loose spool.[3] Philips C-cassette was later used as the first mass storage device for early personal computers in the 1970s and 1980s.

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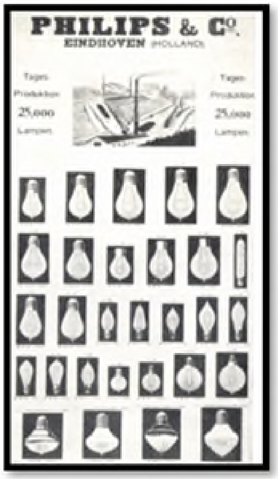
[1] Gerard O'Regan, A BRIEF HISTORY OF COMPUTING at 99 (2012).

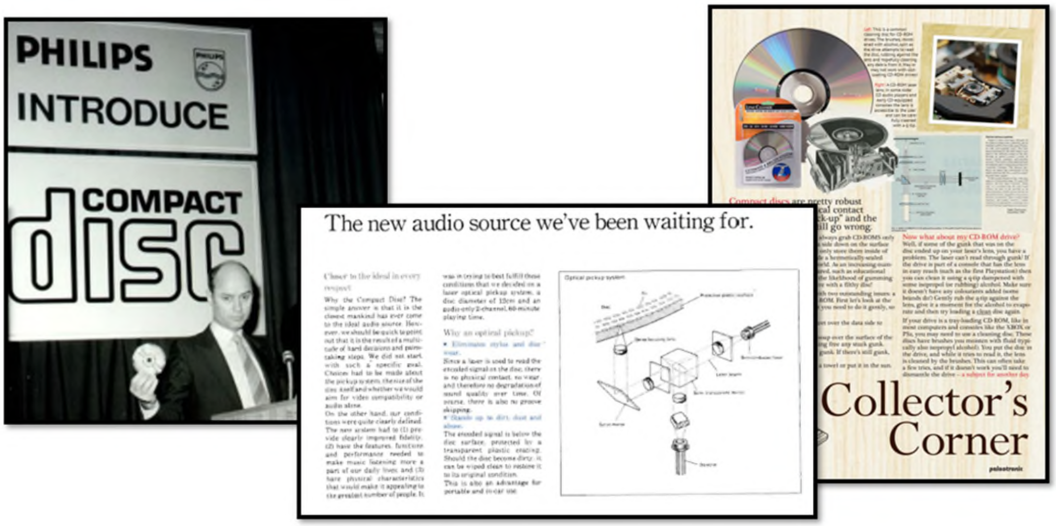
[2] Gerard O'Regan, PILLARS OF COMPUTING: A COMPENDIUM OF SELECT, PIVOTAL TECHNOLOGY FIRMS at 172 (2015) ("Philips invented the compact cassette for audio storage in 1962.")

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



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

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



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

6. 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.[4] 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.

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

[4] *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.[5] 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.[6]

8. 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

9. Dynamic Data owns patents issued by the United States Patent and Trademark Office, including each of the patents-in-suit. Further, Dynamic Data owns patents issued by the State Intellectual Property Office of the People's Republic of China,[7] the European Patent Office,[8] the German Patent and Trademark Office,[9] the Japan Patent Office,[10] and many other national patent offices.

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[5] 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.").

[6] *Id.* at 191.

[7] *See, e.g.,* CN100456831, CN1157053, and CN1199448.

[8] *See, e.g.,* European Patent Nos. EP1090502, EP1101354, EP1334613, and EP1393572.

[9] *See, e.g.,* German Patent Nos. DE60024389, DE60040517, and DE60126642.

[10] *See, e.g.,* Japanese Patent Nos. JP4053422, JP4242656, JP4398099, and JP4440477.

10. 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.

11. The patents-in-suit have been cited by the Defendants in multiple patents as relevant prior art, including the following patents assigned to Qualcomm Incorporated: U.S. Patent Nos. 8,265,158; 8,437,397; 8,537,283; 8649437; U.S. Patent App. Nos. US20080165851, US20090161010, US20090161763; and Chinese Patent No. CN104871209. The patent families of patents-in-suit have been cited by over 270 U.S. and international patents and patent applications assigned to a wide variety of the largest companies operating in the field. The patents-in-suit have been cited by companies such as:

- Samsung Electronics Co., Ltd.[11]
- Dolby Laboratories, Inc.[12]
- Sony Corporation[13]
- STMicroelectronics N.V.[14]
- Marvell Technology Group Ltd.[15]
- Alphabet Corporation[16]
- MediaTek, Inc.[17]
- Intel Corporation[18]
- Toshiba Corporation[19]

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[11] *See, e.g.*, U.S. Patent Nos. 8,254,444; 8,565,309; 8,693,541; 8,861,603; 8,259,225; 8,295,551; 8,542,883; 8,559,518; 8,638,393; 9,167,237; 7,321,396; 9,240,050; 7,840,096; and 8,369,416.

[12] *See, e.g.*, U.S. Patent Nos. 9,078,002; 9,083,979; 9,232,232; 9,247,269; 9,386,321; 9,473,791; 9,549,201; 9,571,855; 9,788,012; 10,080,035; and 10,225,574.

[13] *See, e.g.*, U.S. Patent Nos. 8,391,623; 7,596,243; 7,620,108; 7,885,335; 7,894,522; 7,894,527; 7,957,466; 8,005,308; 8,059,719; 8,085,986; 8,107,748; 8,165,205; and 8,340,186.

[14] *See, e.g.*, U.S. Patent Nos. 8,000,386; 8,494,054; 8,630,338; and 8,989,272.

[15] *See, e.g.*, U.S. Patent Nos. 8,817,771; 8,520,771; 8,542,725; 8,565,325; 8,681,893; 8,897,393; 8,902,726; 8,908,754; 8,942,312; 8,948,216; and 8,953,661.

[16] *See, e.g.*, U.S. Patent Nos. 9,208,573; 8,064,644; and 8,229,174.

[17] *See, e.g.*, U.S. Patent Nos. 9,641,861; 9,563,960; and 9,917,988.

[18] *See, e.g.*, U.S. Patent Nos. 8,405,769 and 7,440,008.

[19] *See, e.g.*, U.S. Patent Nos. 10,038,913 and 8,189,104.

- Synaptics, Inc.[20]

THE PARTIES

DYNAMIC DATA TECHNOLOGIES, LLC

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

13. 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. Dynamic Data pursues the reasonable royalties owed for Defendants' use of the inventions claimed in the patents-in-suit, which arise from Philips' groundbreaking technology, both here in the United States and throughout the world.

QUALCOMM

14. Qualcomm Inc. is a Delaware corporation with its principal place of business at 5775 Morehouse Drive, San Diego, California 92121. Qualcomm Inc. may be served through its registered agent, The Prentice-Hall Corporation System, Inc., 251 Little Falls Drive, Wilmington, Delaware 19808.

15. Qualcomm Technologies, Inc. ("QTI") is a wholly owned subsidiary of Defendant Qualcomm Inc. Qualcomm Technologies, Inc. is a Delaware corporation, and has a principal place of business at 5775 Morehouse Dr., San Diego, California, 92121. Qualcomm Technologies, Inc. may be served through its registered agent, Corporation Service Company, 251 Little Falls Drive, Wilmington, Delaware 19808.

16. QTI is a wholly owned subsidiary of Qualcomm Inc. QTI and Qualcomm Inc. are collectively referred to herein as "Qualcomm."

[20] *See, e.g.*, U.S. Patent Nos. 8,498,342; 8,761,261; and 8,902,994.

LENOVO

17. Lenovo Holding Co. Inc. is a corporation organized under the laws of the State of Delaware with its principal place of business at 1009 Think Place, Morrisville, NC 27650. The Corporation Trust Company, with its principal place of business at 1209 N Orange St, Wilmington, DE 19801, is the registered agent for Lenovo Holding Co. Inc.

18. Lenovo (United States) Inc. is a corporation organized under the laws of the State of Delaware, with its principal place of business at 8001 Development Dr., Morrisville, NC 27560. The Corporation Trust Company, with its principal place of business at 1209 N Orange St, Wilmington, DE 19801, is the registered agent for Lenovo (United States) Inc.

19. Motorola Mobility LLC is an affiliate of Lenovo (United States) Inc., and is a corporation organized under the laws of the State of Delaware, with its principal place of business at 222 W. Merchandise Mart Plaza, Chicago, IL 60654. The Corporation Trust Company, with its principal place of business at 1209 N Orange St, Wilmington, DE 19801, is the registered agent for Motorola Mobility LLC.

20. Lenovo Holding Co. Inc., Lenovo (United States) Inc., and Motorola Mobility LLC (collectively, "Lenovo") provide infringing smart phone devices and tablet devices in the District of Delaware and throughout the United States.

JURISDICTION AND VENUE

21. 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).

22. This Court has personal jurisdiction over Qualcomm Inc. and QTI at least because each is at home in the State of Delaware, where each is incorporated and has a registered agent for

service of process. In addition, Qualcomm Inc. and QTI transact and conduct business in and with residents of the State of Delaware. Dynamic Data's causes of action arise, at least in part, from Qualcomm's contacts with and activities in the State of Delaware. Qualcomm has committed acts of infringement within the State of Delaware by, *inter alia*, directly and/or indirectly making, selling, offering for sale, importing, and/or using products that infringe one or more claims of the patents-in-suit. Qualcomm, directly and/or through intermediaries, uses, sells, ships, distributes, imports into, offers for sale, and/or advertises or otherwise promotes its products throughout the United States, including in the State of Delaware. Further, Qualcomm has office locations in nearby Philadelphia, Pennsylvania, and Bridgewater, New Jersey, and maintains highly interactive and commercial websites, accessible to residents of the State of Delaware, through which Qualcomm promotes and facilitates sales of its products and services, including products that infringe the patents-in-suit. *See, e.g.*, www.qualcomm.com.

23. Qualcomm regularly conducts and solicits business in, engages in other persistent courses of conduct in, and/or derives substantial revenue from goods and services provided to, residents of the State of Delaware.

24. Personal jurisdiction over Lenovo is proper in this District based on one or more of the following: its presence in this judicial district; it has availed itself of the rights and benefits of the laws of Delaware; and has derived substantial revenue from sales of handsets and other cellular devices in Delaware and it has systematic and continuous business contacts with Delaware. Each Lenovo entity is incorporated in Delaware. Lenovo provides cellular device products, which are advertised, offered for sale, sold, and used in Delaware.

25. Venue is proper in this district under 28 U.S.C. § 1400(b) and 28 U.S.C. §§ 1391(b)(1), (b)(2). For purposes of §1400(b), each Defendant is incorporated in Delaware and/or

formed under the laws of Delaware and therefore resides within this District. For purposes of § 1391(b)(1), (b)(2), each Defendant resides in the District of Delaware by virtue of being incorporated in Delaware and is formed under the laws of Delaware.

JOINDER

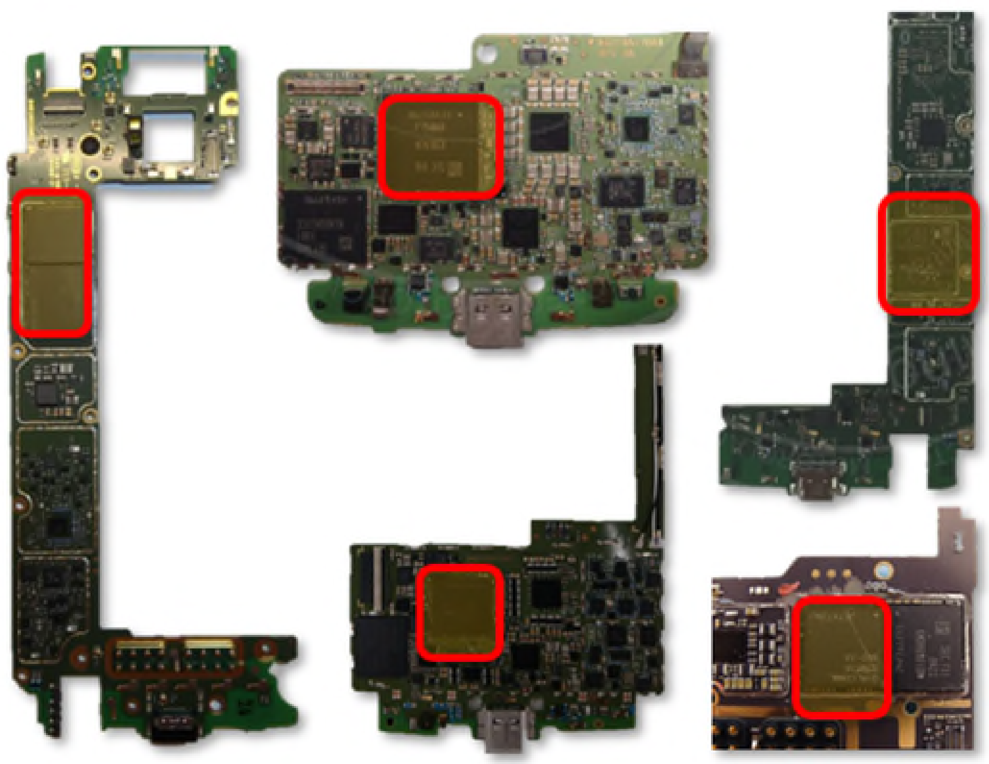
26. Joinder of the Defendants is proper under 35 U.S.C. § 299. The allegations of patent infringement contained herein arise out of the same series of transactions or occurrences relating to the importing into the United States and/or making, using, selling, or offering for sale within the United States, the same products accused of infringing the patents-in-suit, including, Qualcomm's Snapdragon 820, Snapdragon 835, Snapdragon 626, Snapdragon 636, and Snapdragon 625 system on a chips ("SoC") which are incorporated into the accused Lenovo products.

27. Lenovo designs, manufactures, uses, and imports into the United States, sells, and/or offers for sale in the United States cell phones, tablets, and other computing devices that contain integrated circuits designed, manufactured, sold and/or offered for sale by Qualcomm with video encoding and/or decoding functionality.

28. Lenovo and Qualcomm continue to make, use, import into the United States, market, offer for sale, and/or sell in the United States integrated circuits that infringe the patents-in-suit, and/or induce or contribute to the infringement of the patents-in-suit by others, including end-users.

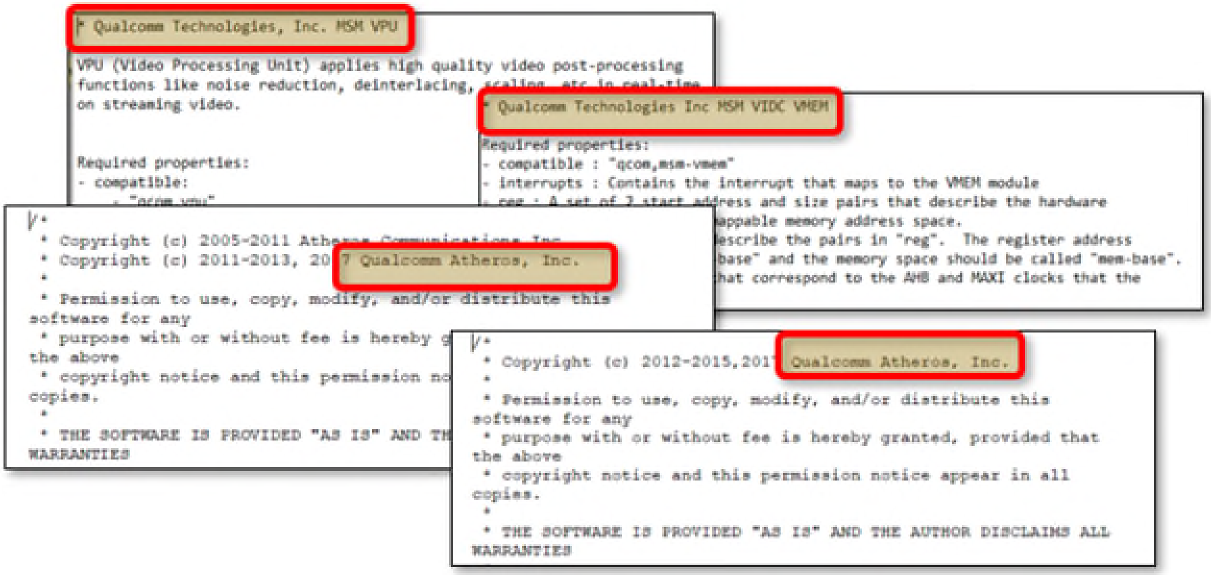
29. Common questions of fact relating to Defendants' infringement arise in this action. Including common questions concerning Qualcomm's and Lenovo's infringement of the patents-in-suit through the incorporation of common Qualcomm SoCs in the accused Lenovo devices.

30. All of the accused Lenovo devices contain a Qualcomm SoC including at least one of the following Qualcomm SoCs: Qualcomm Snapdragon 820, Qualcomm Snapdragon 835, Qualcomm Snapdragon 626, Qualcomm Snapdragon 636, and Qualcomm Snapdragon 625.



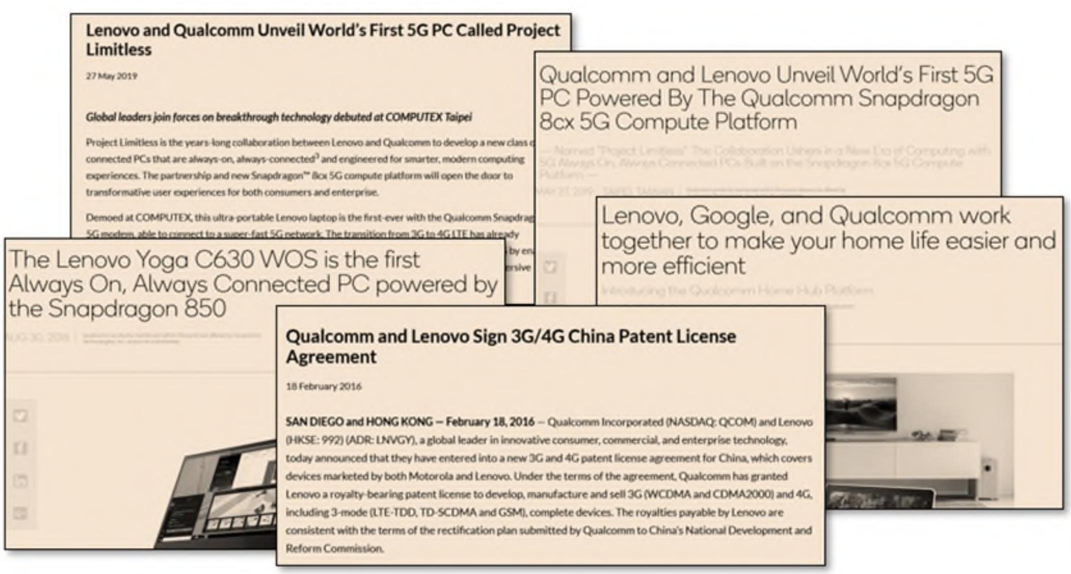
The Accused Devices Containing the Qualcomm Snapdragon SoC chips (identified with added red annotation). *FCC ID: IHDT56VB4 / IC ID: 109O-T56VB4 – Exhibit 9: Internal Photographs of the Moto Z Device*, MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-3 (December 8, 2017); *FCC ID: IHDT56VB2 – Exhibit 9: Internal Photographs Of the Moto Z Force Device,* MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-3 (December 6, 2017); *FCC ID: IHDT56Vc1 – Exhibit 9: Internal Photographs Of the Moto Z Play Device*, MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-3 (December 9, 2017); *Sporton International (Kunshan) Inc. Report No. EP811821*, FCC Report FCC ID IHDT56XE1 at 6 (March 5, 2018) (annotations added).

31. The accused devices contain not only Qualcomm processors but also computer code owned and authored by Qualcomm. For example, the following excerpts from source code loaded onto the accused devices show the extensive incorporation of computer code owned and authored by Qualcomm. Each of the accused devices contains source code files owned and authored by Qualcomm.



Examples of computer code files contained in the source code images for the Qualcomm Products. MOTOROLA MMI-PPW29.131-27-1 IMAGE (last accessed September 2019), *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/ (annotations added to files including the following files: core.c, msm-vpu.txt, pmc.c, and msm_vidc_vmem.txt).

32. Qualcomm and Lenovo have jointly collaborated on the accused devices. Qualcomm and Lenovo, in multiple press releases, have touted the partnership between Qualcomm and Lenovo.

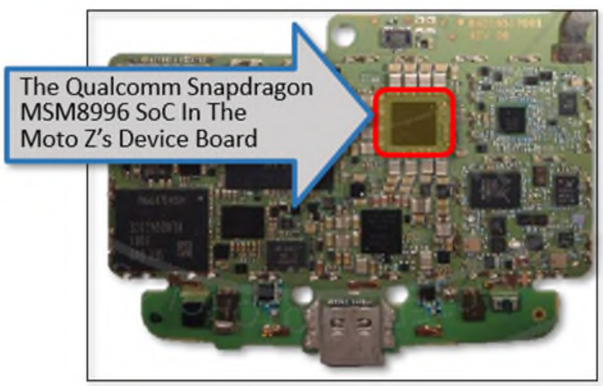


Lenovo and Qualcomm Unveil World's First 5G PC Called Project Limitless, LENOVO WEBSITE (May 27, 2019); *available at*: https://news.lenovo.com/pressroom/press-releases/lenovo-qualcomm-unveil-worlds-first-5g-pc-project-limitless/; *Qualcomm and Lenovo Unveil World's*

First 5G PC Powered By The Qualcomm Snapdragon 8cx 5G Compute Platform, QUALCOMM PRESS RELEASE (May 27, 2019), *available at*: https://www.qualcomm.com/news/releases/2019/05/27/qualcomm-and-lenovo-unveil-worlds-first-5g-pc-powered-qualcomm-snapdragon; *The Lenovo Yoga C630 WOS is the first Always On, Always Connected PC powered by the Snapdragon 850*, QUALCOMM PRESS RELEASE (August 30, 2018), *available at*: https://www.qualcomm.com/news/onq/2018/08/30/lenovo-yoga-c630-wos-first-always-always-connected-pc-powered-snapdragon-850; *Lenovo, Google, and Qualcomm work together to make your home life easier and more efficient*, QUALCOMM PRESS RELEASE (January 8, 2018), *available at*: https://www.qualcomm.com/news/onq/2018/01/08/lenovo-google-and-qualcomm-work-together-make-your-home-life-easier-and-more; *Qualcomm and Lenovo Sign 3G/4G China Patent License Agreemen*t, LENOVO WEBSITE (February 18, 2016), *available at*: https://news.lenovo.com/pressroom/press-releases/qualcomm-and-lenovo-sign-3g-4g-china-patent-license-agreement/.

33. The accused Lenovo devices include the Motorola Moto Z, Motorola Moto Z Force, Motorola Moto Z2 Force Edition, Motorola Moto Z2 Play, Motorola Moto Z3, Motorola Moto Z3 Play, Motorola One, Motorola One Power, and Motorola Moto Z Play (collectively, the "Lenovo Products"). Each of the Lenovo Products contain a Qualcomm processor that performs the infringing functionality.

34. The following image shows the infringing Qualcomm Snapdragon MSM8996 (Qualcomm Snapdragon 820 SoC) in the Lenovo Moto Z device.[21]



FCC ID: IHDT56VB4 / IC ID: 109O-T56VB4 – Exhibit 9: Internal Photographs of the Moto Z Device, MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-3 (December 8, 2017) (annotations added).

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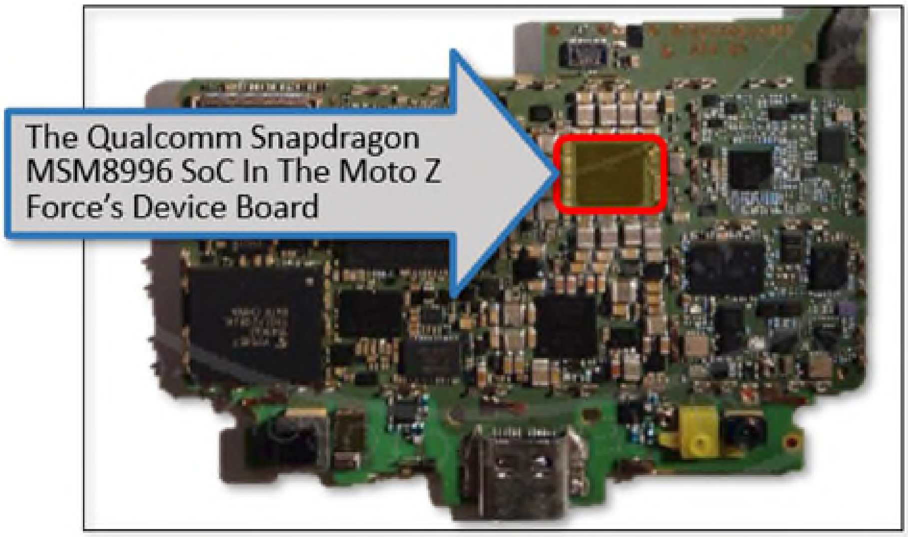
[21] The infringing Lenovo Model includes the Qualcomm Snapdragon 820 SoC which includes an Adreno 530 processor. *See Snapdragon 820 Mobile Platform Specifications,* QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-820-mobile-platform.

35. The following image shows the infringing Qualcomm Snapdragon MSM8996 (Qualcomm Snapdragon 820 SoC) in the Lenovo Moto Z Force device.[22]



FCC ID: IHDT56VB2 – Exhibit 9: Internal Photographs of the Moto Z Force Device, MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-3 (December 6, 2017) (annotations added).

36. The following image shows the infringing Qualcomm Snapdragon MSM8953 (Qualcomm Snapdragon 625 SoC) in the Lenovo Moto Z Play device.[23]

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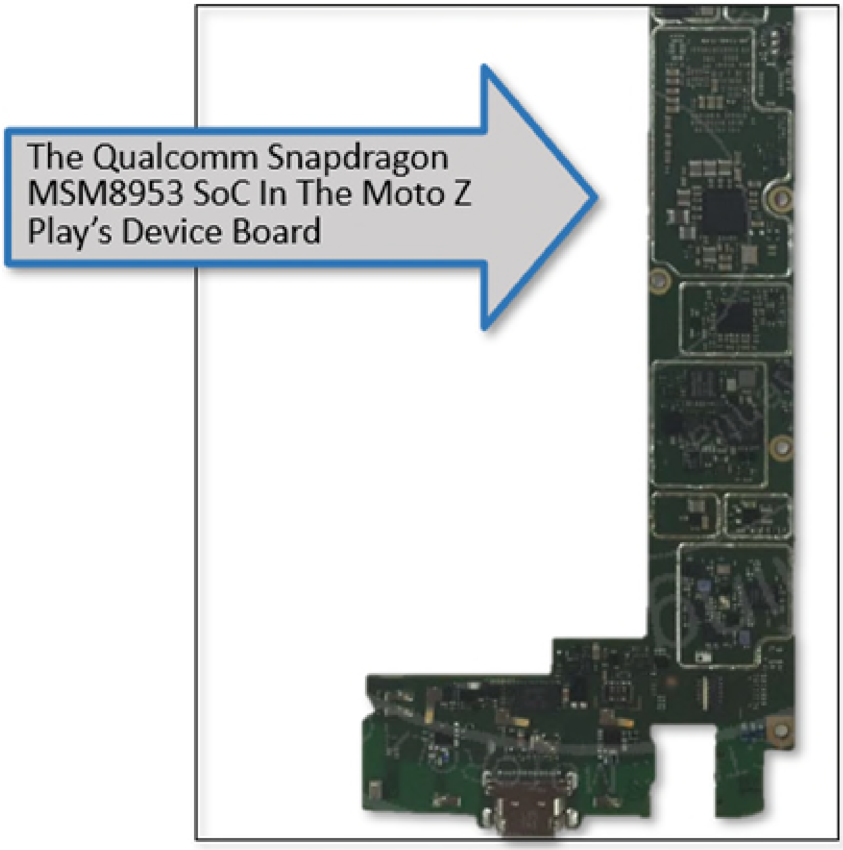
[22] The infringing Lenovo Model includes the Qualcomm Snapdragon 820 SoC which includes an Adreno 530 processor. *See Snapdragon 820 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-820-mobile-platform.

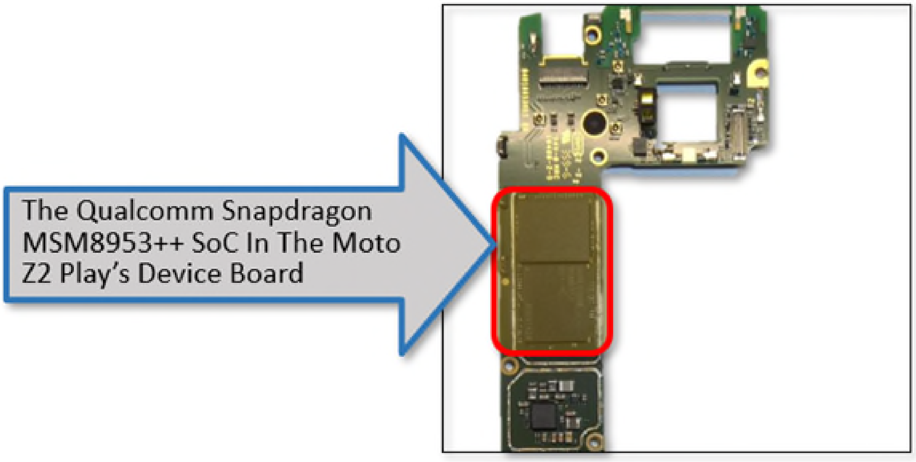
[23] The infringing Lenovo Model includes the Qualcomm Snapdragon 625 SoC which includes an Adreno 506 processor. *See Snapdragon 625 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-625-mobile-platform.



FCC ID: IHDT56Vc1 – Exhibit 9: Internal Photographs of the Moto Z Play Device, MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-3 (December 9, 2017) (annotation added).

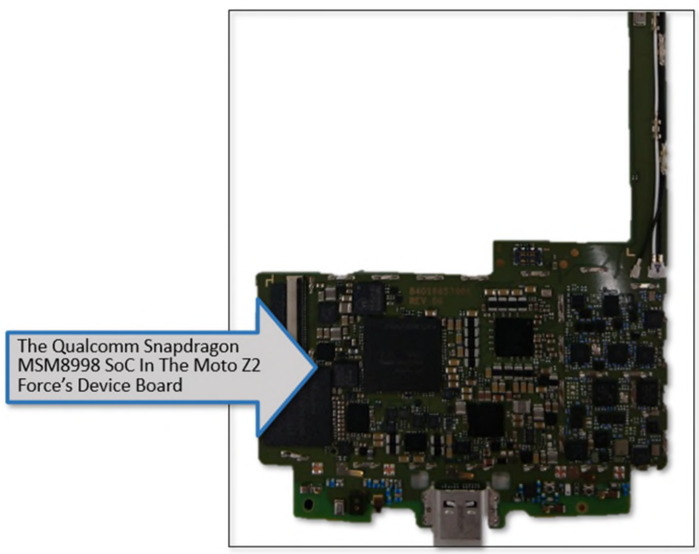
37. The following image shows the infringing Qualcomm Snapdragon MSM8953++ (Qualcomm Snapdragon 626 SoC) in the Lenovo Moto Z2 Play device.[24]

[24] The infringing Lenovo Model includes the Qualcomm Snapdragon 626 SoC which includes an Adreno 506 processor. *See Snapdragon 626 Mobile Platform Specifications,* QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-626-mobile-platform.



FCC ID: IHDT56WA1 – Exhibit 9: Internal Photographs of the Moto Z Play Device, MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-5 (March 13, 2017) (annotations added).

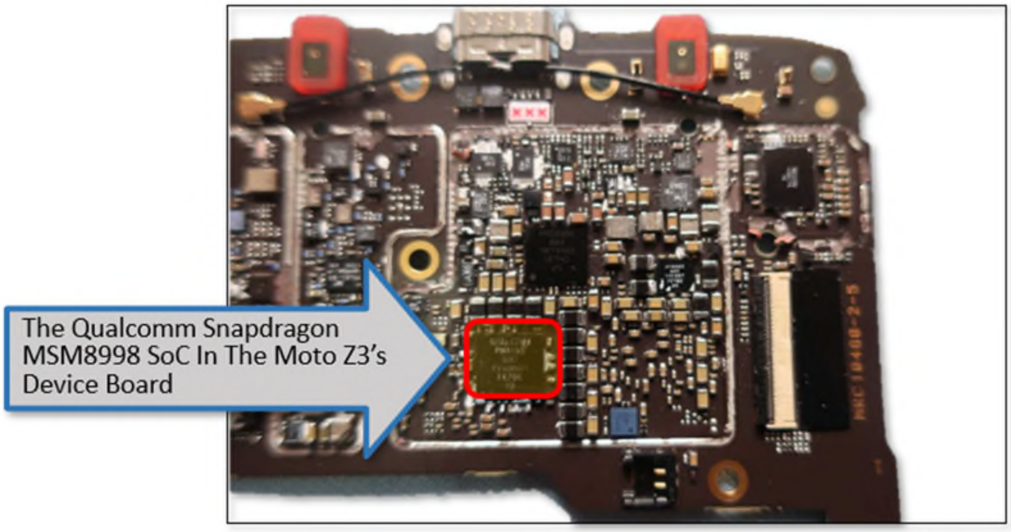
38. The following image shows the infringing Qualcomm Snapdragon MSM8998 (Qualcomm Snapdragon 835 SoC) in the Lenovo Moto Z2 Force device.[25]



FCC ID: IHDT56WB4 – Exhibit 9: Internal Photographs of the Moto Z Play Device, MOTOROLA MOBILITY FEDERAL COMMUNICATIONS COMMISSION SUBMISSION at 9-3 (May 2, 2017) (annotations added).

[25] The infringing Lenovo Model includes the Qualcomm Snapdragon 835 SoC which includes an Adreno 540 processor. *See Snapdragon 835 Mobile Platform Specifications,* QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-835-mobile-platform.

39. The following image shows the infringing Qualcomm Snapdragon MSM8998 (Qualcomm Snapdragon 835 SoC) in the Lenovo Moto Z3 device.[26]

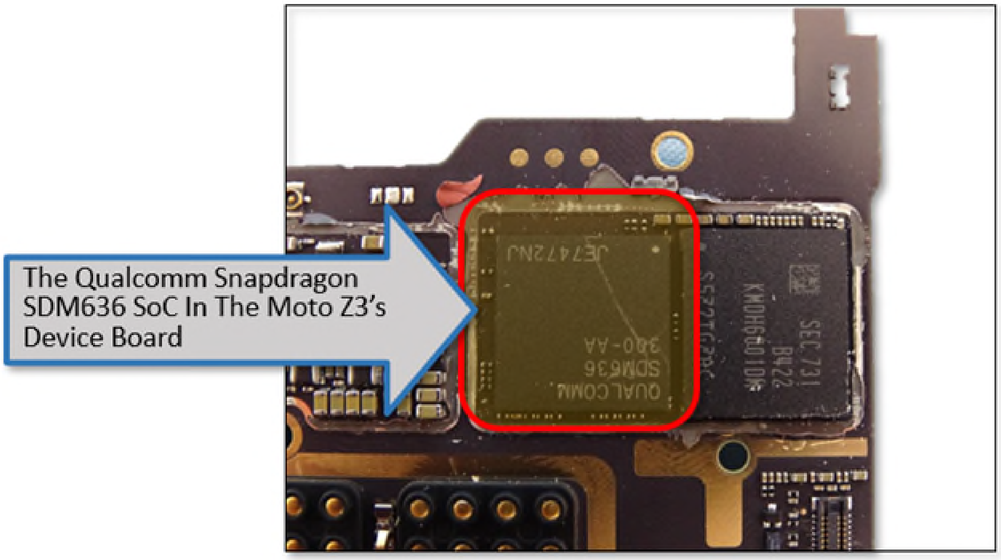


Sporton International (Kunshan) Inc. Report No. EP851503, FCC Report FCC ID IHDT56XJ1 at 18 (May 31, 2018) (annotations added).

40. The following image shows the infringing Qualcomm Snapdragon 636 (Qualcomm Snapdragon SDM636 SoC) in the Lenovo Moto Z3 Play device.[27]

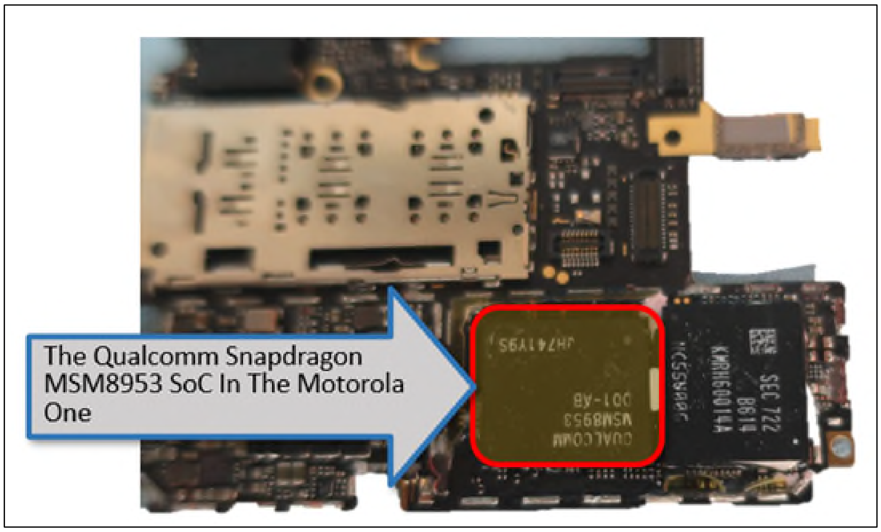
[26] The infringing Lenovo Model includes the Qualcomm Snapdragon 835 SoC which includes an Adreno 540 processor. *See Snapdragon 835 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-835-mobile-platform.

[27] The infringing Lenovo Model includes the Qualcomm Snapdragon SDM636 SoC which includes an Adreno 509 processor. *See Snapdragon SDM636 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-636-mobile-platform.



Sporton International (Kunshan) Inc. Report No. EP811821, FCC Report FCC ID IHDT56XE1 at 6 (March 5, 2018) (annotations added).

41. The following image shows the infringing Qualcomm Snapdragon MSM8953 chip (Qualcomm Snapdragon 625 SoC) in the Lenovo Motorola One device.[28]



Sporton International (Kunshan) Inc. Report No. EP811821, FCC Report FCC ID IHDT56XK2 at 25 (July 30, 2018) (annotations added).

[28] The infringing Lenovo Model includes the Qualcomm Snapdragon 625 SoC which includes an Adreno 506 processor. *See Snapdragon 625 Mobile Platform Specifications*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-625-mobile-platform.

42. Common questions of fact as to the profits and revenues derived by Qualcomm and Lenovo will arise. Common questions of fact will also exist with regard to Qualcomm's and Lenovo's defenses in this litigation, if any.

THE ASSERTED PATENTS

U.S. PATENT NO. 6,639,944

43. U.S. Patent No. 6,639,944 (the "'944 patent") entitled, *Sub-Pixel Accurate Motion Vector Estimation and Compensated Interpolation*, was filed on April 26, 2000, and claims priority to April 26, 1999. Dynamic Data is the owner by assignment of all right, title, and interest in the '944 patent. A true and correct copy of the '944 patent is attached hereto as Exhibit 1.

44. The '944 patent discloses novel methods and systems for sub-pixel accurate motion vector estimation and motion-compensated interpolation or prediction.

45. The inventions disclosed in the '944 patent enable higher accuracy motion estimation at a lower cost through improvements in motion vector estimation and motion-compensated interpolation.

46. The '944 patent discloses a method of generating an intermediate image using sub-pixel accurate motion vectors having vector components that may have non-integer values, from first and second images having a given mutual temporal distance, the intermediate image being at a fractional distance from said first image, said fractional distance being a fraction of said given mutual temporal distance.

47. The '944 patent discloses a method that includes deriving first and second vectors from said sub-pixel accurate motion vectors.

48. The ‘944 patent discloses a method that includes generating an intermediate image by combining first positions in a first image shifted over first vectors and second positions in said second image shifted over second vectors.

49. The ‘944 patent discloses a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by multiplying the vector components of the sub-pixel accurate motion vectors by a fraction to obtain fractional vector components.

50. The ‘944 patent discloses a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by rounding the fractional vector components to obtain vector components of the first vectors, which have only integer vector components.

51. The ‘944 patent discloses a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by subtracting the first vector from the candidate vector to obtain the second vector, whereby the second vectors have vector components that, depending on the candidate vector and the fraction, may have non-integer values.

52. The ‘944 patent family has been cited by 34 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘944 patent family as relevant prior art:

- Himax Media Solutions, Inc.
- Cyberlink Corp.
- Marvell International Ltd.
- Sharp Corporation
- Toshiba Corporation
- Tokyo University
- Samsung Electronics Co., Ltd.
- Intel Corporation
- Broadcom Limited
- Micron Technology, Inc.
- Cisco Systems, Inc.
- Hitachi, Ltd.

U.S. PATENT NO. 6,760,376

53. U.S. Patent No. 6,760,376 (the "'376 patent") entitled, *Motion Compensated Upconversion For Video Scan Rate Conversion*, was filed on November 6, 2000. The '376 patent is subject to a 35 U.S.C. § 154(b) term extension of 697 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '376 patent. A true and correct copy of the '376 patent is attached hereto as Exhibit 2.

54. The '376 patent discloses novel methods and systems for motion compensated upconversion in a video image that uses motion compensation to generate an interpolated video field using motion vectors.

55. The inventions disclosed in the '376 patent provide a sharp video image by comparing a calculated correlation value of pixels with a threshold value.

56. The '376 patent discloses technologies that improve video image quality by selecting a motion compensated pixel that will provide a sharp video image by comparing a calculated correlation value of pixels with a threshold value.

57. The '376 patent discloses a method of motion compensation for use in a video image upconversion unit of the type that uses motion compensation to generate an interpolated field using motion vectors.

58. The '376 patent discloses a method of motion compensation that includes calculating a correlation value from the values of causal neighbor pixels of a generated field and from the values of corresponding neighbor pixels of a next field.

59. The '376 patent discloses a method of motion compensation that includes comparing the correlation value with a threshold value.

60. The ‘376 patent discloses a method of motion compensation that includes setting the value of a pixel to be created within the generated field to be equal to the value of a corresponding pixel of the next field if the correlation value is less than the threshold value.

61. The ‘376 patent family has been cited by twelve patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘376 patent family as relevant prior art:

- Samsung Electronics Co., Ltd.
- Blip X Ltd.
- Himax Technologies Limited
- Snell Ltd.
- Robert Bosch Gmbh
- Hyundai Motor Company

U.S. PATENT NO. 6,782,054

62. U.S. Patent No. 6,782,054 (the "'054 patent") entitled, *Method And Apparatus For Motion Vector Estimation*, was filed on April 20, 2001. The ‘054 patent is subject to a 35 U.S.C. § 154(b) term extension of 485 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.

63. The ‘054 patent discloses novel methods and systems for motion estimation in a sequence of moving video pictures.

64. The inventions disclosed in the ‘054 patent increase the speed of convergence of motion vectors to improve the convergence process.

65. The ‘054 patent discloses a method to enhance motion estimation that includes selecting a displacement vector as a best motion vector for a region in a field from a plurality of at least two candidate motion vectors by applying an error function to each of said plural candidate

motion vectors, wherein the candidate motion vector with the least error is selected as the displacement vector for the region in the field.

66. The ‘054 patent discloses a method to enhance motion estimation that includes an error function comprising a first penalty term that depends on a type of the candidate motion vector and a second penalty term that depends on the position and size of the candidate motion vector.

67. The ‘054 patent family has been cited by 113 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘054 patent family as relevant prior art:

- Samsung Electronics Co., Ltd.
- Sony Corporation
- MediaTek Inc.
- ***Qualcomm Incorporated***
- Micronas GmbH
- Google Inc.
- Thomson Licensing
- Brightscale, Inc.
- Genesis Microchip Inc.
- STMicroelectronics SA
- Toshiba Corp.
- Micron Technology, Inc.
- Realtek Semiconductor Corp.
- Intel Corporation

U.S. PATENT NO. 7,058,227

68. U.S. Patent No. 7,058,227 (the "'227 patent") entitled, *Problem Area Location in An Image Signal*, was filed on July 17, 2002, and claims priority to August 21, 1998. The ‘227 patent is subject to a 35 U.S.C. § 154(b) term extension of 723 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘227 patent. A true and correct copy of the ‘227 patent is attached hereto as Exhibit 4.

69. The ‘227 patent discloses novel methods and systems for detecting occlusion and reducing halo effects in motion compensated pictures.

70. The ’227 patent further discloses a method and device for interpolating images between existing images.

71. The ‘227 patent discloses technologies capable of adapting the interpolation strategy depending on a segmentation of the image in various areas.

72. The ‘227 patent discloses a method of locating problem areas in an image signal that includes estimating a motion vector field for the image signal.

73. The ‘227 patent discloses a method of locating problem areas in an image signal that includes detecting edges in the motion vectors field.

74. The ‘227 patent discloses a method of locating problem areas in an image signal that includes comparing edge locations in successive field periods to identify both foreground and background.

75. The ‘227 patent family has been cited by 70 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘227 patent family as relevant prior art:

- Integrated Device Technology, Inc.
- ***Qualcomm Inc.***
- MediaTek Inc.
- Mitsubishi Denki Kabushiki Kaisha
- Panasonic Corporation
- Samsung Electronics Co., Ltd.
- Sony Corporation
- Toshiba Corporation
- Pixelworks, Inc.
- Google, LLC
- Avid Technology, Inc.

U.S. PATENT NO. 7,039,109

76. U.S. Patent No. 7,039,109 (the "'109 patent") entitled, *Reducing Halo-Like Effects In Motion-Compensated Interpolation*, was filed on January 14, 2002, and claims priority to January 16, 2001. The '109 patent is subject to a 35 U.S.C. § 154(b) term extension of 583 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '109 patent. A true and correct copy of the '109 patent is attached hereto as Exhibit 5.

77. The '109 patent discloses novel methods and systems for motion-compensated interpolation of a data-signal wherein the data-signal comprises successive images comprised of groupings of pixels.

78. The '109 patent further discloses a method and device for generating motion vectors, each motion vector corresponding to a group of pixels of one image, between a group of pixels of said one image and a second group of pixels of another image in the data-signal.

79. The '109 patent discloses technologies that provide a motion-compensated interpolation that reduces the area of the halo-effect in the interpolated images of the data-signal.

80. The '109 patent discloses technologies capable of estimating the reliability of each motion vector corresponding to a particular group of pixels in a data signal.

81. The '109 patent teaches calculating weights as a function of the reliability of the motion vectors.

82. The '109 patent discloses generating an interpolated luminous intensity of a group of pixels for an interpolated image by calculating, on the basis of these weights, a weighted average of the interpolated results.

83. The '109 patent discloses estimating the reliability of a motion vector. The reliability of a motion vector can be a function of the accuracy of the motion vector, the relative

frequency of occurrence of the motion vector in the neighboring groups of pixels of the first group of pixels, or a function of both the accuracy of the motion vector and its relative occurrence.

84. The '109 patent discloses interpolation between images. In one embodiment the interpolation is done for each motion vector assigned to a group of pixels. The motion vectors each yields an interpolation result, wherein each interpolation result is provided with a weight that is calculated on the basis of the reliability of the motion vectors.

85. The '109 patent discloses that for each interpolation result a weight is calculated as a function of the reliability of the motion vector which yielded the interpolation result. Further, each group of pixels is assigned a multiple of motion vectors that in turn leads to a multiple of interpolation results and corresponding weights per group of pixels.

86. The '109 patent family has been cited by 52 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the '109 patent family as relevant prior art:

- Advanced Micro Devices, Inc.
- Fujitsu Limited
- Sharp Corporation
- ***Qualcomm Inc.***
- Sony Corporation
- Nikon Corporation
- Technicolor S.A.
- Samsung Electronics Co., Ltd.
- Dolby Laboratories, Inc.
- Nikon Corporation
- Innolux Corp.

COUNT I
INFRINGEMENT OF U.S. PATENT NO. 6,639,944

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

QUALCOMM INFRINGES THE '944 PATENT

88. Qualcomm designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for sub-pixel accurate motion vector estimation and motion-compensated interpolation or prediction.

89. Qualcomm has directly infringed and continues to directly infringe the ’944 patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the ‘944 patent. Qualcomm products that infringe one or more claims of the ‘944 patent include, but are not limited to, the following Qualcomm Snapdragon processors: Snapdragon 855+, Snapdragon 855, Snapdragon 850, Snapdragon 845, Snapdragon 835, Snapdragon 821, Snapdragon 820, Snapdragon 730G, Snapdragon 730, Snapdragon 712, Snapdragon 710, Snapdragon 675, Snapdragon 670, Snapdragon 665, Snapdragon 660, Snapdragon 653, Snapdragon 652, Snapdragon 650, Snapdragon 636, Snapdragon 632, Snapdragon 630, Snapdragon 626, Snapdragon 625, Snapdragon 610, Snapdragon 450, Snapdragon 439, Snapdragon 435, Snapdragon 429, Snapdragon 215, and the Snapdragon 212 (collectively, the “Qualcomm ’944 Products”).

90. The Qualcomm ‘944 Products perform decoding of video in compliance with the H.265 standard. Specifically, each of the Qualcomm ‘944 Products perform decoding using an

HEVC decoder: Snapdragon 855+,[29] Snapdragon 855,[30] Snapdragon 850,[31] Snapdragon 845,[32] Snapdragon 835,[33] Snapdragon 821,[34] Snapdragon 820,[35] Snapdragon 730G,[36] Snapdragon 730,[37]

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[29] *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC), HDR10+, HLG, HDR10, H.264 (AVC), VP8, VP9").

[30] *Qualcomm Snapdragon 855 Mobile Platform Specification*, Qualcomm Website, *available at*: https://www.qualcomm.com/products/snapdragon-855-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC)").

[31] *Qualcomm Snapdragon 850 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019) ("Video Capture Formats: HDR, HLG, HEVC . . . Codec Support: H.265(HEVC)").

[32] *Qualcomm Snapdragon 845 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (May 2018) ("Ultra HD Premium video playback and encoding @ 4K (3840x2160) 60fps, 10bit HDR, Rec 2020 color gamut. . . Slow motion HEVC video encoding of either HD (720p) video up to 480fps or FHD (1080p) up to 240fps . . . H.264 (AVC), H.265 (HEVC)").

[33] *Qualcomm Snapdragon 835 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-835-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback @ 60 fps . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP9.").

[34] *Qualcomm Snapdragon 821 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-821-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC)").

[35] *Qualcomm Snapdragon 820 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2016) ("4K HEVC video (Decode: 60 fps, 10-bit. Encode: 30 fps)").

[36] *Qualcomm Snapdragon 730G Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730g-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[37] *Qualcomm Snapdragon 730 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Capture (30 FPS): 4K Ultra HD video capture . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

Snapdragon 712,[38] Snapdragon 710,[39] Snapdragon 675,[40] Snapdragon 670,[41] Snapdragon 665,[42] Snapdragon 660,[43] Snapdragon 653,[44] Snapdragon 652,[45] Snapdragon 650,[46] Snapdragon 636,[47]

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[38] *Qualcomm Snapdragon 712 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-712-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[39] *Qualcomm Snapdragon 710 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[40] *Qualcomm Snapdragon 675 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (February 2019) ("Visual Processing System . . . H.264 (AVC), H.265 (HEVC), VP8 and VP9 playback . . . Video capture . . . HEVC video capture").

[41] *Qualcomm Snapdragon 670 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-670-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[42] *Qualcomm Snapdragon 665 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-665-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[43] *Qualcomm Snapdragon 660 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-660-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[44] *Qualcomm Snapdragon 653 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("Efficient, high-quality video streaming Embedded HEVC H.265 hardware decoder and integrated Qualcomm VIVE 802.11ac WiFi technology and Bluetooth 4.1 solutions.").

[45] *Qualcomm Snapdragon 652 Mobile Platform Product Specfication*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-652-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

[46] *Qualcomm Snapdragon 650 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-650-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

[47] *Qualcomm Snapdragon 636 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

Snapdragon 632,[48] Snapdragon 630,[49] Snapdragon 626,[50] Snapdragon 625,[51] Snapdragon 610,[52] Snapdragon 450,[53] Snapdragon 439,[54] Snapdragon 435,[55] Snapdragon 429,[56] Snapdragon 215,[57] and the Snapdragon 212.[58]

91. The Qualcomm '944 Products contain a multimedia subsystem wherein video

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[48] *Qualcomm Snapdragon 632 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-632-mobile-platform (last visited September 2019) ("Video . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[49] *Qualcomm Snapdragon 630 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

[50] *Qualcomm Snapdragon 626 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("4K Ultra HD video – Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth").

[51] *Qualcomm Snapdragon 625 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-625-mobile-platform (last visited September 2019) ("4K Ultra HD video - Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth.").

[52] *Qualcomm Snapdragon 610 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2014) ("Efficient high-quality video streaming – Embedded HEVC H.265 hardware decoder.").

[53] *Qualcomm Snapdragon 450 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video – FHD+@60fps HEVC capture and playback").

[54] *Qualcomm Snapdragon 439 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-439-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8").

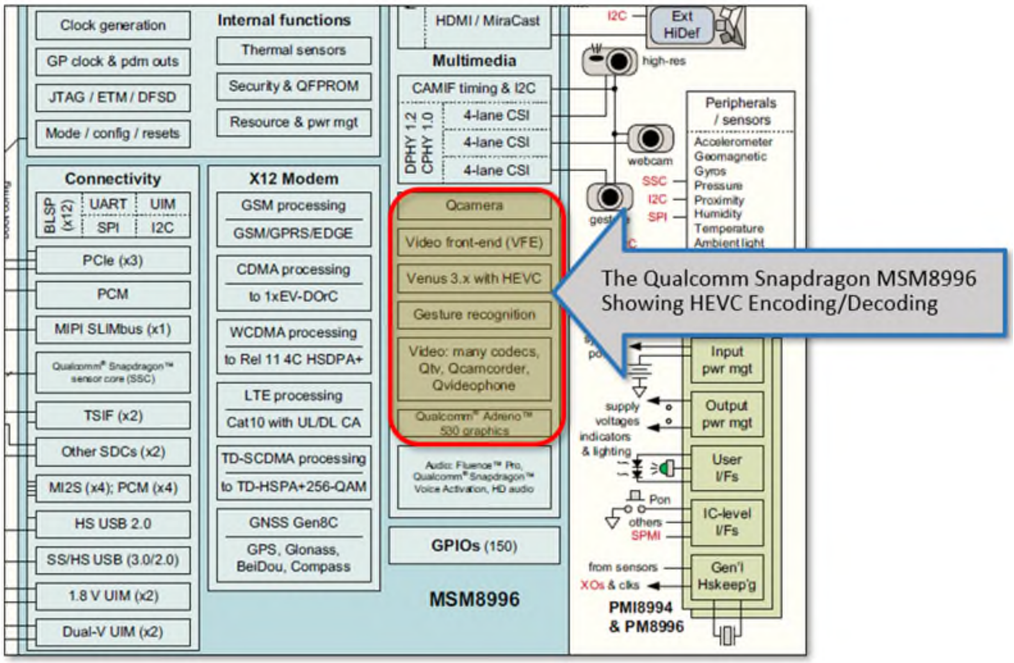
[55] *Qualcomm Snapdragon 435 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform (last visited September 2019) ("With a 21MP dual ISP and Qualcomm Adreno 505 GPU integration, the Snapdragon 435 supports rich, high-quality camera images and stunning graphics with optimum speed.").

[56] *Qualcomm Snapdragon 429 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform (last visited September 2019) ("GPU Name: Qualcomm Adreno 504 GPU").

[57] *Qualcomm Snapdragon 215 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/qualcomm-215-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8").

[58] *Qualcomm Snapdragon 212 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/qualcomm-snapdragon-212-mobile-platform (last visited September 2019) ("HD video content on the fly - With native HEVC, maximize device storage and watch streaming HD content as quick as you can click the link.").

content is decoded in compliance with the HEVC standard. For example, the following excerpt from a publicly accessible copy of the Snapdragon 820 Device Specification shows the multimedia system responsible for encoding and decoding is identified as "Venus 3.x with HEVC."[59]



MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (annotations added).

92. The Qualcomm '944 Products all perform decoding of video content in compliance with the HEVC Standard. Specifically, all of the Qualcomm '944 Products contain an Adreno 300 to 600 series graphic processing unit.[60] Further, the Qualcomm '944 Products each contain a video

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[59] *See MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019)

[60] *See e.g., Snapdragon 435 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform ("With a 21MP dual ISP and Qualcomm® Adreno™ 505 GPU integration, the Snapdragon 435 supports rich, high-quality camera images and stunning graphics with optimum speed."); *Snapdragon 429 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform ("GPU Name: Qualcomm® Adreno™ 504 GPU").

core that is used to decode HEVC content.

93. Qualcomm makes, uses, sells, offers for sale, or imports into the United States the Qualcomm ‘944 Products and thus directly infringes at least one or more claims of the ’944 patent. Upon information and belief, Qualcomm also uses the Qualcomm ‘944 Products via its internal use and testing in the United States, directly infringing one or more claims of the ’944 patent.

94. Qualcomm has induced and continues to induce and contribute to infringement of the ‘944 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the ‘944 patent, including, but not limited to, the Qualcomm ‘944 Products. Qualcomm provides these Qualcomm ‘944 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the ‘944 patent.

95. One or more Qualcomm subsidiaries and/or affiliates use the Qualcomm ’944 Products in regular business operations.

96. The Qualcomm ’944 Products are available to businesses and individuals throughout the United States.

97. The Qualcomm ’944 Products are provided to businesses and individuals located in the State of Delaware.

LENOVO INFRINGES THE ‘944 PATENT

98. Lenovo designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for sub-pixel accurate motion vector estimation and motion-compensated interpolation or prediction.

99. Lenovo has directly infringed and continues to directly infringe the ’944 patent by making, using, selling, offering for sale, or importing into the United States products and/or

methods covered by one or more claims of the '944 patent. Lenovo products that infringe one or more claims of the '944 patent include, but are not limited to, the following Lenovo products: Motorola Moto Z, Motorola Moto Z Force, Motorola Moto Z Play, Motorola Moto Z2 Force Edition, Motorola Moto Z2 Play, Motorola Moto Z3, Motorola Moto Z3 Play, Motorola One, Motorola One Power, Lenovo Yoga C630 13" Laptop, Lenovo Tab M10, Lenovo Smart Tab M10 (HD), Lenovo Tab 4 10 Plus, Lenovo Smart Tab M10 , and the Lenovo Smart Tab P10 (collectively, the "Lenovo '944 Products").

100. The Lenovo '944 Products contain functionality for decoding video data in compliance with the H.265 standard. The below excerpt from documentation of the infringing devices shows support for the infringing functionality.

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3, MIDI,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Microphones
4 far-field mic system

Headphone jack
USB-C to 3.5mm converter included

Motorola Z3 Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019) (annotation added) ("Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K.").

audio + video

Speakers

Front port loud speaker

Audio playback

AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3,

Audio format

AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback

MPEG4, H.263, H.264, H.265, VP8, VP8

Video format

H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Motorola Moto Z3 Play Specifications, MOTOROLA SUPPORT WEBSITE, ***available at***: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019) (annotation added) ("Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K").

101. Exemplar documentation from Qualcomm establishes that the accused Lenovo '944 Products contain functionality for decoding video in a manner that infringes the '944 patent.

Video applications performance	
Encode	1080p120/4K30/4x 1080p30: H.264, VP8, HEVC
Decode	1080p240/4K60/8x 1080p30: H.264, VP8, HEVC 8/10-bit, VP9
Concurrency	4K60 decode + 4K30 encode 4K60 decode + 1080p60 encode
Graphics	Adreno 530 3D graphics accelerator with 64-bit addressing 624 MHz OpenGL ES 3.0/3.1/GEP, GL4.4, DX11.3/4, Path Rendering OpenCL 2.0 Full, Renderscript-Next

SM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P (February 9, 2016), ***available at***: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (emphasis added).

102. Source code for the Lenovo '944 Products shows that they support the infringing functionality as shown in the below excerpt from the source code for the MMI-PPW29.131-27-1 image. The source code excerpted is made available via Lenovo through its GitHub repository. *See* MOTOROLA MOBILITY LLC GITHUB REPOSITORY (last visited September 2019), ***available at***: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208.

```
enum vdec_codec {
        VDEC_CODECTYPE_H264 = 0x1,
        VDEC_CODECTYPE_H263 = 0x2,
        VDEC_CODECTYPE_MPEG4 = 0x3,
        VDEC_CODECTYPE_DIVX_3 = 0x4,
        VDEC_CODECTYPE_DIVX_4 = 0x5,
        VDEC_CODECTYPE_DIVX_5 = 0x6,
        VDEC_CODECTYPE_DIVX_6 = 0x7,
        VDEC_CODECTYPE_XVID = 0x8,
        VDEC_CODECTYPE_MPEG1 = 0x9,
        VDEC_CODECTYPE_MPEG2 = 0xa,
        VDEC_CODECTYPE_VC1 = 0xb,
        VDEC_CODECTYPE_VC1_RCV = 0xc,
        VDEC_CODECTYPE_HEVC = 0xd,
        VDEC_CODECTYPE_MVC = 0xe,
        VDEC_CODECTYPE_VP8 = 0xf,
        VDEC_CODECTYPE_VP9 = 0x10,
};
```

msm_vidc_dec.h, MOTOROLA MMI-PPW29.131-27-1 IMAGE (last accessed September 2019), *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/ (annotations added).

103. The Lenovo '944 Products all contain functionality for performing the decoding of video content using a Qualcomm processor. *See e.g.*, Motorola Moto Z (containing a Qualcomm Snapdragon 820 processor), Motorola Moto Z Force (containing a Qualcomm Snapdragon 820 processor), Motorola Moto Z Play (containing a Qualcomm Snapdragon 625 processor), Motorola Moto Z2 Force Edition (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z2 Play (containing a Qualcomm Snapdragon 626 processor), Motorola Moto Z3 (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z3 Play (containing a Qualcomm Snapdragon 636 processor), Motorola One (containing a Qualcomm Snapdragon 625 processor), Lenovo Yoga C630 13" Laptop (containing a Qualcomm Snapdragon 850 processor), Lenovo Tab M10 (containing a Qualcomm Snapdragon 429 processor), Lenovo Smart Tab M10 (HD) (containing a Qualcomm Snapdragon 450 processor), Lenovo Tab 4 10 Plus (containing a Qualcomm Snapdragon 625 processor), Lenovo Smart Tab M10 (containing a Qualcomm Snapdragon 450 processor), and the Lenovo Smart Tab P10 (containing a Qualcomm Snapdragon 450 processor).

104. Lenovo makes, uses, sells, offers for sale, or imports into the United States the Lenovo ‘944 Products and thus directly infringes at least one or more claims of the ’944 patent. Upon information and belief, Lenovo also uses the Lenovo ‘944 Products via its internal use and testing in the United States, directly infringing one or more claims of the ’944 patent.

105. Lenovo has induced and continues to induce and contribute to infringement of the ‘944 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the ‘944 patent, including, but not limited to, the Lenovo ‘944 Products. Lenovo provides these Lenovo ‘944 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the ‘944 patent.

106. One or more Lenovo subsidiaries and/or affiliates use the Lenovo ’944 Products in regular business operations.

107. The Lenovo ’944 Products are available to businesses and individuals throughout the United States.

108. The Lenovo ’944 Products are provided to businesses and individuals located in the State of Delaware.

INFRINGEMENT OF THE ‘944 PATENT

109. The Qualcomm ‘944 Products and Lenovo ‘944 Products (collectively, the “Qualcomm-Lenovo ‘944 Products”) perform a method of generating an intermediate image using sub-pixel accurate motion vectors having vector components that may have non-integer values, from first and second images having a given mutual temporal distance, the intermediate image being at a fractional distance from said first image, said fractional distance being a fraction of said given mutual temporal distance.

110. The Qualcomm-Lenovo '944 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).

111. The Qualcomm-Lenovo '944 Products perform a method that includes deriving first and second vectors from said sub-pixel accurate motion vectors.

112. The Qualcomm-Lenovo '944 Products perform a method that includes generating an intermediate image by combining first positions in a first image shifted over first vectors and second positions in said second image shifted over second vectors.

> 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).

113. The Qualcomm-Lenovo '944 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by multiplying the vector components of the sub-pixel accurate motion vectors by a fraction to obtain fractional vector components.

> 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.").

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

115. The Qualcomm-Lenovo '944 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by rounding the fractional vector components to obtain vector components of the first vectors, which have only integer vector components.

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

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

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

116. The Qualcomm-Lenovo '944 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by subtracting the first vector from the candidate vector to obtain the second vector, whereby the second vectors have vector components that, depending on the candidate vector and the fraction, may have non-integer values.

117. The Qualcomm-Lenovo '944 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.

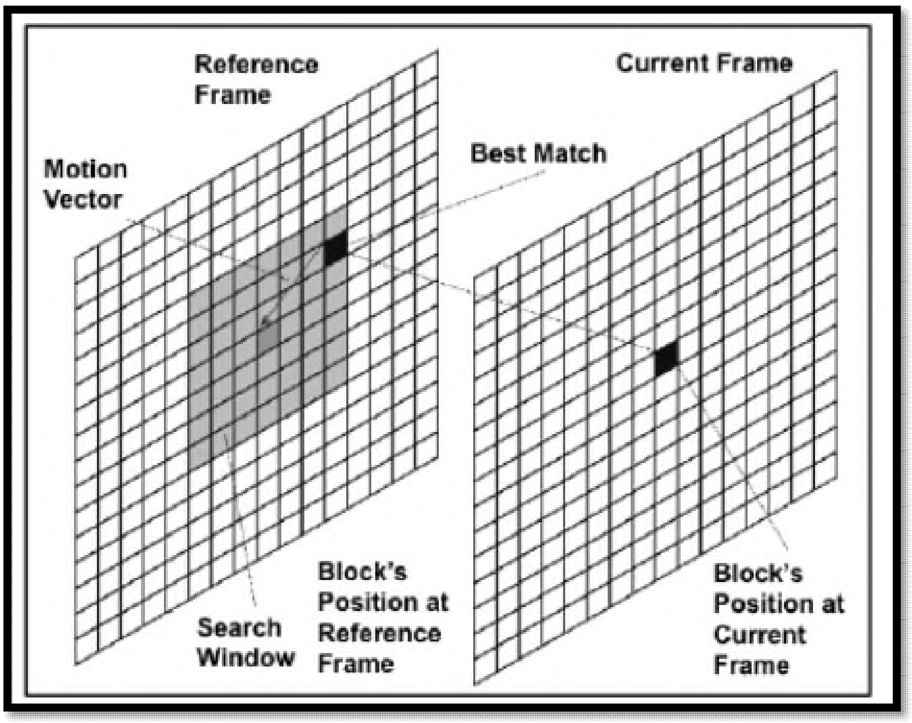
Series H: Audiovisual and Multimedia Systems- Infrastructure of Audiovisual Services – Coding of Moving Video, INTERNATIONAL TELECOMMUNICATIONS UNIONS - TU-T H.265, V.5 at I (February 2018).

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

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

Sung-Fang Tsai, *et al., Encoder Hardware Architecture for HEVC*, High Efficiency Video Coding (HEVC) at 347 (September 2014) (emphasis added).

119. The following exemplary drawings reflect that the corresponding image segment of a reference picture is co-located with the current image segment of a current picture.



R.C. LINS, *et al., A Faster Pixel-Decimation Method for Block Motion Estimation in H.264/AVC*, PUBLISHED IN TEND. MAT. APL. COMPUT., VOL. 15, NO. 1 at 120 (2014), *available at*: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S2179-84512014000100010.

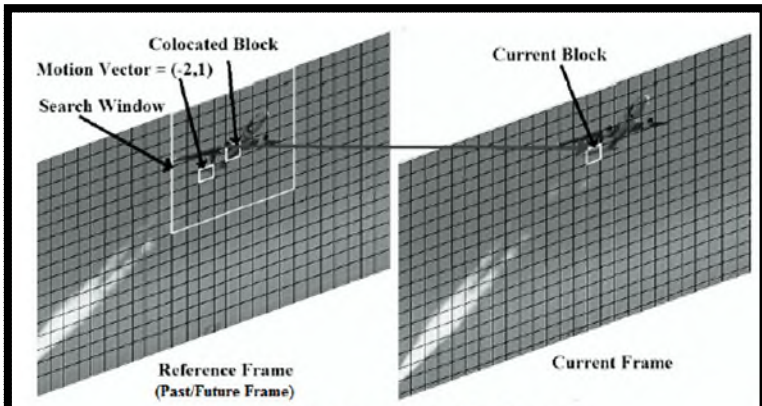


Fig.1(b) Illustration of ME Process

Purnachand Nalluri, *et al.*, *Fast Motion Estimation Algorithm for HEVC Video Encoder*, published in 9TH CONFERENCE ON TELECOMMUNICATIONS, VOL. 1 at 1 (May 2013) (attached hereto as Exhibit_ZL 5), *available at*: https://www.it.pt/Publications/PaperConference/14332

120. For AMVP mode with motion estimation, the main goal of the motion estimation is to find the best matching block of each current PU and determine the real MV which represents the motion translation in the successive frame. The MV difference between the optimal AMVP candidate and the real MV derived from the motion estimation is encoded and transmitted together with other information, e.g., the optimal AMVP and reference frame indexes. The motion estimation is conducted in two stages, the integer motion estimation (IME) at integer pixel accuracy and the fractional motion estimation (FME) at subpixel accuracy. According to the "High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Improved Encoder Description Update 9" approved by JCT-VC, the best candidate MVP selected from the AMVP candidate list is used as an initial search center of the IME, which indicates that the search center of the IME is offset from the co-located block within the reference frame by the best candidate MVP.

121. Therefore, when the Qualcomm-Lenovo '944 Products processes the video data using AMVP mode based on the IME, the co-located block within the reference frame of the current PU corresponds to the selected image segment, and the best candidate MVP corresponds

to the offset vector within the reference frame from the co-located block of the current PU (i.e., the selected image segment) to the search center.

> To derive the motion vector(s) for each PU, a block matching algorithm is performed in the HM encoder. For AMVP, find the best candidate MV predictor for each ref_idx and ref_pic_list using xEstimateMvPredAMVP(), called from predInterSearch(). The default search range for the first search in the HM encoder is 96 integer pixels, however the CTC [3] uses a value of 64. A search window is defined according to the search range, relative to the best candidate MV predictor. Firstly an integer-pel search is performed, followed by a fractional-pel refinement search.

The Joint Collaborative Team on Video Coding (JCT-VC), *High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Improved Encoder Description Update 9*, ISO/IEC JTC1/SC29/WG11 N17047 at 43 (July 2017) (emphasis added), *available at*: https://mpeg.chiariglione.org/standards/mpeg-h/high-efficiency-video-coding/n17047-high-efficiency-video-coding-hevc-test-model-16.

122. By complying with the HEVC standard, the Qualcomm-Lenovo '944 Products necessarily infringe the '944 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '944 patent, including but not limited to claim 2 of the '944 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 Qualcomm and Lenovo's infringement of the '944 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.").

123. The Qualcomm-Lenovo '944 Products perform a method that includes deriving first and second vectors from said sub-pixel accurate motion vectors.

124. The Qualcomm-Lenovo ‘944 Products perform a method that includes generating an intermediate image by combining first positions in a first image shifted over first vectors and second positions in said second image shifted over second vectors.

125. The Qualcomm-Lenovo ‘944 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by multiplying the vector components of the sub-pixel accurate motion vectors by a fraction to obtain fractional vector components.

126. The Qualcomm-Lenovo ‘944 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by rounding the fractional vector components to obtain vector components of the first vectors, which have only integer vector components.

127. The Qualcomm-Lenovo ‘944 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by subtracting the first vector from the candidate vector to obtain the second vector, whereby the second vectors have vector components that, depending on the candidate vector and the fraction, may have non-integer values.

128. By making, using, testing, offering for sale, and/or selling products and services for sub-pixel accurate motion vector estimation and motion-compensated interpolation or prediction, including but not limited to the Qualcomm-Lenovo ’944 Products, Qualcomm and Lenovo have injured Dynamic Data and are liable to the Plaintiff for directly infringing one or more claims of the ‘944 patent, including at least claim 2 pursuant to 35 U.S.C. § 271(a).

129. Qualcomm and Lenovo also indirectly infringe the ‘944 patent by actively inducing infringement under 35 U.S.C. § 271(b).

130. Qualcomm and Lenovo have had knowledge of the '944 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Qualcomm and Lenovo knew of the '944 patent and knew of its infringement, including by way of this lawsuit.

131. Qualcomm intended to induce patent infringement by third-party customers and users of the Qualcomm '944 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. Qualcomm specifically intended and was aware that the normal and customary use of the accused products would infringe the '944 patent. Qualcomm performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '944 patent and with the knowledge that the induced acts would constitute infringement. For example, Qualcomm provides the Qualcomm '944 Products that have the capability of operating in a manner that infringe one or more of the claims of the '944 patent, including at least claim 2, and Qualcomm further provides documentation and training materials that cause customers and end users of the Qualcomm '944 Products to utilize the products in a manner that directly infringe one or more claims of the '944 patent.[61] By providing instruction and training to customers and

[61] *See, e.g.*, *MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019); *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019); *Qualcomm High Efficiency Video Coding (HEVC) Video Encoder*, USER MANUAL (July 11, 2017); *Snapdragon 850 Mobile Compute Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019); *Snapdragon 710 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019); *Snapdragon 653 Mobile Platform,* QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon/processors/653 (last visited September 2019); *Snapdragon 212 Mobile Platform,* QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/snapdragon/processors/212 (last visited September 2019).

end-users on how to use the Qualcomm ’944 Products in a manner that directly infringes one or more claims of the ‘944 patent, including at least claim 2, Qualcomm specifically intended to induce infringement of the ‘944 patent. Qualcomm engaged in such inducement to promote the sales of the Qualcomm ’944 Products, e.g., through Qualcomm user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the ‘944 patent. Accordingly, Qualcomm 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 ‘944 patent, knowing that such use constitutes infringement of the ‘944 patent.

132. Lenovo intended to induce patent infringement by third-party customers and users of the Lenovo ’944 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. Lenovo specifically intended and was aware that the normal and customary use of the Lenovo ‘944 Products would infringe the ‘944 patent. Lenovo performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘944 patent and with the knowledge that the induced acts would constitute infringement. For example, Lenovo provides the Lenovo ’944 Products that have the capability of operating in a manner that infringe one or more of the claims of the ‘944 patent, including at least claim 2, and Lenovo further provides documentation and training materials that cause customers and end users of the Lenovo ’944 Products to utilize the products in a manner that directly infringe one or more claims of the ‘944 patent.[62] By providing instruction and training to customers and end-users on how to use the

[62] *See, e.g.*, *Motorola Z3 Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019); *Motorola Moto Z3 Play Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019); MOTOROLA MOBILITY LLC GITHUB

Lenovo ’944 Products in a manner that directly infringes one or more claims of the ‘944 patent, including at least claim 2, Lenovo specifically intended to induce infringement of the ‘944 patent. Lenovo engaged in such inducement to promote the sales of the Lenovo ’944 Products, e.g., through Lenovo user manuals, product support, marketing materials, and training materials to actively induce the users of the Lenovo ’944 Products to infringe the ‘944 patent. Accordingly, Lenovo 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 ‘944 patent, knowing that such use constitutes infringement of the ‘944 patent.

133. The ‘944 patent is well-known within the industry as demonstrated by multiple citations to the ‘944 patent in published patents and patent applications assigned to technology companies and academic institutions.

134. Qualcomm and Lenovo are utilizing the technology claimed in the ‘944 patent without paying a reasonable royalty. Qualcomm and Lenovo are infringing the ‘944 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

135. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘944 patent. As a result of Qualcomm and Lenovo’s infringement of the ‘944 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate

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REPOSITORY, *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208 ((last visited September 2019); *Lenovo Knowledge Base*, LENOVO WEBSITE, *available at*: https://forums.lenovo.com/t5/English-Community/tkbc-p/Community-EN (last visited September 2019); *Lenovo Tab M10 Platform Specfication*, LENOVO DOCUMENATION (August 2019); *Lenovo Tab P10 Platform Specifications*, LENOVO DOCUMENTATION (June 2019); *Lenovo Open Source Code - Tab P10 / Smart Tab 10 Tablet (TB-X705L*), LENOVO SUPPORT WEBSITE, *available at*: https://support.lenovo.com/us/en/downloads/ds506313 (code released January 31, 2019).

to compensate for Qualcomm and Lenovo's infringement, but in no event less than a reasonable royalty for the use made of the invention by Qualcomm and Lenovo with interest and costs as fixed by the Court.

COUNT II
INFRINGEMENT OF U.S. PATENT NO. 6,760,376

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

QUALCOMM INFRINGES THE '376 PATENT

137. Qualcomm designs, makes, sells, offers to sell, imports, and/or uses Qualcomm products that calculate a correlation value from neighboring pixels in a field and a frame of video data, including but not limited to, the following Qualcomm Snapdragon processors: Snapdragon 855+, Snapdragon 855, Snapdragon 850, Snapdragon 845, Snapdragon 835, Snapdragon 821, Snapdragon 820, Snapdragon 730G, Snapdragon 730, Snapdragon 712, Snapdragon 710, Snapdragon 675, Snapdragon 670, Snapdragon 665, Snapdragon 660, Snapdragon 653, Snapdragon 652, Snapdragon 650, Snapdragon 636, Snapdragon 632, Snapdragon 630, Snapdragon 626, Snapdragon 625, Snapdragon 610, Snapdragon 450, Snapdragon 439, Snapdragon 435, Snapdragon 429, Snapdragon 215, and the Snapdragon 212 (collectively, the "Qualcomm '376 Products").

138. Qualcomm has directly infringed and continues to directly infringe the '376 patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '376 patent.

139. The Qualcomm '376 Products comprise an input for receiving encoded data and a decoder that is compliant with the H.265 standard.

140. The Qualcomm '376 Products perform decoding of video in compliance with the H.265 standard. Specifically, each of Qualcomm '376 Products perform decoding using an HEVC decoder: Snapdragon 855+,[63] Snapdragon 855,[64] Snapdragon 850,[65] Snapdragon 845,[66] Snapdragon 835,[67] Snapdragon 821,[68] Snapdragon 820,[69] Snapdragon 730G,[70] Snapdragon 730,[71]

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[63] *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC), HDR10+, HLG, HDR10, H.264 (AVC), VP8, VP9").

[64] *Qualcomm Snapdragon 855 Mobile Platform Specification*, Qualcomm Website, *available at*: https://www.qualcomm.com/products/snapdragon-855-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC)").

[65] *Qualcomm Snapdragon 850 Mobile Platform Specification,* QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019) ("Video Capture Formats: HDR, HLG, HEVC . . . Codec Support: H.265(HEVC)").

[66] *Qualcomm Snapdragon 845 Mobile Platform Product Brief,* QUALCOMM DOCUMENTATION at 2 (May 2018) ("Ultra HD Premium video playback and encoding @ 4K (3840x2160) 60fps, 10bit HDR, Rec 2020 color gamut. . . Slow motion HEVC video encoding of either HD (720p) video up to 480fps or FHD (1080p) up to 240fps . . . H.264 (AVC), H.265 (HEVC)").

[67] *Qualcomm Snapdragon 835 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-835-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback @ 60 fps . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP9.").

[68] *Qualcomm Snapdragon 821 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-821-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC)").

[69] *Qualcomm Snapdragon 820 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2016) ("4K HEVC video (Decode: 60 fps, 10-bit. Encode: 30 fps)").

[70] *Qualcomm Snapdragon 730G Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730g-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[71] *Qualcomm Snapdragon 730 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Capture (30 FPS): 4K Ultra HD video capture . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

Snapdragon 712,[72] Snapdragon 710,[73] Snapdragon 675,[74] Snapdragon 670,[75] Snapdragon 665,[76] Snapdragon 660,[77] Snapdragon 653,[78] Snapdragon 652,[79] Snapdragon 650,[80] Snapdragon 636,[81]

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[72] *Qualcomm Snapdragon 712 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-712-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[73] *Qualcomm Snapdragon 710 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[74] *Qualcomm Snapdragon 675 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (February 2019) ("Visual Processing System . . . H.264 (AVC), H.265 (HEVC), VP8 and VP9 playback . . . Video capture . . . HEVC video capture").

[75] *Qualcomm Snapdragon 670 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-670-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[76] *Qualcomm Snapdragon 665 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-665-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[77] *Qualcomm Snapdragon 660 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-660-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[78] *Qualcomm Snapdragon 653 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("Efficient, high-quality video streaming Embedded HEVC H.265 hardware decoder and integrated Qualcomm VIVE 802.11ac WiFi technology and Bluetooth 4.1 solutions.").

[79] *Qualcomm Snapdragon 652 Mobile Platform Product Specfication*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-652-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

[80] *Qualcomm Snapdragon 650 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-650-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

[81] *Qualcomm Snapdragon 636 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

Snapdragon 632,[82] Snapdragon 630,[83] Snapdragon 626,[84] Snapdragon 625,[85] Snapdragon 610,[86] Snapdragon 450,[87] Snapdragon 439,[88] Snapdragon 435,[89] Snapdragon 429,[90] Snapdragon 215,[91] and the Snapdragon 212.[92]

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82 *Qualcomm Snapdragon 632 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-632-mobile-platform (last visited September 2019) ("Video . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

83 *Qualcomm Snapdragon 630 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

84 *Qualcomm Snapdragon 626 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("4K Ultra HD video – Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth").

85 *Qualcomm Snapdragon 625 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-625-mobile-platform (last visited September 2019) ("4K Ultra HD video - Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth.").

86 *Qualcomm Snapdragon 610 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2014) ("Efficient high-quality video streaming – Embedded HEVC H.265 hardware decoder.").

87 *Qualcomm Snapdragon 450 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video – FHD+@60fps HEVC capture and playback").

88 *Qualcomm Snapdragon 439 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-439-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8").

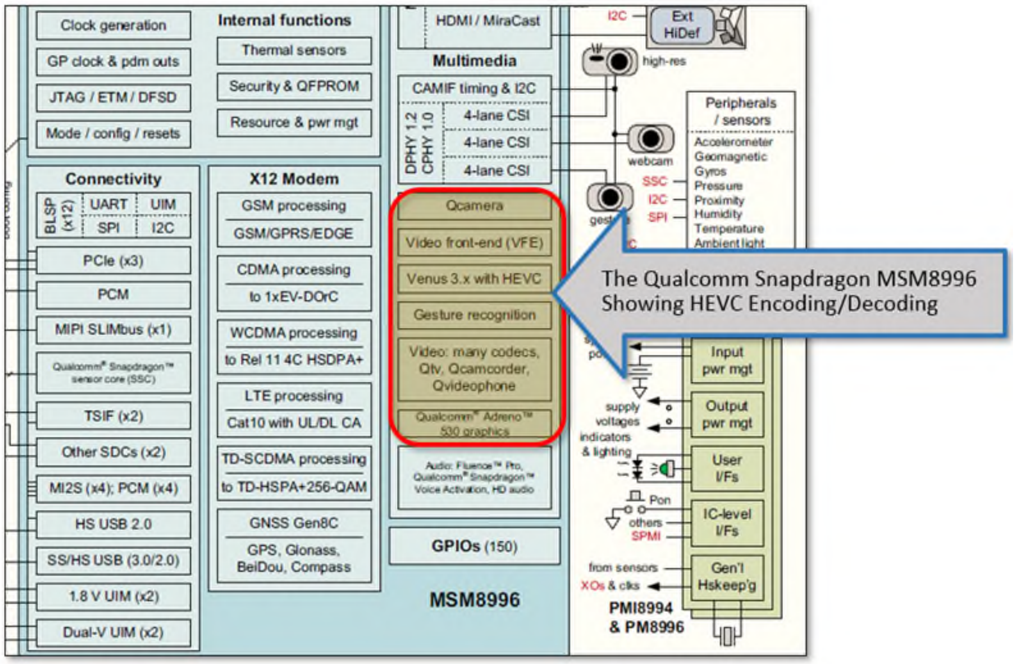
89 *Qualcomm Snapdragon 435 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform (last visited September 2019) ("With a 21MP dual ISP and Qualcomm Adreno 505 GPU integration, the Snapdragon 435 supports rich, high-quality camera images and stunning graphics with optimum speed.").

90 *Qualcomm Snapdragon 429 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform (last visited September 2019) ("GPU Name: Qualcomm Adreno 504 GPU").

91 *Qualcomm Snapdragon 215 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/qualcomm-215-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8").

92 *Qualcomm Snapdragon 212 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/qualcomm-snapdragon-212-mobile-platform (last visited September 2019) ("HD video content on the fly - With native HEVC, maximize device storage and watch streaming HD content as quick as you can click the link.").

141. The Qualcomm '376 Products contain a multimedia subsystem wherein video content is decoded in compliance with the HEVC standard. For example, the following excerpt from a publicly accessible copy of the Snapdragon 820 Device Specification shows the multimedia system responsible for encoding and decoding is identified as "Venus 3.x with HEVC."[93]



MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (annotations added).

142. The Qualcomm '376 Products all perform decoding of video content in compliance with the HEVC standard. Specifically, all of the Qualcomm '376 Products contain an Adreno 300 to 600 series graphic processing unit.[94] Further, the Qualcomm '376 Products each contain a video core that is used to decode HEVC content.

[93] *See MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019)

[94] *See e.g.*, *Snapdragon 435 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform ("With a 21MP dual ISP and Qualcomm® Adreno™ 505 GPU integration, the Snapdragon 435

143. Qualcomm makes, uses, sells, offers for sale, or imports into the United States the Qualcomm ‘376 Products and thus directly infringes at least one or more claims of the ’376 patent. Upon information and belief, Qualcomm also uses the Qualcomm ‘376 Products via its internal use and testing in the United States, directly infringing one or more claims of the ’376 patent.

144. Qualcomm has induced and continues to induce and contribute to infringement of the ‘376 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the ‘376 patent, including, but not limited to, the Qualcomm ‘376 Products. Qualcomm provides these Qualcomm ‘376 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the ‘376 patent.

145. One or more Qualcomm subsidiaries and/or affiliates use the Qualcomm ’376 Products in regular business operations.

146. The Qualcomm ’376 Products are available to businesses and individuals throughout the United States.

147. The Qualcomm ’376 Products are provided to businesses and individuals located in the State of Delaware.

LENOVO INFRINGES THE ‘376 PATENT

148. Lenovo designs, makes, sells, offers to sell, imports, and/or uses Lenovo products that calculate a correlation value from neighboring pixels in a field and a frame of video data,

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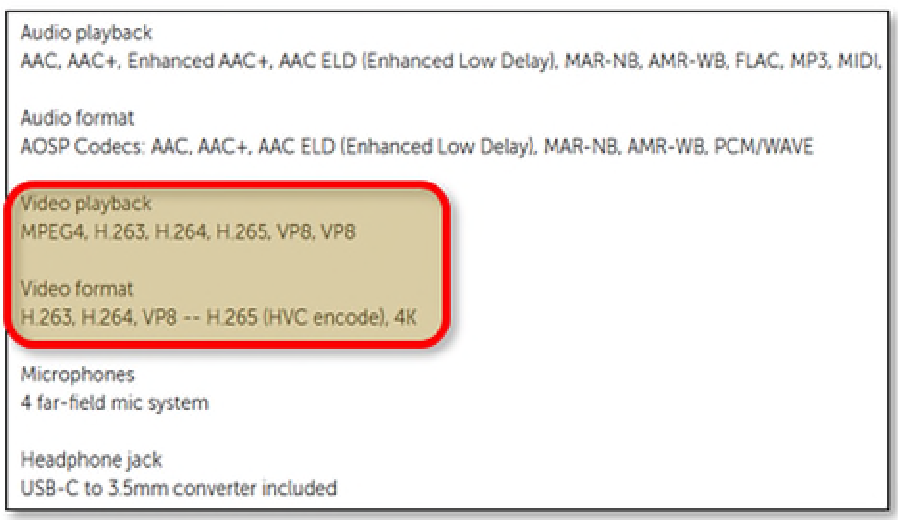
supports rich, high-quality camera images and stunning graphics with optimum speed.”); *Snapdragon 429 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform (“GPU Name: Qualcomm® Adreno™ 504 GPU”).

including but not limited to, the following Lenovo products: Motorola Moto Z, Motorola Moto Z Force, Motorola Moto Z Play, Motorola Moto Z2 Force Edition, Motorola Moto Z2 Play, Motorola Moto Z3, Motorola Moto Z3 Play, Motorola One, Lenovo Yoga C630 13" Laptop, Lenovo Tab M10, Lenovo Smart Tab M10 (HD), Lenovo Tab 4 10 Plus, Lenovo Smart Tab M10 , and the Lenovo Smart Tab P10 (collectively, the "Lenovo '376 Products").

149. Lenovo has directly infringed and continues to directly infringe the '376 patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '376 patent.

150. The Lenovo '376 Products comprise an input for receiving encoded data and a decoder that is compliant with the H.265 standard.

151. The Lenovo '376 Products perform decoding of video in compliance with the H.265 standard. The below excerpt from documentation of the infringing devices shows support for the infringing functionality.


Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3, MIDI,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Microphones
4 far-field mic system

Headphone jack
USB-C to 3.5mm converter included

Motorola Z3 Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019) (annotation added) ("Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K.").

audio + video

Speakers
Front port loud speaker

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Motorola Moto Z3 Play Specifications, MOTOROLA SUPPORT WEBSITE, ***available at***: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019) (annotation added) ("Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K").

152. Exemplar documentation from Qualcomm establishes that the accused Lenovo '376 Products contain functionality for decoding video in a manner that infringes the '376 patent.

Video applications performance	
Encode	1080p120/4K30/4x 1080p30: H.264, VP8, HEVC
Decode	1080p240/4K60/8x 1080p30: H.264, VP8, HEVC 8/10-bit, VP9
Concurrency	4K60 decode + 4K30 encode 4K60 decode + 1080p60 encode
Graphics	Adreno 530 3D graphics accelerator with 64-bit addressing 624 MHz OpenGL ES 3.0/3.1/GEP, GL4.4, DX11.3/4, Path Rendering OpenCL 2.0 Full, Renderscript-Next

SM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P (February 9, 2016), ***available at***: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (emphasis added).

153. Source code for the Lenovo '376 Products shows that they support the infringing functionality as shown in the below excerpt from the source code for the MMI-PPW29.131-27-1 image. The source code excerpted is made available via Lenovo through its GitHub repository. *See* MOTOROLA MOBILITY LLC GITHUB REPOSITORY (last visited September 2019), ***available at***: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208.

```
enum vdec_codec {
        VDEC_CODECTYPE_H264 = 0x1,
        VDEC_CODECTYPE_H263 = 0x2,
        VDEC_CODECTYPE_MPEG4 = 0x3,
        VDEC_CODECTYPE_DIVX_3 = 0x4,
        VDEC_CODECTYPE_DIVX_4 = 0x5,
        VDEC_CODECTYPE_DIVX_5 = 0x6,
        VDEC_CODECTYPE_DIVX_6 = 0x7,
        VDEC_CODECTYPE_XVID = 0x8,
        VDEC_CODECTYPE_MPEG1 = 0x9,
        VDEC_CODECTYPE_MPEG2 = 0xa,
        VDEC_CODECTYPE_VC1 = 0xb,
        VDEC_CODECTYPE_VC1_RCV = 0xc,
        VDEC_CODECTYPE_HEVC = 0xd,
        VDEC_CODECTYPE_MVC = 0xe,
        VDEC_CODECTYPE_VP8 = 0xf,
        VDEC_CODECTYPE_VP9 = 0x10,
};
```

msm_vidc_dec.h, MOTOROLA MMI-PPW29.131-27-1 IMAGE (last accessed September 2019), *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/ (annotations added).

154. The Lenovo '376 Products all contain functionality for performing the decoding of video content using a Qualcomm processor. *See e.g.*, Motorola Moto Z (containing a Qualcomm Snapdragon 820 processor), Motorola Moto Z Force (containing a Qualcomm Snapdragon 820 processor), Motorola Moto Z Play (containing a Qualcomm Snapdragon 625 processor), Motorola Moto Z2 Force Edition (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z2 Play (containing a Qualcomm Snapdragon 626 processor), Motorola Moto Z3 (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z3 Play (containing a Qualcomm Snapdragon 636 processor), Motorola One (containing a Qualcomm Snapdragon 625 processor), Lenovo Yoga C630 13" Laptop (containing a Qualcomm Snapdragon 850 processor), Lenovo Tab M10 (containing a Qualcomm Snapdragon 429 processor), Lenovo Smart Tab M10 (HD) (containing a Qualcomm Snapdragon 450 processor), Lenovo Tab 4 10 Plus (containing a Qualcomm Snapdragon 625 processor), Lenovo Smart Tab M10 (containing a Qualcomm Snapdragon 450 processor), and the Lenovo Smart Tab P10 (containing a Qualcomm Snapdragon 450 processor).

155. Lenovo makes, uses, sells, offers for sale, or imports into the United States the Lenovo ‘376 Products and thus directly infringes at least one or more claims of the ’376 patent. Upon information and belief, Lenovo also uses the Lenovo ‘376 Products via its internal use and testing in the United States, directly infringing one or more claims of the ’376 patent.

156. Lenovo has induced and continues to induce and contribute to infringement of the ‘376 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the ‘376 patent, including, but not limited to, the Lenovo ‘376 Products. Lenovo provides these Lenovo ‘376 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the ‘376 patent.

157. One or more Lenovo subsidiaries and/or affiliates use the Lenovo ’376 Products in regular business operations.

158. The Lenovo ’376 Products are available to businesses and individuals throughout the United States.

159. The Lenovo ’376 Products are provided to businesses and individuals located in the State of Delaware.

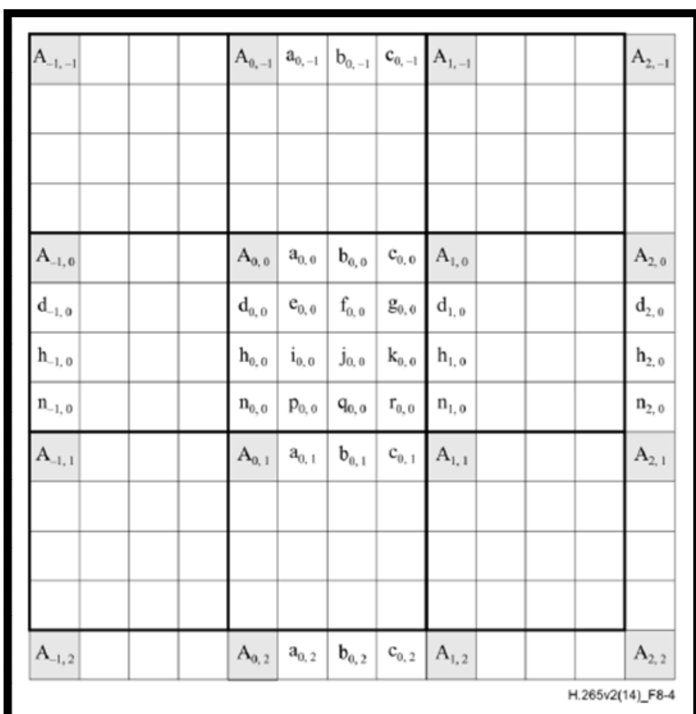
INFRINGEMENT OF THE ‘376 PATENT

160. The Qualcomm ‘376 Products and Lenovo ‘376 Products (collectively, the “Qualcomm-Lenovo ‘376 Products”) include technology for motion compensated upconversion in a video image that uses motion compensation to generate an interpolated video field using motion vectors.

161. One or more of the Qualcomm-Lenovo ’376 Products use upconversion units to generate an interpolated field using motion vectors in the process of performing motion compensation.

162. The Qualcomm-Lenovo '376 Products use upconversion units within an image retrieved from memory.

163. The Qualcomm-Lenovo '376 Products calculate a correlation value from the value of causal neighbor pixels of a generated field. Specifically, during the decoding process correlation values are calculated as part of interpolating pixel values in a frame. The interpolated luma sample value is calculated based on a "luma location in full-sample units (xIntL, yIntL)" "a luma location in fractional-sample units (xFracL, yFracL), and a "luma reference sample array refPicLXL." The following figure from the HEVC specification that is implemented by the Qualcomm-Lenovo '376 Products shows the values of neighbor pixels are used to calculate a correlation value. The below figure in the shaded blocks with upper-case letters shows the integer samples (whole pixels) and the un-shaded blocks with lower-case letter show the fraction sample position for quarter luma interpretation.



Series H: Audio Visual and Multimedia Systems: Infrastructure of Audiovisual Services – Coding of Moving Video, HIGH EFFICIENCY VIDEO CODING ITU-T REC. V.5 § 8.5.3.3.2 (February 2018).

Inputs to this process are:

– a luma location (xCb, yCb) specifying the top-left sample of the current luma coding block relative to the top-left luma sample of the current picture
– a luma location (xBl, yBl) specifying the top-left sample of the current luma prediction block relative to the top-left sample of the current luma coding block
– two variables nPbW and nPbH specifying the width and the height of the luma prediction block
– a luma motion vector mvLX given in quarter-luma-sample units

Series H: Audio Visual and Multimedia Systems: Infrastructure of Audiovisual Services – Coding of Moving Video, HIGH EFFICIENCY VIDEO CODING ITU-T REC. V.5 § 8.5.3.3.3.1 (February 2018).

164. Further, the chroma area is subject to interpolation using a similar procedure implemented by the Qualcomm-Lenovo '376 Products. The following figure shows the positions of the integer pixel sample, 1/2 pixel samples, 1/4 pixel samples, and 1/8 pixel samples of the chrominance components of the reference image. It is assumed that chrominance sample point Bi, j is located at the integer sample point (xB i,j, yBi, j). The values of 1/2 pixel points ae0,0, ea0,0; 1/4 pixel point ac0,0, ag0,0, ca0,0, ga0,0; and 1/8 pixel point ab0,0, ad0,0, af0,0, ah0,0, ba0,0, da0,0, fa0,0, ha 0,0 can be obtained on the nearest integer pixel in the horizontal and vertical directions and similarly the value of sub-pixel sample point bX0,0, cX0,0, dX0,0, eX0,0, fX0,0, gX0,0 and hX0,0 (among which, X presents any one in b, c, d, e, f, g and h) can be obtained by the 4-beat filter interpolation in the vertical direction. As can be seen from the figure in the HEVC specification which shows all the adjacent pixels are examined in calculating the chroma interpolation sample.

	$ha_{0,-1}$	$hb_{0,-1}$	$hc_{0,-1}$	$hd_{0,-1}$	$he_{0,-1}$	$hf_{0,-1}$	$hg_{0,-1}$	$hh_{0,-1}$	
$ah_{-1,0}$	$B_{0,0}$	$ab_{0,0}$	$ac_{0,0}$	$ad_{0,0}$	$ae_{0,0}$	$af_{0,0}$	$ag_{0,0}$	$ah_{0,0}$	$B_{1,0}$
$bh_{-1,0}$	$ba_{0,0}$	$bb_{0,0}$	$bc_{0,0}$	$bd_{0,0}$	$be_{0,0}$	$bf_{0,0}$	$bg_{0,0}$	$bh_{0,0}$	$ba_{1,0}$
$ch_{-1,0}$	$ca_{0,0}$	$cb_{0,0}$	$cc_{0,0}$	$cd_{0,0}$	$ce_{0,0}$	$cf_{0,0}$	$cg_{0,0}$	$ch_{0,0}$	$ca_{1,0}$
$dh_{-1,0}$	$da_{0,0}$	$db_{0,0}$	$dc_{0,0}$	$dd_{0,0}$	$de_{0,0}$	$df_{0,0}$	$dg_{0,0}$	$dh_{0,0}$	$da_{1,0}$
$eh_{-1,0}$	$ea_{0,0}$	$eb_{0,0}$	$ec_{0,0}$	$ed_{0,0}$	$ee_{0,0}$	$ef_{0,0}$	$eg_{0,0}$	$eh_{0,0}$	$ea_{1,0}$
$fh_{-1,0}$	$fa_{0,0}$	$fb_{0,0}$	$fc_{0,0}$	$fd_{0,0}$	$fe_{0,0}$	$ff_{0,0}$	$fg_{0,0}$	$fh_{0,0}$	$fa_{1,0}$
$gh_{-1,0}$	$ga_{0,0}$	$gb_{0,0}$	$gc_{0,0}$	$gd_{0,0}$	$ge_{0,0}$	$gf_{0,0}$	$gg_{0,0}$	$gh_{0,0}$	$ga_{1,0}$
$hh_{-1,0}$	$ha_{0,0}$	$hb_{0,0}$	$hc_{0,0}$	$hd_{0,0}$	$he_{0,0}$	$hf_{0,0}$	$hg_{0,0}$	$hh_{0,0}$	$ha_{1,0}$
	$B_{0,1}$	$ab_{0,1}$	$ac_{0,1}$	$ad_{0,1}$	$ae_{0,1}$	$af_{0,1}$	$ag_{0,1}$	$ah_{0,1}$	$B_{1,1}$

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165. When generating a luma interpolation value the Qualcomm-Lenovo '376 Products generate correlation value based on the values of previous frame. For example, for a luma sample location (xL = 0..nPbW − 1, yL = 0..nPbH − 1) the corresponding prediction luma sample values (predSamplesLXL[xL][yL]) are derived using the following process which calculates a correlation value from the previous frame (refPixLXl).

– The variables $xInt_L$, $yInt_L$, $xFrac_L$ and $yFrac_L$ are derived as follows:

$$xInt_L = xPb + (mvLX[0] >> 2) + x_L \quad (8\text{-}216)$$

$$yInt_L = yPb + (mvLX[1] >> 2) + y_L \quad (8\text{-}217)$$

$$xFrac_L = mvLX[0] \,\&\, 3 \quad (8\text{-}218)$$

$$yFrac_L = mvLX[1] \,\&\, 3 \quad (8\text{-}219)$$

– The prediction luma sample value $predSamplesLX_L[x_L][y_L]$ is derived by invoking the process specified in clause 8.5.3.3.3.2 with ($xInt_L$, $yInt_L$), ($xFrac_L$, $yFrac_L$) and $refPicLX_L$ as inputs.

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166. The Qualcomm-Lenovo '376 Products contain functionality for generating luma sample values based on pixels adjacent to the area that is subject to interpolation form the basis for the first correlation value.

Inter Prediction

- Interpolation filters for luma

- For Luma fractional pixels
  - A single consistent separable interpolation process to generate all fractional positions .
  - Pixel accuracy is 1/4
  - 7-tap for quarter pixel and 8-tap for half pixel
  - Filter kernel were partially derived from DCT basis function equations.

FILTER COEFFICIENTS FOR LUMA FRACTIONAL SAMPLE INTERPOLATION

index	−3	−2	−1	0	1	2	3	4
hfilter[i]	−1	4	−11	40	40	−11	4	1
qfilter[i]	−1	4	−10	58	17	−5	1	

Oscar C. Au, HIGH EFFICIENCY VIDEO CODING (HEVC) PRESENTATION at 33 (October 2013).

167. The Qualcomm-Lenovo '376 calculate a correlation value based on the neighborhood pixels as shown in the below excerpt from the HEVC specification.

168. A correlation value is compared by the Qualcomm-Lenovo '376 Products to a threshold value. Specifically, the HEVC Specification describes that the correlation value which

is generated as part of the output of the interpolation process is the (nPbW)x(nPbH) array predSamplesLXL of prediction luma sample values.

Outputs of this process are:

– an (nPbW)x(nPbH) array predSamplesLX$_L$ of prediction luma sample values

– when ChromaArrayType is not equal to 0, two (nPbW / SubWidthC)x(nPbH / SubHeightC) arrays predSamplesLX$_{Cb}$ and predSamplesLX$_{Cr}$ of prediction chroma sample values.

The location (xPb, yPb) given in full-sample units of the upper-left luma samples of the current prediction block relative to the upper-left luma sample location of the given reference sample arrays is derived as follows:

$$xPb = xCb + xBl \quad (8\text{-}214)$$

$$yPb = yCb + yBl \quad (8\text{-}215)$$

Let (xInt$_L$, yInt$_L$) be a luma location given in full-sample units and (xFrac$_L$, yFrac$_L$) be an offset given in quarter-sample units. These variables are used only in this clause for specifying fractional-sample locations inside the reference sample arrays refPicLX$_L$, refPicLX$_{Cb}$ and refPicLX$_{Cr}$.

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169. The interpolation process implemented by the Qualcomm-Lenovo '376 Products uses the values that are assigned as part of the interpolation process if they are above a certain threshold.

– The array rpRefSamplesLX$_L$ and, when ChromaArrayType is not equal to 0, the arrays rpRefSamplesLX$_{Cb}$ and rpRefSamplesLX$_{Cr}$ are derived as follows:

  – Let the reference sample array rpRefPicLX$_L$ correspond to the decoded sample array S$_L$ derived in clause 8.7 for the previously decoded picture rpRefPic.

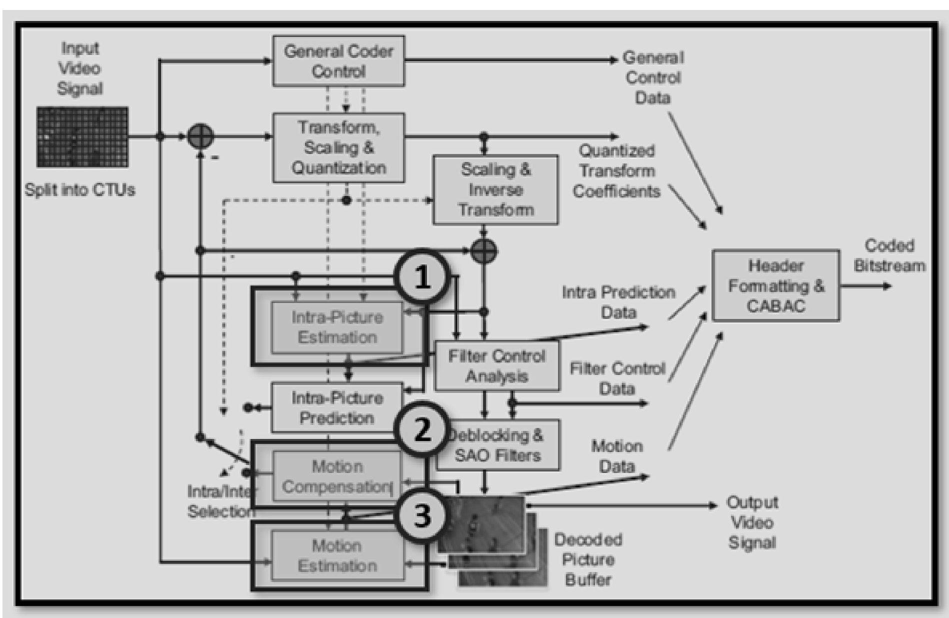
  – When ChromaArrayType is not equal to 0, let the reference sample arrays rpRefPicLX$_{Cb}$ and rpRefPicLX$_{Cr}$ correspond to the decoded sample arrays S$_{Cb}$ and S$_{Cr}$, respectively, derived in clause 8.7 for the previously decoded picture rpRefPic.

  – The array rpRefSamplesLX$_L$ and, when ChromaArrayType is not equal to 0, the arrays rpRefSamplesLX$_{Cb}$ and rpRefSamplesLX$_{Cr}$ are derived by invoking the bilinear sample interpolation process specified in clause I.8.5.3.3.3.2 with the luma locations (xCb, yCb) and (xBl, yBl), the luma prediction block width nPbW, the luma prediction block height nPbH, the motion vector mvLX equal to (mvLX + mvRp), and, when ChromaArrayType is not equal to 0, the motion vector mvCLX equal to (mvCLX + mvRpC), the reference arrays with rpRefPicLX$_L$, and, when ChromaArrayType is not equal to 0, the arrays rpRefPicLX$_{Cb}$ and rpRefPicLX$_{Cr}$ as inputs.

Series H: Audio Visual and Multimedia Systems: Infrastructure of Audiovisual Services – Coding of Moving Video, HIGH EFFICIENCY VIDEO CODING ITU-T REC. V.5 § I.8.5.3.3.3.2 (February 2018).

170. The Qualcomm-Lenovo '376 Products set the value of a pixel to be created within said generated field to be equal to the value of a corresponding pixel of said prior frame if the correlation value is less than a threshold value. Specifically, the Qualcomm-Lenovo '376 Products use the pixel value of Ref0 or ReF2 (where Ref0 and Ref2 represent the prior and next frames in the video stream). By way of example, the interpolation value will be discarded and the pixel value of a prior frame based on inter prediction would be used instead of the interpolated value. *See Series H: Audio Visual and Multimedia Systems: Infrastructure of Audiovisual Services – Coding of Moving Video,* HIGH EFFICIENCY VIDEO CODING ITU-T REC. V.5 § 8.5.3.3.3.2 (February 2018).

171. The frames are then processed by the Qualcomm-Lenovo '376 Products using both motion compensation and motion estimation. The motion compensation functionality used by the Qualcomm-Lenovo '376 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).

172. The Qualcomm-Lenovo ’376 Products calculate a correlation value from the values of causal neighbor pixels of a generated field and from the values of corresponding neighbor pixels of a next field.

> 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).

173. The Qualcomm-Lenovo ’376 Products compare the correlation value with a threshold value.

> 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).

174. The Qualcomm-Lenovo’376 Products set the value of a pixel to be created within the generated field to be equal to the value of a corresponding pixel of the next field if the correlation value is less than the threshold value.

175. Qualcomm and Lenovo have directly infringed and continue to directly infringe the ‘376 patent by, among other things, making, using, offering for sale, and/or selling technology for motion compensated upconversion in a video image that uses motion compensation to generate an interpolated video field using motion vectors, including but not limited to the Qualcomm-Lenovo ’376 Products.

176. By complying with the HEVC standard, the Qualcomm-Lenovo '376 Productsnecessarily infringe the '376 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '376 patent, including but not limited to claim 4 of the '376 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 Qualcomm and Lenovo's infringement of the '376 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.").

177. By making, using, testing, offering for sale, and/or selling products and services for motion compensated upconversion in a video image that uses motion compensation to generate an interpolated video field using motion vectors, including but not limited to the Qualcomm-Lenovo '376 Products, Qualcomm and Lenovo have injured Dynamic Data and are liable to the Plaintiff for directly infringing one or more claims of the '376 patent, including at least claim 4 pursuant to 35 U.S.C. § 271(a).

178. Qualcomm and Lenovo have also indirectly infringed the '376 patent by actively inducing infringement under 35 U.S.C. § 271(b).

179. Qualcomm and Lenovo have had knowledge of the '376 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Qulacomm and Lenovo knew of the '376 patent and knew of their infringement, including by way of this lawsuit.

180. Qualcomm intended to induce patent infringement by third-party customers and users of the Qualcomm ’376 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. Qualcomm specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘376 patent. Qualcomm performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘376 patent and with the knowledge that the induced acts would constitute infringement. For example, Qualcomm provides the Qualcomm ’376 Products that have the capability of operating in a manner that infringe one or more of the claims of the ‘376 patent, including at least claim 4, and Qualcomm further provides documentation and training materials that cause customers and end users of the Qualcomm ’376 Products to utilize the products in a manner that directly infringe one or more claims of the ‘376 patent.[95] By providing instruction and training to customers and end-users on how to use the Qualcomm ‘376 Products in a manner that directly infringes one or more claims of the ‘376 patent, including at least claim 4, Qualcomm specifically intended to induce infringement of the ‘376 patent. Qualcomm engaged in such inducement to promote the

[95] *See, e.g.*, *MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019); *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019); *Qualcomm High Efficiency Video Coding (HEVC) Video Encoder*, USER MANUAL (July 11, 2017); *Snapdragon 850 Mobile Compute Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019); *Snapdragon 710 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019); *Snapdragon 653 Mobile Platform,* QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon/processors/653 (last visited September 2019); *Snapdragon 212 Mobile Platform,* QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/snapdragon/processors/212 (last visited September 2019).

sales of the Qualcomm ’376 Products, e.g., through Qualcomm user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the ‘376 patent. Accordingly, Qualcomm 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 ‘376 patent, knowing that such use constitutes infringement of the ‘376 patent.

181. Lenovo intended to induce patent infringement by third-party customers and users of the Lenovo ’376 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. Lenovo specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘376 patent. Lenovo performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘376 patent and with the knowledge that the induced acts would constitute infringement. For example, Lenovo provides the Lenovo ’376 Products that have the capability of operating in a manner that infringe one or more of the claims of the ‘376 patent, including at least claim 4, and Lenovo further provides documentation and training materials that cause customers and end users of the Lenovo ’376 Products to utilize the products in a manner that directly infringe one or more claims of the ‘376 patent.[96] By

[96] *See, e.g., Motorola Z3 Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019); *Motorola Moto Z3 Play Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019); MOTOROLA MOBILITY LLC GITHUB REPOSITORY, *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208 ((last visited September 2019); *Lenovo Knowledge Base*, LENOVO WEBSITE, *available at*: https://forums.lenovo.com/t5/English-Community/tkbc-p/Community-EN (last visited September 2019); *Lenovo Tab M10 Platform Specfication*, LENOVO DOCUMENATION (August 2019); *Lenovo Tab P10 Platform Specifications*, LENOVO DOCUMENTATION (June 2019); *Lenovo Open Source Code - Tab P10 / Smart Tab 10 Tablet (TB-X705L*), LENOVO SUPPORT WEBSITE, *available at*: https://support.lenovo.com/us/en/downloads/ds506313 (code released January 31, 2019).

providing instruction and training to customers and end-users on how to use the Lenovo '376 Products in a manner that directly infringes one or more claims of the '376 patent, including at least claim 4, Lenovo specifically intended to induce infringement of the '376 patent. Lenovo engaged in such inducement to promote the sales of the Lenovo '376 Products, e.g., through Lenovo user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '376 patent. Accordingly, Lenovo 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 '376 patent, knowing that such use constitutes infringement of the '376 patent.

182. The '376 patent is well-known within the industry as demonstrated by multiple citations to the '376 patent in published patents and patent applications assigned to technology companies and academic institutions. Qualcomm and Lenovo are utilizing the technology claimed in the '376 patent without paying a reasonable royalty. Qualcomm and Lenovo are infringing the '376 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

183. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '376 patent. As a result of Qualcomm and Lenovo's infringement of the '376 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Qualcomm and Lenovo's infringement, but in no event less than a reasonable royalty for the use made of the invention by Qualcomm and Lenovo with interest and costs as fixed by the Court.

COUNT III
INFRINGEMENT OF U.S. PATENT NO. 6,782,054

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

QUALCOMM INFRINGES THE '054 PATENT

185. Qualcomm designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for motion estimation in a sequence of moving video pictures.

186. Qualcomm designs, makes, sells, offers to sell, imports, and/or uses Qualcomm products that comply with the H.265 standard. By way of example, the following Qualcomm products perform encoding pursuant to the H.265 standard: Snapdragon 855+, Snapdragon 855, Snapdragon 850, Snapdragon 845, Snapdragon 835, Snapdragon 821, Snapdragon 820, Snapdragon 730G, Snapdragon 730, Snapdragon 712, Snapdragon 710, Snapdragon 675, Snapdragon 670, Snapdragon 665, Snapdragon 660, Snapdragon 653, Snapdragon 652, Snapdragon 650, Snapdragon 636, Snapdragon 632, Snapdragon 630, Snapdragon 626, Snapdragon 625, Snapdragon 450, Snapdragon 439, Snapdragon 435, and the Snapdragon 429 processor (collectively, the "Qualcomm '054 Products").

187. The accused Qualcomm '054 Products comply with the HEVC image processing standard. Specifically, each of Qualcomm '054 Products perform encoding in compliance with

the HEVC standard: Snapdragon 855+,[97] Snapdragon 855,[98] Snapdragon 850,[99] Snapdragon 845,[100] Snapdragon 835,[101] Snapdragon 821,[102] Snapdragon 820,[103] Snapdragon 730G,[104]

[97] *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC), HDR10+, HLG, HDR10, H.264 (AVC), VP8, VP9").

[98] *Qualcomm Snapdragon 855 Mobile Platform Specification*, Qualcomm Website, *available at*: https://www.qualcomm.com/products/snapdragon-855-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC)").

[99] *Qualcomm Snapdragon 850 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019) ("Video Capture Formats: HDR, HLG, HEVC . . . Codec Support: H.265(HEVC)").

[100] *Qualcomm Snapdragon 845 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (May 2018) ("Ultra HD Premium video playback and encoding @ 4K (3840x2160) 60fps, 10bit HDR, Rec 2020 color gamut. . . Slow motion HEVC video encoding of either HD (720p) video up to 480fps or FHD (1080p) up to 240fps . . . H.264 (AVC), H.265 (HEVC)").

[101] *Qualcomm Snapdragon 835 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-835-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback @ 60 fps . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP9.").

[102] *Qualcomm Snapdragon 821 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-821-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC)").

[103] *Qualcomm Snapdragon 820 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2016) ("4K HEVC video (Decode: 60 fps, 10-bit. Encode: 30 fps)").

[104] *Qualcomm Snapdragon 730G Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730g-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

Snapdragon 730,[105] Snapdragon 712,[106] Snapdragon 710,[107] Snapdragon 675,[108] Snapdragon 670,[109] Snapdragon 665,[110] Snapdragon 660,[111] Snapdragon 653,[112] Snapdragon 652,[113]

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[105] *Qualcomm Snapdragon 730 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Capture (30 FPS): 4K Ultra HD video capture . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[106] *Qualcomm Snapdragon 712 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-712-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[107] *Qualcomm Snapdragon 710 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[108] *Qualcomm Snapdragon 675 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (February 2019) ("Visual Processing System . . . H.264 (AVC), H.265 (HEVC), VP8 and VP9 playback . . . Video capture . . . HEVC video capture").

[109] *Qualcomm Snapdragon 670 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-670-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[110] *Qualcomm Snapdragon 665 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-665-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[111] *Qualcomm Snapdragon 660 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-660-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[112] *Qualcomm Snapdragon 653 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("Efficient, high-quality video streaming Embedded HEVC H.265 hardware decoder and integrated Qualcomm VIVE 802.11ac WiFi technology and Bluetooth 4.1 solutions.").

[113] *Qualcomm Snapdragon 652 Mobile Platform Product Specfication*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-652-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

Snapdragon 650,[114] Snapdragon 636,[115] Snapdragon 632,[116] Snapdragon 630,[117] Snapdragon 626,[118] Snapdragon 625,[119] Snapdragon 450,[120] Snapdragon 439,[121] Snapdragon 435,[122] and the Snapdragon 429.[123]

188. The Qualcomm '054 Products contain a multimedia subsystem wherein video content is encoded in compliance with the HEVC standard. For example, the following excerpt from a publicly accessible copy of the Snapdragon 820 Device Specification shows the multimedia

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[114] *Qualcomm Snapdragon 650 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-650-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

[115] *Qualcomm Snapdragon 636 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

[116] *Qualcomm Snapdragon 632 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-632-mobile-platform (last visited September 2019) ("Video . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[117] *Qualcomm Snapdragon 630 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

[118] *Qualcomm Snapdragon 626 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("4K Ultra HD video – Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth").

[119] *Qualcomm Snapdragon 625 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-625-mobile-platform (last visited September 2019) ("4K Ultra HD video - Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth.").

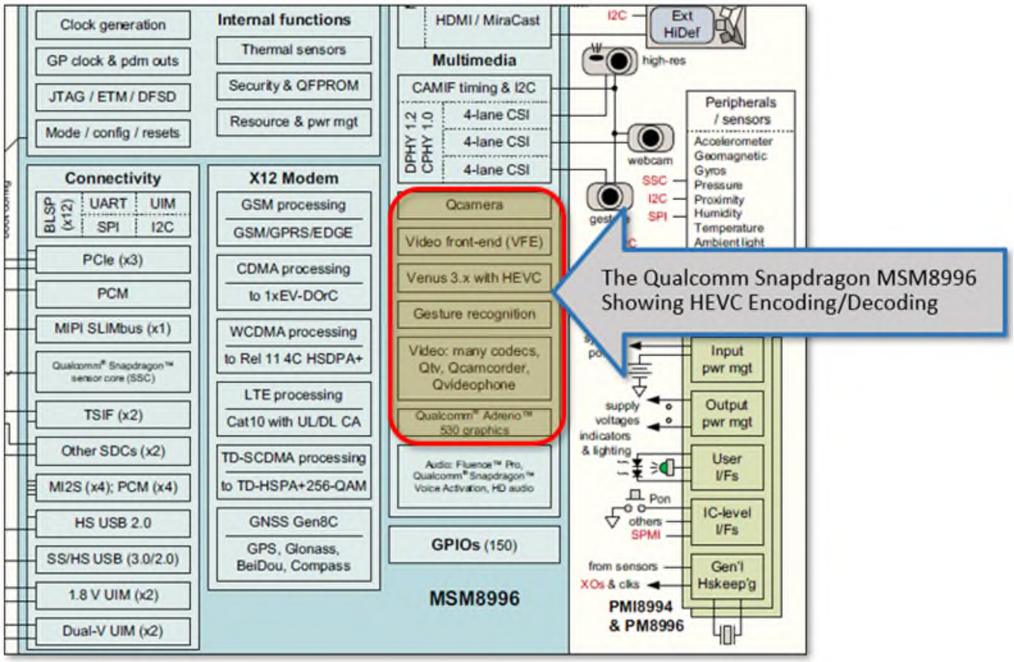
[120] *Qualcomm Snapdragon 450 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video – FHD+@60fps HEVC capture and playback").

[121] *Qualcomm Snapdragon 439 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-439-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8").

[122] *Qualcomm Snapdragon 435 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform (last visited September 2019) ("With a 21MP dual ISP and Qualcomm Adreno 505 GPU integration, the Snapdragon 435 supports rich, high-quality camera images and stunning graphics with optimum speed.").

[123] *Qualcomm Snapdragon 429 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform (last visited September 2019) ("GPU Name: Qualcomm Adreno 504 GPU").

system responsible for encoding and decoding is identified as "Venus 3.x with HEVC."[124]



MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (annotations added).

189. The Qualcomm '054 Products all perform encoding of video content in compliance with the HEVC standard. Specifically, all of the Qualcomm '054 Products contain an Adreno 300 to 600 series graphic processing unit.[125] Further, the Qualcomm '054 Products each contain a video core that is used to encode HEVC content.

190. Qualcomm makes, uses, sells, offers for sale, or imports into the United States the

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[124] *See MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019)

[125] *See e.g.*, *Snapdragon 435 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform ("With a 21MP dual ISP and Qualcomm® Adreno™ 505 GPU integration, the Snapdragon 435 supports rich, high-quality camera images and stunning graphics with optimum speed."); *Snapdragon 429 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform ("GPU Name: Qualcomm® Adreno™ 504 GPU").

Qualcomm '054 Products and thus directly infringes at least one or more claims of the '054 patent. Upon information and belief, Qualcomm also uses the Qualcomm '054 Products via its internal use and testing in the United States, directly infringing one or more claims of the '054 patent.

191. Qualcomm has induced and continues to induce and contribute to infringement of the '054 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the '054 patent, including, but not limited to, the Qualcomm '054 Products. Qualcomm provides these Qualcomm '054 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the '054 patent.

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

193. The Qualcomm '054 Products are available to businesses and individuals throughout the United States.

194. The Qualcomm '054 Products are provided to businesses and individuals located in the State of Delaware.

LENOVO INFRINGES THE '054 PATENT

195. Lenovo designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for motion estimation in a sequence of moving video pictures.

196. Lenovo designs, makes, sells, offers to sell, imports, and/or uses Lenovo products for enhanced motion estimation including but not limited to, the following Lenovo products: Motorola Moto Z2 Force Edition, Motorola Moto Z2 Play, Motorola Moto Z3, and the Motorola Moto Z3 Play (collectively, the "Lenovo '054 Products").

197. Lenovo has directly infringed and continues to directly infringe the ’054 patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the ‘054 patent.

198. The Lenovo ‘054 Products perform motion estimation enhancements in compliance with the H.265 standard. The below excerpts from Lenovo documentation of the infringing devices shows support for the infringing functionality in the Lenovo ‘054 Products.

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3, MIDI,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Microphones
4 far-field mic system

Headphone jack
USB-C to 3.5mm converter included

Motorola Z3 Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019) (annotation added) (“Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K.”).

audio + video
Speakers
Front port loud speaker

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Motorola Moto Z3 Play Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019) (annotation added) (“Video playback

- MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K").

199. Documentation from Qualcomm establishes that the accused Lenovo '054 Products contain functionality for encoding video in a manner that infringes the '054 patent.

Video applications performance	
Encode	1080p120/4K30/4x 1080p30: H.264, VP8, HEVC
Decode	1080p240/4K60/8x 1080p30: H.264, VP8, HEVC 8/10-bit, VP9
Concurrency	4K60 decode + 4K30 encode 4K60 decode + 1080p60 encode
Graphics	Adreno 530 3D graphics accelerator with 64-bit addressing 624 MHz OpenGL ES 3.0/3.1/GEP, GL4.4, DX11.3/4, Path Rendering OpenCL 2.0 Full, Renderscript-Next

SM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (emphasis added).

200. Source code for the Lenovo '054 Products shows that they support the infringing functionality as shown in the below excerpt from the source code for the MMI-PPW29.131-27-1 image. The source code excerpted is made available via Lenovo through its GitHub repository. *See* MOTOROLA MOBILITY LLC GITHUB REPOSITORY (last visited September 2019), *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208.

```
enum vdec_codec {
	VDEC_CODECTYPE_H264 = 0x1,
	VDEC_CODECTYPE_H263 = 0x2,
	VDEC_CODECTYPE_MPEG4 = 0x3,
	VDEC_CODECTYPE_DIVX_3 = 0x4,
	VDEC_CODECTYPE_DIVX_4 = 0x5,
	VDEC_CODECTYPE_DIVX_5 = 0x6,
	VDEC_CODECTYPE_DIVX_6 = 0x7,
	VDEC_CODECTYPE_XVID = 0x8,
	VDEC_CODECTYPE_MPEG1 = 0x9,
	VDEC_CODECTYPE_MPEG2 = 0xa,
	VDEC_CODECTYPE_VC1 = 0xb,
	VDEC_CODECTYPE_VC1_RCV = 0xc,
	VDEC_CODECTYPE_HEVC = 0xd,
	VDEC_CODECTYPE_MVC = 0xe,
	VDEC_CODECTYPE_VP8 = 0xf,
	VDEC_CODECTYPE_VP9 = 0x10,
};
```

msm_vidc_dec.h, MOTOROLA MMI-PPW29.131-27-1 IMAGE (last accessed September 2019), *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/ (annotations added).

201. The Lenovo '054 Products all contain functionality for performing the decoding of video content using a Qualcomm processor. *See e.g.,* Motorola Moto Z2 Force Edition (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z2 Play (containing a Qualcomm Snapdragon 626 processor), Motorola Moto Z3 (containing a Qualcomm Snapdragon 835 processor), and the Motorola Moto Z3 Play (containing a Qualcomm Snapdragon 636 processor).

202. Lenovo makes, uses, sells, offers for sale, or imports into the United States the Lenovo '054 Products and thus directly infringes at least one or more claims of the '054 patent. Upon information and belief, Lenovo also uses the Lenovo '054 Products via its internal use and testing in the United States, directly infringing one or more claims of the '054 patent.

203. Lenovo has induced and continues to induce and contribute to infringement of the '054 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the '054 patent, including, but not limited to, the Lenovo '054 Products. Lenovo provides these Lenovo '054 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the '054 patent.

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

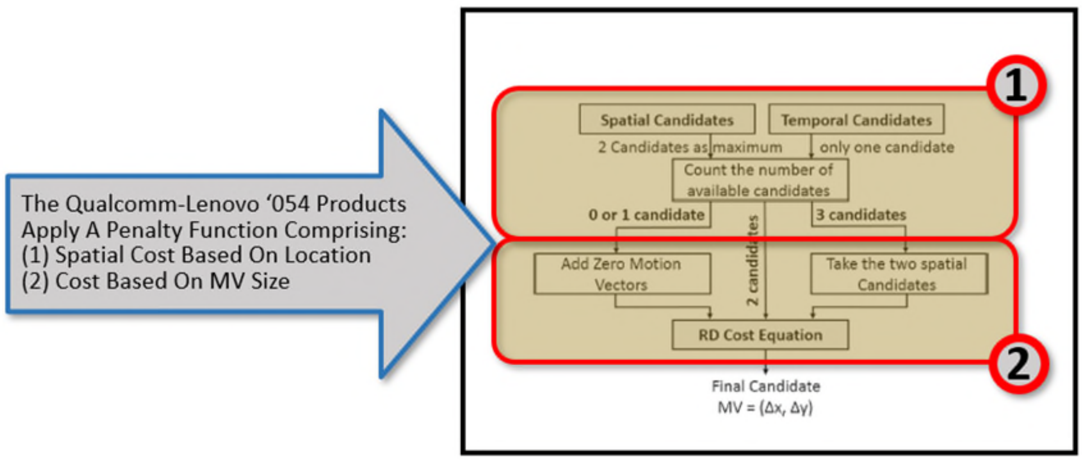
205. The Lenovo '054 Products are available to businesses and individuals throughout the United States.

206. The Lenovo '054 Products are provided to businesses and individuals located in the State of Delaware.

INFRINGEMENT OF THE '054 PATENT

207. The Qualcomm '054 Products and Lenovo '054 Products (collectively, the "Qualcomm-Lenovo '054 Products") contain functionality for enhanced motion estimation by

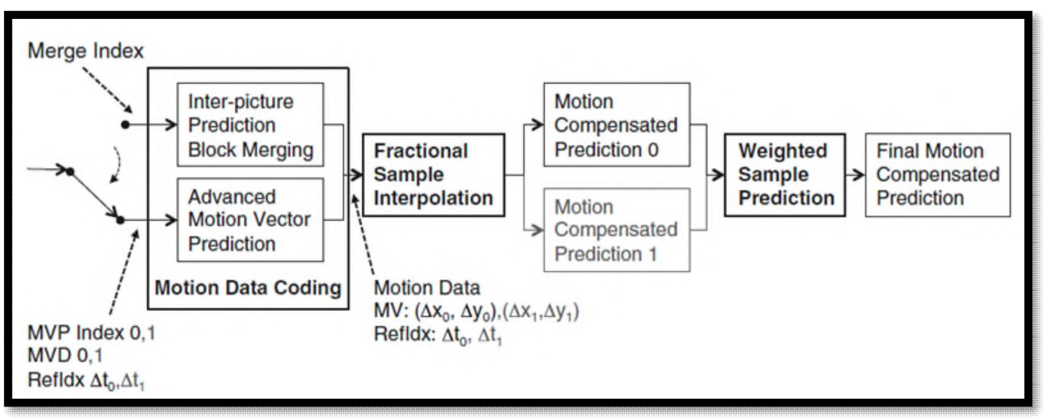
applying an error function having a penalty that depends on both the "size of the candidate motion vectors" and "a spatial position of said video region within the video image." '054 Patent, claim 1(b). The "error function" is comprised of the entire advanced motion vector prediction ("AMVP") process including: (1) the selection of two motion vectors from up to seven candidate motion vectors and (2) the use of a rate distortion cost computation to select a best motion vector from the candidate motion vectors. The below diagram shows that the AMVP process implemented by the Qualcomm-Lenovo '054 Products comprises an error function containing two parts: a penalty based on the spatial location of the candidate motion vectors and a penalty based on the size of the motion vector.



Ahmed M. Abdelsalam, Ahmed Shalaby, Mohammed S. Sayed, *Towards An FPGA-Based HEVC Encoder: A Low Complexity Rate Distortion Scheme For AMVP*, CIRCUITS SYST. SIGNAL PROCESS at 7 (February 10, 2017) (annotations added).

208. The Qualcomm-Lenovo '054 Products select a displacement vector as a best motion vector for a region in a field (prediction unit or PU) from at least two candidate motion vectors. The selection of a displacement vector as the best motion vector is performed by the Qualcomm-Lenovo '054 Products by applying an error function to each of said plural candidate motion vectors, wherein the candidate motion vector with the least error is selected as the displacement vector for the region in the field. Specifically, the candidate motion vectors are extracted from a

set of previous motion vectors and are associated with a video region. The Qualcomm-Lenovo '054 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. The following block diagram illustrates the motion vector selection process in the Qualcomm-Lenovo '054 Products. Specifically, the encoded video data received by the Qualcomm-Lenovo '054 Products is encoded using inter-picture prediction where the motion data of a block is correlated with neighboring blocks. Further, the Qualcomm-Lenovo '054 Products receive data that is encoded using advanced motion vector prediction where the best predictor for each motion block is based on applying a penalty value (also referred to as a cost) to each candidate motion vector.



Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 116 (September 2014).

209. The Qualcomm-Lenovo '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 Qualcomm-Lenovo '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 et al, *Block Merging for Quadtree-Based Partitioning in HEVC, IEEE TRANS. CIR. AND SYS. FOR VIDEO TECHNOLOGY, Vol. 22* No. 12 at 1723 (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.").

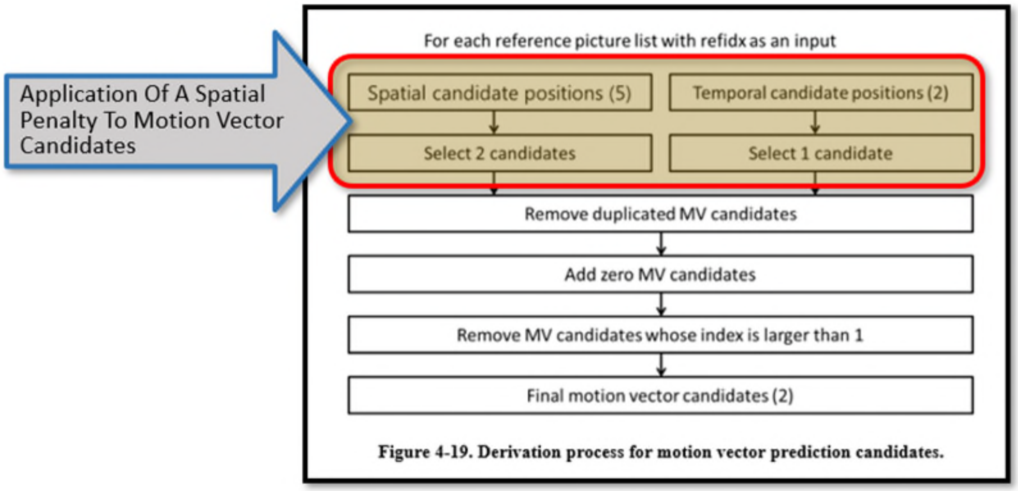
210. The Advanced Motion Vector Prediction ("AMVP") implemented by the Qualcomm-Lenovo '054 Products comprises an error function in which up to seven motion vectors generated by the motion estimation process are analyzed based on the video region in which each candidate motion vector is located.

> The performance of motion estimation highly depends on the MVP [motion vector prediction]. If the MVP is close to the calculated MV, the MVD [motion vector different] between the MVP and the calculated MV is small, and the MVP is more accurate. However, in the H.265/HEVC standard, a total of seven spatial and temporal MVs are added to the candidate list to predict the MVP.

Xiantao Jiang, et. al., *Spatial Correlation-Based Motion-Vector Prediction for Video-Coding Efficiency Improvement*, SYMMETRY Vol. 11 Issue 2 at 5 (January 23, 2019).

211. The selection of two motion vectors by the Qualcomm-Lenovo '054 Producs (from up to seven candidate motion vectors) is based on the spatial location of the candidate motion

vectors in video regions. The Joint Collaborative Team on Video Coding has described the motion vector prediction process as "exploit[ing] spatio-temporal correlation of motion vector with neighbouring PUs, which is used for explicit transmission of motion parameters."[126]



Chris Rosewarne, Benjamin Bross, Matteo Naccari, Karl Sharman, Gary Sullivan, *High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Improved Description Update 9*, JOINT COLLABORATIVE TEAM ON VIDEO CODING (JCT-VC), DOCUMENT JCTVC-AB1002 at 26 (July 2017).

212. The candidate motion vectors are comprised of motion vectors from five spatial neighboring blocks and two co-located blocks. *See* Shihoa Wang, et. al., *Unified Parameter Decoder Architecture for H.265/HEVC Motion Vector Boundary Strength Decoding*, IEICE TRANS. FUNDAMENTALS. Vol. E98-A No. 7 at 1357 (July 2015) ("In AMVP, all seven reference blocks are categorized into three regions A, B, and Col regions. Each region will produce at most one candidate so that a list of at most three candidates can be constructed.").

213. The seven candidate motion vectors used in the motion estimation process by the Qualcomm-Lenovo '054 Products are comprised of two temporal candidate motion vectors and

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[126] Chris Rosewarne, Benjamin Bross, Matteo Naccari, Karl Sharman, Gary Sullivan, *High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Improved Description Update 9*, JOINT COLLABORATIVE TEAM ON VIDEO CODING (JCT-VC), DOCUMENT JCTVC-AB1002 § 4.4.2 (July 2017).

five spatial candidate motion vectors. The below diagram depicts the locations of these seven candidate motion vectors.

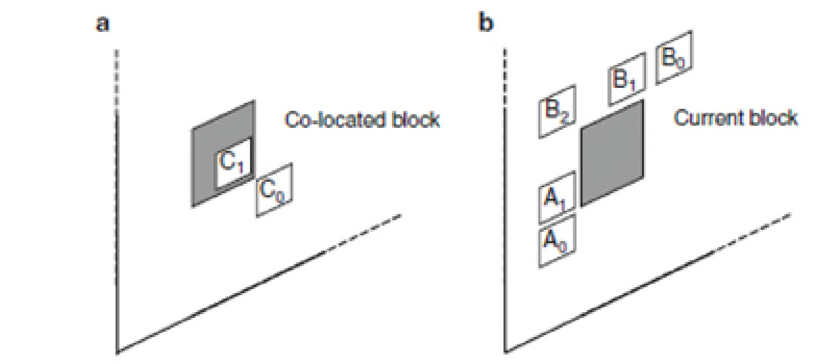


Fig. 5.4 Motion vector predictor and merge candidates. (a) Temporal. (b) Spatial

Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 118 (September 2014).

214. The Qualcomm-Lenovo '054 Products then apply a penalty to these motion vectors based on the spatial location of the motion vector within the video image. Specifically, two motion vector candidates are derived based on spatial motion vectors of prediction units located in five different positions. The order of derivation for left side of the current prediction unit is set as follows: A0, A1, scaled A0, scaled A1 and the order of derivation for a motion vector above the current prediction unit is set as B0, B1, B2, scaled B0, scaled B1, scaled B2. *See* Ahmed M. Abdelsalam, Ahmed Shalaby, Mohammed S. Sayed, *Towards An FPGA-Based HEVC Encoder: A Low Complexity Rate Distortion Scheme For AMVP*, CIRCUITS SYST. SIGNAL PROCESS at 6 (February 10, 2017) (emphasis added) ("In HEVC, AMVP exploits the available pre-calculated motion vectors of the surrounding PBs in order to determine the centre point of the current block's search window. There are two types of motion vector candidates that are adopted as AMVP candidates, namely spatial candidates (A0, A1, B0, B1 and B2) and temporal candidates (C0 and C1).").

215. Because the spatial motion vectors are derived by the Qualcomm-Lenovo ‘054 Products from five candidates based on their spatial locations the derivation of motion vector candidates performs a penalty function based on the spatial location of the five candidate motion vectors. For candidate motion vectors that are located spatially in a region that is not preferred the motion vector from the spatially preferred video region is selected. The below diagram from a paper describing the HEVC encoding process shows that in deriving the candidate motion vector list as between motion vectors located in video regions A0 and A1 the motion vector located spatially in region A1 is penalized. Similarly, between motion vectors located in video regions B0, B1, and B2 the motion vectors located in B1 and B2 are penalized based on their spatial location.

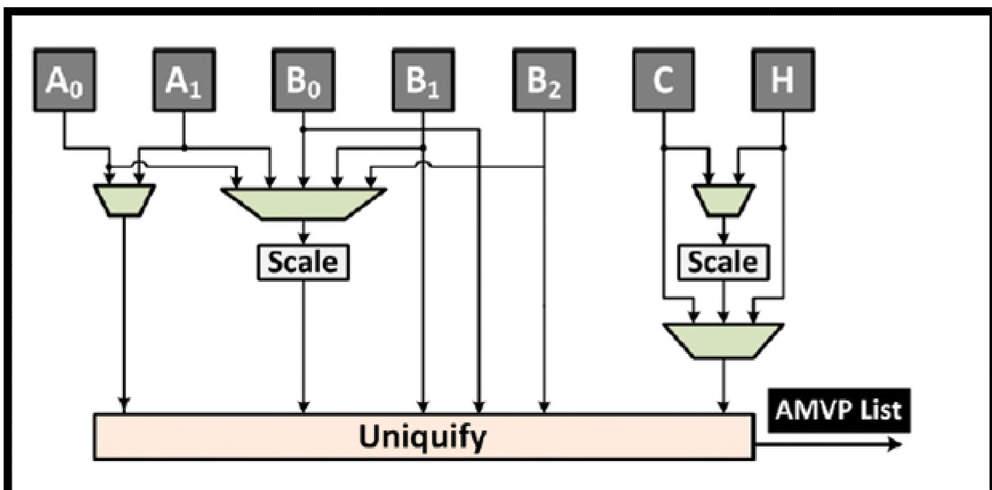


Fig. 16. Block diagram of the AMVP block.

Sinangil, Mahmut E., Vivienne Sze, Minhua Zhou, and Anantha P. Chandrakasan, *Cost and Coding Efficient Motion Estimation Design Considerations for High Efficiency Video Coding (HEVC) Standard*, IEEE J. SEL. TOP. SIGNAL PROCESS. Vol. 7 No. 6 at 1017-1028 (December 2013).

216. Further evidence of infringement of the ‘054 Patent by the Qualcomm-Lenovo ‘054 Products is demonstrated in the HEVC specification which describes the derivation process for motion vector predictor candidates as first generating motion vector predictor candidates for areas

A0, A1, B2, B1, and B3. Specifically, to generate candidate motion vectors for a video region, the video region is defined by the luma location (xCb, yCb, xPb, yPb) with a size (nCbS) and width (nPbW) and height (nPbH). Five spatial candidate motion vectors are then generated in the neighboring prediction units (mvLXN). The following excerpt from the HEVC standard describes the generation of up to five candidate motion vectors.[127]

8.5.3.2.7 Derivation process for motion vector predictor candidates

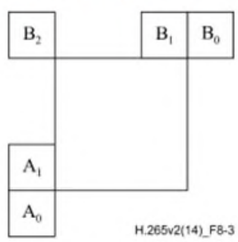
Inputs to this process are:

- a luma location (xCb, yCb) of the top-left sample of the current luma coding block relative to the top-left luma sample of the current picture,
- a variable nCbS specifying the size of the current luma coding block,
- a luma location (xPb, yPb) specifying the top-left sample of the current luma prediction block relative to the top-left luma sample of the current picture,
- two variables nPbW and nPbH specifying the width and the height of the luma prediction block,
- the reference index of the current prediction unit partition refIdxLX, with X being 0 or 1,
- a variable partIdx specifying the index of the current prediction unit within the current coding unit.

Outputs of this process are (with N being replaced by A or B):

- the motion vectors mvLXN of the neighbouring prediction units,
- the availability flags availableFlagLXN of the neighbouring prediction units.

Figure 8-3 provides an overview of spatial motion vector neighbours.



High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.2.7 (February 2018) .

[127] *See also* Chris Rosewarne, Benjamin Bross, Matteo Naccari, Karl Sharman, Gary Sullivan, *High Efficiency Video Coding (HEVC) Test Model 16 (HM 16) Improved Description Update 9,* JOINT COLLABORATIVE TEAM ON VIDEO CODING (JCT-VC), DOCUMENT JCTVC-AB1002 at 27-28 (July 2017) ("The order of derivation for the left side of the current PU is defined as A_0, A_1,and scaled A_0,scaled A_1. The order of derivation for the above side of the current PU is defined as B_0, B_1, B_2, scaled B_0, scaled B_1, scaled B_2. For each side there are therefore four cases that can be used as motion vector candidate, with two cases not required to use spatial scaling, and two cases where spatial scaling is used.").

217. Once the five candidate motion vectors have been generated the Qualcomm-Lenovo '054 Products apply an error function that narrows the candidate motion vectors based on their spatial location. Specifically, for candidate motion vectors A0 and A1 the motion vector for A0 will be selected. The HEVC specification requires that the motion vector located in A0 (xNbA0, yNbA0) will be selected over A1 (xNbA1, yNbA1). The A0 motion vector will then be assigned the value mvLXA.

When availableA$_0$ or availableA$_1$ is equal to TRUE, the variable isScaledFlagLX is set equal to 1.

The following applies for (xNbA$_k$, yNbA$_k$) from (xNbA$_0$, yNbA$_0$) to (xNbA$_1$, yNbA$_1$):

– When availableA$_k$ is equal to TRUE and availableFlagLXA is equal to 0, the following applies:
  – If PredFlagLX[xNbA$_k$][yNbA$_k$] is equal to 1 and DiffPicOrderCnt(RefPicListX[RefIdxLX[xNbA$_k$][yNbA$_k$]], RefPicListX[refIdxLX]) is equal to 0, availableFlagLXA is set equal to 1 and the following applies:

    mvLXA = MvLX[xNbA$_k$][yNbA$_k$] (8-171)

  – Otherwise, when PredFlagLY[xNbA$_k$][yNbA$_k$] (with Y = !X) is equal to 1 and DiffPicOrderCnt(RefPicListY[RefIdxLY[xNbA$_k$][yNbA$_k$]], RefPicListX[refIdxLX]) is equal to 0, availableFlagLXA is set equal to 1 and the following applies:

    mvLXA = MvLY[xNbA$_k$][yNbA$_k$] (8-172)

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.2.7 (February 2018).

218. The Qualcomm-Lenovo '054 Products apply a penalty function to the candidate motion vectors located in regions B0, B1, and B2. The regions B0, B1, and B2 are defined in the HEVC standard as (xNbB0, yNbB0), (xNbB1, yNbB1), and (xNbB2, yNbB2) respectively. Between the candidate motion vectors located in video regions B_0, B_1, B_2 the derivation process will pick B_0 as between B_0, B_1, and B_2 and B_1 between B_1 and B_2. The below excerpt from the HEVC standard shows this process.

The following applies for ($xNbB_k$, $yNbB_k$) from ($xNbB_0$, $yNbB_0$) to ($xNbB_2$, $yNbB_2$):

– The availability derivation process for a prediction block as specified in clause 6.4.2 is invoked with the luma location (xCb, yCb), the current luma coding block size nCbS, the luma prediction block location (xPb, yPb), the luma prediction block width nPbW, the luma prediction block height nPbH, the luma location (xNbY, yNbY) set equal to ($xNbB_k$, $yNbB_k$) and the partition index partIdx as inputs, and the output is assigned to the prediction block availability flag $availableB_k$.

– When $availableB_k$ is equal to TRUE and availableFlagLXB is equal to 0, the following applies:

  – If PredFlagLX[$xNbB_k$][$yNbB_k$] is equal to 1, and DiffPicOrderCnt(RefPicListX[RefIdxLX[$xNbB_k$][$yNbB_k$]], RefPicListX[refIdxLX]) is equal to 0, availableFlagLXB is set equal to 1 and the following assignments are made:

$$mvLXB = MvLX[xNbB_k][yNbB_k] \quad (8\text{-}184)$$

$$refIdxB = RefIdxLX[xNbB_k][yNbB_k] \quad (8\text{-}185)$$

  – Otherwise, when PredFlagLY[$xNbB_k$][$yNbB_k$] (with Y = !X) is equal to 1 and DiffPicOrderCnt(RefPicListY[RefIdxLY[$xNbB_k$][$yNbB_k$]], RefPicListX[refIdxLX]) is equal to 0, availableFlagLXB is set equal to 1 and the following assignments are made:

$$mvLXB = MvLY[xNbB_k][yNbB_k] \quad (8\text{-}186)$$

$$refIdxB = RefIdxLY[xNbB_k][yNbB_k] \quad (8\text{-}187)$$

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.2.7 (February 2018).

219. Similar to the derivation process of the two spatial motion vectors one temporal motion vector can be selected by the Qualcomm-Lenovo '054 Products. The selection of the temporal motion vector is based on the selecting a motion vector based on penalizing one of the temporal motion vectors based on its spatial location

- up to two *spatial candidate* MVPs that are derived from five spatial neighboring blocks
- one *temporal candidate* MVPs derived from two temporal, co-located blocks when both spatial candidate MVPs are not available or they are identical
- zero motion vectors when the spatial, the temporal or both candidates are not available

Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 117 (September 2014) (emphasis added).

220. For the two temporal candidate motion vectors the spatial video region C_0 is given a preference over C_1. Thus, if there are temporal candidate motion vectors located in regions C_1

and C_0 the C_1 candidate is penalized based on its spatial location within a video region. The derivation process for the temporal candidate motion vector is outlined in the below excerpt from the HEVC Standard in which the available temporal candidate motion vectors are identified as mvLXCol.

Inputs to this process are:

– a luma location (xPb, yPb) specifying the top-left sample of the current luma prediction block relative to the top-left luma sample of the current picture,

– two variables nPbW and nPbH specifying the width and the height of the luma prediction block,

– a reference index refIdxLX, with X being 0 or 1.

Outputs of this process are:

– the motion vector prediction mvLXCol,

– the availability flag availableFlagLXCol.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.2.7 (February 2018).

221. The Qualcomm-Lenovo '054 Products select a best motion vector by applying an error function to the candidate motion vectors that comprises two penalty terms. One of the penalty terms depends on the candidate motion vector either as calculated in a current frame or as calculated in a previous frame. Specifically, the cost function used by the Qualcomm-Lenovo '054 Products generate match errors for the respective candidate motion vectors.

222. The Qualcomm-Lenovo '054 Products calculate 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 predication. The Qualcomm-Lenovo '054 Products comprise a selector for selecting a motion vector from the candidate motion vectors by comparing the match errors of the candidate motion vectors. The coding performed by the Qualcomm-Lenovo '054 Products select the current motion vector from the candidate motion vectors by comparing the match errors of the respective candidate motion vectors, characterized in that the motion estimation unit is arranged to add a further candidate motion vector to the set of

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

223. The Qualcomm-Lenovo ‘054 Products contain functionality wherein the penalty term depends on the position and size of the candidate motion vectors. As discussed above the penalty depends on the position of the candidate motion vector as AMVP applies a penalty to the candidate motion vectors based on the spatial location of the motion vector within the video image. Specifically, two motion vector candidates are derived based on spatial motion vectors of prediction units located in five different positions.

224. The penalty that is applied by the Qualcomm-Lenovo ‘054 Products to the candidate motion vectors is also based on the size of the candidate motion vectors. Specifically, the Qualcomm-Lenovo ‘054 Products use a rate distortion cost (“RD Cost Equation”) that selects the best motion vector based on the size of the motion vector and the spatial position of the motion vector. The formula is selected based on the following equation:

$$J\text{cost} = \underset{m \in \{1,2\}}{\arg\min}\ D(m) + \lambda .\ R(m)$$

The *J*cost “is the best rate distortion cost among the final two motion vector candidates.” Ahmed M. Abdelsalam, Ahmed Shalaby, Mohammed S. Sayed, *Towards An FPGA-Based HEVC Encoder: A Low Complexity Rate Distortion Scheme For AMVP*, CIRCUITS SYST. SIGNAL PROCESS at 7 (February 10, 2017). In calculating the rate distortion cost, the Qualcomm-Lenovo ‘054 Products take into account the size of the motion vectors. In calculating the penalty value, the size of the motion vectors is compared. “Rate term R(*m*) represents an estimated number of required bits to transmit the motion parameters.” *Id*. In order to calculate the estimated number of required bits, AMVP uses a bit width calculator. The location of the bit width calculator within AMVP is shown in the figure below. The bit width calculator feeds directly into the RD Cost Calculation Unit.

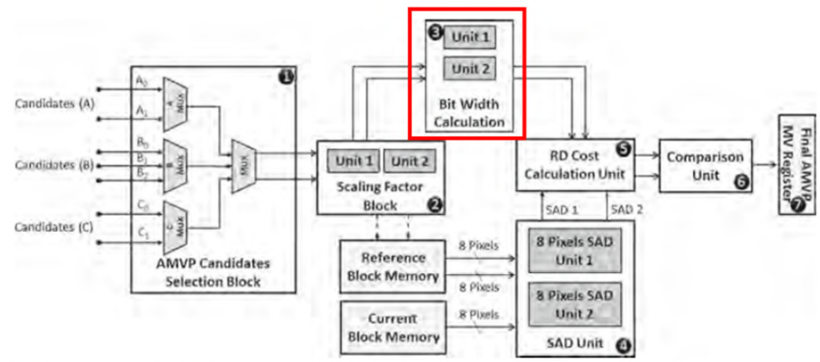


Fig. 8 Abstraction level of the proposed AMVP hardware implementation for HEVC encoder

Ahmed M. Abdelsalam, Ahmed Shalaby, Mohammed S. Sayed, *Towards An FPGA-Based HEVC Encoder: A Low Complexity Rate Distortion Scheme For AMVP*, CIRCUITS SYST. SIGNAL PROCESS at 17 (February 10, 2017) (annotations added).

225. The bit width calculation conducted by the Qualcomm-Lenovo '054 Products sums the number of bits required to transmit the X direction information and the number of bits required to transmit the Y direction information. The size of the motion vector directly influences the number of bits required. A larger motion vector is going to have a larger number in either the X direction or Y direction or both. A larger number requires more bits to represent that number. For example; the number 3 requires two bits, the number 3 is represented as 11 in binary. The number 16 however requires five bits, the number 16 is represented as 10000 in binary. Since larger motion vectors require more bits to transfer the information, they are more costly from a computational point of view.

> The number of bits for every scaled motion vector is computed using a bit width calculation unit as shown in Fig. 10. The bit width calculation unit consists of two look-up tables (LUT), one LUT for motion vector in X direction and another LUT for motion vector in Y direction. Each LUT stores the number of bits for all possible motion vectors in both directions. Hence, the number of bits in X and Y directions is added together and the resulted total number of bits is fed alongside with the corresponding SAD value to the RD cost function.

Ahmed M. Abdelsalam, Ahmed Shalaby, Mohammed S. Sayed, *Towards An FPGA-Based HEVC Encoder: A Low Complexity Rate Distortion Scheme For AMVP*, CIRCUITS SYST. SIGNAL PROCESS at 18 (February 10, 2017) (emphasis added).

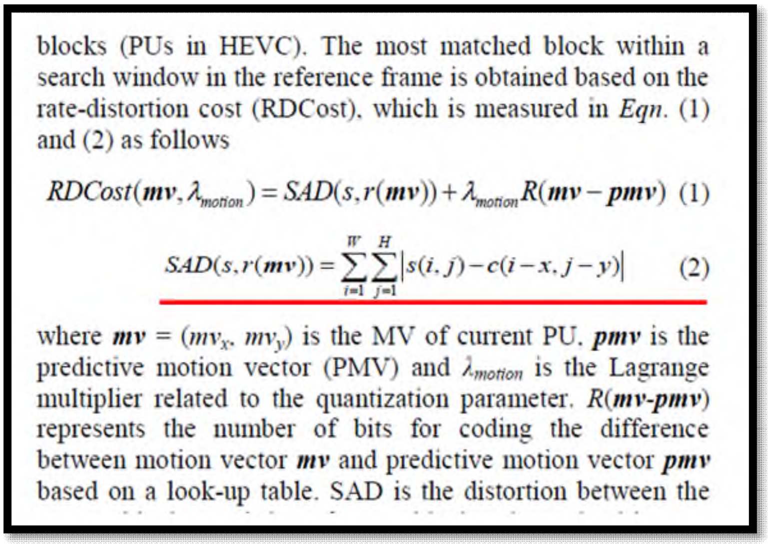
226. In calculating the penalty value, the Qualcomm-Lenovo '054 Products compare the size of the motion vectors using the distortion D(*m*). The distortion D(*m*) is measured as the sum of absolute difference (SAD) value between (1) the current prediction block and (2) the candidate prediction block indicated by index *m*,

The calculation of the Distortion *D(m)* uses the sum of absolute difference value

> Given that J_{cost} is the best rate distortion cost among the two final AMVP candidates 1 and 2. Rate term *R (m)* represents an estimated number of required bits to transmit the motion parameters. The distortion *D (m)* is measured as the sum of absolute difference (SAD) value between (1) the current PB and (2) the candidate PB indicated by index *m*,

Ahmed M. Abdelsalam, Ahmed Shalaby, Mohammed S. Sayed, *Towards An FPGA-Based HEVC Encoder: A Low Complexity Rate Distortion Scheme For AMVP*, CIRCUITS SYST. SIGNAL PROCESS at 7 (February 10, 2017) (annotations added).

227. The specific SAD value equation is shown in Equation 2 below (emphasis added).



blocks (PUs in HEVC). The most matched block within a search window in the reference frame is obtained based on the rate-distortion cost (RDCost), which is measured in *Eqn*. (1) and (2) as follows

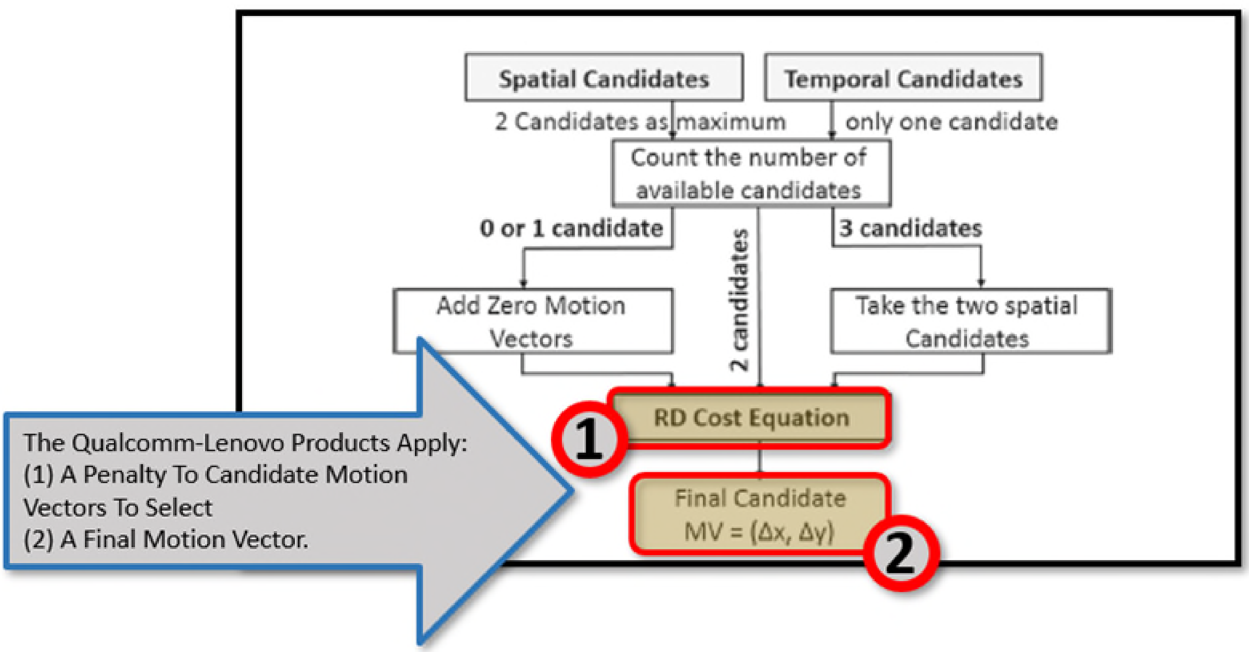
$$RDCost(\boldsymbol{mv}, \lambda_{motion}) = SAD(s, r(\boldsymbol{mv})) + \lambda_{motion} R(\boldsymbol{mv} - \boldsymbol{pmv}) \quad (1)$$

$$SAD(s, r(\boldsymbol{mv})) = \sum_{i=1}^{W} \sum_{j=1}^{H} |s(i,j) - c(i-x, j-y)| \quad (2)$$

where $\boldsymbol{mv} = (mv_x, mv_y)$ is the MV of current PU, $\boldsymbol{pmv}$ is the predictive motion vector (PMV) and λ_{motion} is the Lagrange multiplier related to the quantization parameter. $R(\boldsymbol{mv}\text{-}\boldsymbol{pmv})$ represents the number of bits for coding the difference between motion vector $\boldsymbol{mv}$ and predictive motion vector $\boldsymbol{pmv}$ based on a look-up table. SAD is the distortion between the

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)

228. The Qualcomm-Lenovo '054 Products, in selecting a final motion vector, penalize motion vectors using an RD Cost Equation which is based on a SAD equation (the SAD value is dependent on the size of the motion vector).



Ahmed M. Abdelsalam, Ahmed Shalaby, Mohammed S. Sayed, *Towards An FPGA-Based HEVC Encoder: A Low Complexity Rate Distortion Scheme For AMVP*, CIRCUITS SYST. SIGNAL PROCESS at 7 (February 10, 2017) (annotations added).

229. Any implementation of the HEVC standard would infringe the ‘054 patent as every possible implementation of the standard requires: selecting a displacement vector as a best motion vector for a region in a field from a plurality of at least two candidate motion vectors by applying an error function to each of said plural candidate motion vectors, wherein the candidate motion vector with the least error is selected as the displacement vector for the region in the field; wherein said error function comprises a first penalty term that depends on a type of said candidate motion vector and a second penalty term that depends on the position and size of said candidate motion vector.

230. By complying with the HEVC standard, the Qualcomm-Lenovo ‘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 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 Qualcom and Lenovo’s infringement of the ‘054 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.”

231. By making, using, testing, offering for sale, and/or selling products and services for motion estimation in a sequence of moving video pictures, including but not limited to the

Qualcomm-Lenovo ‘054 Products, Qualcomm and Lenovo have injured Dynamic Data and are liable to Dynamic Data for directly infringing one or more claims of the ‘054 patent, including at least claim 13 pursuant to 35 U.S.C. § 271(a).

232. Qualcomm and Lenovo also indirectly infringe the ‘054 patent by actively inducing infringement under 35 U.S.C. § 271(b).

233. Qualcomm has had knowledge of the ‘054 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Qualcomm knew of the ‘054 patent and knew of its infringement, including by way of this lawsuit.

234. Alternatively, Qualcomm has had knowledge of the ‘054 patent since at least June 21, 2016 based on Qualcomm’s citation of the ‘054 Patent family in its own patents as relevant prior art, including at least: Chinese Patent No. CN104871209A issued on May 17, 2017 (assigned to Qualcomm) and U.S. Patent No. 9,374,506 issued on June 21, 2016 (assigned to Qualcomm).

235. Lenovo has had knowledge of the ‘054 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Lenovo knew of the ‘054 patent and knew of its infringement, including by way of this lawsuit.

236. Qualcomm intended to induce patent infringement by third-party customers and users of the Qualcomm ‘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. Qualcomm specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘054 patent. Qualcomm 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, Qualcomm provides the Qualcomm ‘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 13, and Qualcomm further provides documentation and training materials that cause customers and end users of the Qualcomm '054 Products to utilize the products in a manner that directly infringe one or more claims of the '054 patent.[128] By providing instruction and training to customers and end-users on how to use the Qualcomm '054 Products in a manner that directly infringes one or more claims of the '054 patent, including at least claim 13, Qualcomm specifically intended to induce infringement of the '054 patent. Qualcomm engaged in such inducement to promote the sales of the Qualcomm '054 Products, e.g., through Qualcomm user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '054 patent. Accordingly, Qualcomm has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '054 patent, knowing that such use constitutes infringement of the '054 patent.

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

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[128] *See, e.g.*, *MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019); *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019); *Qualcomm High Efficiency Video Coding (HEVC) Video Encoder*, USER MANUAL (July 11, 2017); *Snapdragon 850 Mobile Compute Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019); *Snapdragon 710 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019); *Snapdragon 653 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon/processors/653 (last visited September 2019).

would infringe the '054 patent. Lenovo 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, Lenovo provides the Lenovo '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 13, and Lenovo further provides documentation and training materials that cause customers and end users of the Lenovo '054 Products to utilize the products in a manner that directly infringe one or more claims of the '054 patent.[129] By providing instruction and training to customers and end-users on how to use the Lenovo '054 Products in a manner that directly infringes one or more claims of the '054 patent, including at least claim 13, Lenovo specifically intended to induce infringement of the '054 patent. On information and belief, Lenovo engaged in such inducement to promote the sales of the Lenovo '054 Products, e.g., through Lenovo user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '054 patent. Accordingly, Lenovo has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '054 patent, knowing that such use constitutes infringement of the '054 patent.

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

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[129] *See, e.g.*, *Motorola Z3 Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019); *Motorola Moto Z3 Play Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019); MOTOROLA MOBILITY LLC GITHUB REPOSITORY, *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208 ((last visited September 2019); *Lenovo Knowledge Base*, LENOVO WEBSITE, *available at*: https://forums.lenovo.com/t5/English-Community/tkbc-p/Community-EN (last visited September 2019).

companies and academic institutions. Qualcomm and Lenovo are utilizing the technology claimed in the ‘054 patent without paying a reasonable royalty. Qualcomm and Lenovo are 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 Qualcomm and Lenovo’s infringement of the ‘054 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Qualcomm and Lenovo’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Qualcomm and Lenovo with interest and costs as fixed by the Court.

COUNT IV
INFRINGEMENT OF U.S. PATENT NO. 7,058,227

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

QUALCOMM INFRINGES THE ‘227 PATENT

242. Qualcomm designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for locating problem areas in an image signal to identify foreground and background in motion compensated pictures.

243. Qualcomm designs, makes, sells, offers to sell, imports, and/or uses Qualcomm products that implement VP9/VP8 compliant image processing functionality, including the following products: Snapdragon 855+ Mobile Platform, Snapdragon 855 Mobile Platform, Snapdragon 850 Mobile Platform, Snapdragon 845 Mobile Platform, Snapdragon 835 Mobile Platform, Snapdragon 730G Mobile Platform, Snapdragon 730 Mobile Platform, Snapdragon 712

Mobile Platform, Snapdragon 710 Mobile Platform, Snapdragon 675 Mobile Platform, Snapdragon 670 Mobile Platform, Snapdragon 665 Mobile Platform, Snapdragon 660 Mobile Platform, Snapdragon 636 Mobile Platform, Snapdragon 632 Mobile Platform, and Snapdragon 630 Mobile Platform (collectively, the "Qualcomm '227 Product(s)").

244. One or more Qualcomm subsidiaries and/or affiliates use the Qualcomm '227 Products in regular business operations.

245. The accused Qualcomm '227 Products comply with the VP9/VP8 standard. The below excerpts from documentation regarding the Qualcomm Products shows that the Qualcomm '227 Products suppors encoding into VP9/VP8 format content.

Video	**Video Capture:** Up to 4K Ultra HD video capture @ 30FPS
	Video Playback: Up to 4K Ultra HD video playback @ 60 fps
	Codec Support: H.265 (HEVC), H.264 (AVC), VP9

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

Video	**Video Capture:** Up to 4K Ultra HD video capture @ 30FPS, Up to 1080p video capture @120 FPS
	Video Playback: Up to 4K Ultra HD Premium video playback
	Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9
	Video Software: Rec. 2020 color gamut video capture, Up to 10-bits per color video capture

Snapdragon 710 Mobile Platform, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019).

Video	**Video Capture:** Up to 4K Ultra HD video capture @ 30FPS, Up to 1080p video capture @120 FPS **Video Playback:** Up to 4K Ultra HD video playback **Codec Support:** H.265 (HEVC), H.264 (AVC), VP8, VP9

Snapdragon 636 Mobile Platform, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-636-mobile-platform (last visited September 2019).

246. All of the Qualcomm '227 Products contain an Adreno 500 or Adreno 600 series graphic processing unit. Further, the Qualcomm '227 Products each contain a video core that is used to process VP9/VP8 compliant content.

247. Qualcomm makes, uses, sells, offers for sale, or imports into the United States the Qualcomm '227 Products and thus directly infringes at least one or more claims of the '227 patent. Upon information and belief, Qualcomm also uses the Qualcomm '227 Products via its internal use and testing in the United States, directly infringing one or more claims of the '227 patent.

248. Qualcomm has induced and continues to induce and contribute to infringement of the '227 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the '227 patent, including, but not limited to, the Qualcomm '227 Products. Qualcomm provides these Qualcomm '227 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the '227 patent.

249. One or more Qualcomm subsidiaries and/or affiliates use the Qualcomm '227 Products in regular business operations.

250. The Qualcomm '227 Products are available to businesses and individuals throughout the United States.

251. The Qualcomm ’227 Products are provided to businesses and individuals located in the State of Delaware.

LENOVO INFRINGES THE ‘227 PATENT

252. Lenovo designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for locating problem areas in an image signal to identify foreground and background in motion compensated pictures.

253. Lenovo designs, makes, sells, offers to sell, imports, and/or uses products that implement VP9/VP8 compliant image processing functionality, including the following products: Motorola Moto Z2 Force Edition, Motorola Moto Z3, and the Motorola Moto Z3 Play (collectively, the “Lenovo ‘227 Products”).

254. Lenovo has directly infringed and continues to directly infringe the ’227 patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the ‘227 patent.

255. The Lenovo ‘227 Products perform motion estimation enhancements in compliance with the VP9/VP8 standard. The below excerpts from Lenovo documentation of the infringing devices identifies the infringing functionality.

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3, MIDI,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Microphones
4 far-field mic system

Headphone jack
USB-C to 3.5mm converter included

Motorola Z3 Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019) (annotation added) ("Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K.").

audio + video
Speakers
Front port loud speaker

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Motorola Moto Z3 Play Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019) (annotation added) ("Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K").

256. The Lenovo '227 Products all contain functionality for performing the decoding of video content using a Qualcomm processor. *See e.g.,* Motorola Moto Z2 Force Edition (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z3 (containing a Qualcomm Snapdragon 835 processor), and the Motorola Moto Z3 Play (containing a Qualcomm Snapdragon 636 processor).

257. Lenovo makes, uses, sells, offers for sale, or imports into the United States the Lenovo ‘227 Products and thus directly infringes at least one or more claims of the ’227 patent. Upon information and belief, Lenovo also uses the Lenovo ‘227 Products via its internal use and testing in the United States, directly infringing one or more claims of the ’227 patent.

258. Lenovo has induced and continues to induce and contribute to infringement of the ‘227 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the ‘227 patent, including, but not limited to, the Lenovo ‘227 Products. Lenovo provides these Lenovo ‘227 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the ‘227 patent.

259. One or more Lenovo subsidiaries and/or affiliates use the Lenovo ’227 Products in regular business operations.

260. The Lenovo ’227 Products are available to businesses and individuals throughout the United States.

261. The Lenovo ’227 Products are provided to businesses and individuals located in the State of Delaware.

INFRINGEMENT OF THE ‘227 PATENT

262. The Qualcomm ‘227 Products and Lenovo ‘227 Products (collectively, the “Qualcomm-Lenovo ‘227 Products”) estimate a motion vector field for an image signal. The Qualcomm-Lenovo ‘227 Products use segmentation to identify background motion vectors for a pixel on a covered (occluded) region of an image. Specifically, the Qualcomm-Lenovo ‘227 Products process the video stream to identify background and foreground areas in encoded video content. The (static) background is then coded at a higher quality compared to the rest of the frame in certain reference frames (such as the “alt-ref” frame) that provides prediction that persists over

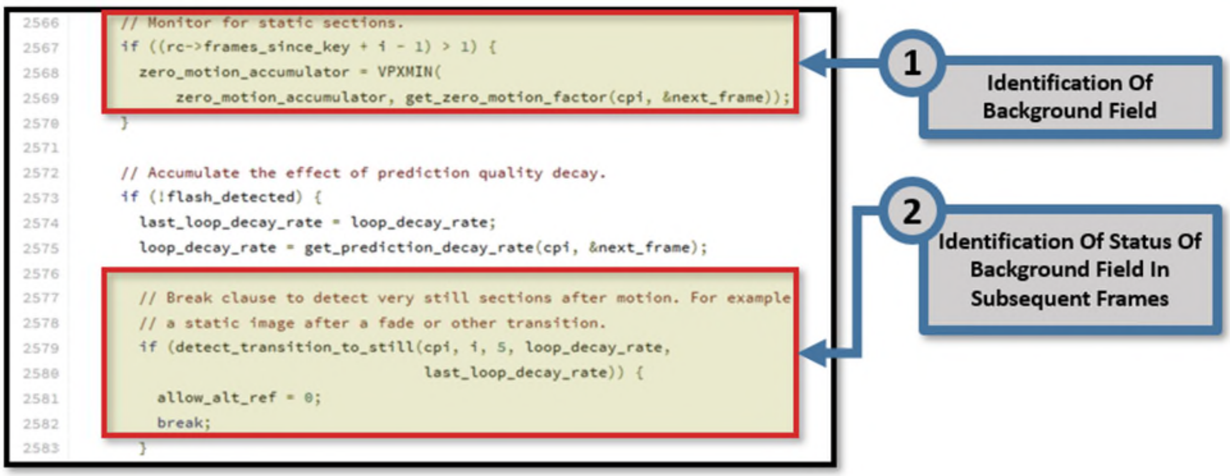
a number of frames. In contrast, for the frames between these persistent reference frames, the background is given fewer bits by, for example, restricting the set of available reference buffers, using only the ZERO_MV coding mode, or skipping the residual coefficient block. The below excerpt from documentation of the encoding used by the Qualcomm-Lenovo ‘227 Products describes the use of segmentation to identify the motion model to be used in assigning motion vectors to a field in an image.

> VP9 provides a means of segmenting the image and then applying various signals or adjustments at the segment level. Segmentation can be particularly efficient and useful when the segmentation of a video sequence persists or changes little for many frames.
>
> Up to 8 segments may be specified for any given frame. For each of these segments it is possible to specify:
>
> - a quantizer,
> - a loop filter strength,
> - a prediction reference frame,
> - a block skip mode that implies the use of a zero motion vector and that no residual will be coded.
>
> Each of these data values for each segment may be individually updated at the frame level. Where a value is not updated in a given frame, the value from the previous frame persists. The exceptions to this are key frames, intra only frames or other frames where independence from past frame values is required (for example to enable error resilience). In such cases all values are reset to a default.

Segmentation Map, VP9 BITSTREAM & DECODING PROCESS SPECIFICATION - v0.6 § 5.15 (2016) (annotation added) (“Each of these data values for each segment may be individually updated at the frame level. Where a value is not updated in a given frame, the value from the previous frame persists.”).

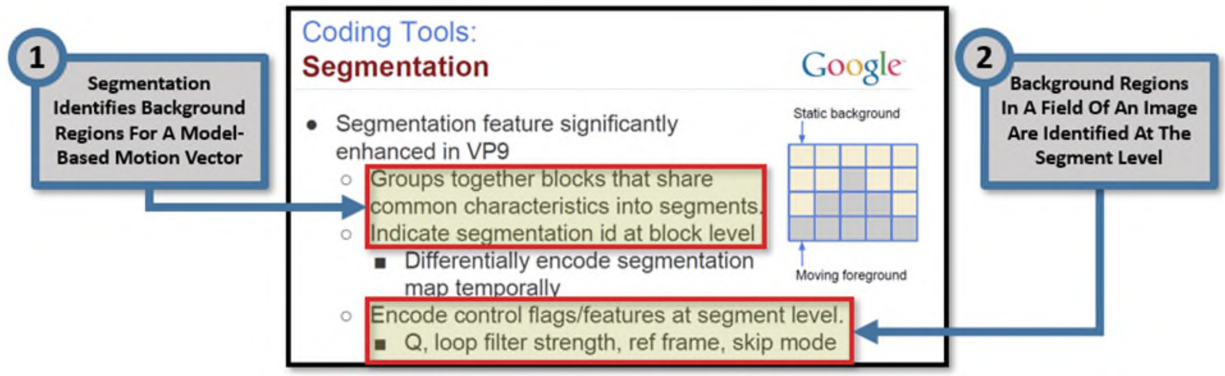
263. The Qualcomm-Lenovo ’227 Products perform a method of locating problem areas in an image signal that includes estimating a motion vector field for the image signal. The Qualcomm-Lenovo ’227 Products process video data using segmentation features that allowing each superblock or macroblock to specify a segment-ID to which it belongs. Then, for each segment, the frame header can convey common features that will be applied to all MBs/SB32s/SB64s belonging to the same segment ID. Further, the segmentation map is coded across frames by the Qualcomm-Lenovo ’227 Products in order to minimize the size of the signaling overhead. In the reference implementation of the image signal processing method used by the Qualcomm-Lenovo ’227 Products segmentation is used to identify background (occluded

pixels) and foreground pixels in encoded video content. The (static) background is coded at a higher quality compared to the rest of the frame in certain reference frames (such as the alt-ref frame) that provides prediction that persists over a number of frames. The following excerpt from the reference implementation of the VP9 coding process shows fields in an image are determined to be comprised of background pixels.



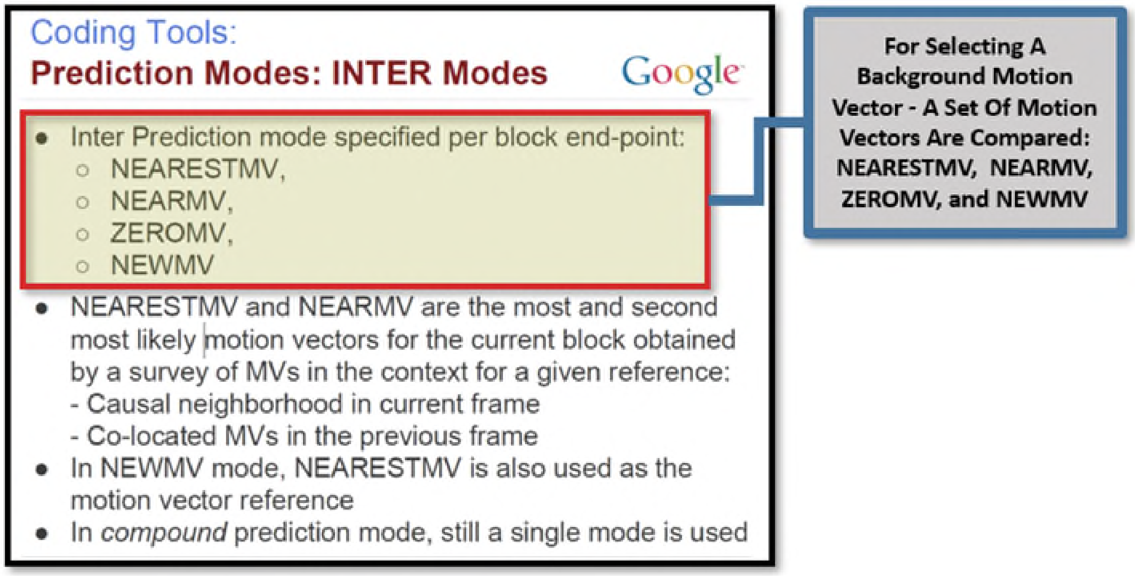
VP9 Encoder Reference Implementation – VP9_firstpass.c, WEBM SOURCE REPOSITORY (last visited September 2019), *available at*: https://chromium.googlesource.com/webm/libvpx/+/master/vp9 (annotations added).

264. The Qualcomm-Lenovo '227 Products perform a method of locating problem areas in an image signal that includes comparing edge locations in successive field periods to identify both foreground and background. For the frames between these persistent reference frames, the background is given fewer bits by, for example, restricting the set of available reference buffers, using only the ZERO_MV coding mode, or skipping the residual coefficient block. The following excerpt from documentation of the coding process used by the Qualcomm-Lenovo '227 Products shows how segmentation is used to identify fields in an image that are comprised of background pixels and thus comparing edge locations in successive field periods.



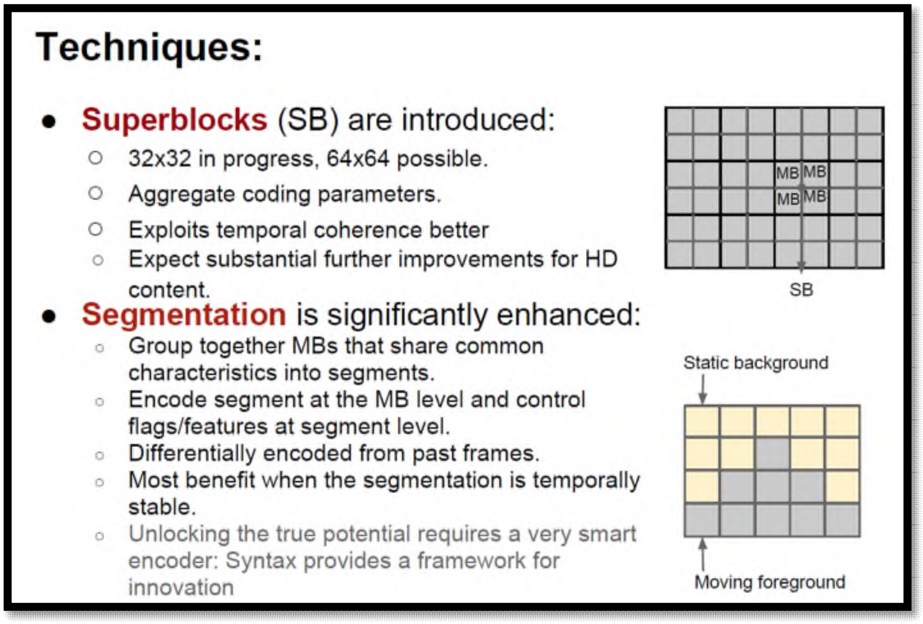
Debargha Mukherjee, A TECHNICAL OVERVIEW OF VP9: THE LATEST ROYALTY FREE VIDEO CODEC FROM GOOGLE at 28 (2016) (annotations added).

265. With the three best candidate reference vectors best, nearest and near identified, the Qualcomm-Lenovo ‘227 Products can either signal the use of the vector identified as the nearest (NEAREST_MV mode) or near (NEAR_MV mode) or, if neither of them is deemed appropriate, signal the use of a completely new motion vector (NEW_MV mode). The Qualcomm-Lenovo ‘227 Products compare the motion vectors to determine a best motion vector. If the region is completely static (comprises only pixels that are a background region in the image) then the ZERO_MV will comprise the best motion vector and a (0, 0) motion vector will be assigned as the background motion vector for the pixels in the field of the image.



Debargha Mukherjee, A TECHNICAL OVERVIEW OF VP9: THE LATEST ROYALTY FREE VIDEO CODEC FROM GOOGLE at 15 (2016) (annotations added).

266. The Qualcomm-Lenovo ‘227 Products detect edges in a motion vector field by coding fields in an image at the macroblock or superblock level with a “Segment ID” that bitstream codes a segment ID for each block. “In some parts of the image there may be a large region that can all be predicted at the same time (e.g. a still background image), while in other parts there may be some fine details that are changing (e.g. in a talking head) and a smaller block size would be appropriate. VP9 provides the ability to vary the block size to handle a range of prediction sizes.” *Superblocks*, VP9 BITSTREAM & DECODING PROCESS SPECIFICATION - V0.6 § 5.6 (2016). The Segment ID enables the computing of a model-based motion vector for pixels on the basis of a motion model. For example, if the field of an image is determined to be static, the motion model will select a best motion vector from a set of motion vectors that include: New MV; Nearest MV; Near MV; and Zero MV. The below excerpt from the documentation of the process used by the Qualcomm-Lenovo ‘227 Products shows how regions in an image (macroblocks) can be grouped together to form Superblocks based on segmentation thus enabling the detecting of edges in motion vector fields.



Adrian Grange, OVERVIEW OF VP-NEXT: A NEXT GENERATION OPEN VIDEO CODEC at 12 (2012).

267. The Qualcomm-Lenovo '227 Products compute a model-based motion vector for the pixel on the basis of a motion model being determined on the basis of a part of a motion vector field of the image.

> In the reference implementation, segmentation is currently used to identify background and foreground areas in encoded video content. The (static) background is then coded at a higher quality compared to the rest of the frame in certain reference frames (such as the alt-ref frame) that provides prediction that persists over a number of frames. In contrast, for the frames between these persistent reference frames, the background is given fewer bits by, for example, restricting the set of available reference buffers, using only the ZERO_MV coding mode, or skipping the residual coefficient block. The result is that more bits are available to code the foreground-portion of the scene, while still preserving very good perceptual quality on the static background. Other use cases involving spatial and temporal masking for perceptual quality improvement are conceivable.

A VP9 Bitstream Overview, NETWORK WORKING GROUP § 2.8 (February 18, 2013) (emphasis added).

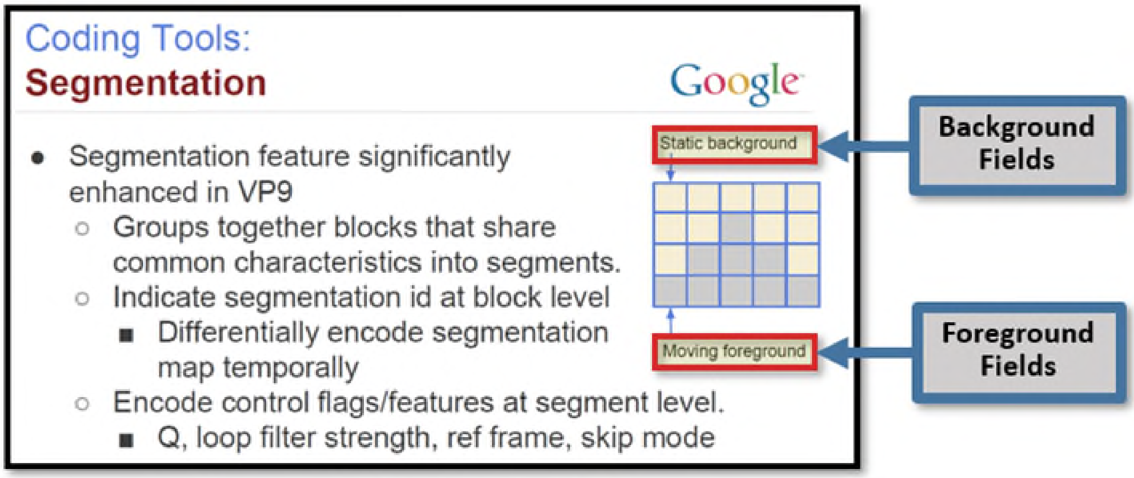
268. The Qualcomm-Lenovo ‘227 Products process macroblocks into segments (regions) on a block-by-block basis to create segmentation maps that code shape information. The below excerpt from the VP9 Bitstream & Decoding Process Specification implemented by the Qualcomm-Lenovo ‘227 Products identifies the syntax wherein a part of an image field is identified as a “segment.”

segmentation_params( ) {	Type
segmentation_enabled	f(1)
if (segmentation_enabled == 1) {	
segmentation_update_map	f(1)
if (segmentation_update_map == 1) {	
for (i = 0; i < 7; i++)	
segmentation_tree_probs[i] = read_prob( )	
segmentation_temporal_update	f(1)
for (i = 0; i < 3; i++)	
segmentation_pred_prob[i] = segmentation_temporal_update ? read_prob( ) : 255	

Segmentation Params Syntax, VP9 Bitstream & Decoding Process Specification - v0.6 § 6.2.11 (2016) (annotation added).

269. The Qualcomm-Lenovo ‘227 Products utilize segments that are background (static) regions of inter blocks which contain blocks that are encoded from a fixed reference (previous) frame.

270. The Qualcomm-Lenovo ’227 Products perform a method of locating problem areas in an image signal that includes estimating a motion vector field for the image signal.



Debargha Mukherjee, A TECHNICAL OVERVIEW OF VP9: THE LATEST ROYALTY FREE VIDEO CODEC FROM GOOGLE at 28 (2016) (annotations added).

271. The Qualcomm-Lenovo '227 Products further use a motion model that forms the basis for computing a model-based motion vector. The coded pixel information for a block contains the residual between the previous frame and the current frame, which can be zero (skip), using the coded pixel information of a previous frame block corresponding to a current frame block (only a motion vector pointing to the reference frame).

Consider the **residual** block. This is defined to be the difference between the prediction (assume we have been instructed to use vertical prediction) and the source image:

0	0	0	0
0	0	0	0
10	10	10	10
10	10	10	10

The residual only contains small numbers, so is cheaper to represent than the original contents.

Predicting Image Data, VP9 BITSTREAM & DECODING PROCESS SPECIFICATION - V0.6 § 5.4 (2016) ("In VP9 all blocks are represented by some information specifying how to predict the contents of the block (in this case the intra mode), plus transform coefficients of the residual block.").

272. Further, the Qualcomm-Lenovo '227 Products compute a prediction for the "first blocks in the video where we do not have any coded pixels. In these cases the decoder pretends that it has decoded pixels with a fixed value for the off-screen locations." *Id.* at 14. Inter prediction

in the VP9 format then determines a motion vector "that specifies the offset in the previous frame of the part of the image to use as a prediction for [an inter block]." *Id.* at 14.

5.15 Segmentation map

VP9 provides a means of segmenting the image and then applying various signals or adjustments at the segment level. Segmentation can be particularly efficient and useful when the segmentation of a video sequence persists or changes little for many frames.

Up to 8 segments may be specified for any given frame. For each of these segments it is possible to specify:

- a quantizer,
- a loop filter strength,
- a prediction reference frame,
- a block skip mode that implies the use of a zero motion vector and that no residual will be coded.

Each of these data values for each segment may be individually updated at the frame level. Where a value is not updated in a given frame, the value from the previous frame persists. The exceptions to this are key frames, intra only frames or other frames where independence from past frame values is required (for example to enable error resilience). In such cases all values are reset to a default.

It is possible to indicate segment affiliation for any prediction block of size 8x8 pixels or greater. Updates to this **segmentation map** are explicitly coded using either a temporal coding or direct coding strategy (chosen at the frame level).

If no explicit update is coded for a block's segment affiliation, then it persists from frame to frame with the same provisos detailed above for the segment data values. In regard to key frames, intra only frames and frames where independence from past frames is required, the segment affiliation for each block defaults to 0 unless explicitly updated.

Internally, segment affiliation is stored at the resolution of 8x8 blocks (a segment map). This can lead to conflicts when, for example, a transform size of 32x32 is selected for a 64x64 region. If the different component 8x8 blocks that comprise a larger region have different segment affiliations, then the segment affiliation for the larger region is defined as being the lowest segment id of any of the contributing 8x8 regions.

Segmentation Map, VP9 BITSTREAM & DECODING PROCESS SPECIFICATION - V0.6 § 5.15 (2016)

273. The Qualcomm-Lenovo'227 Products perform a method of locating problem areas in an image signal that includes comparing edge locations in successive field periods to identify both foreground and background. The Qualcomm-Lenovo '227 Products utilize the compression format calculation of motion vectors temporally between frames to find a difference (residual) between blocks in a given frame (next frame) and a reference frame. This is performed for "INTER blocks."

5.5 Inter prediction

Suppose we are now trying to compress a whole video sequence.

Consider what we can predict about the next image from the previous one: there may be some still parts of the image in the background, so some blocks may be identical to their contents in the previous frame. Similarly, if the camera is panning or some object is moving, there may be blocks that are very similar to a slightly shifted part of the previous frame.

VP9 takes advantage of these cases by using **inter blocks**. An inter block contains a motion vector that specifies the offset in the previous frame of the part of the image to use as a prediction for this block. So, for example, still blocks will be represented by a zero motion vector. The motion vector contains information about both a vertical and horizontal offset to allow for both types of movement.

As for intra blocks, the decoding process works by first computing the prediction, and then inverse transforming the transform coefficients and adding the result (the residual) to this prediction.

Id. at 14.

274. The Qualcomm-Lenovo '227 Products perform the selecting of a particular motion vector of the set of motion vectors on the basis of the comparing and assigning a particular motion vector as the background motion vector. The Qualcomm-Lenovo '227 Products calculate motion vectors temporally between frames to find a difference (residual) between blocks in a given frame (next frame) and a reference frame.

275. The Qualcomm-Lenovo '227 Products select a motion vector from a set of motion vectors following a comparison of a best motion vector. In the specification for the coding process used by the Qualcomm-Lenovo '227 Products shows the image field (block) is assigned a motion vector based on the best match. The below excerpt from the specification shows this syntax.

inter_block_mode_info( ) {	Type
read_ref_frames( )	
for (j = 0; j < 2; j++) {	
if (ref_frame[j] > INTRA_FRAME) {	
find_mv_refs(ref_frame[j], -1)	
find_best_ref_mvs(j)	
}	
}	
isCompound = ref_frame[1] > INTRA_FRAME	
if (seg_feature_active(SEG_LVL_SKIP)) {	
y_mode = ZEROMV	
} else if (MiSize >= BLOCK_8X8) {	
inter_mode	T
y_mode = NEARESTMV + inter_mode	
}	

Inter Block Mode Info Syntax, VP9 BITSTREAM & DECODING PROCESS SPECIFICATION - V0.6 § 6.4.16 (2016) (annotation added).

276. Following the selection of the motion vector for the background pixel block the motion vector is assigned to the block by the Qualcomm-Lenovo '227 Products. The below excerpt from the VP9 Bitstream & Decoding Process Specification that governs the coding process used by the Qualcomm-Lenovo '227 Products shows this assignment.

assign_mv(isCompound) {	Type
Mv[1] = ZeroMv	
for (i = 0; i < 1 + isCompound; i++) {	
if (y_mode == NEWMV)	
read_mv(i)	
else if (y_mode == NEARESTMV)	
Mv[i] = NearestMv[i]	
else if (y_mode == NEARMV)	
Mv[i] = NearMv[i]	
else	
Mv[i] = ZeroMv	
}	

Assign MV Syntax, VP9 BITSTREAM & DECODING PROCESS SPECIFICATION - V0.6 § 6.4.18 (2016) (annotation added).

277. Qualcomm and Lenovo have directly infringed and continue to directly infringe the ‘227 patent by, among other things, making, using, offering for sale, and/or selling technology for comparing edge locations in successive field periods to identify areas of foreground and background in motion compensated pictures.

278. By making, using, testing, offering for sale, and/or selling products and services for detecting edges in motion vectors fields and identifying foreground and background areas in motion compensated pictures, including but not limited to the Qualcomm-Lenovo ’227 Products, Qualcomm and Lenovo have injured Dynamic Data and are liable to Dynamic Data for directly infringing one or more claims of the ‘227 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

279. Qualcomm and Lenovo also indirectly infringe the ‘227 patent by actively inducing infringement under 35 U.S.C. § 271(b).

280. Qualcomm has had knowledge of the ‘227 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Qualcomm knew of the ‘227 patent and knew of its infringement, including by way of this lawsuit.

281. Alternatively, Qualcomm has had knowledge of the ‘227 patent since at least July 10, 2008 based on Qualcomm’s citation of the ‘227 patent family in its own patents and patent applications as relevant prior art, including at least:

- U.S. Patent No. 8,265,158 granted on September 11, 2012 and assigned to Qualcomm.
- U.S. Patent No. 8,437,397 granted on May 7, 2013 and assigned to Qualcomm.
- U.S. Patent No. 8,537,283 granted on September 17, 2017 and assigned to Qualcomm.
- U.S. Patent No. 8,649,437 granted on February 11, 2014 and assigned to Qualcomm.
- U.S. Patent Application No. US20080165851 published on July 10, 2008 and assigned to Qualcomm.

- U.S. Patent Application No. US20090161010 published on June 25, 2009 and assigned to Qualcomm.
- U.S. Patent Application No. US20090161763 published on June 25, 2009 and assigned to Qualcomm.

282. Qualcomm intended to induce patent infringement by third-party customers and users of the Qualcomm ’227 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. Qualcomm specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘227 patent. Qualcomm performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘227 patent and with the knowledge that the induced acts would constitute infringement. For example, Qualcomm provides the Qualcomm ’227 Products that have the capability of operating in a manner that infringe one or more of the claims of the ‘227 patent, including at least claim 1, and Qualcomm further provides documentation and training materials that cause customers and end users of the Qualcomm ’227 Products to utilize the products in a manner that directly infringe one or more claims of the ‘227 patent.[130] By providing instruction and training to customers and end-users on how to use the Qualcomm ’227 Products in a manner that directly infringes one or more claims of the ‘227 patent, including at least claim 1, Qualcomm specifically intended to

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[130] *See, e.g.*, *MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019); *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019); *Qualcomm High Efficiency Video Coding (HEVC) Video Encoder*, USER MANUAL (July 11, 2017); *Snapdragon 850 Mobile Compute Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019); *Snapdragon 710 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019); *Snapdragon 653 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon/processors/653 (last visited September 2019).

induce infringement of the ‘227 patent. Qualcomm engaged in such inducement to promote the sales of the Qualcomm ’227 Products, e.g., through Qualcomm user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the ‘227 patent. Accordingly, Qualcomm 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 ‘227 patent, knowing that such use constitutes infringement of the ‘227 patent.

283. Lenovo has had knowledge of the ‘227 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Lenovo knew of the ‘227 patent and knew of its infringement, including by way of this lawsuit.

284. Lenovo intended to induce patent infringement by third-party customers and users of the Lenovo ’227 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. Lenovo specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘227 patent. Lenovo performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘227 patent and with the knowledge that the induced acts would constitute infringement. For example, Lenovo provides the Lenovo ’227 Products that have the capability of operating in a manner that infringe one or more of the claims of the ‘227 patent, including at least claim 1, and Lenovo further provides documentation and training materials that cause customers and end users of the Lenovo ’227 Products to utilize the products in a manner that directly infringe one or more claims of the ‘227 patent.[131] By

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[131] *See, e.g.*, *See, e.g.*, *Motorola Z3 Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019); *Motorola Moto Z3 Play Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019); MOTOROLA MOBILITY LLC GITHUB

providing instruction and training to customers and end-users on how to use the Lenovo ’227 Products in a manner that directly infringes one or more claims of the ‘227 patent, including at least claim 1, Lenovo specifically intended to induce infringement of the ‘227 patent. Lenovo engaged in such inducement to promote the sales of the Lenovo ’227 Products, e.g., through Lenovo user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the ‘227 patent. Accordingly, Lenovo 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 ‘227 patent, knowing that such use constitutes infringement of the ‘227 patent.

285. The ‘227 patent is well-known within the industry as demonstrated by multiple citations to the ‘227 patent in published patents and patent applications assigned to technology companies and academic institutions. Qualcomm and Lenovo are utilizing the technology claimed in the ‘227 patent without paying a reasonable royalty. Qualcomm and Lenovo are infringing the ‘227 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

286. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘227 patent. As a result of Qualcomm and Lenovo’s infringement of the ‘227 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Qualcomm and Lenovo’s infringement, but in no event less than a reasonable

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REPOSITORY, *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208 ((last visited September 2019); *Lenovo Knowledge Base*, LENOVO WEBSITE, *available at*: https://forums.lenovo.com/t5/English-Community/tkbc-p/Community-EN (last visited September 2019).

royalty for the use made of the invention by Qualcomm and Lenovo with interest and costs as fixed by the Court.

COUNT V
INFRINGEMENT OF U.S. PATENT NO. 7,039,109

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

QUALCOMM INFRINGES THE '109 PATENT

288. Qualcomm designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for motion-compensated interpolation of a data-signal comprising successive images wherein each image comprises groups of pixels.

289. Qualcomm has directly infringed and continues to directly infringe the '109 patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the '109 patent. Qualcomm products that infringe one or more claims of the '109 patent include, but are not limited to, the following Qualcomm Snapdragon processors: Snapdragon 855+, Snapdragon 855, Snapdragon 850, Snapdragon 845, Snapdragon 835, Snapdragon 821, Snapdragon 820, Snapdragon 730G, Snapdragon 730, Snapdragon 712, Snapdragon 710, Snapdragon 675, Snapdragon 670, Snapdragon 665, Snapdragon 660, Snapdragon 653, Snapdragon 652, Snapdragon 650, Snapdragon 636, Snapdragon 632, Snapdragon 630, Snapdragon 626, Snapdragon 625, Snapdragon 610, Snapdragon 450, Snapdragon 439, Snapdragon 435, Snapdragon 429, Snapdragon 215, and the Snapdragon 212 (collectively, the "Qualcomm '109 Products").

290. The Qualcomm '109 Products perform profcessing of video in compliance with the H.265 standard. Specifically, each of the Qualcomm '109 Products contain functionality for

processing HEVC encoded data using an HEVC decoder: Snapdragon 855+,[132] Snapdragon 855,[133] Snapdragon 850,[134] Snapdragon 845,[135] Snapdragon 835,[136] Snapdragon 821,[137] Snapdragon

[132] *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC), HDR10+, HLG, HDR10, H.264 (AVC), VP8, VP9").

[133] *Qualcomm Snapdragon 855 Mobile Platform Specification*, Qualcomm Website, *available at*: https://www.qualcomm.com/products/snapdragon-855-mobile-platform (last visited September 2019) ("Video Capture Formats: HDR10, HLG, HEVC . . . Codec Support: H.265 (HEVC)").

[134] *Qualcomm Snapdragon 850 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019) ("Video Capture Formats: HDR, HLG, HEVC . . . Codec Support: H.265(HEVC)").

[135] *Qualcomm Snapdragon 845 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (May 2018) ("Ultra HD Premium video playback and encoding @ 4K (3840x2160) 60fps, 10bit HDR, Rec 2020 color gamut. . . Slow motion HEVC video encoding of either HD (720p) video up to 480fps or FHD (1080p) up to 240fps . . . H.264 (AVC), H.265 (HEVC)").

[136] *Qualcomm Snapdragon 835 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-835-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback @ 60 fps . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP9.").

[137] *Qualcomm Snapdragon 821 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-821-mobile-platform (last visited September 2019) ("Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC)").

820,[138] Snapdragon 730G,[139] Snapdragon 730,[140] Snapdragon 712,[141] Snapdragon 710,[142] Snapdragon 675,[143] Snapdragon 670,[144] Snapdragon 665,[145] Snapdragon 660,[146] Snapdragon

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138 *Qualcomm Snapdragon 820 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2016) ("4K HEVC video (Decode: 60 fps, 10-bit. Encode: 30 fps)").

139 *Qualcomm Snapdragon 730G Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730g-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

140 *Qualcomm Snapdragon 730 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-730-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Capture (30 FPS): 4K Ultra HD video capture . . . Video Playback: Up to 4K Ultra HD Premium video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

141 *Qualcomm Snapdragon 712 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-712-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

142 *Qualcomm Snapdragon 710 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

143 *Qualcomm Snapdragon 675 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (February 2019) ("Visual Processing System . . . H.264 (AVC), H.265 (HEVC), VP8 and VP9 playback . . . Video capture . . . HEVC video capture").

144 *Qualcomm Snapdragon 670 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-670-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

145 *Qualcomm Snapdragon 665 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-665-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

146 *Qualcomm Snapdragon 660 Mobile Platform Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-660-mobile-platform (last visited September 2019) ("Video Capture Formats: HEVC . . . Video Playback: Up to 4K Ultra HD video playback . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

653,[147] Snapdragon 652,[148] Snapdragon 650,[149] Snapdragon 636,[150] Snapdragon 632,[151] Snapdragon 630,[152] Snapdragon 626,[153] Snapdragon 625,[154] Snapdragon 610,[155] Snapdragon

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[147] *Qualcomm Snapdragon 653 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("Efficient, high-quality video streaming Embedded HEVC H.265 hardware decoder and integrated Qualcomm VIVE 802.11ac WiFi technology and Bluetooth 4.1 solutions.").

[148] *Qualcomm Snapdragon 652 Mobile Platform Product Specfication*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-652-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

[149] *Qualcomm Snapdragon 650 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-650-mobile-platform (last visited September 2019) ("Embedded HEVC H.265 hardware decoder provides better video compression at the same visual quality for significant bandwidth and content storage savings.").

[150] *Qualcomm Snapdragon 636 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

[151] *Qualcomm Snapdragon 632 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-632-mobile-platform (last visited September 2019) ("Video . . . Codec Support: H.265 (HEVC), H.264 (AVC), VP8, VP9").

[152] *Qualcomm Snapdragon 630 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video . . . H.264 (AVC), H.265 (HEVC), VP9").

[153] *Qualcomm Snapdragon 626 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2016) ("4K Ultra HD video – Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth").

[154] *Qualcomm Snapdragon 625 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-625-mobile-platform (last visited September 2019) ("4K Ultra HD video - Premium 4K video with HEVC capture and playback for optimal balance of quality and bandwidth.").

[155] *Qualcomm Snapdragon 610 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 1 (2014) ("Efficient high-quality video streaming – Embedded HEVC H.265 hardware decoder.").

450,[156] Snapdragon 439,[157] Snapdragon 435,[158] Snapdragon 429,[159] Snapdragon 215,[160] and the Snapdragon 212.[161]

291. The Qualcomm '109 Products contain a multimedia subsystem wherein video content is decoded in compliance with the HEVC standard. For example, the following excerpt from a publicly accessible copy of the Snapdragon 820 Device Specification shows the multimedia system responsible for encoding and decoding is identified as "Venus 3.x with HEVC."[162]

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[156] *Qualcomm Snapdragon 450 Mobile Platform Product Brief*, QUALCOMM DOCUMENTATION at 2 (2017) ("Video – FHD+@60fps HEVC capture and playback").

[157] *Qualcomm Snapdragon 439 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-439-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8").

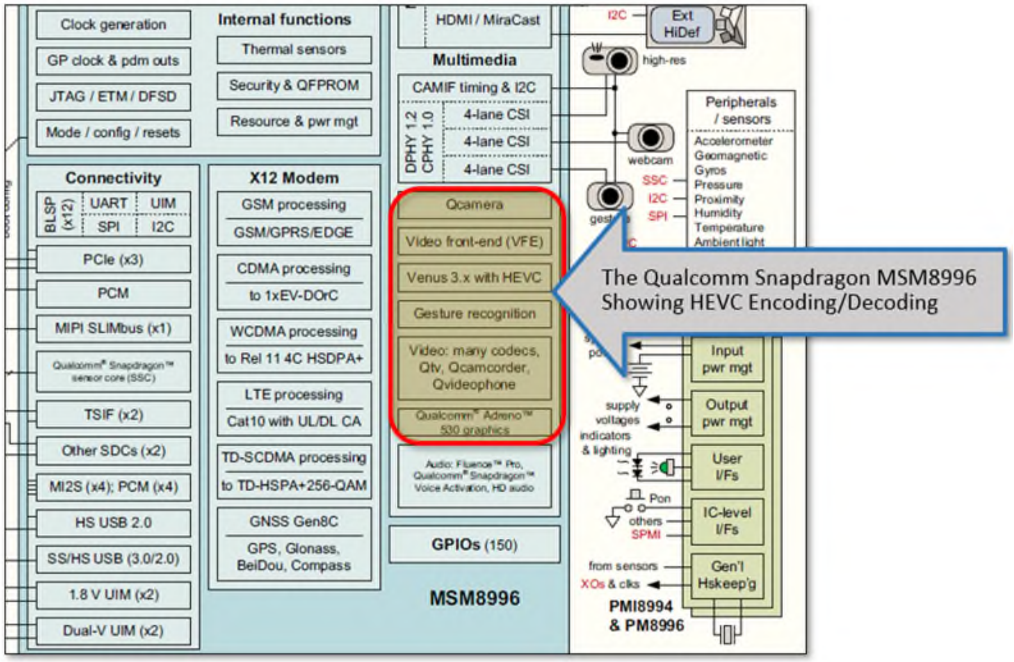
[158] *Qualcomm Snapdragon 435 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform (last visited September 2019) ("With a 21MP dual ISP and Qualcomm Adreno 505 GPU integration, the Snapdragon 435 supports rich, high-quality camera images and stunning graphics with optimum speed.").

[159] *Qualcomm Snapdragon 429 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform (last visited September 2019) ("GPU Name: Qualcomm Adreno 504 GPU").

[160] *Qualcomm Snapdragon 215 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/qualcomm-215-mobile-platform (last visited September 2019) ("Codec Support: H.265 (HEVC), H.264 (AVC), VP8").

[161] *Qualcomm Snapdragon 212 Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/qualcomm-snapdragon-212-mobile-platform (last visited September 2019) ("HD video content on the fly - With native HEVC, maximize device storage and watch streaming HD content as quick as you can click the link.").

[162] *See MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019).



MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (annotations added).

292. The Qualcomm '109 Products all perform decoding of video content in compliance with the HEVC standard. Specifically, all of the Qualcomm '109 Products contain an Adreno 300 to 600 series graphic processing unit.[163] Further, the Qualcomm '109 Products each contain a video core that is used to decode HEVC content.

293. Qualcomm makes, uses, sells, offers for sale, or imports into the United States the Qualcomm '109 Products and thus directly infringes at least one or more claims of the '109 patent. Upon information and belief, Qualcomm also uses the Qualcomm '109 Products via its internal

[163] *See e.g., Snapdragon 435 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-435-mobile-platform ("With a 21MP dual ISP and Qualcomm® Adreno™ 505 GPU integration, the Snapdragon 435 supports rich, high-quality camera images and stunning graphics with optimum speed."); *Snapdragon 429 Mobile Platform*, QUALCOMM WEBSITE (last visited September 2019), *available at*: https://www.qualcomm.com/products/snapdragon-429-mobile-platform ("GPU Name: Qualcomm® Adreno™ 504 GPU").

use and testing in the United States, directly infringing one or more claims of the ’109 patent.

294. Qualcomm has induced and continues to induce and contribute to infringement of the ‘109 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the ‘109 patent, including, but not limited to, the Qualcomm ‘109 Products. Qualcomm provides these Qualcomm ‘109 Products to others, such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the ‘109 patent.

295. One or more Qualcomm subsidiaries and/or affiliates use the Qualcomm ’109 Products in regular business operations.

296. The Qualcomm ’109 Products are available to businesses and individuals throughout the United States.

297. The Qualcomm ’109 Products are provided to businesses and individuals located in the State of Delaware.

LENOVO INFRINGES THE ‘109 PATENT

298. Lenovo designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for motion-compensated interpolation of a data-signal comprising successive images wherein each image comprises groups of pixels.

299. Lenovo has directly infringed and continues to directly infringe the ’109 patent by making, using, selling, offering for sale, or importing into the United States products and/or methods covered by one or more claims of the ‘109 patent. Lenovo products that infringe one or more claims of the ‘109 patent include, but are not limited to, the following Lenovo products: Motorola Moto Z, Motorola Moto Z Force, Motorola Moto Z Play, Motorola Moto Z2 Force Edition, Motorola Moto Z2 Play, Motorola Moto Z3, Motorola Moto Z3 Play, Motorola One,

Motorola One Power, Lenovo Yoga C630 13" Laptop, Lenovo Tab M10, Lenovo Smart Tab M10 (HD), Lenovo Tab 4 10 Plus, Lenovo Smart Tab M10 , and the Lenovo Smart Tab P10 (collectively, the "Lenovo '109 Products").

300. The Lenovo '109 Products contain functionality for processing video data in compliance with the H.265 standard. The below excerpt from documentation of the infringing devices shows support for the infringing functionality.

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3, MIDI,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Microphones
4 far-field mic system

Headphone jack
USB-C to 3.5mm converter included

Motorola Z3 Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019) (annotation added) ("Video playback - MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K.").

audio + video
Speakers
Front port loud speaker

Audio playback
AAC, AAC+, Enhanced AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, FLAC, MP3,

Audio format
AOSP Codecs: AAC, AAC+, AAC ELD (Enhanced Low Delay), MAR-NB, AMR-WB, PCM/WAVE

Video playback
MPEG4, H.263, H.264, H.265, VP8, VP8

Video format
H.263, H.264, VP8 -- H.265 (HVC encode), 4K

Motorola Moto Z3 Play Specifications, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019) (annotation added) ("Video playback

- MPEG4, H.263, H.264, H.265, VP8, VP8 . . . Video format - H.263, H.264, VP8 -- H.265 (HVC encode), 4K").

301. Exemplar documentation from Qualcomm establishes that the accused Lenovo '109 Products contain functionality for decoding video in a manner that infringes the '109 patent.

Video applications performance	
Encode	1080p120/4K30/4x 1080p30: H.264, VP8, HEVC
Decode	1080p240/4K60/8x 1080p30: H.264, VP8, HEVC 8/10-bit, VP9
Concurrency	4K60 decode + 4K30 encode 4K60 decode + 1080p60 encode
Graphics	Adreno 530 3D graphics accelerator with 64-bit addressing 624 MHz OpenGL ES 3.0/3.1/GEP, GL4.4, DX11.3/4, Path Rendering OpenCL 2.0 Full, Renderscript-Next

SM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P (February 9, 2016), ***available at***: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019) (emphasis added).

302. Source code for the Lenovo '109 Products shows that they support the infringing functionality as shown in the below excerpt from the source code for the MMI-PPW29.131-27-1 image. The source code excerpted is made available via Lenovo through its GitHub repository. *See* MOTOROLA MOBILITY LLC GITHUB REPOSITORY (last visited September 2019), ***available at***: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208.

```
enum vdec_codec {
        VDEC_CODECTYPE_H264 = 0x1,
        VDEC_CODECTYPE_H263 = 0x2,
        VDEC_CODECTYPE_MPEG4 = 0x3,
        VDEC_CODECTYPE_DIVX_3 = 0x4,
        VDEC_CODECTYPE_DIVX_4 = 0x5,
        VDEC_CODECTYPE_DIVX_5 = 0x6,
        VDEC_CODECTYPE_DIVX_6 = 0x7,
        VDEC_CODECTYPE_XVID = 0x8,
        VDEC_CODECTYPE_MPEG1 = 0x9,
        VDEC_CODECTYPE_MPEG2 = 0xa,
        VDEC_CODECTYPE_VC1 = 0xb,
        VDEC_CODECTYPE_VC1_RCV = 0xc,
        VDEC_CODECTYPE_HEVC = 0xd,
        VDEC_CODECTYPE_MVC = 0xe,
        VDEC_CODECTYPE_VP8 = 0xf,
        VDEC_CODECTYPE_VP9 = 0x10,
};
```

msm_vidc_dec.h, MOTOROLA MMI-PPW29.131-27-1 IMAGE (last accessed September 2019), *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/ (annotations added).

303. The Lenovo ‘109 Products all contain functionality for performing the decoding of video content using a Qualcomm processor. *See e.g.*, Motorola Moto Z (containing a Qualcomm Snapdragon 820 processor), Motorola Moto Z Force (containing a Qualcomm Snapdragon 820 processor), Motorola Moto Z Play (containing a Qualcomm Snapdragon 625 processor), Motorola Moto Z2 Force Edition (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z2 Play (containing a Qualcomm Snapdragon 626 processor), Motorola Moto Z3 (containing a Qualcomm Snapdragon 835 processor), Motorola Moto Z3 Play (containing a Qualcomm Snapdragon 636 processor), Motorola One (containing a Qualcomm Snapdragon 625 processor), Lenovo Yoga C630 13" Laptop (containing a Qualcomm Snapdragon 850 processor), Lenovo Tab M10 (containing a Qualcomm Snapdragon 429 processor), Lenovo Smart Tab M10 (HD) (containing a Qualcomm Snapdragon 450 processor), Lenovo Tab 4 10 Plus (containing a Qualcomm Snapdragon 625 processor), Lenovo Smart Tab M10 (containing a Qualcomm Snapdragon 450 processor), and the Lenovo Smart Tab P10 (containing a Qualcomm Snapdragon 450 processor).

304. Lenovo makes, uses, sells, offers for sale, or imports into the United States the Lenovo ‘109 Products and thus directly infringes at least one or more claims of the ’109 patent. Upon information and belief, Lenovo also uses the Lenovo ‘109 Products via its internal use and testing in the United States, directly infringing one or more claims of the ’109 patent.

305. Lenovo has induced and continues to induce and contribute to infringement of the ‘109 patent by intending that others make, use, import into, offer for sale, or sell in the United States, products and/or methods covered by one or more claims of the ‘109 patent, including, but not limited to, the Lenovo ‘109 Products. Lenovo provides these Lenovo ‘109 Products to others,

such as manufacturers, customers, resellers, and end-use consumers who, in turn, use, offer for sale, or sell in the United States these products that infringe one or more claims of the ‘109 patent.

306. One or more Lenovo subsidiaries and/or affiliates use the Lenovo ’109 Products in regular business operations.

307. The Lenovo ’109 Products are available to businesses and individuals throughout the United States.

308. The Lenovo ’109 Products are provided to businesses and individuals located in the State of Delaware.

INFRINGEMENT OF THE ‘109 PATENT

309. The Qualcomm ‘109 Products and Lenovo ‘109 Products (collectively, the “Qualcomm-Lenovo ‘109 Products”) contain functionality for motion-compensated interpolation of a data-signal. Specifically, the Qualcomm-Lenovo ‘109 Products process motion data associated with motion compensation. The motion data processed by the Qualcomm-Lenovo ‘109 Products include a first estimated motion vector of pixels within a reference frame prior to the current frame and a second estimated motion vector within the reference field after the current field. The Qualcomm-Lenovo ‘109 Products generate motion data in the form of a bi-directional prediction unit (PU) which has two motion vectors (referencing a prior frame and a subsequent frame in the sequence). The two motion vectors are combined to make a “bi-predictive merge candidate.” One of the motion vectors is obtained from “reference picture list0” and the other motion vector is obtained from “reference picture list1.”

8.5.3.3.2 Reference picture selection process

Input to this process is a reference index refIdxLX.

Output of this process is a reference picture consisting of a two-dimensional array of luma samples $refPicLX_L$ and, when ChromaArrayType is not equal to 0, two two-dimensional arrays of chroma samples $refPicLX_{Cb}$ and $refPicLX_{Cr}$.

The output reference picture RefPicListX[refIdxLX] consists of a pic_width_in_luma_samples by pic_height_in_luma_samples array of luma samples $refPicLX_L$ and, when ChromaArrayType is not equal to 0, two PicWidthInSamplesC by PicHeightInSamplesC arrays of chroma samples $refPicLX_{Cb}$ and $refPicLX_{Cr}$.

The reference picture sample arrays $refPicLX_L$, $refPicLX_{Cb}$ and $refPicLX_{Cr}$ correspond to decoded sample arrays S_L, S_{Cb} and S_{Cr} derived in clause 8.7 for a previously-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 § I.8.5.3.3 (February 2018).

310. The reference pictures that are used by the Qualcomm-Lenovo '109 Products to generate a motion vector comprise both the forward and prior reference pictures which are referred to in the HEVC encoding process implemented by the Qualcomm-Lenovo '109 Products as "refPicLXcb" and "refPicLXcr." The following excerpt describes the implementation of the encoding process in the Qualcomm-Lenovo '109 Products, which use bi-predictive slices.

> Since a merge candidate comprises all motion data and the TMVP is only one motion vector, the derivation of the whole motion data only depends on the slice type. For bi-predictive slices, a TMVP is derived for each reference picture list. Depending on the availability of the TMVP for each list, the prediction type is set to bi-prediction or to the list for which the TMVP is available. All associated reference picture indices are set equal to zero. Consequently for uni-predictive slices, only the TMVP for list 0 is derived together with the reference picture index equal to zero.

Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 123 (September 2014) (emphasis added) (describing the use of bi-prediction in which motion data is derived from the forward and prior reference pictures in generating temporal arrays/vectors).

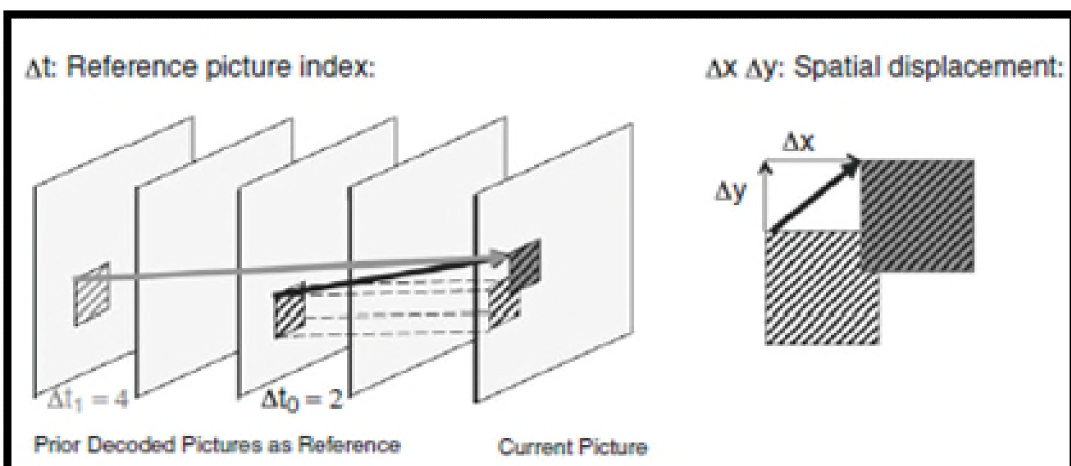
311. The Qualcomm-Lenovo '109 Products' interpolation process contain bi-prediction functionality that computes a first estimated motion prediction and a second estimated motion prediction. The below excerpt from documentation of the encoding method used by the Qualcomm-Lenovo '109 Products describes that the encoding process includes functionality for

generating a second intensity estimate for the pixel data and the edge data determined according to motion. In bi-prediction, the second estimate is defined as Δx_1, Δy_1, Δt_1.

> In case of bi-prediction, two sets of motion data ($\Delta x_0, \Delta y_0, \Delta t_0$ and $\Delta x_1, \Delta y_1, \Delta t_1$) are used to generate two MCPs (possibly from different pictures), which are then combined to get the final MCP. Per default, this is done by averaging but in case of weighted prediction, different weights can be applied to each MCP, e.g. to compensate for scene fade outs. The reference pictures that can be used in bi-prediction are stored in two separate lists, namely list 0 and list 1. In order to limit the memory bandwidth in slices allowing bi-prediction, the HEVC standard restricts PUs with 4×8 and 8×4 luma prediction blocks to use uni-prediction only. Motion data is derived at the encoder using a motion estimation process. Motion

Id. at 114 (emphasis added).

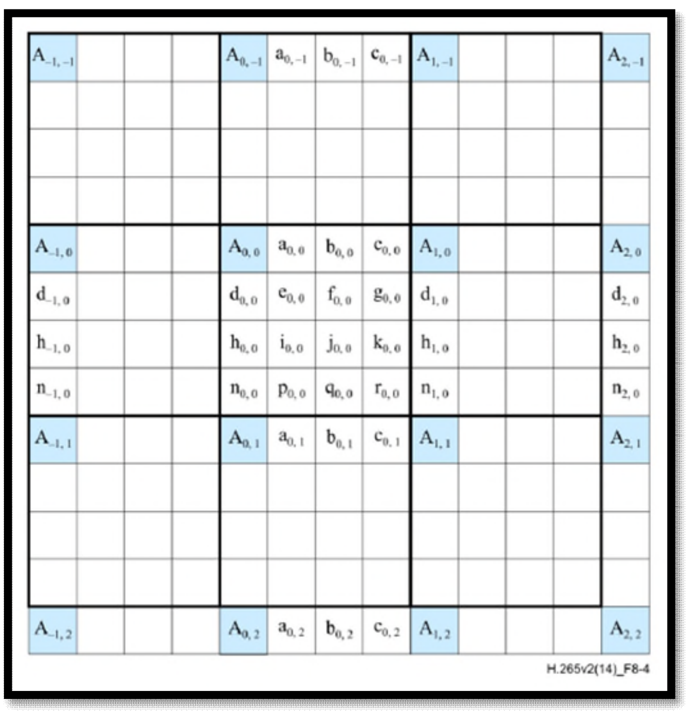
312. The Qualcomm-Lenovo '109 Products generate motion vectors that correspond to a group of pixels of a first image, between a group of pixels of the first image, and a second group of pixels of another image in the data signal. The image data processed by the Qualcomm-Lenovo '109 Products is encoded 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. The general concept of inter-frame-based encoding using motion-compensated prediction based on a translational motion model is illustrated below.



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

313. The Qualcomm-Lenovo '109 Products generate interpolated results as a function of the motion vectors that correspond to the groups of pixels in a first and second image. Specifically, during the decoding process correlation values are calculated as part of interpolating vectors. The interpolated luma sample value is calculated based on a "luma location in full-sample units (xIntL, yIntL)" "a luma location in fractional-sample units (xFracL, yFracL), and a "luma reference sample array refPicLXL."

314. The following figure shows how interpolated results are generated based on the values of neighboring prediction units. The below figure in the shaded blocks with upper-case letters shows the integer samples (whole pixels) and the un-shaded blocks with lower-case letter show the fraction sample position for quarter luma interpretation.



Series H: Audio Visual and Multimedia Systems: Infrastructure of Audiovisual Services – Coding of Moving Video, HIGH EFFICIENCY VIDEO CODING ITU-T REC. V.5 § 8.5.3.3.2 (February 2018).

315. The following excerpt from the HEVC specification shows how in generating interpolated results a luma motion vector mvLX is used.

Inputs to this process are:

- a luma location (xCb, yCb) specifying the top-left sample of the current luma coding block relative to the top-left luma sample of the current picture
- a luma location (xBl, yBl) specifying the top-left sample of the current luma prediction block relative to the top-left sample of the current luma coding block
- two variables nPbW and nPbH specifying the width and the height of the luma prediction block
- a luma motion vector mvLX given in quarter-luma-sample units

Series H: Audio Visual and Multimedia Systems: Infrastructure of Audiovisual Services – Coding of Moving Video, HIGH EFFICIENCY VIDEO CODING ITU-T REC. V.5 § 8.5.3.3.3.1 (February 2018).

316. The Qualcomm-Lenovo '109 Products contain functionality for estimating the reliabity of each motion vector that corresponds to a group of pixels. For example, the variables predFlagL0 and predFlagL1 are reliability values that are generated by the decoding process. The predFlagL0 and L1 values are prediction utilization values that are used to generate prediction utilization and reliability of the vectors.

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).

317. As shown in the excepted document below, the reliability value for the motion vectors is used and the weight given to a a motion vector is a factor of this reliability value.

> Inputs to this process are:
>
> – two variables nPbW and nPbH specifying the width and the height of the current prediction block,
> – two (nPbW)x(nPbH) arrays predSamplesL0 and predSamplesL1,
> – the prediction list utilization flags, predFlagL0 and predFlagL1,
> – the reference indices refIdxL0 and refIdxL1,
> – a variable cIdx specifying colour component index.
>
> Output of this process is the (nPbW)x(nPbH) array pbSamples of prediction sample values.
>
> **Reliability Value Used In The Intensity-Calculation Procedure**

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.3.4.1 (February 2018) (annotation added).

318. The Qualcomm-Lenovo ‘109 Products calculate weights as a function of the reliability value of motion vectors.

> The prediction samples inside the current luma prediction block, $predSamples_L[x_L + xBl][y_L + yBl]$ with $x_L = 0..nPbW - 1$ and $y_L = 0..nPbH - 1$, are derived by invoking the weighted sample prediction process specified in clause 8.5.3.3.4 with the prediction block width nPbW, the prediction block height nPbH and the sample arrays $predSamplesL0_L$ and $predSamplesL1_L$, and the variables predFlagL0, predFlagL1, refIdxL0, refIdxL1 and cIdx equal to 0 as inputs.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.3.1 (February 2018) (emphasis added).

319. The Qualcomm-Lenovo ‘109 Products generate an interpolated luminous intensity of a group of pixels for an interpolated image by calculating, on the basis of weights (which are a function of the reliability value of a motion vector), a weighted average of the interpolated results. For example, in weighted sample prediction, a multiplicative weighting factor that generates a final motion data for a pixel (including the interpolated intensity of the pixel) by blending a first intensity estimate and second intensity estimate. The intensity estimates are variables that include for Luma values the LumaWeightL0, LumaWeightL1, luma_offsetl0, and luma_offset_l1. For Chroma values the intensity estimates include ChromaWeightL0, ChromaWeightL1,

chromaoffsetL0, and chromaoffsetL1. The derivation of these variables is identified in the below excerpt from the HEVC specification.

The variables log2Wd, o0, o1, w0 and w1 are derived as follows:

– If cIdx is equal to 0 for luma samples, the following applies:

log2Wd = luma_log2_weight_denom + shift1 (8-267)

w0 = LumaWeightL0[refIdxL0] (8-268)

w1 = LumaWeightL1[refIdxL1] (8-269)

o0 = luma_offset_l0[refIdxL0] << WpOffsetBdShift_Y (8-270)

o1 = luma_offset_l1[refIdxL1] << WpOffsetBdShift_Y (8-271)

– Otherwise (cIdx is not equal to 0 for chroma samples), the following applies:

log2Wd = ChromaLog2WeightDenom + shift1 (8-272)

w0 = ChromaWeightL0[refIdxL0][cIdx − 1] (8-273)

w1 = ChromaWeightL1[refIdxL1][cIdx − 1] (8-274)

o0 = ChromaOffsetL0[refIdxL0][cIdx − 1] << WpOffsetBdShift_C (8-275)

o1 = ChromaOffsetL1[refIdxL1][cIdx − 1] << WpOffsetBdShift_C (8-276)

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.3.4.3 (February 2018) (emphasis added).

320. By complying with the HEVC standard, the Qualcomm-Lenovo '109 Products necessarily infringe the '109 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '109 patent, including but not limited to claim 1 of the '109 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 Qualcomm and Lenovo's infringement of the '109 patent: "8.5.3.3.3 Fractional sample interpolation process," "8.5.3.3.3.2 Luma sample interpolation process," "8.5.3.3.4 Weighted sample prediction process," "8.5.3.3.4.2 Default weighted sample prediction process," "F.7.3.6.3 Weighted prediction parameters syntax," "F.7.4.7.3 Weighted prediction parameters semantics," "I.8.5.3.3 Decoding

process for inter prediction samples," "8.3.2 Decoding process for reference picture set;" "8.5.2 Inter prediction process;" and "8.5.3 Decoding process for prediction units in inter prediction mode.").

321. The Qualcomm-Lenovo '109 Products perform a method that includes deriving first and second vectors from said sub-pixel accurate motion vectors.

322. The Qualcomm-Lenovo '109 Products perform a method that includes generating an intermediate image by combining first positions in a first image shifted over first vectors and second positions in said second image shifted over second vectors.

323. The Qualcomm-Lenovo '109 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by multiplying the vector components of the sub-pixel accurate motion vectors by a fraction to obtain fractional vector components.

324. The Qualcomm-Lenovo '109 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by rounding the fractional vector components to obtain vector components of the first vectors, which have only integer vector components.

325. The Qualcomm-Lenovo '109 Products perform a method that includes deriving first and second vectors from sub-pixel accurate motion vectors by subtracting the first vector from the candidate vector to obtain the second vector, whereby the second vectors have vector components that, depending on the candidate vector and the fraction, may have non-integer values.

326. By making, using, testing, offering for sale, and/or selling products and services for sub-pixel accurate motion vector estimation and motion-compensated interpolation or prediction, including but not limited to the Qualcomm-Lenovo '109 Products, Qualcomm and Lenovo have

injured Dynamic Data and are liable to the Plaintiff for directly infringing one or more claims of the ‘109 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

327. Qualcomm and Lenovo also indirectly infringe the ‘109 patent by actively inducing infringement under 35 U.S.C. § 271(b).

328. Qualcomm has had knowledge of the ‘109 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Qualcomm knew of the ‘109 patent and knew of its infringement, including by way of this lawsuit.

329. Alternatively, Qualcomm has had knowledge of the ‘109 patent since at least June 25, 2009 based on Qualcomm’s citation of the ‘109 patent family as relevant prior art in Qualcomm’s own published patent applications issued patents.

- U.S. Patent No. 8,265,158 granted on September 11, 2012 and assigned to Qualcomm.
- U.S. Patent No. 8,537,283 granted on September 17, 2017 and assigned to Qualcomm.
- U.S. Patent No. 8,649,437 granted on February 11, 2014 and assigned to Qualcomm.
- U.S. Patent Application No. US20090161010 published on June 25, 2009 and assigned to Qualcomm.
- U.S. Patent Application No. US20090161763 published on June 25, 2009 and assigned to Qualcomm.

330. Qualcomm intended to induce patent infringement by third-party customers and users of the Qualcomm ’109 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. Qualcomm specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘109 patent. Qualcomm performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘109 patent and with the knowledge that the induced acts would constitute infringement. For example, Qualcomm provides the Qualcomm ’109 Products that have the capability of operating

in a manner that infringe one or more of the claims of the '109 patent, including at least claim 1, and Qualcomm further provides documentation and training materials that cause customers and end users of the Qualcomm '109 Products to utilize the products in a manner that directly infringe one or more claims of the '109 patent.[164] By providing instruction and training to customers and end-users on how to use the Qualcomm '109 Products in a manner that directly infringes one or more claims of the '109 patent, including at least claim 1, Qualcomm specifically intended to induce infringement of the '109 patent. Qualcomm engaged in such inducement to promote the sales of the Qualcomm '109 Products, e.g., through Qualcomm user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '109 patent. Accordingly, Qualcomm 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 '109 patent, knowing that such use constitutes infringement of the '109 patent.

331. Lenovo has had knowledge of the '109 patent since at least service of this Complaint or shortly thereafter, and on information and belief, Lenovo knew of the '109 patent and knew of its infringement, including by way of this lawsuit.

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[164] *See, e.g.*, *MSM8996/APQ8096/MSM8996SG/APQ8096SG Device Specification*, QUALCOMM DOCUMENT NO. 80-NT204-1 REV. P at 17 (February 9, 2016), *available at*: https://osch.oss-cn-shanghai.aliyuncs.com/blogContentFile/1562660229092.pdf (last visited September 2019); *Qualcomm Snapdragon 855+ Mobile Platform Product Specification*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-855-plus-mobile-platform (last visited September 2019); *Qualcomm High Efficiency Video Coding (HEVC) Video Encoder*, USER MANUAL (July 11, 2017); *Snapdragon 850 Mobile Compute Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-850-mobile-compute-platform (last visited September 2019); *Snapdragon 710 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon-710-mobile-platform (last visited September 2019); *Snapdragon 653 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/products/snapdragon/processors/653 (last visited September 2019); *Snapdragon 212 Mobile Platform*, QUALCOMM WEBSITE, *available at*: https://www.qualcomm.com/snapdragon/processors/212 (last visited September 2019).

332. Lenovo intended to induce patent infringement by third-party customers and users of the Lenovo ’109 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. Lenovo specifically intended and was aware that the normal and customary use of the Lenovo ‘109 Products would infringe the ‘109 patent. Lenovo performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘109 patent and with the knowledge that the induced acts would constitute infringement. For example, Lenovo provides the Lenovo ’109 Products that have the capability of operating in a manner that infringe one or more of the claims of the ‘109 patent, including at least claim 1, and Lenovo further provides documentation and training materials that cause customers and end users of the Lenovo ’109 Products to utilize the products in a manner that directly infringe one or more claims of the ‘109 patent.[165] By providing instruction and training to customers and end-users on how to use the Lenovo ’109 Products in a manner that directly infringes one or more claims of the ‘109 patent, including at least claim 1, Lenovo specifically intended to induce infringement of the ‘109 patent. Lenovo engaged in such inducement to promote the sales of the Lenovo ’109 Products, e.g., through Lenovo user manuals, product support, marketing materials, and training materials to

[165] *See, e.g.*, *Motorola Z3 Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/documents/MS132417/ (last visited September 2019); *Motorola Moto Z3 Play Specifications*, MOTOROLA SUPPORT WEBSITE, *available at*: https://support.motorola.com/us/en/products/cell-phones/moto-z-family/moto-z3-play/documents/MS130460/ (last visited September 2019); MOTOROLA MOBILITY LLC GITHUB REPOSITORY, *available at*: https://github.com/MotorolaMobilityLLC/kernel-msm/issues/208 ((last visited September 2019); *Lenovo Knowledge Base*, LENOVO WEBSITE, *available at*: https://forums.lenovo.com/t5/English-Community/tkbc-p/Community-EN (last visited September 2019); *Lenovo Tab M10 Platform Specfication,* LENOVO DOCUMENATION (August 2019); *Lenovo Tab P10 Platform Specifications*, LENOVO DOCUMENTATION (June 2019); *Lenovo Open Source Code - Tab P10 / Smart Tab 10 Tablet (TB-X705L*), LENOVO SUPPORT WEBSITE, *available at*: https://support.lenovo.com/us/en/downloads/ds506313 (code released January 31, 2019).

actively induce the users of the Lenovo ’109 Products to infringe the ‘109 patent. Accordingly, Lenovo 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 ‘109 patent, knowing that such use constitutes infringement of the ‘109 patent.

333. The ‘109 patent is well-known within the industry as demonstrated by multiple citations to the ‘109 patent in published patents and patent applications assigned to large technology companies and prominent academic institutions.

334. Qualcomm and Lenovo are utilizing the technology claimed in the ‘109 patent without paying a reasonable royalty. Qualcomm and Lenovo are infringing the ‘109 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

335. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the ‘109 patent. As a result of Qualcomm and Lenovo’s infringement of the ‘109 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Qualcomm and Lenovo’s infringement, but in no event less than a reasonable royalty for the use made of the invention by Qualcomm and Lenovo 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 Defendants Qualcomm and Lenovo have infringed, either literally and/or under the doctrine of equivalents, the ‘944, ‘376, ‘054, ‘227, and ‘109 patents;

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

C. A judgment and order finding that Defenndants’ 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 Defendants.

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.

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