UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

DYNAMIC DATA TECHNOLOGIES, LLC, ***Plaintiff,*** v. **SAMSUNG ELECTRONICS CO., LTD.,** **SAMSUNG ELECTRONICS AMERICA, INC.,** ***Defendants.***	**Civil Action No. 2:18-CV-00459-RWS** **JURY TRIAL DEMANDED**

FIRST AMENDED COMPLAINT FOR PATENT INFRINGEMENT

Dynamic Data Technologies, LLC ("Dynamic Data") bring this action and make the following allegations of patent infringement relating to U.S. Patent Nos.: 8,189,105 (the "'105 patent"); 8,135,073 (the "'073 patent"); 6,774,918 (the "'918 patent"); 8,184,689 (the "'689 patent"); 6,996,177 (the "'177 patent"); 8,311,112 (the "'112 patent"); 7,894,529 (the "'529 patent"); 7,519,230 (the "'230 patent"); 7,542,041 (the "'041 patent"); 7,571,450 (the "'450 patent"); 7,750,979 (the "'979 patent"); 7,532,216 (the "'216 patent"); 8,385,426 (the "'426 patent"); 7,982,799 (the "'799 patent"); and 8,073,054 (the "'054 patent"); (collectively, the "patents-in-suit"). Defendants Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, "Samsung" or "Defendant") infringes each of the patents-in-suit in violation of the patent laws of the United States of America, 35 U.S.C. § 1 *et seq*.

INTRODUCTION

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

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

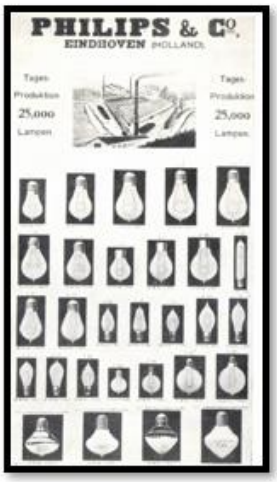
DYNAMIC DATA'S LANDMARK INVENTIONS

3. The groundbreaking inventions in image and video processing taught in the patents-in-suit were pioneered by Philips. Video and image processing were at the heart of Philips' business for over fifty years. In 1891, Philips, then known as Philips & Company, was founded in Eindhoven, Netherlands to manufacture carbon-filament lamps.[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).

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

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.

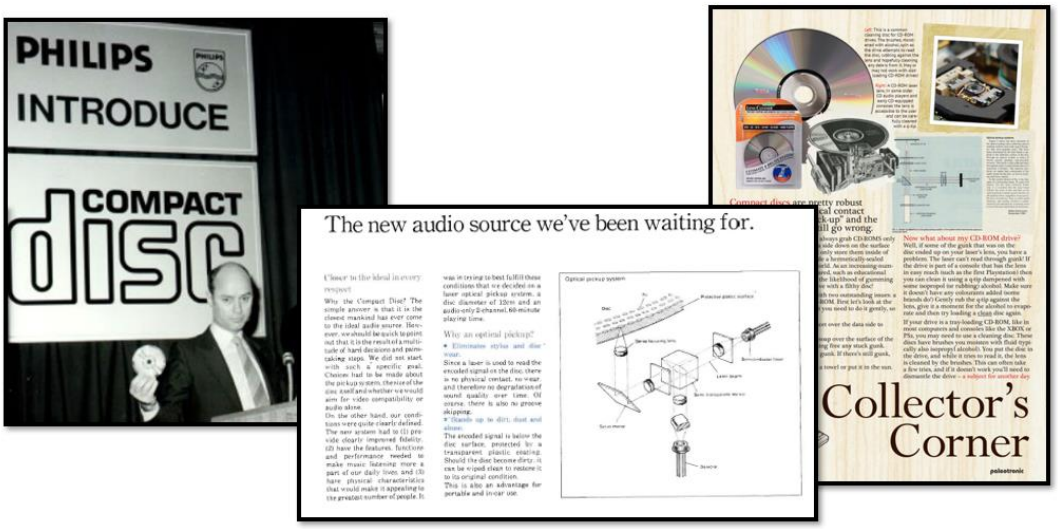


THE ROTARIAN MAGAZINE, Vol. 101 No. 6 at 70 (December 1962) (advertisement showing Philips Norelco device which used cassettes for recording audio for transcription); Fred Chandler, *European Mfrs. Bid For Market Share*, BILLBOARD MAGAZINE AT P-6 (April 8, 1967) (image of the Philips EL 3300 battery-operated 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.

[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).



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's patent portfolio includes over 1,200 patent assets, with over 470 issued patents granted by patent offices around the world. Dynamic Data owns numerous patents issued by the United States Patent and Trademark Office, including each of the patents-in-suit, The State Intellectual Property Office of the People's Republic of China,[7] the European Patent Office,[8] the German Patent and Trademark Office,[9] the Japan Patent Office,[10] and many other national patent offices.

---

[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.*, CN100504925C; CN100438609C; CN1679052B; CN1333373C; CN1329870C; CN1303818C.

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

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

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

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. Dynamic Data is the owner by assignment of over 1,000 of these patent assets, which include over 400 patents issued by patent offices around the world.

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

- ***Samsung Electronics Co., Ltd***.[11]
- Qualcomm Inc.[12]
- Google LLC[13]
- Intel Corporation[14]
- Broadcom Corporation[15]
- Microsoft Corporation[16]
- Sony Corporation[17]
- Fujitsu Ltd.[18]
- Panasonic Corporation[19]
- Matsushita Electric Industrial Company Limited[20]

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

[12] *See, e.g.*, U.S. Patent Nos. 7,840,085; 8,649,437; 8,750,387; 8,918,533; 9,185,439; 9,209,934; 9,281,847; 9,319,448; 9,419,749; 9,843,844; 9,917,874; and 9,877,033.

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

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

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

[16] *See, e.g.*, U.S. Patent Nos. 7,453,939; 7,670,227; 7,408,986; 7,421,129; 7,558,320; and 7,929,599.

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

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

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

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

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 along with the several hundred additional issued United States and international Patents.

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

SAMSUNG

15. On information and belief, Samsung Electronics Co. Ltd. ("SEC"), is a corporation organized under the laws of Korea, with its principal place of business located at 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonngi-do 443-742, Republic of Korea.

16. On information and belief, Samsung Electronics America, Inc. ("SEA") is a corporation organized under the laws of the State of New York with its principal place of business at 85 Challenger Road, Ridgefield Park, New Jersey 07660. SEA may be served by serving its registered agent CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201-3136.

17. SEA is a wholly-owned subsidiary of SEC. SEA and SEC are collectively referred to herein as "Samsung."

18. On information and belief, Samsung conducts business operations within the Eastern District of Texas in its facilities at 1301 East Lookout Drive, Richardson, Texas 75080 and 1000 Klein Road, Plano, Texas 75074.

JURISDICTION AND VENUE

19. 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).

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

21. Venue is proper in this district under 28 U.S.C. §§ 1391(b)-(d) and 1400(b). Defendant Samsung is registered to do business in the State of Texas, has offices in the State of Texas, and upon information and belief, has transacted business in the Eastern District of Texas and has committed acts of direct and indirect infringement in the Eastern District of Texas. Samsung maintains a regular and established place of business within the Eastern District of Texas at 1301 East Lookout Drive, Richardson, Texas 75080 and 1000 Klein Road, Plano, Texas 75074.

THE ASSERTED PATENTS

U.S. PATENT NO. 8,189,105

22. U.S. Patent No. 8,189,105 entitled, *Systems and Methods of Motion and Edge Adaptive Processing Including Motion Compensation Features*, was filed on October 17, 2007.

The ‘105 Patent is subject to a 35 U.S.C. § 154(b) term extension of 1258 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ’105 Patent. A true and correct copy of the ’105 Patent is attached hereto as Exhibit 1.

23. The ‘105 patent discloses novel systems and methods for processing pixel information based on received motion and edge data.

24. The ‘105 patent further discloses the use of a blending component (implemented by hardware, software, firmware, combinations thereof, etc.) that implements interpolating intensity of the pixel to equal to the first intensity estimate if motion reliability data is below a threshold.

25. The ‘105 patent in one embodiment teaches using segmentation to average four contiguous pixels into one averaged pixel segment during motion detection.

26. The ’105 Patent and its underlying patent applications and foreign counterparts have been cited by 46 patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ’105 Patent and its underlying patent application as relevant prior art:

- Flextronics Ap, LLC
- Qingdao Hisense Electronics Co., Ltd.
- Hon Hai Precision Industry Co., Ltd.
- Intel Corporation
- Sony Corporation
- Fujitsu Corporation
- Himax Media Solutions, Inc.
- Ati Technologies Ulc
- Sharp Kabushiki Kaisha
- Xerox Corporation

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

27. U.S. Patent No. 8,135,073 (the “’073 patent”) entitled, *Enhancing Video Images Depending On Prior Image Enhancements*, was filed on December 12, 2003, and claims priority

to December 19, 2002. The ‘073 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,799 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘073 patent. A true and correct copy of the ‘073 patent is attached hereto as Exhibit 2.

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

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

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

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

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

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

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

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

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

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

36. U.S. Patent No. 6,774,918 (“the ‘918 patent”) entitled, *Video Overlay Processor with Reduced Memory And Bus Performance Requirements*, was filed on June 28, 2000. The ‘918 patent is subject to a 35 U.S.C. § 154(b) term extension of 591 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘918 patent. A true and correct copy of the ‘918 patent is attached hereto as Exhibit 3.

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

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

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

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

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

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

43. The ‘918 patent claims a technical solution to a problem unique to video processing.

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

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

45. U.S. Patent No. 8,184,689 (the “’689 patent”) entitled, *Method Video Encoding And Decoding Preserving Cache Localities*, was filed on August 7, 2006, and claims priority to August

17, 2005. The '689 patent is subject to a 35 U.S.C. § 154(b) term extension of 948 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '689 patent. A true and correct copy of the '689 patent is attached hereto as Exhibit 4.

46. The '689 patent discloses novel methods and apparatuses for encoding and decoding video data.

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

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

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

50. The '689 patent discloses a method for encoding and decoding a video stream comprising simultaneous encoding/decoding of more than one image of the video stream, by accessing said subset, wherein the simultaneously encoding/decoding is performed by access sharing to at least one image.

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

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

52. U.S. Patent No. 6,996,177 (the "'177 patent") entitled, *Motion Estimation*, was filed on July 24, 2000, and claims priority to August 22, 1999. The '177 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,103 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '177 patent. A true and correct copy of the '177 patent is attached hereto as Exhibit 5.

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

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

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

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

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

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

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

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

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

60. U.S. Patent No. 8,311,112 (the “’112 patent”) entitled, *System And Method For Video Compression Using Predictive Coding*, was filed on December 31, 2008. The ‘112 patent is subject to a 35 U.S.C. § 154(b) term extension of 847 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘112 patent. A true and correct copy of the ‘112 patent is attached hereto as Exhibit 6.

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

62. The ‘112 patent discloses novel technologies for video compression that perform predictive coding on a macroblock of a video frame such that a set of pixels of the macroblock is coded using some of the pixels from the same video frame as reference pixels and the rest of the macroblock is coded using reference pixels from at least one other video frame.

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

64. The ‘112 patent discloses a system for video compression comprising an inter-frame coding unit configured to perform predictive coding on the rest of the macroblock of pixels

using a second group of reference pixels, the second group of reference pixels being from at least one other video frame.

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

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

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

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

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

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

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

70. The ‘529 patent discloses a method wherein an image is subdivided into a number of image blocks, and a motion estimation technique is implemented to assign at least one motion

vector to each of the image blocks where a modified motion vector is generated for at least a first image block.

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

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

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

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

U.S. PATENT NO. 7,519,230

75. U.S. Patent No. 7,519,230 (the “‘230 patent”) entitled, *Background Motion Vector Detection*, was filed on December 16, 2003, and claims priority to January 23, 2003. The ‘230 patent is subject to a 35 U.S.C. § 154(b) term extension of 685 days. Dynamic Data is the owner of all right, title, and interest in the ‘230 patent. A true and correct copy of the ‘230 patent is attached hereto as Exhibit 8.

76. The ‘230 patent claims specific methods and systems to select a background motion vector for a pixel in an occlusion region of an image.

77. The ‘230 patent discloses systems and methods determine the correct motion vector in occlusion regions, thereby reducing or eliminating artifacts of motion compensated image rate converters, which are referred to as “halos” in the display of video images.

78. The ‘230 patent claims a method of selecting a background motion vector for a pixel in an occlusion region of an image comprising computing a model-based motion vector for the pixel on basis of a motion model being determined on basis of a part of a motion vector field of the image.

79. The ‘230 patent claims a method of selecting a background motion vector for a pixel in an occlusion region of an image comprising comparing the model-based motion vector with each of the motion vectors of the set of motion vectors.

80. The ‘230 patent claims a method of selecting a background motion vector for a pixel in an occlusion region of an image comprising selecting a particular motion vector of the set of motion vectors on basis of the comparing and for assigning the particular motion vector as the background motion vector.

81. The ‘230 patent has been cited by 28 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘230 patent as relevant prior art:

- Sony Corporation
- Fujitsu Ltd.
- Motorola Solutions Inc.
- Nokia Oyj
- Qualcomm Inc.
- ***Samsung Electronics Co., Ltd***.
- Toshiba Corporation

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

82. U.S. Patent No. 7,542,041 (the “041 patent”) entitled, *Runtime Configurable Virtual Video Pipeline*, was filed on April 2, 2004, and claims priority to April 3, 2003. The ‘041 patent is subject to a 35 U.S.C. § 154(b) term extension of 288 days. Dynamic Data is the owner

by assignment of all right, title, and interest in the '041 patent. A true and correct copy of the '041 patent is attached hereto as Exhibit 9.

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

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

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

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

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

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

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

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

91. The '041 patent discloses, in one embodiment, a processing system wherein a plurality of auxiliary elements are within a selected pipeline of the multiple pipelines, between a

pair of core pipeline elements of the plurality of core pipeline elements to process the data as it traverses between the pair of core elements.

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

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

93. U.S. Patent No. 7,571,450 (the “’450 patent”) entitled, *System For And Method Of Displaying Information*, was filed on February 12, 2003, and claims priority to March 11, 2002. The ‘450 patent is subject to a 35 U.S.C. § 154(b) term extension of 846 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘450 patent. A true and correct copy of the ‘450 patent is attached hereto as Exhibit 10.

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

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

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

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

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

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

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

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

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

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

104. The ‘450 patent and its underlying patent application have been cited by several patents and patent applications as relevant prior art. Specifically, patents issued to AT&T Intellectual Property I LP, Nokia Oyj, ***Samsung Electronics Co., Ltd***., and ZTE Corporation have all cited the ‘450 patent and its underlying patent application as relevant prior art.

U.S. PATENT NO. 7,750,979

105. U.S. Patent No. 7,750,979 (the “’979 patent”) entitled, *Pixel-Data Line Buffer Approach Having Variable Sampling Patterns*, was filed on October 26, 2001. The ‘979 patent is subject to a 35 U.S.C. § 154(b) term extension of 2,749 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘979 patent. A true and correct copy of the ‘979 patent is attached hereto as Exhibit 11.

106. The ‘979 patent discloses novel methods and systems for motion compensation in video signal processing.

107. The ‘979 patent discloses methods and systems that use line buffers that are decoupled and that can deliver a fixed number of pixels, as may be required by a video processing stage, using a sampling pattern that is defined as one among several selectable sampling windows.

108. The ‘979 patent discloses a video processing circuit having an input stream of pixels corresponding to an array of video pixels.

109. The ‘979 patent further discloses having a variable window size for sampling subsets of the array as a two-dimensional window that spans the pixels in the array.

110. The ‘979 patent further discloses having a video processing stage that inputs pixels using a fixed number of pixels.

111. The ‘979 patent further discloses a method for delivering the input stream of pixels to the video processing stage.

112. The ‘979 patent further discloses a method comprising establishing a window size and a sampling-window size, such that the window size is a multiple of the sampling-window size and the sampling-window size defines the fixed number of pixels.

113. The ‘979 patent further discloses a method comprising storing pixels from the input stream into a first set of line butters, the pixels stored in the first set of line butters including pixels for the established window size.

114. The ‘979 patent further discloses a method comprising prefetching the stored pixels from the first set of line butters into a second set of line buffers, the second set of line buffers being sufficiently long to store at least the pixels corresponding to the established sampling-window size.

115. The ‘979 patent further discloses a method comprising fetching the fixed number of pixels from the second set of line buffers for the video processing stage.

U.S. PATENT NO. 7,532,216

116. U.S. Patent No. 7,532,216 (the “‘216 patent”) entitled, *Method Of Scaling A Graphic Character*, was filed on December 7, 2005, and claims priority to December 7, 2004. Dynamic Data is the owner of all right, title, and interest in the ‘216 patent. A true and correct copy of the ‘216 patent is attached hereto as Exhibit 12.

117. The ‘216 patent claims specific methods to scale alphanumeric characters.

118. The ‘216 patent discloses a method performed in a processer of scaling a graphic character defined by a character matrix with a number of character units that are indivisible at least in a horizontal direction or a vertical direction.

119. The ‘216 patent discloses a method of scaling alphanumeric characters that minimizes or avoids asymmetries in the display of enlarged characters.

120. The ‘216 patent claims a method of scaling alphanumeric characters performed in the processor comprising dividing the character matrix into a first character segment and at least one second character segment, each character segment including at least one of the character units.

121. The ‘216 patent claims a method of scaling alphanumeric characters performed in the processor comprising symmetrically scaling the first character segment using a first scaling factor.

122. The ‘216 patent claims a method of scaling alphanumeric characters performed in the processor comprising scaling within the processor the at least one second character segment using a second scaling factor different from the first scaling factor to provide a scaled character matrix, and filtering of the scaled character matrix to provide a filtered scaled character matrix.

123. The ‘216 patent has been cited by several patents and patent applications as relevant prior art. Specifically, patents issued to Microsoft Corporation, Siemens AG, Novatek Microelectronics Corp., and Arphic Tech Co., Ltd. have all cited the ‘216 patent as relevant prior art.

U.S. PATENT NO. 8,385,426

124. U.S. Patent No. 8,385,426 (the “‘426 patent”) entitled, *Method For A Mosaic Program Guide*, was filed on December 12, 2003, and claims priority to December 16, 2002. The ‘426 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,974 days. Dynamic Data is the owner of all right, title, and interest in the ‘426 patent. A true and correct copy of the ‘426 patent is attached hereto as Exhibit 13.

125. The ‘426 patent claims specific methods and systems to generate a mosaic program guide.

126. The ‘426 patent discloses methods and systems of providing mosaic program guides by generating I frames from a coded video bit stream, placing each I frame into mosaic windows, and combining the mosaic windows into a mosaic video frame.

127. The ‘426 patent discloses technology that enables providers of encoded video content to save significant resources by streamlining the process of presenting mosaic program guides.

128. The ‘426 patent claims a method of generating a mosaic program guide comprising generating I frames from a coded video bit stream by a video decoder of a receiver.

129. The ‘426 patent claims a method of generating a mosaic program guide comprising placing each I frame into one of a multiplicity of mosaic windows by the receiver.

130. The ‘426 patent claims a method of generating a mosaic program guide comprising combining in the receiver the multiplicity of mosaic windows into a mosaic video frame.

131. The ‘426 patent has been cited by 49 United States and international patents and patent applications as relevant prior art. Specifically, patents issued to the following companies have cited the ‘426 patent as relevant prior art:

- ActiveVideo Networks Inc.
- ARRIS Group Inc.
- Cox Communications Inc.
- Echostar Broadcasting Holding Corp.
- Google LLC
- DIVX LLC
- Huawei Technologies Co., Ltd.
- Konica Minolta Technology USA Inc.
- LG Electronics Inc.
- Panasonic Corp.
- Qualcomm Inc.
- ***Samsung Electronics Co., Ltd.***
- Sony Corp.
- Verizon Patent and Licensing Inc.

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

132. U.S. Patent No. 7,982,799 (the "'799 patent") entitled, *Method And Device For Interpolation Of An Image Information Value For Pixel Of An Interline,* was filed on December 29, 2006, and claims priority to December 30, 2005. The '799 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,233 days. Dynamic Data is the owner by assignment of all right, title, and interest in the '799 patent. A true and correct copy of the '799 patent is attached hereto as Exhibit 14.

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

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

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

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

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

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

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

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

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

141. U.S. Patent No. 8,073,054 (the “’054 patent”) entitled, *Unit For And Method Of Estimating A Current Motion Vector*, was filed on December 12, 2002, and claims priority to January 17, 2002. The ‘054 patent is subject to a 35 U.S.C. § 154(b) term extension of 1,162 days. Dynamic Data is the owner by assignment of all right, title, and interest in the ‘054 patent. A true and correct copy of the ‘054 patent is attached hereto as Exhibit 15.

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

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

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

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

146. The ‘054 patent discloses a motion estimation unit comprising a selector for selecting the current motion vector from the candidate motion vectors by means of comparing the match errors of the respective candidate motion vectors, characterized in that the motion estimation unit is arranged to add a further candidate motion vector to the set of candidate motion vectors by calculating the further candidate motion vector on basis of a first motion vector and a second motion vector, both belonging to the set of previously estimated motion vectors.

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

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

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

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

COUNT I
INFRINGEMENT OF U.S. PATENT NO. 8,189,105

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

151. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for motion compensation in video signal processing.

152. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for processing pixel information based on received motion and edge data.

153. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung products that contain H.265 decoding functionality including: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy Note8, Galaxy S8, Galaxy S8+, Galaxy S7, Galaxy S7 Edge, Galaxy S7 Active; Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), Exynos 7 Series (7885), Exynos 7 Series (7880), Exynos 5 Series (7872), Exynos 8 Octa (8890), Exynos 7 Octa (7420), Exynos 7 Octa (7870), Exynos 7 Octa (7580), Exynos 7 Quad (7570), Exynos 7 Dual (7270); Samsung Smart TVs, including model groups: 18TV_Premium (UHD), 18TV_STANDARD1 (UHD), 18TV_STANDARD2 (UHD),

18TV_STANDARD3 (FHD), 2017 - 17TV_PREMIUM (UHD), 17TV_STANDARD (FHD), 17AV_BD (UHD), 16TV_PREMIUM (UHD), 16TV_STANDARD1 (UHD), 16TV_STANDARD2 (FHD), 15TV_PREMIUM (UHD), 15TV_STANDARD1 (UHD), 15TV_STANDARD2 (FHD); Samsung Tablet products, including: Galaxy Tab S2, Galaxy Tab S3, Galaxy Tab E, Galaxy Tab S, Galaxy Tab S4, Galaxy Tab A 10.1 (2016), Galaxy Tab A 7.0 (2016), Galaxy TabPro S, Galaxy Tab A (8", 9.7" and 10.1" models) (2015);and Samsung 4K Blue-ray products, including: UBD-M8500/ZA, UBD-M7500/ZA, UBD-M9500/ZA, UBD-K8500/ZA, UBD-M9700/ZA (collectively, the "Samsung '105 Products").

154. On information and belief, one or more Samsung subsidiaries and/or affiliates use the Samsung '105 Products in regular business operations.

155. On information and belief, the Samsung '105 Products perform video processing compliant with the HEVC standard. Specifically, the Samsung '105 Products comply with HEVC decoding pursuant to the H.265 standard. *See e.g.*, *Samsung S9 | S9+ The Phone Reimagined*, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895)*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos 8895 Specifications*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors Listing*, SAMSUNG WEBSITE, *available at*:

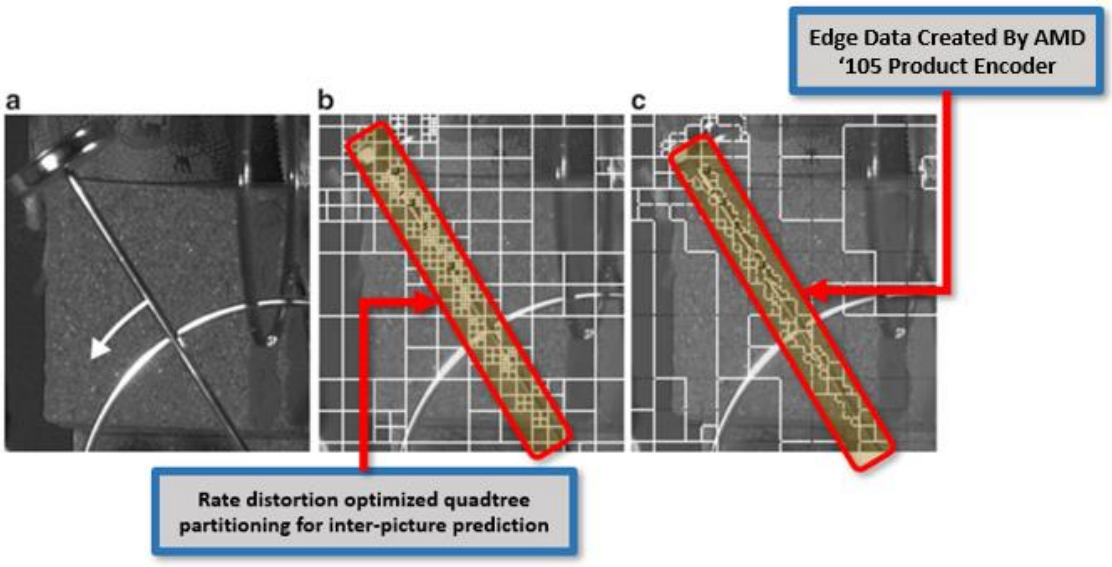
https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing specifications for the Exynos processors showing the accused Exynos Devices support HEVC decodinmg); *Samsung S8 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s8/specs/; *Samsung S7 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s7/; Samsung SmartTV Specifications 2015-2019, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications (containing links to the accused Samsung TV's showing that they support HEVC decoding).

156. On information and belief, by complying with the HEVC standard, the Samsung devices – such as the Samsung '105 Products - necessarily infringe the '105 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '105 patent, including but not limited to claim 1 of the '105 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 Samsung's infringement of the '105 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.").

157. On information and belief, the Samsung '105 Products comply with the HEVC standard, which requires processing edge data from edge-adaptive interpolation processing.

158. The Samsung '105 Products use two types of prediction methods for processing pixel information when encoding and decoding video data in HEVC format: inter prediction and intra prediction. Inter prediction utilizes motion vectors for block-based inter prediction to exploit temporal statistical dependencies between different pictures. Intra prediction uses various spatial prediction modes to exploit spatial statistical dependencies in the source signal for a single picture. The HEVC Specification (*e.g.*, *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)) sets forth the standard that is followed by HEVC compliant devices such as the Samsung '105 Products, and is relevant to both decoding and encoding that are performed pursuant to the HEVC standard. For instance, the Samsung '105 Products perform a method for encoding a video signal comprised of pixels using motion vectors when performing encoding of H.265/HEVC video data.

159. During the encoding process the Samsung '105 Products process pixel information based on edge data. The edge data is generated by the Samsung '105 Products using merge mode estimation. Specifically, the Samsung '105 Products generate merge estimation regions which identify edge information within a video frame. The merge estimation regions are comprised of prediction units ("PU") that contain luma values. For example, in the below diagram PUs are shown. The encoding process then identifies along the edges of each prediction unit a merge estimation region ("MER"). The MER regions thus identify the edges and the PU contains the intensity estimate for the pixels.



Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 114 (September 2014) (annotations added).

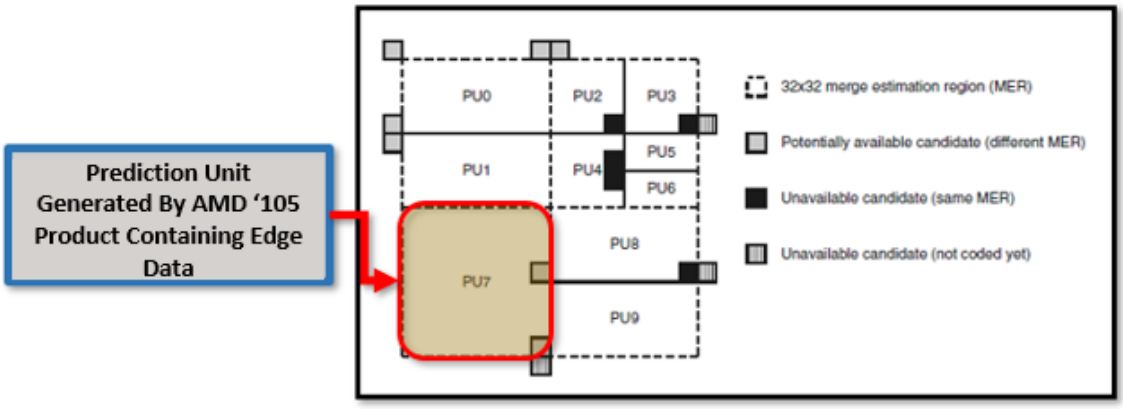
160. The Samsung '105 Products, in the process of encoding video content in HEVC format, generate merge estimation regions generate edge data that include luma location and luma values which include a first intensity estimate. The HEVC standard describes this process as leading to the generation of luma motion vector mvL0 and mvL1.

> [T]he derivation process for luma motion vectors for merge mode as specified in clause I.8.5.3.2.7 is invoked with the luma location (xCb, yCb), the luma location (xPb, yPb), the variables nCbS, nPbW, nPbH, and the partition index partIdx as inputs, and the output being the luma motion vectors mvL0, mvL1, the reference indices refIdxL0, refIdxL1, the prediction list utilization flags predFlagL0 and predFlagL1, the flag ivMcFlag, the flag vspMcFlag, and the flag subPbMotionFlag.

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.8.5.3.2.1 (February 2018) (emphasis added).

161. The Samsung '105 Products perform the step of processing edge data from an edge adaptive interpolation process wherein the edge data includes a first intensity estimate of the pixel. Specifically, the Samsung '105 Products implement HEVC encoding which utilizes Parallel Merge Mode and Merge Estimation Regions (MER's) within the interpolation process to determine pixel

edges. Parallel Merge Mode Estimation identifies the edge data within a prediction unit. The below diagram shows how video data is portioned into 10 prediction units and edge data is calculated and passed to the encoder.



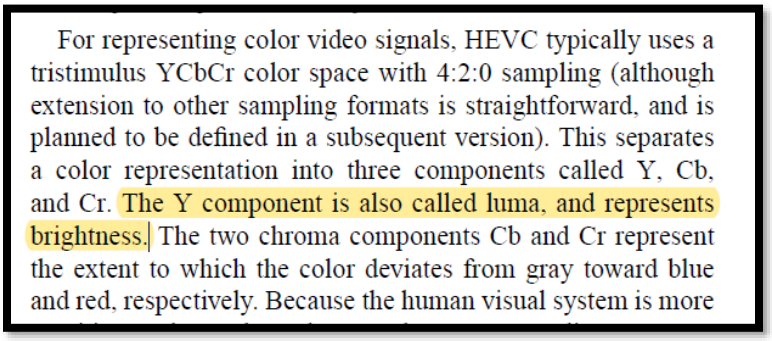
Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 127 (September 2014) (annotations added).

162. The merge estimation processes implemented by the Samsung '105 Products is "adaptive." The below excerpt from documentation regarding the HEVC encoding process describes that the "merge estimation level is adaptive."

> In order to enable an encoder to trade-off parallelism and coding efficiency, the parallel merge estimation level is adaptive and signaled as `log2_parallel_merge_level_minus2` in the picture parameter set. The following MER sizes are allowed: 4×4 (no parallel merge estimation possible), 8×8, 16×16, 32×32 and 64 × 64. A higher degree of parallelization, enabled by a larger MER, excludes more potential candidates from the merge candidate list.

Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 128 (September 2014) (emphasis added).

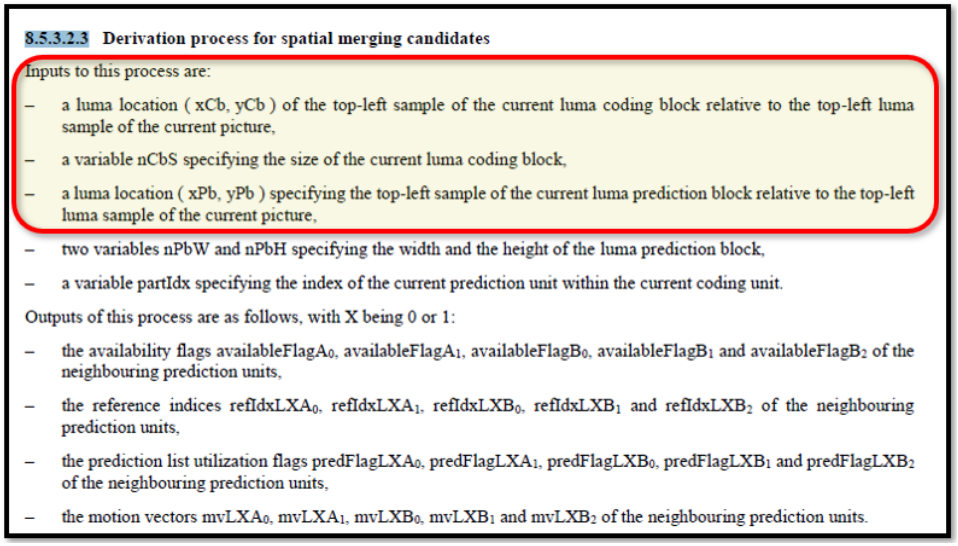
163. The edge data that is processed from the edge adaptive interpolation process includes intensity estimates for pixels such as pixels in the merge estimation region. The intensity estimate or brightness estimate is referred to as "luma" in the encoding functionality implemented by the Samsung '105 Products.



For representing color video signals, HEVC typically uses a tristimulus YCbCr color space with 4:2:0 sampling (although extension to other sampling formats is straightforward, and is planned to be defined in a subsequent version). This separates a color representation into three components called Y, Cb, and Cr. The Y component is also called luma, and represents brightness. The two chroma components Cb and Cr represent the extent to which the color deviates from gray toward blue and red, respectively. Because the human visual system is more

Gary J. Sullivan, Jens-Rainer Ohm, Woo-Jin Han, and Thomas Wiegand, Fellow, IEEE, *Overview of the High Efficiency Video Coding (HEVC) Standard*, published in IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, Vol. 22, No. 12 at 1654 (December 2012) (emphasis added).

164. The motion estimation region ("MER") is an adaptive interpolation process in which the edges of images are calculated and include the intensity estimates of pixels by way of a luma value. The below excerpt from the HEVC specification describes how during the generation of merge estimation regions edge data includes luminosity values (intensity estimates) for pixels within a region.



8.5.3.2.3 Derivation process for spatial merging 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,
- a variable partIdx specifying the index of the current prediction unit within the current coding unit.

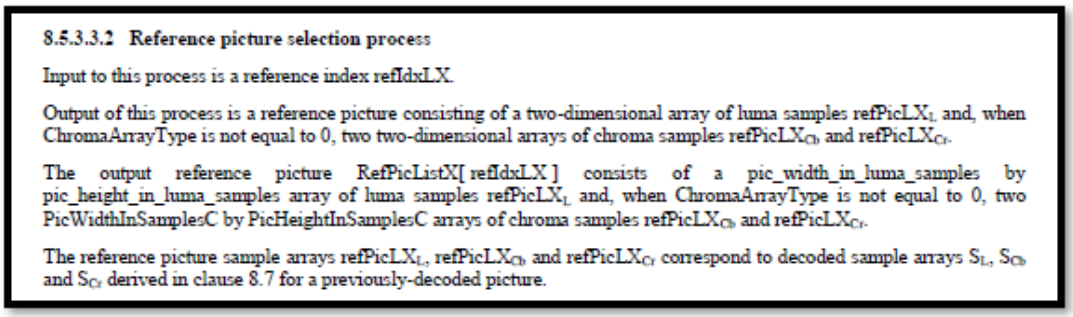
Outputs of this process are as follows, with X being 0 or 1:

- the availability flags availableFlagA$_0$, availableFlagA$_1$, availableFlagB$_0$, availableFlagB$_1$ and availableFlagB$_2$ of the neighbouring prediction units,
- the reference indices refIdxLXA$_0$, refIdxLXA$_1$, refIdxLXB$_0$, refIdxLXB$_1$ and refIdxLXB$_2$ of the neighbouring prediction units,
- the prediction list utilization flags predFlagLXA$_0$, predFlagLXA$_1$, predFlagLXB$_0$, predFlagLXB$_1$ and predFlagLXB$_2$ of the neighbouring prediction units,
- the motion vectors mvLXA$_0$, mvLXA$_1$, mvLXB$_0$, mvLXB$_1$ and mvLXB$_2$ of the neighbouring prediction units.

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.8.5.2.3 (February 2018) (emphasis added).

165. The Samsung '105 Products process motion data associated with motion compensation. The motion data processed by the Samsung '105 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. Specifically, the Samsung '105 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.

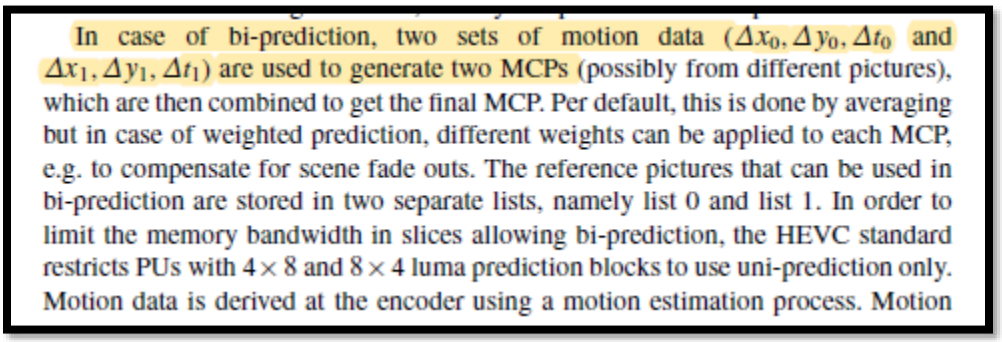
High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § I.8.5.3.3 (February 2018).

166. The reference pictures that are used 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 Samsung '105 Products as "refPicLXcb" and "refPicLXcr." The following excerpt describing the implementation of the encoding process in the Samsung '105 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) 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).

167. The Samsung '105 Products' interpolation process contains 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 Samsung '105 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

Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 114 (September 2014) (emphasis added).

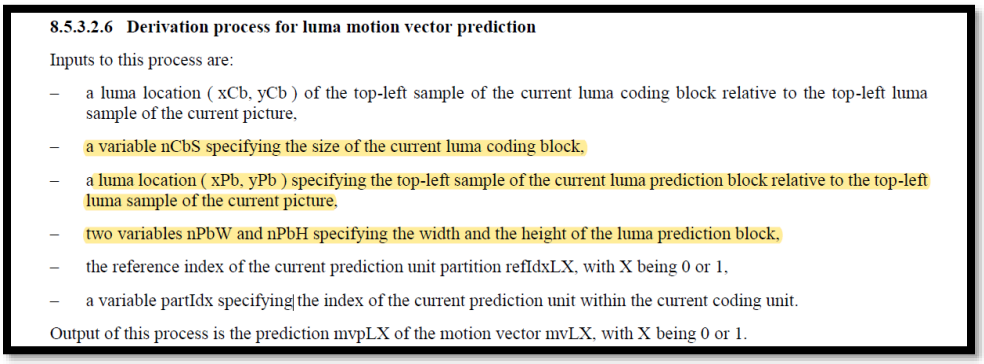
168. In AMVP the system generates a temporal intermediate candidate based on bi-directional motion data. The "inter_pred_idc [x0] [y0] specifies whether list0, list1, or bi-prediction is used for the current prediction unit" according to the below referenced table. "The array indices x0, y0 specify the location (x0, y0) of the top-left luma sample of the considered prediction block relative to the top-left luma sample of the picture."

Table 7-11 – Name association to inter prediction mode

inter_pred_idc	Name of inter_pred_idc	
	(nPbW + nPbH) != 12	(nPbW + nPbH) == 12
0	PRED_L0	PRED_L0
1	PRED_L1	PRED_L1
2	PRED_BI	na

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 7.4.9.6 (February 2018).

169. The Samsung '105 Products generate a second intensity estimate based on the edge data and the motion data. The edge data is combined with the temporal intermediate candidate to generate the temporal candidate. The prediction unit based on the first and second motion vector (motion data) is then combined with the edge data to generate a second intensity estimate. Once the reference picture for obtaining the co-located PU is selected then the position of the co-located Pu will be selected among two candidate positions. A second intensity estimate is generated by using the bi-directional motion vectors and the edge data. The below excerpt from the HEVC specification describes that for a luma motion vector prediction the generation of a second intensity estimate is based on the motion data and the edge data. The edge data here is comprised by the luma location and luma prediction block information. Further, the luma motion vectors mvLO and mvL1 are combined with the edge data including luma location xCB yCB xBL and yBl to generate a second intensity estimate.



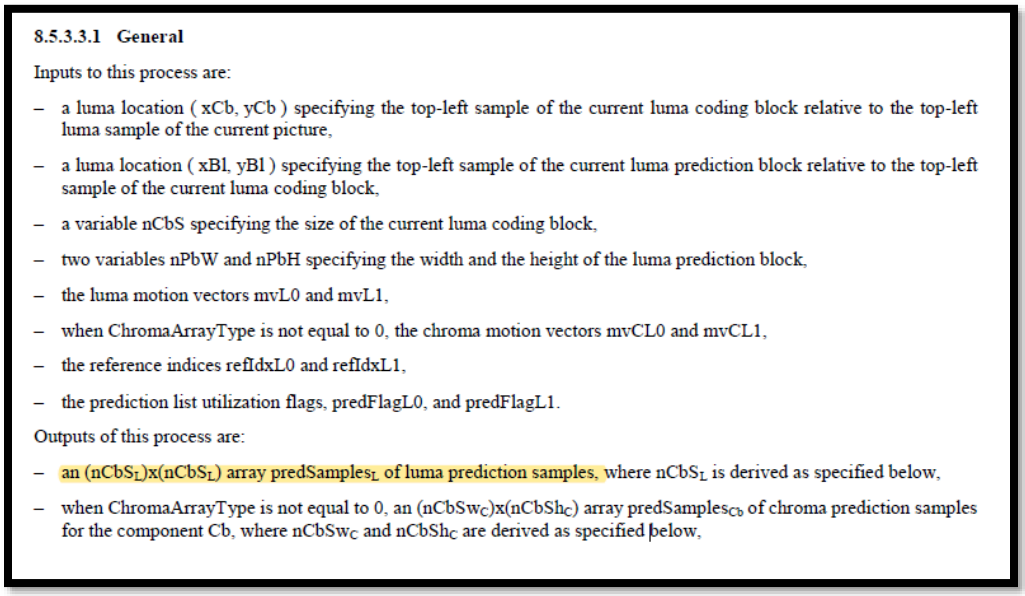
8.5.3.2.6 Derivation process for luma motion vector prediction

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.

Output of this process is the prediction mvpLX of the motion vector mvLX, with X being 0 or 1.

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.5.3.2.6 (February 2018) (emphasis added).



8.5.3.3.1 General

Inputs to this process are:

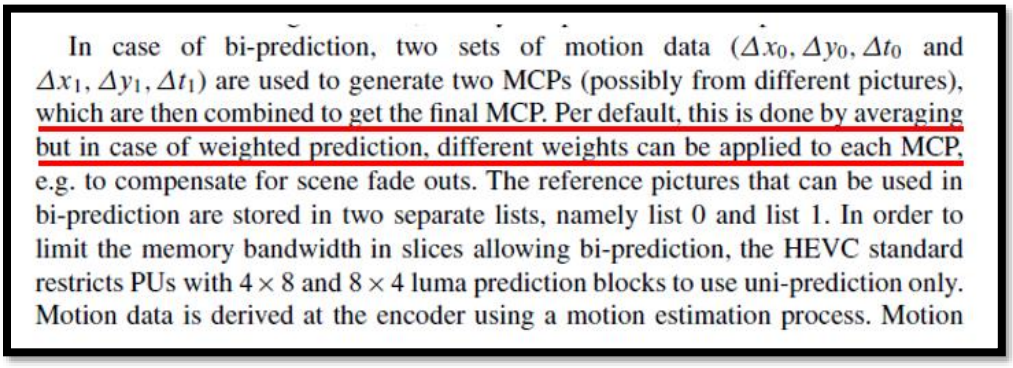
- a luma location (xCb, yCb) specifying the top-left sample of the current luma coding block relative to the top-left luma sample of the current picture,
- a luma location (xBl, yBl) specifying the top-left sample of the current luma prediction block relative to the top-left sample of the current luma coding block,
- a variable nCbS specifying the size of the current luma coding block,
- two variables nPbW and nPbH specifying the width and the height of the luma prediction block,
- 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,
- the prediction list utilization flags, predFlagL0, and predFlagL1.

Outputs of this process are:

- an $(nCbS_L)x(nCbS_L)$ array $predSamples_L$ of luma prediction samples, where $nCbS_L$ is derived as specified below,
- when ChromaArrayType is not equal to 0, an $(nCbSw_C)x(nCbSh_C)$ array $predSamples_{Cb}$ of chroma prediction samples for the component Cb, where $nCbSw_C$ and $nCbSh_C$ are derived as specified below,

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).

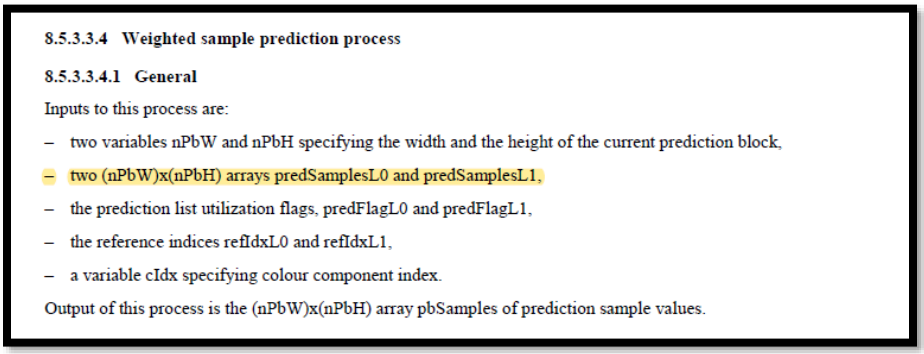
170. The Samsung '105 Products perform a mixing process in which the final edge/motion data of a pixel is calculated based on a first intensity estimate, second intensity estimate, and motion reliability data. Specifically, the Samsung '105 Products encode pixel data using bi-prediction wherein use two types of mixing functions: average mixing and weighted mixing.



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

Benjamin Bross et al, *Inter-Picture Prediction in HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 123 (September 2014) (emphasis added).

171. The HEVC standard includes functionality to perform a mixing process. In MERGE mode, an up-to five-entry MERGE candidate list is first constructed with four (MV, Refldx) pairs from spatial neighbor blocks and one (MV, Refldx) pair from temporal bottom-right or collocated neighbor block, where Refldx is the index of the reference picture that the MV pointed to. After that, the encoder decides to use which candidate (MV, Refldx) pair to encode current block and then encode the candidate index into bitstream. In MERGE mode, the selected (MV, Refldx) pair is directly used to encode current block, and no MVD information needs to be coded. The number of merge candidates could be configured at encoder, with up to five merge candidates."



8.5.3.3.4 Weighted sample prediction process

8.5.3.3.4.1 General

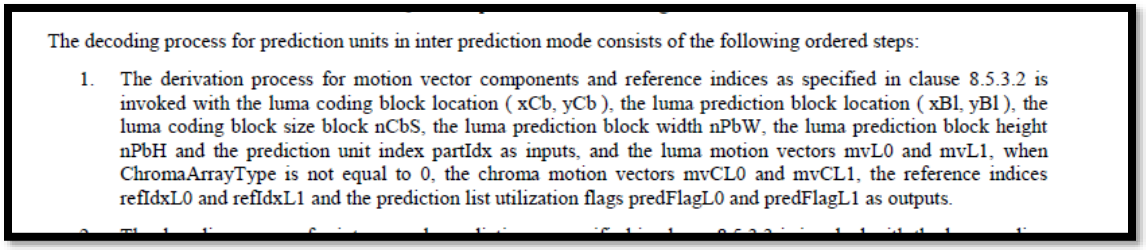
Inputs to this process are:

- 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.

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) (emphasis added).

172. 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).

173. On information and belief, any implementation of the HEVC standard would infringe the '105 patent as every implementation of the standard requires: processing edge data from edge-adaptive interpolation processing, including a first intensity estimate for the pixel as well as data pertaining to one or more pixels that neighbor the pixel; processing motion data associated with motion compensation processing, wherein the motion data includes a first estimated motion vector for a pixel in a reference field prior to the present field and a second estimated motion vector for a pixel in a reference field subsequent to the present field; determining a second intensity estimate for the pixel as a function of the edge data and the motion data; and performing a blending process wherein final edge/motion data of the pixel is calculated as a function of the first intensity estimate, the second intensity estimate, and motion reliability data characterizing reliability of the motion data.

174. On information and belief, the Samsung '105 Products are available to businesses and individuals throughout the United States.

175. On information and belief, the Samsung '105 Products are provided to businesses and individuals located in the Eastern District of Texas.

176. By making, using, testing, offering for sale, and/or selling products and services for enhancing subsequent images of a video stream in which frames are encoded based on previous frames using prediction and motion estimation, including but not limited to the Samsung '105 Products, Samsung has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '105 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

177. On information and belief, Samsung also indirectly infringes the '105 patent by actively inducing infringement under 35 USC § 271(b).

178. Samsung has had knowledge of the '105 patent since at least service of this First Amended Complaint or shortly thereafter, and on information and belief, Samsung knew of the '105 patent and knew of its infringement, including by way of this lawsuit.

179. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '105 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. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '105 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '105 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '105 Products that have the capability of operating in a manner that infringe one or more of the claims of the '105 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '105 Products to utilize the products in a manner that directly infringe one or more claims of the '105 patent.[21] By providing instruction and training to customers and end-

[21] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone*

users on how to use the Samsung '105 Products in a manner that directly infringes one or more claims of the '105 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '105 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '105 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '105 patent. Accordingly, Samsung 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 '105 patent, knowing that such use constitutes infringement of the '105 patent.

180. The '105 patent is well-known within the industry as demonstrated by multiple citations to the '105 patent in published patents and patent applications assigned to technology

---

Galaxy S8 S8+, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL; *Galaxy Note9*, SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Exynos 5 Series (7872): Diffusion of Prime Performance*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-5-series-7872/ (last visited Nov. 2018); *2018 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2018-tv-video-specifications (last visited Nov. 2018); *2017 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2017-tv-video-specifications (last visited Nov. 2018); *2016 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2016-tv-video-specifications (last visited Nov. 2018); *2015 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2015-tv-video-specifications (last visited Nov. 2018); *Galaxy Tab S2 Tablet*, SAMSUNG USER MANUAL (2016); *Galaxy Tab E Android Tablet*, SAMSUNG USER MANUAL (2015); *Galaxy Tab S4*, SAMSUNG USER MANUAL (2018); *Galaxy Tab A Tablet*, SAMSUNG USER MANUAL (2016); *UBD-M8500*, SAMSUNG USER MANUAL (2017); *Ultra HD Blu-ray Player*, SAMSUNG USER MANUAL (2015).

companies and academic institutions. Samsung is utilizing the technology claimed in the '105 patent without paying a reasonable royalty. Samsung is infringing the '105 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

181. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '105 patent.

182. As a result of Samsung's infringement of the '105 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

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

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

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

185. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung devices capable of decoding video data in compliance with the H.265 standard. The Accused Products include, but are not limited to, Samsung smartphones, tablets, televisions, and other devices capable of performing decoding of video data using the H.265 standard. By way of example, the following Samsung Products perform decoding pursuant to the H.265 standard: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy Note8, Galaxy S8, Galaxy S8+, Galaxy S7, Galaxy S7 Edge,

Galaxy S7 Active; Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), Exynos 7 Series (7885), Exynos 7 Series (7880), Exynos 5 Series (7872), Exynos 8 Octa (8890), Exynos 7 Octa (7420), Exynos 7 Octa (7870), Exynos 7 Octa (7580), Exynos 7 Quad (7570), Exynos 7 Dual (7270); Samsung Smart TVs, including model groups: 18TV_Premium (UHD), 18TV_STANDARD1 (UHD), 18TV_STANDARD2 (UHD), 18TV_STANDARD3 (FHD), 2017 - 17TV_PREMIUM (UHD), 17TV_STANDARD (FHD), 17AV_BD (UHD), 16TV_PREMIUM (UHD), 16TV_STANDARD1 (UHD), 16TV_STANDARD2 (FHD), 15TV_PREMIUM (UHD), 15TV_STANDARD1 (UHD), 15TV_STANDARD2 (FHD); Samsung Tablet products, including: Galaxy Tab S2, Galaxy Tab S3, Galaxy Tab E, Galaxy Tab S, Galaxy Tab S4, Galaxy Tab A 10.1 (2016), Galaxy Tab A 7.0 (2016), Galaxy TabPro S, Galaxy Tab A (8", 9.7" and 10.1" models) (2015);and Samsung 4K Blu-ray products, including: UBD-M8500/ZA, UBD-M7500/ZA, UBD-M9500/ZA, UBD-K8500/ZA, UBD-M9700/ZA (collectively, the "Samsung '073 Product(s)").

186. The Samsung '073 Products perform video processing compliant with the H.265 standard. Specifically, the Samsung '073 products perform HEVC decoding. *See e.g.*, *Samsung S9 | S9+ The Phone Reimagined*, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895)*, SAMSUNG EXYNOS PRODUCT SPECIFICATIONS WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895 ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos 8895 Specifications*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-

series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors Listing*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing specifications for the Exynos processors showing the accused Exynos Devices support HEVC decodinmg); *Samsung S8 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s8/specs/; *Samsung S7 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s7/; Samsung SmartTV Specifications 2015-2019, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications (containing links to the accused Samsung TV's showing that they support HEVC decoding).

187. On information and belief, one or more Samsung subsidiaries and/or affiliates use the Samsung '073 Products in regular business operations.

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

189. The Samsung '073 Products contain a hardware-based decoder on their system on chip ("SoC") processors.

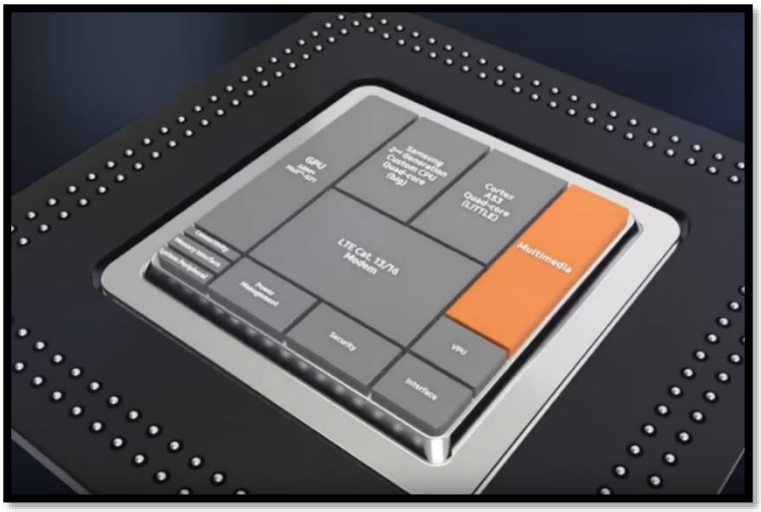
> By fully supporting a 64-bit architecture in both hardware and software, the Exynos 7420 enables running performance intensive tasks without any buffering. . . . With a newly added HEVC (H.265) encoder to its advanced Multi Format Codec (MFC) that features H.265 (HEVC) decoder and VP9 decoder, the processor can record and playback 4K video at 30fps.

Exynos 7 Octa (7420), SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-7-octa-7420/.

190. Samsung has explained that its inclusion of HEVC decoding and encoding functionality in its system on chip products makes them "absolute multimedia powerhouse[s] . . . allow[ing] for ultra-smooth 4K video playback capabilities . . . ." *Interview: Meizu explains why Exynos powers its flagship device*, SAMSUNG WEBSITE BLOG (Dec. 16, 2016), *available at*: https://www.samsung.com/semiconductor/minisite/exynos/newsroom/blog/interview-meizu-explains-why-exynos-powers-its-flagship-device/.

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

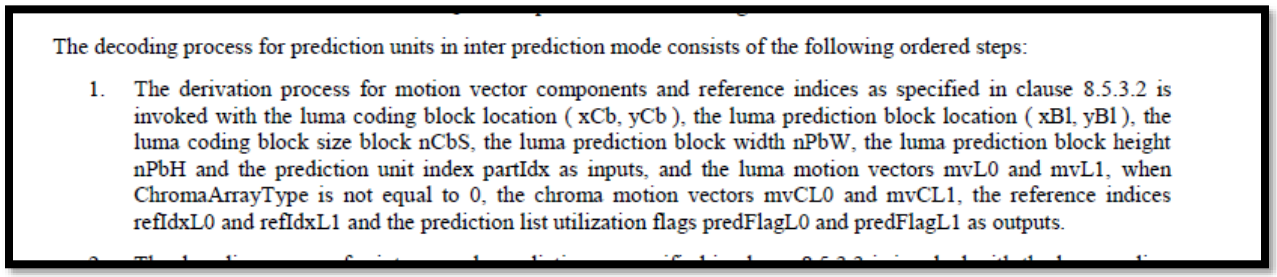
192. The following image of the Samsung Exynos 9 Series processor shows two central processing units and two graphics processing units that process pixel information by receiving a video stream with encoded frame-based video information including a first and second frame.



Introducing the Samsung Exynos 9 Series (8995) processor, SAMSUNG YOUTUBE CHANNEL (April 11, 2017), *available at*: https://www.youtube.com/watch?v=ZayD-rzml-4.

193. On information and belief, by complying with the HEVC standard, the Samsung devices – such as the Samsung '073 Products - necessarily infringe the '073 patent. The mandatory sections of the HEVC standard require the elements required by certain claims of the '073 patent, including but not limited to claim 14 of the '073 patent. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018) (The following sections of the HEVC Standard are relevant to Samsung's infringement of the '073 patent: "8.3.2 Decoding process for reference picture set;" "8.5.4 Decoding process for the residual signal of coding units coded in inter prediction mode;" "8.6 Scaling, transformation and array construction process prior to deblocking filter process;" "8.5.2 Inter prediction process;" "8.5.3 Decoding process for prediction units in inter prediction mode;" and "8.7.2 Deblocking filter process;" "8.7.3 Sample adaptive offset process.").

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



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

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

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

195. On information and belief, Samsung has directly infringed and continues to directly infringe the '073 patent by, among other things, making, using, offering for sale, and/or selling technology for enhancing subsequent images of a video stream in which frames are encoded based

on previous frames using prediction and motion estimation, including but not limited to the Samsung '073 Products.

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

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

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

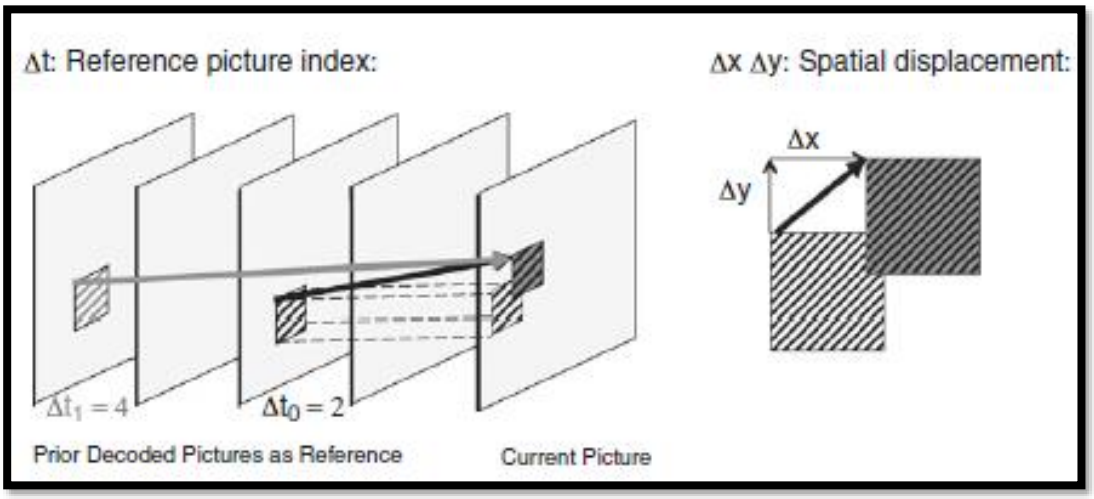
197. On information and belief, the Samsung '073 Products receive encoded video data that is encoded using inter-frame coding. Specifically, the encoded video stream received by the Samsung '073 Products is coded using its predecessor frame. Inter-prediction used in the encoded video data received by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

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

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

198. The encoded video stream received by the Samsung '073 Products is encoded using inter-picture prediction that makes use of the temporal correlation between pictures to derive a motion-compensated prediction (MCP) for a block of image samples. For this block-based motion compensated prediction, a video picture is divided into rectangular blocks. Assuming

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



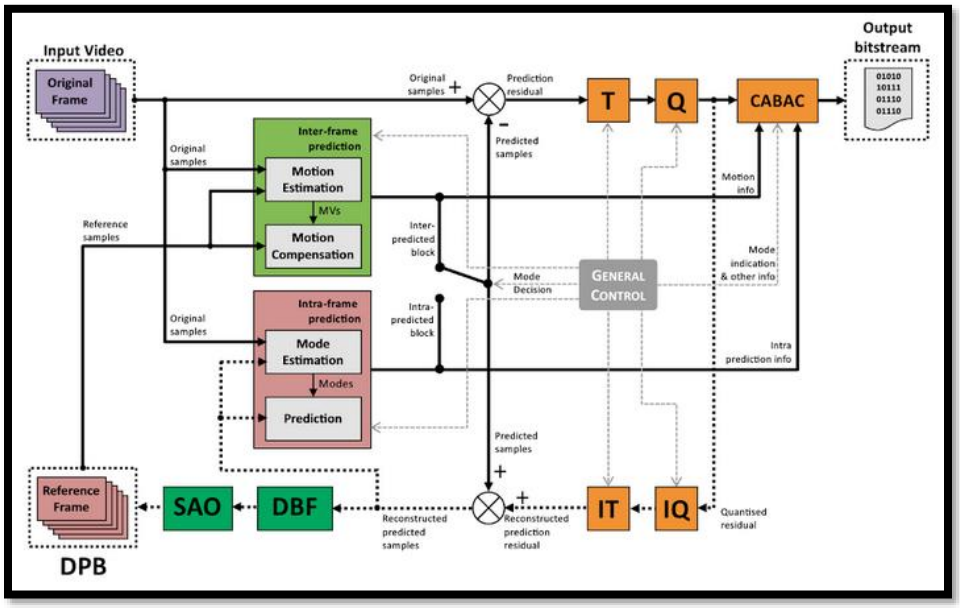
Benjamin Bross, *Inter-Picture Prediction In HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 114 (September 2014).

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

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

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

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



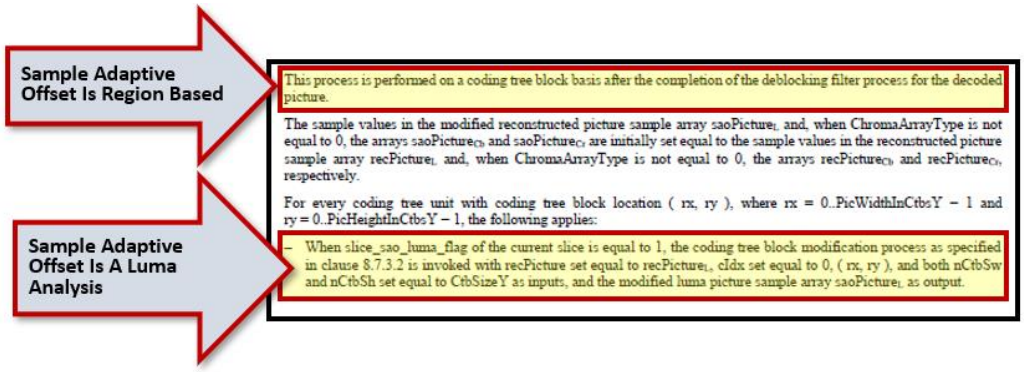
Guilherme Corrêa, *et al.*, COMPLEXITY-AWARE HIGH EFFICIENCY VIDEO CODING at 16 (2015).

201. On information and belief, any implementation of the HEVC standard would infringe the '073 patent as every implementation of the standard requires: receiving a video stream containing encoded frame based video information (including both an encoded first frame and an encoded second frame); the encoded second frame that is received depends on the encoding of the first frame, the encoding of the second frame includes motion vectors indicating differences in positions between regions of the second frame and corresponding regions of the first frame; the motion vectors define correspondence between regions of the second frame and corresponding regions of the first frame; decoding the video stream by recovering the motion vectors in the second stream; and determining a re-mapping strategy for the video enhancement of the decoded first frame using a region-based analysis where the first frame is remapped using a remapping strategy

and at least one region of the second frame is remapped depending on the re-mapping strategy for corresponding regions of the first frame.

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

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

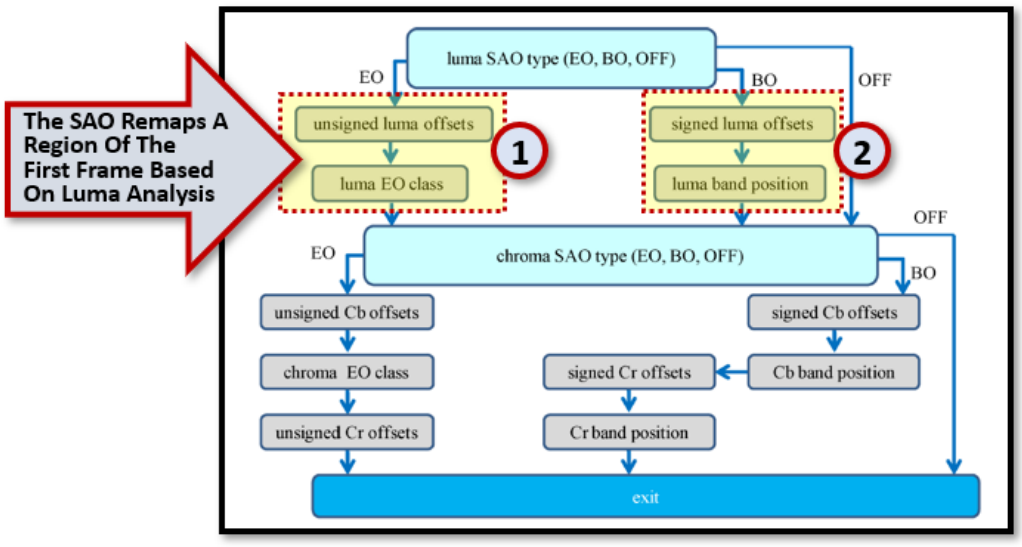


High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 8.7.3.1 (April 2015) (annotations added).

204. On information and belief, the Samsung '073 Products contain functionality wherein a decoder applies sample adaptive offset to a decoded reference frame (first frame). Further, the Samsung '073 Products apply the sample adaptive offset functions to remap a portion

of the region based on luminance values (luma). "SAO can be applied to not only luma but also chroma." Chih-Ming Fu, *et al.*, Sample Adaptive Offset in the HEVC Standard, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 22, NO. 12 AT 1765 (December 2012).

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



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

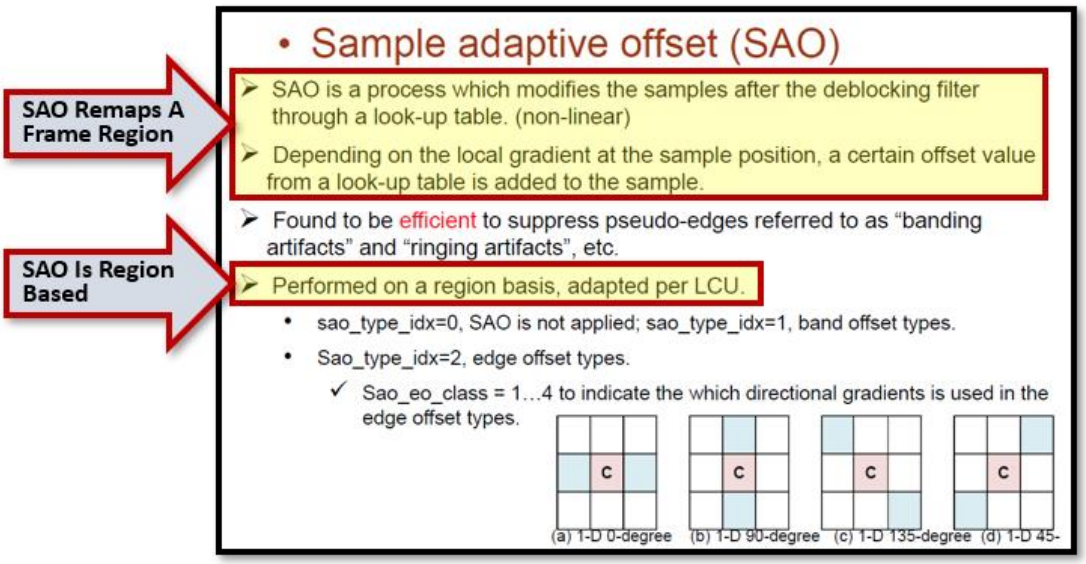
206. Further, HEVC documentation makes clear that the application of the standard adaptive offset remapping policy is based on a luminance analysis. The below shows that slices of a region have a standard adaptive offset applied based on a "luma flag."

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

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

207. Commentary on the use of sample adaptive offset functionality in decoding HEVC video further confirms that the use of Sample Adaptive Offset (such as that implemented by the Samsung '073 Products) is region based and remaps pixel values in a region of a frame by modifying pixels based on an offset value. "[A]fter the deblocking filter through a look-up table . . . [and applying] a certain offset value from a look-up-table is added to the sample."[22]

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



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

208. On information and belief, when the Samsung '073 Products decode a second frame, the application of the remapping policy (sample adaptive offset) will be determined based on the application of sample adaptive offset to the first frame (reference picture). Thus, the application of the remapping policy (sample adaptive offset) to the first frame has the effect of increasing the quality of the reference picture such that the second frame might no longer require the application of sample adaptive offset (remapping policy).[23]

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

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

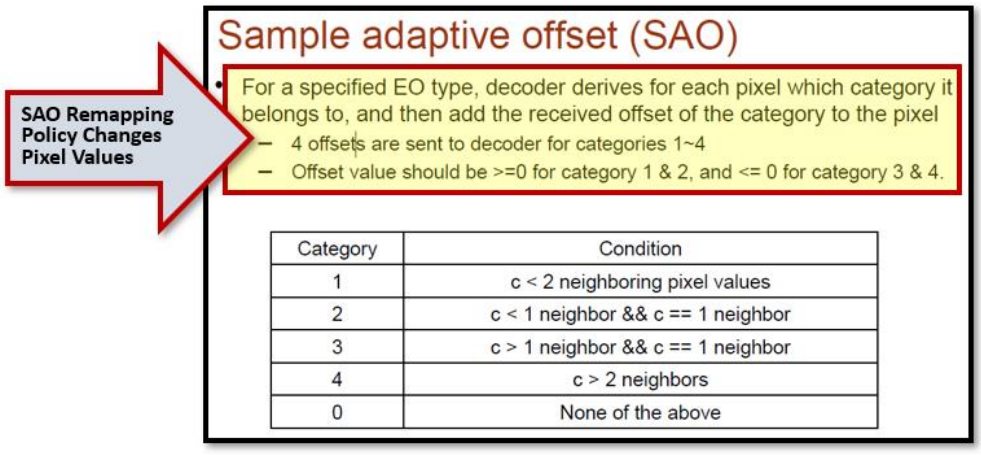
Andrey Norkin, Chih-Ming Fu, Yu-Wen Huang, and Shawmin Lei, *In-Loop Filters In HEVC*, IN HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 171 (September 2014) (annotations added).

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

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

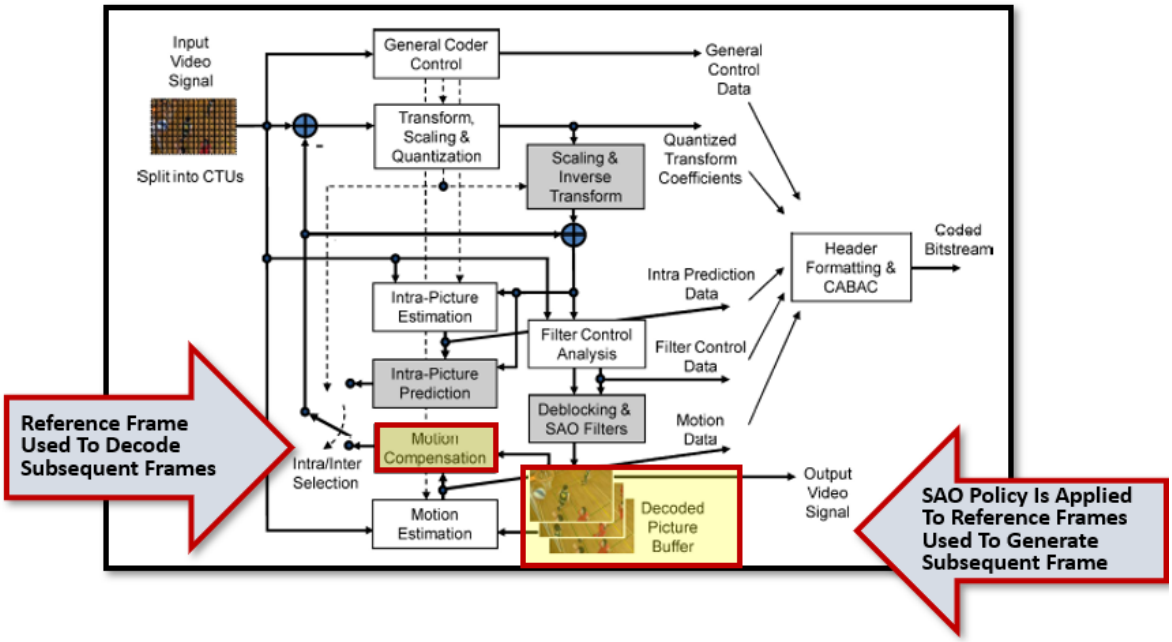
Mehul Tikekar, *et al.*, *Decoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (Vivienne Sze, Madhukar Budagavi, and Gary J. Sullivan (Editors)) at 335 (September 2014).

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



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

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



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

212. The Samsung '073 Products receive encoded video data wherein the second frame includes a region encoding a motion vector difference in position between the region corresponding to the second frame indicating the first frame, the motion vector defines a region between the frame and the second frame corresponding to the first region the correspondence relationship. Specifically, the encoded video data received by the Samsung '073 Products use a translational motion model wherein the position of the block in a previously decoded picture is

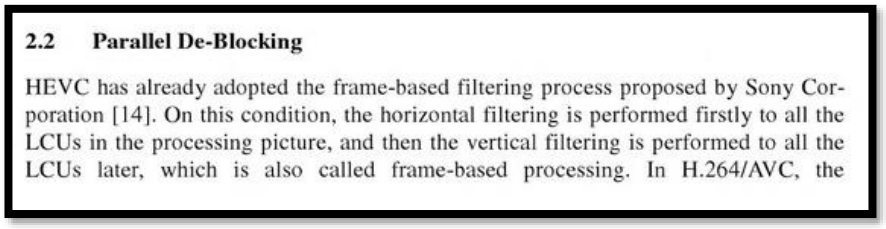
indicated by a motion vector: Δx; Δy where Δx specifies the horizontal and Δy the vertical displacement relative to the position of the current block. The motion vectors: Δx and Δy are of fractional sample accuracy to more accurately capture the movement of the underlying object. Interpolation is applied on the reference pictures to derive the prediction signal when the corresponding motion vector has fractional sample accuracy. The previously decoded picture is referred to as the reference picture and indicated by a reference index Δt to a reference picture list. These translational motion model parameters, *i.e.*, motion vectors and reference indices, are further referred to as motion data. Two kinds of inter-picture prediction are allowed in modern video coding standards, namely uni-prediction and bi-prediction.

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

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

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

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



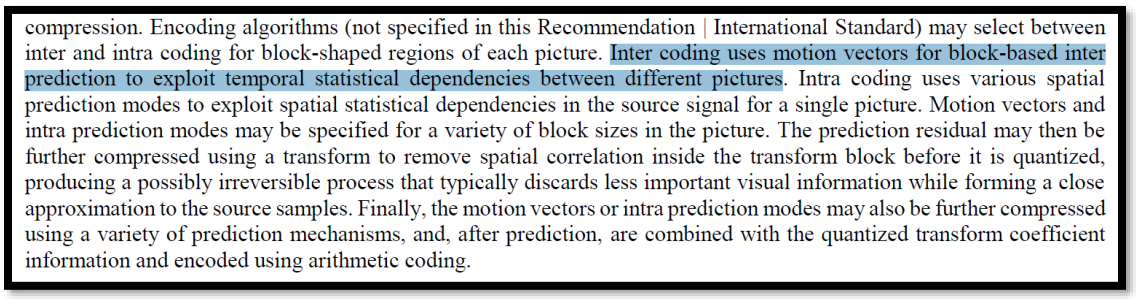
2.2 Parallel De-Blocking

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

Ming-Ting Sun, *et al.*, *Advances in Multimedia Information Processing,* PCM 2012: 13TH PACIFIC-RIM CONFERENCE ON MULTIMEDIA PROCEEDINGS VOLUME 7674 at 274 (December 4-6,

2012) ("HEVC has already adopted the frame-based filtering process proposed by Sony Corporation.").

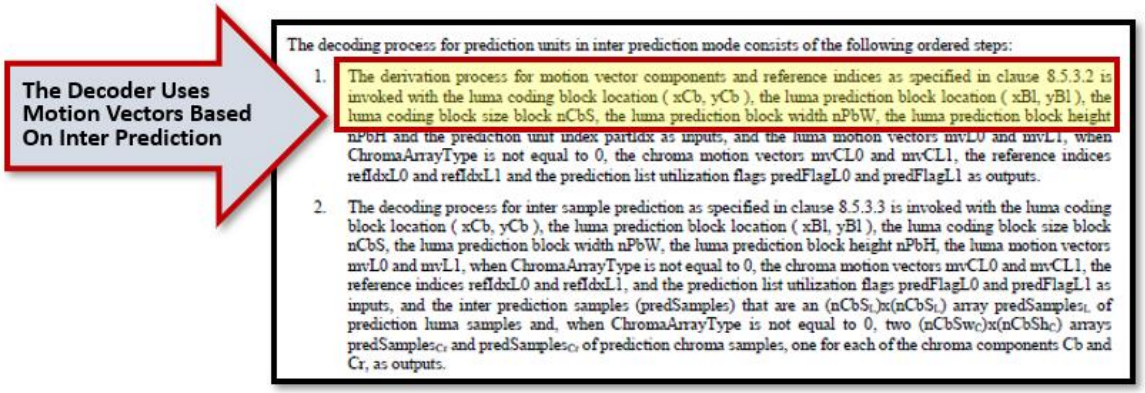
215. On information and belief, one or more of the Samsung '073 Products include a video decoder comprising an input for receiving video information wherein the encoding of the second frame depends on the encoding of the first frame, the encoding of the second frame includes motion vectors indicating differences in positions between regions of the second frame and corresponding regions of the first frame, the motion vectors define correspondence between regions of the second frame and corresponding regions of the first frame. The Overview of Design Characteristics for HEVC encoded video data describes the use of "motion vectors for block-based inter prediction to exploit temporal statistical dependencies between frames."



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

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

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



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

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

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

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

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

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

219. On information and belief, the Samsung '073 Products contain a decoder ("Decoding Unit") that uses HEVC inter prediction, which identifies "motion vectors pointing to one reference frame (uni-prediction) or two reference frames (bi-prediction) to predict a block of pixels."[24]

> Each interpicture-predicted PB is assigned one or two motion vectors and reference picture indices. To minimize worst-case memory bandwidth, PBs of luma size 4×4 are not allowed for interpicture prediction, and PBs of luma sizes 4×8 and 8×4 are restricted to unipredictive coding. The interpicture prediction process is further described as follows.

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

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

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

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

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

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

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

225. Alternatively, Samsung has had knowledge of the '073 patent since at least September 23, 2009, when Korean Patent Application No. KR20090099720A, which is owned by Samsung, and cites the '073 patent as relevant prior art, was filed.

226. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '073 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '073 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '073 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '073 Products that have the capability of operating in a manner that infringe one or more of the claims of the '073 patent, including at least claim 14, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '073 Products to utilize the products in a manner that directly infringe one or more claims of the '073 patent.[25] By providing instruction and training to customers and end-

[25] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL; *Galaxy Note9*, SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile*

users on how to use the Samsung '073 Products in a manner that directly infringes one or more claims of the '073 patent, including at least claim 14, Samsung specifically intended to induce infringement of the '073 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '073 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '073 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '073 patent, knowing that such use constitutes infringement of the '073 patent.

227. The '073 patent is well-known within the industry as demonstrated by multiple citations to the '073 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '073 patent without paying a reasonable royalty. Samsung is infringing the '073 patent in a manner

---

innovation, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Exynos 5 Series (7872): Diffusion of Prime Performance*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-5-series-7872/ (last visited Nov. 2018); *2018 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2018-tv-video-specifications (last visited Nov. 2018); *2017 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2017-tv-video-specifications (last visited Nov. 2018); *2016 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2016-tv-video-specifications (last visited Nov. 2018); *2015 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2015-tv-video-specifications (last visited Nov. 2018); *Galaxy Tab S2 Tablet*, SAMSUNG USER MANUAL (2016); *Galaxy Tab E Android Tablet*, SAMSUNG USER MANUAL (2015); *Galaxy Tab S4*, SAMSUNG USER MANUAL (2018); *Galaxy Tab A Tablet*, SAMSUNG USER MANUAL (2016); *UBD-M8500*, SAMSUNG USER MANUAL (2017); *Ultra HD Blu-ray Player*, SAMSUNG USER MANUAL (2015).

best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

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

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

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

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

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

232. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung products containing H.265-compliant decoding functionality, including but not limited to: Samsung Mobile Galaxy products, including: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy Note8, Galaxy S8, Galaxy S8+, Galaxy S7, Galaxy S7 Edge, Galaxy S7 Active; Samsung Smart TVs, including model groups: 18TV_Premium (UHD), 18TV_STANDARD1 (UHD), 18TV_STANDARD2 (UHD), 18TV_STANDARD3 (FHD), 2017 - 17TV_PREMIUM (UHD), 17TV_STANDARD (FHD), 17AV_BD (UHD), 16TV_PREMIUM (UHD), 16TV_STANDARD1 (UHD), 16TV_STANDARD2 (FHD), 15TV_PREMIUM (UHD), 15TV_STANDARD1 (UHD), 15TV_STANDARD2 (FHD); and Samsung Tablet products,

including: Galaxy Tab S2, Galaxy Tab S3, Galaxy Tab E, Galaxy Tab S, Galaxy Tab S4, Galaxy Tab A 10.1 (2016), Galaxy Tab A 7.0 (2016), Galaxy TabPro S, Galaxy Tab A (8", 9.7" and 10.1" models) (collectively, the "Samsung '918 Product(s)").

233. The Samsung '918 Products perform video processing compliant with the H.265 standard. Specifically, the Samsung '918 Products perform HEVC decoding. *See e.g.*, *Samsung S9 | S9+ The Phone Reimagined*, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895)*, SAMSUNG EXYNOS SOC SPECIFICATIONS WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos 8895 Specifications*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors Listing*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing specifications for the Exynos processors showing the accused Exynos Devices support HEVC decodinmg); *Samsung S8 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s8/specs/; *Samsung S7 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s7/; Samsung SmartTV Specifications 2015-2019, SAMSUNG DEVELOPER WEBSITE, *available at*:

https://developer.samsung.com/tv/develop/specifications/media-specifications (containing links to the accused Samsung TV's showing that they support HEVC decoding).

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

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

236. On information and belief, the Samsung '918 Products use two types of prediction methods for decoding video data: inter prediction and intra prediction. Inter prediction utilizes motion vectors as well as an offset center and creates a list of possible motion vectors (MV) for the search area. The HEVC Specification (*e.g.*, *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (April 2015)) sets forth the standard that is followed by HEVC compliant devices and is relevant to both decoding and encoding that are performed pursuant to the HEVC standard. For instance, the Samsung Products perform a method for decoding a video signal using motion vectors when performing encoding of H.265/HEVC video data. For example, the Samsung Products contain functionality for decoding a video signal using motion vectors and motion estimation.

237. On information and belief, by complying with the HEVC standard, the Samsung devices – such as the Samsung '918 Products - necessarily infringe the '918 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '918 patent, including but not limited to claim 18. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018). The following sections of the HEVC Standard are relevant

to Samsung's infringement of the '918 patent: "5.3 Logical operators;" "5.10 Variables, syntax elements and tables;" "5.11 Text description of logical operations;" "7.2 Specification of syntax functions and descriptors;" "7.3.1 NAL unit syntax;" "7.3.2 Raw byte sequence payloads, trailing bits and byte alignment syntax;" "7.3.5 Supplemental enhancement information message syntax;" "7.4.2 NAL unit semantics;" and "7.4.6 Supplemental enhancement information message semantics."

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

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

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

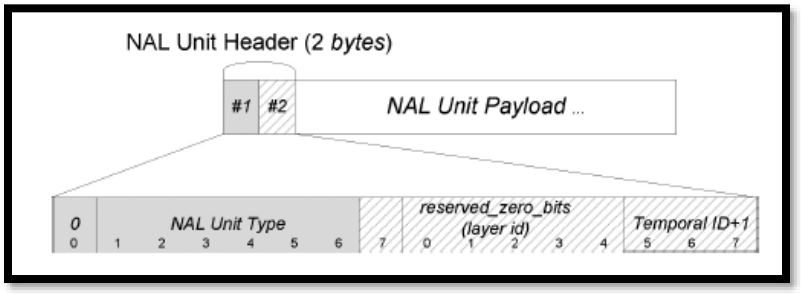
239. On information and belief, the VCL NAL Units contain segments of data which are used to generate an image (*e.g.*, HEVC image) on a display device. Each VCL NAL Unit comprises a discrete number of bites which make up a segment. The following excerpt from the

HEVC specification describes the NAL unit as being a segment with a "demarcation" setting forth where the segment ends and begins.

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

High Efficiency Video Coding, Series H: Audiovisual And Multimedia Systems: Infrastructure Of Audiovisual Services – Coding Of Moving Video Rec. ITU-T H.265 at § 7.4.2.1 (February 2018) (emphasis added).

240. On information and belief, VCL NAL Units comprise discrete video data that ends. It is between the receipt of VCL NAL Units that the overlay data (Non-VCL NAL Unit) data is received by the Samsung Products.



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

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

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

243. On information and belief, the HEVC bitstream structure is comprised of discreet data. In the gaps between the receipt by the Samsung '918 Products of VCL NAL Units Non-VCL NAL Units are received by the Samsung Products' decoder.

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

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

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

Table 2.2 The 32 HEVC non-VCL NAL unit types

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

Gary J. Sullivan et al, HIGH EFFICIENCY VIDEO CODING (HEVC) at 29 (September 2014).

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

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

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 7.3.5 (February 2018).

246. On information and belief, the Samsung '918 Products combine the VCL NAL Unit and Non-VCL NAL Unit information to create images that contain overlay information.

> The NAL units are decoded by the decoder to produce the decoded pictures that are output from the decoder. Both the encoder and decoder store pictures in a decoded picture buffer (DPB). This buffer is mainly used for storing pictures so that previously coded pictures can be used to generate prediction signals to use when coding other pictures. These stored pictures are called reference pictures. . . . There are two classes of NAL units in HEVC—video coding layer (VCL) NAL units and non-VCL NAL units. Each VCL NAL unit carries one slice segment of coded picture data while the non-VCL NAL units contain control information that typically relates to multiple coded pictures. One coded picture, together with the non-VCL NAL units that are associated with the coded picture, is called an HEVC access unit.

Gary J. Sullivan et al, HIGH EFFICIENCY VIDEO CODING (HEVC) at 14-15 (September 2014) (emphasis added).

247. By making, using, testing, offering for sale, and/or selling products for downloading on-screen display (OSD) data for generating an image on a display device, including but not limited to the Samsung '918 Products, Samsung has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '918 Patent, including at least claim 18 pursuant to 35 U.S.C. § 271(a).

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

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

250. Alternatively, Samsung has had knowledge of the '918 patent since at least March 22, 2011, when United States Patent No. 7,911,537, which is owned by Samsung and cites the '918 patent as relevant prior art, was issued.

251. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '918 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '918 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '918 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '918 Products that have the capability of operating in a manner that infringe one or more of the claims of the '918 patent, including at least claim 18, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '918 Products to utilize the products in a manner that directly infringe one or more claims of the '918 patent.[26] By providing instruction and training to customers and end-

[26] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL; *2018 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*:

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

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

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

---

https://developer.samsung.com/tv/develop/specifications/media-specifications/2018-tv-video-specifications (last visited Nov. 2018); *2017 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2017-tv-video-specifications (last visited Nov. 2018); *2016 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2016-tv-video-specifications (last visited Nov. 2018); *2015 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2015-tv-video-specifications (last visited Nov. 2018); *Galaxy Tab S2 Tablet*, SAMSUNG USER MANUAL (2016); *Galaxy Tab E Android Tablet*, SAMSUNG USER MANUAL (2015); *Galaxy Tab S4*, SAMSUNG USER MANUAL (2018); *Galaxy Tab A Tablet*, SAMSUNG USER MANUAL (2016).

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

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

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

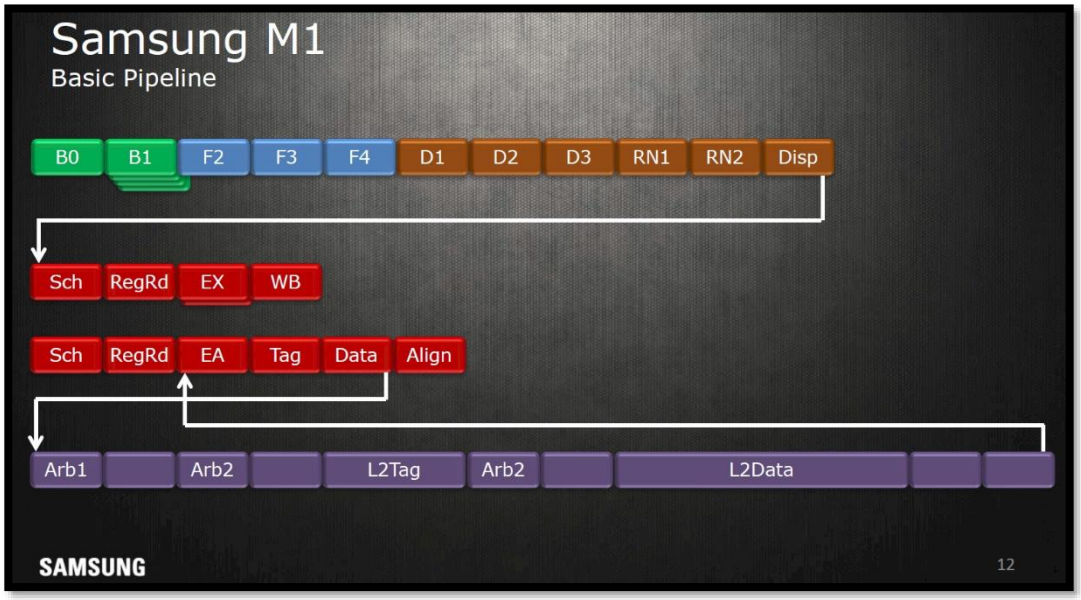
256. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for encoding and decoding video data.

257. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 7 Dual (7270), Exynos 7 Octa (7420), Exynos 7 Octa (7580), Exynos 7 Octa (7870), Exynos 7 Quad (7570), Exynos 7 Series (7880), Exynos 7 Series (7885), Exynos 7 Series (9610), Exynos 8 Octa (8890), Exynos 9 Series (8895), and Exynos 9 Series (9810); and Samsung Mobile Galaxy products, including: Galaxy Note8, Galaxy Note9, Galaxy S7, Galaxy S7 Active, Galaxy S7 Edge, Galaxy S8, Galaxy S8+, Galaxy S9, Galaxy S9+ (collectively, the "Samsung '689 Product(s)").

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

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

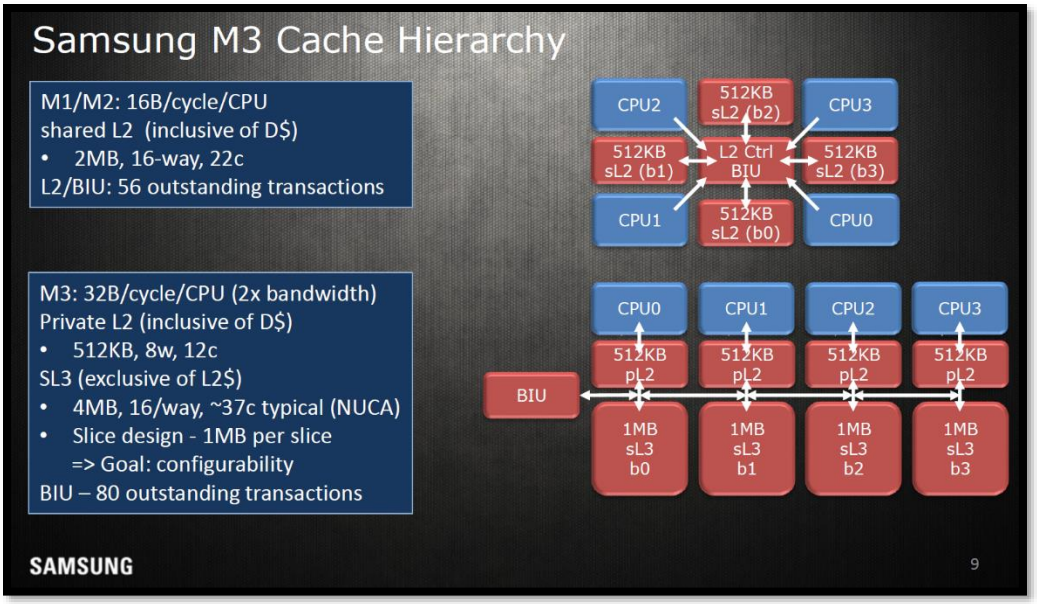
260. The below image shows the Basic Pipeline structure in the Samsung M1 product. The Samsung M1 is a microarchitecture for a subset of the accused Samsung Exynos SoC processors.



Brad Burgess, SAMSUNG EXYNOS M1 PROCESSOR, HOTCHIPS 2016 PRESENTATION at 12 (2016) (showing the basic pipelines structure in the Samsung Exynos M1 microarchitecture).

261. The Samsung '689 Products have a processing unit coupled to a first memory.

262. On information and belief, the '689 Products have various memory structures including an L2 and L1 cache that are connected to the processing unit. These connections between cache memory structures and the processing unit are shown below.

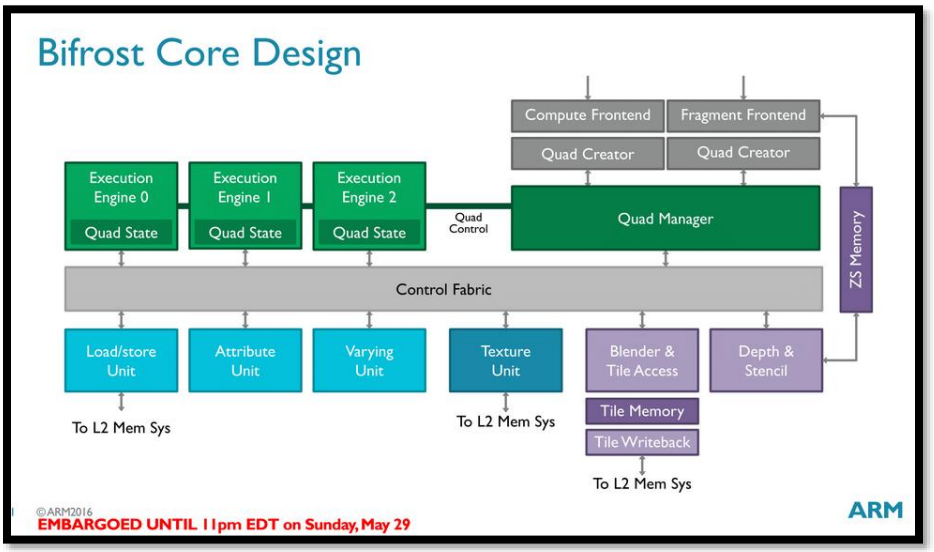


Jeff Rupley, Samsung M3 Processor, HOTCHIPS 2018 PRESENTATION at 9 (2018).

263. The Samsung '689 Products provide a subset of image data stored in the second memory in the first memory.

264. One or more of the infringing Exynos products contains a GPU based on the Mali architecture. The units of work in the Mali GPU pipeline are scheduled on a per render-target basis, where a render target may be a window surface or an off-screen render buffer. A single render target is processed in a two-step process. First, the GPU processes the vertex shading[2] for all draw calls in the render target, and second, the fragment shading for the entire render target is processed. The logical rendering pipeline for Mali is therefore a three-stage pipeline of: CPU processing, geometry processing, and fragment processing stages.

265. The infringing Exynos chips are based on Mali microarchitecture. Specifically, chips such as the Exynos 7885 have Mali-G71 (Bifrost) architecture. These GPUs contain a control fabric as shown in the below slide from ARM entitled Bifrost Core Design.



Alan Tsai, *Bifrost – The GPU Architecture For The Next Five Billion*, ARM TRECH FOUJM PRESENTATION at 21 (July 1, 2016).

266. The Samsung '689 Products support the simultaneous encoding and decoding of more than one image of the video stream, by accessing said subset, wherein the simultaneously encoding/decoding is performed by access sharing to at least one image.

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

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

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

270. By making, using, testing, offering for sale, and/or selling products and services for encoding and decoding video data, including but not limited to the Samsung '689 Products,

Samsung has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '689 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

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

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

273. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '689 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '689 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '689 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '689 Products that have the capability of operating in a manner that infringe one or more of the claims of the '689 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '689 Products to utilize the products in a manner that directly infringe one or more claims of the '689 patent.[27] By providing instruction and training to customers and end-

[27] *See, e.g.*, *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Galaxy Note9*, SAMSUNG USER

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

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

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

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

MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL; *Galaxy Note9*, SAMSUNG SPEC SHEET.

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

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

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

279. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung products that comply with the H.265 video encoding standard. By way of example, the following Samsung Products perform encoding pursuant to the H.265 standard: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy S8, Galaxy S8+; and Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), Exynos 7 Series (7885), Exynos 7 Series (7880), Exynos 5 Series (7872), Exynos 8 Octa (8890), Exynos 7 Octa (7420), Exynos 7 Octa (7870), Exynos 7 Dual (7270) (collectively, the "Samsung '177 Product(s)").

280. The Samsung '177 Products perform video processing compliant with the H.265 standard. Specifically, the Samsung '177 products perform HEVC encoding. *See e.g.*, SAMSUNG S9 | S9+ THE PHONE REIMAGINED, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895) Specification*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing

specifications for the Exynos processors showing the accused Exynos Devices support HEVC encoding).

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

282. On information and belief, one or more of the Samsung '177 Products include technology for motion estimation and motion-compensated picture signal processing.

283. The Samsung '177 Products contain a hardware-based encoder on their system on chip ("SoC") processors.

> By fully supporting a 64-bit architecture in both hardware and software, the Exynos 7420 enables running performance intensive tasks without any buffering. . . . With a newly added HEVC (H.265) encoder to its advanced Multi Format Codec (MFC) that features H.265 (HEVC) decoder and VP9 decoder, the processor can record and playback 4K video at 30fps.

Exynos 7 Octa (7420), SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-7-octa-7420/.

284. Samsung has explained that its inclusion of HEVC decoding and encoding functionality in its system on chip products makes them "absolute multimedia powerhouse[s] . . . allow[ing] for ultra-smooth 4K video playback capabilities . . . ." *INTERVIEW: Meizu explains why Exynos powers its flagship device*, SAMSUNG WEBSITE BLOG (Dec. 16, 2016), *available at*: https://www.samsung.com/semiconductor/minisite/exynos/newsroom/blog/interview-meizu-explains-why-exynos-powers-its-flagship-device/.

285. The following excerpt from Samsung's documentation shows that the video captured using the Samsung Products is encoded using High Efficiency Video Coding ("HEVC"): "The powerful MFC in the Exynos 8895 allows users to not only play 4K contents but also record creative videos in 4K resolution using efficient video codec such as H.265 (HEVC)."

How the Exynos 8895 enables the Samsung Galaxy S8 and S8+ to push the limit, SAMSUNG WEBSITE (April 6, 2017), *available at*: https://www.samsung.com/semiconductor/insights/tech-trends/how-the-exynos-8895-enables-the-samsung-galaxy-s8-and-s8plus-to-push-the-limit/.

Innovation is Alive. Samsung Semiconductor at CES 2018, SAMSUNG WEBSITE (Jan. 19, 2018), *available at*: https://www.samsung.com/semiconductor/insights/news-events/innovation-is-alive-samsung-semiconductor-at-ces-2018/.

286. On information and belief, the Samsung '177 Products use a block-based motion vector estimation process that compares a plurality of candidate vectors to the determine block-based motion vectors.

287. On information and belief, the Samsung '177 Products contain a video encoder that selects an image segment of a second video image corresponding to an image segment of a first video image. The image segment has an image segment center.

288. On information and belief, the Samsung '177 Products use a Prediction Unit matching method wherein the motion vector represents the displacement between the current Prediction Unit in the current frame and the matching Prediction Unit in the reference frame.

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

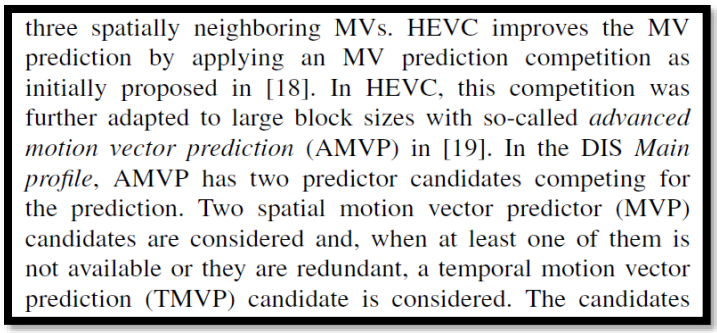
Sung-Fang Tsai, *et al., Encoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 347 (September 2014) (emphasis added).

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

290. On information and belief, one or more of the Samsung '177 Products include technology for motion estimation and motion-compensated picture signal processing.

291. On information and belief, one or more of the Samsung '177 Products include technology for estimating a current motion vector for a group of pixels of an image.

292. On information and belief, the Samsung '177 Products carry out a block-based motion vector estimation process that involves comparing a plurality of candidate vectors to determine block-based motion vectors. The Samsung '177 Products generate two predictor candidate motion vectors (a spatial motion vector and temporal motion vector). The first predictor candidate motion vector is drawn from a list of spatial motion vector candidates.



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

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

293. On information and belief, the Samsung '177 Products utilize a motion vector selection process wherein the candidate motion vectors are constructed into an index and then the motion vectors are compared. "In AMVP, the motion vector selection process is composed by two steps in encoder implementation. The first step is the motion vector candidate set construction process and the second step is the best motion vector selection step. In the first step, the motion vector candidate set is organized by selecting the motion vectors spatially and temporally." Gwo-Long Li, Chuen-Ching Wang, and Kuang-Hung Chiang, *An Efficient Motion Vector Prediction Method for Avoiding AMVP Data Dependency For HEVC*, 2014 IEEE INTERNATIONAL CONFERENCE ON ACOUSTIC, SPEECH AND SIGNAL PROCESSING (ICASSP) at 13 (2014).

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

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

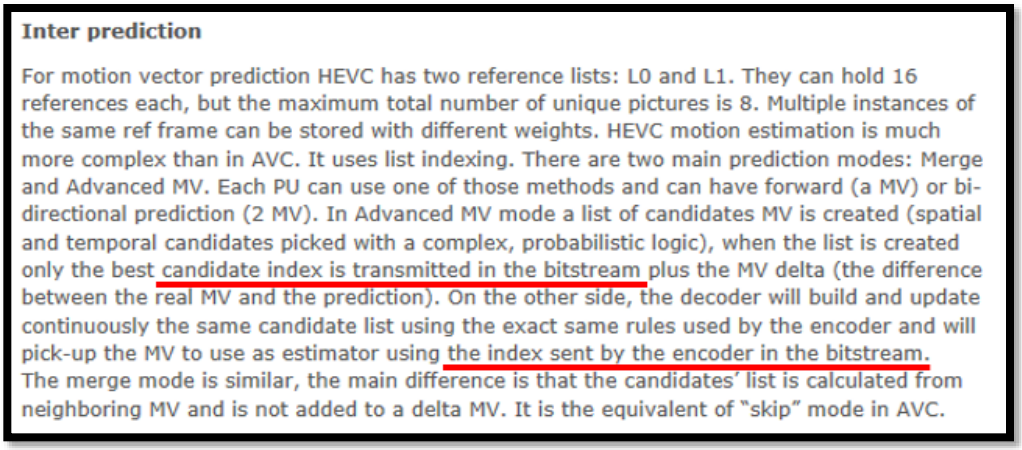
296. On information and belief, the Samsung '177 Products are provided to businesses and individuals located in the Eastern District of Texas.

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

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

299. On information and belief, the Samsung '177 Products use a block-based motion vector estimation process that compares a plurality of candidate vectors to determine block-based motion vectors. The Samsung '177 Products contain a video encoder that selects an image segment of a second video image corresponding to an image segment of a first video image.

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



Inter prediction

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

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

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

Thomas Wiegand, *Block Merging for Quadtree-Based Partitioning in HEVC, IEEE TRANS. CIR. AND SYS. FOR VIDEO TECHNOLOGY, Vol. 22* No. 12 (December 2012).

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

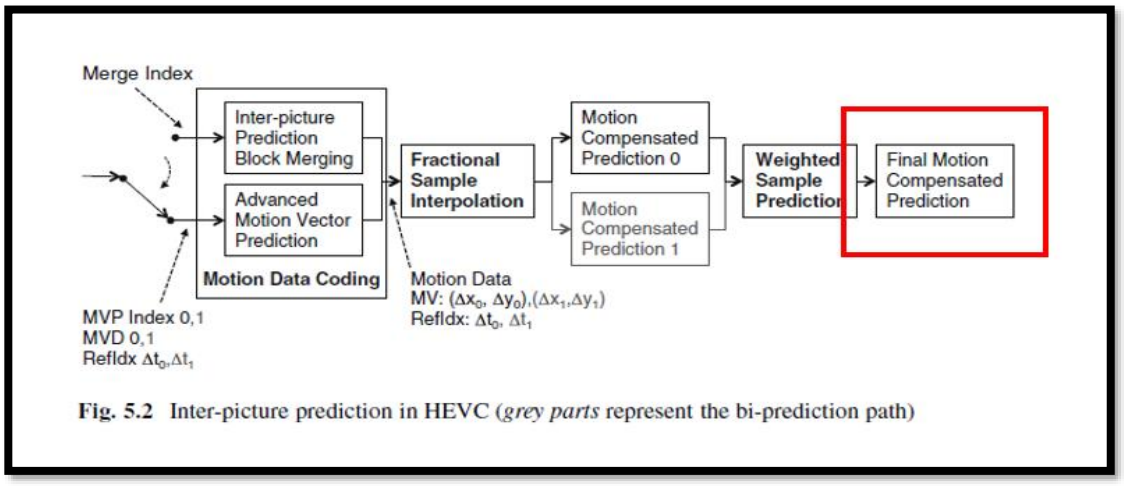


Fig. 5.2 Inter-picture prediction in HEVC (*grey parts* represent the bi-prediction path)

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

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

> Motion vector signaling: Advanced motion vector prediction (AMVP) is used, including derivation of several most probable candidates based on data from adjacent PBs and the reference picture. A "merge" mode for MV coding can be also used, allowing the inheritance of MVs from neighboring PBs. Moreover,

> compared to H.264/MPEG-4 AVC, improved "skipped" and "direct" motion inference are also specified.

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

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

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

306. On information and belief, Samsung has directly infringed and continues to directly infringe the '177 Patent by, among other things, making, using, offering for sale, and/or selling technology for determining motion vectors that are each assigned to individual image regions, including but not limited to the Samsung '177 Products.

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

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

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

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

311. Alternatively, Samsung has had knowledge of the '177 patent since at least May 12, 2009, when United States Patent No. 7,532,764, which is owned by Samsung and cites the '177 patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the '177 patent since at least October 15, 2013, when United States Patent No. 8,559,518, which is owned by Samsung and cites the '177 patent as relevant prior art, was issued.

312. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '177 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '177 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '177 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '177 Products that have the capability of operating in a manner that infringe one or more of the claims of the '177 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '177 Products to utilize the products in a manner that directly infringe one or more claims of the '177 patent.[28] By providing instruction and training to customers and end-

[28] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Galaxy Note9,* SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Exynos 5 Series (7872): Diffusion of Prime Performance*, SAMSUNG WEBSITE, *available at*:

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

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

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

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

---

https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-5-series-7872/ (last visited Nov. 2018).

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

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

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

318. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung products that comply with the H.265 video encoding standard. By way of example, the following Samsung Products perform encoding pursuant to the H.265 standard: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy S8, Galaxy S8+; and Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), Exynos 7 Series (7885), Exynos 7 Series (7880), Exynos 5 Series (7872), Exynos 8 Octa (8890), Exynos 7 Octa (7420), Exynos 7 Octa (7870), Exynos 7 Dual (7270) (collectively, the "Samsung '112 Product(s)").

319. The Samsung 'XXX Products perform video processing compliant with the H.265 standard. Specifically, the Samsung 'XXX products perform HEVC encoding. *See e.g.*, SAMSUNG S9 | S9+ THE PHONE REIMAGINED, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895) Specification*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing

specifications for the Exynos processors showing the accused Exynos Devices support HEVC encoding).

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

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

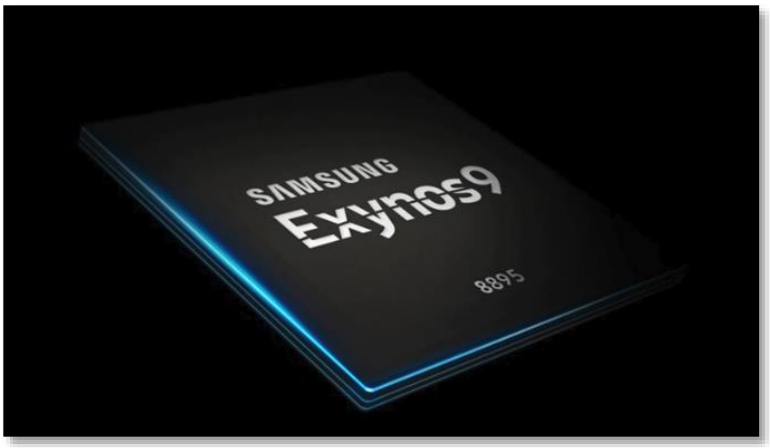
322. The Samsung '112 Products contain a hardware-based encoder on their system on chip ("SoC") processors.

> By fully supporting a 64-bit architecture in both hardware and software, the Exynos 7420 enables running performance intensive tasks without any buffering. . . . With a newly added HEVC (H.265) encoder to its advanced Multi Format Codec (MFC) that features H.265 (HEVC) decoder and VP9 decoder, the processor can record and playback 4K video at 30fps.

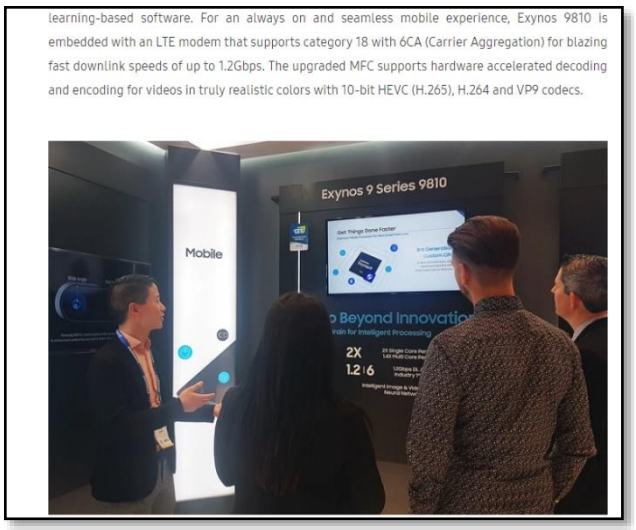
Exynos 7 Octa (7420), SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-7-octa-7420/.

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

324. The following excerpt from Samsung's documentation shows that the video captured using the Samsung Products is encoded using High Efficiency Video Coding ("HEVC"): "The powerful MFC in the Exynos 8895 allows users to not only play 4K contents but also record creative videos in 4K resolution using efficient video codec such as H.265 (HEVC)."



How the Exynos 8895 enables the Samsung Galaxy S8 and S8+ to push the limit, SAMSUNG WEBSITE (April 6, 2017), *available at*: https://www.samsung.com/semiconductor/insights/tech-trends/how-the-exynos-8895-enables-the-samsung-galaxy-s8-and-s8plus-to-push-the-limit/.



Innovation is Alive. Samsung Semiconductor at CES 2018, SAMSUNG WEBSITE (Jan. 19, 2018), *available at*: https://www.samsung.com/semiconductor/insights/news-events/innovation-is-alive-samsung-semiconductor-at-ces-2018/.

325. The Samsung '112 Products contain an image processing unit that receives, at a minimum, two frames of a video from memory. These frames are then processed by the video compensation unit of the Samsung Products. Further, the Samsung Products contain an encoder for motion estimation. "[***T]he encoder needs to perform motion estimation***, which is one of the

most computationally expensive operations in the encoder, and complexity is reduced by allowing less candidates."[29]

326. The Samsung '112 Products perform encoding using motion compensation, specifically, inter-picture prediction wherein the Samsung Product makes use of the temporal correlation between pictures in order to derive a motion-compensated prediction for a block of image samples. Each image is divided into blocks (prediction units) and the Samsung '112 Product compares the prediction unit in a first image with the spatially neighboring prediction units in a second image (reference image). The displacement between the current prediction unit and the matching prediction unit in the second image (reference image) is signaled using a motion vector.

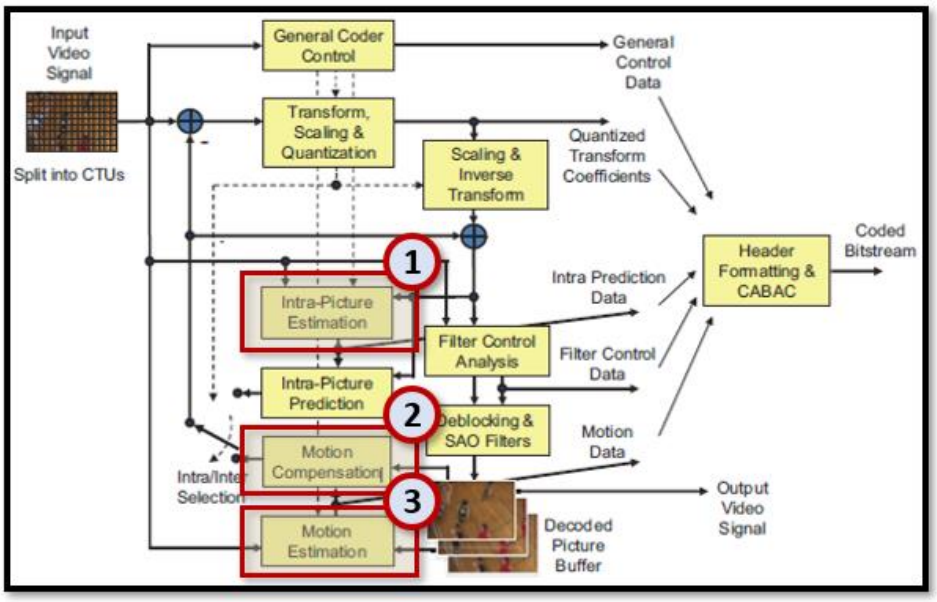
327. The Samsung '112 Products contain functionality wherein during the motion estimation process the block size used for prediction units can range from 4 × 8/8 × 4 to 64 × 64.

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

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

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

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



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).

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

Summary

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

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

330. Samsung has directly infringed and continues to directly infringe the '112 Patent by, among other things, making, using, offering for sale, and/or selling technology for video compression, including but not limited to the Samsung '112 Products.

331. The Samsung '112 Products comprise a system wherein an intra-frame coding unit is configured to perform predictive coding on a set of pixels of a macroblock of pixels. Further, the predictive coding functionality uses a first group of reference pixels and a macroblock of pixels from the video frame. Specifically, the Samsung Products, when selecting a temporal candidate for HEVC intra-frame encoding, default to the right bottom position just outside of the collocated prediction unit.

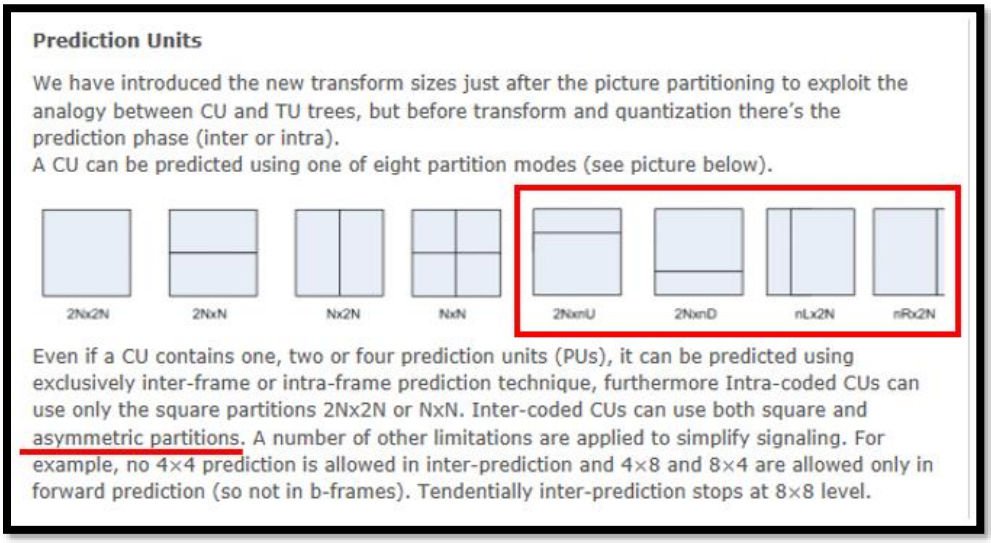
> It can be seen from Fig. 5.4b that only motion vectors from spatial neighboring blocks to the left and above the current block are considered as spatial MVP candidates. This can be explained by the fact that the blocks to the right and below the current block are not yet decoded and hence, their motion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

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

332. Descriptions of the HEVC encoding process, which are implemented by the Samsung '112 Products, state "for the temporal candidate, the right bottom position just outside of the collocated PU of the reference picture is used if it is available. Otherwise, the center position is used instead." Gary J. Sullivan, *et al., Overview of the High Efficiency Video Coding (HEVC) Standard,* IEEE TRANS. ON CIRCUIT AND SYSTEMS FOR VIDEO TECHNOLOGY at 13 (December 2012).

333. The Samsung '112 Products encode video data such that a predetermined search area (S) center is offset from the center of the image segment. The predetermined search area is

called a partition and there are eight different partition modes in the H.265 standard, these partition modes are shown in the figure below. The last four partition modes are asymmetric, meaning their center is offset from the overall CU center.



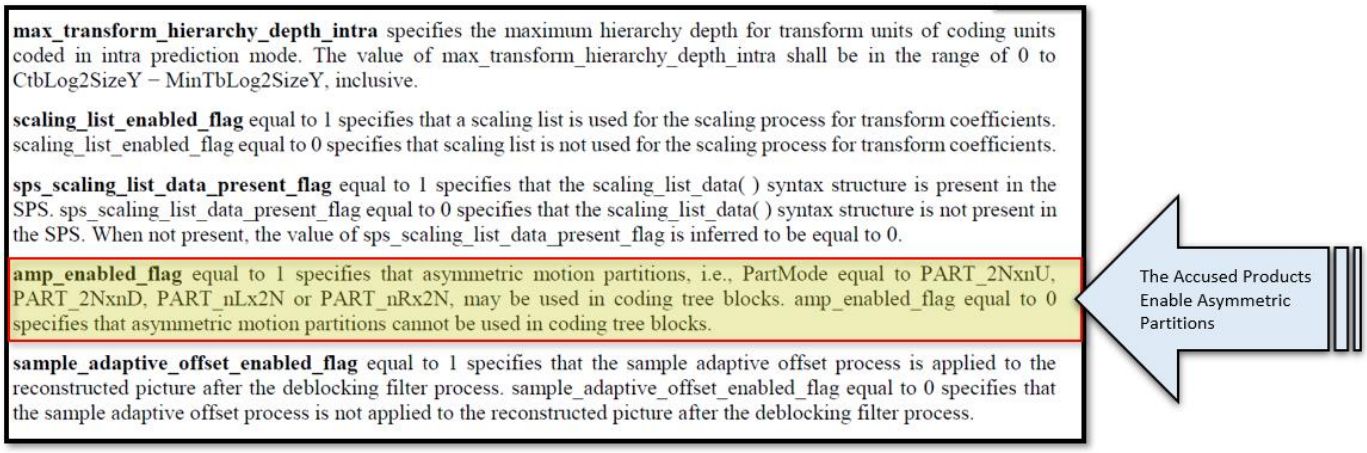
Prediction Units

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

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

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

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



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

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

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

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

sample_adaptive_offset_enabled_flag equal to 1 specifies that the sample adaptive offset process is applied to the reconstructed picture after the deblocking filter process. sample_adaptive_offset_enabled_flag equal to 0 specifies that the sample adaptive offset process is not applied to the reconstructed picture after the deblocking filter process.

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

335. The Samsung '112 Products receive encoded video data that is encoded using intra-frame coding. Specifically, the encoded video stream received by the Samsung '112 Products is coded using a reference group of pixels in the video frame. Intra-frame prediction used in the encoded video data received by the Samsung '112 Products allows a transform block to span across multiple prediction blocks for intra-frame-picture predicted coding units to maximize the potential coding efficiency benefits of the quadtree-structured transform block partitioning.

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

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

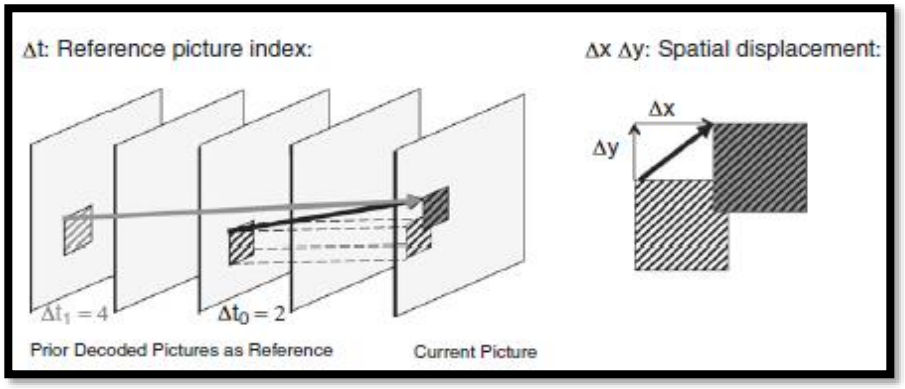
336. The Samsung '112 Products comprise functionality for retrieving image motion data related to the search area. Specifically, the Samsung '112 Products retrieve data relating to the motion search area. The data, which includes the motion vector index, is sent from the encoder and retrieved by the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

> Since inter-picture prediction typically compensates for the motion of real-world objects between pictures of a video sequence, it is also referred to as motion-compensated prediction. While intra-picture prediction exploits the spatial redundancy between neighboring blocks inside a picture, motion-compensated prediction utilizes the large amount of temporal redundancy between pictures. In either case, the resulting prediction error, which is formed by taking the difference between the original block and its prediction, ***is transmitted using transform coding, which exploits the spatial redundancy inside a block and consists of a decorrelating linear transform, scalar quantization*** of the transform coefficients and entropy coding of the resulting transform coefficient levels.

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

337. Samsung '112 Products comprise an inter-frame coding unit that is configured to perform predictive coding on the rest of the macroblock of pixels using a second group of reference

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



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

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

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

340. On information and belief, by complying with the HEVC standard, the Samsung devices – such as the Samsung '112 Products - necessarily infringe the '112 patent. The mandatory

sections of the HEVC standard require the elements required by certain claims of the '112 patent, including but not limited to claim 11 of the '112 patent. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018) (The following sections of the HEVC Standard are relevant to Samsung's infringement of the '112 patent: "8.3.2 Decoding process for reference picture set;" "8.5.4 Decoding process for the residual signal of coding units coded in inter prediction mode;" "8.6 Scaling, transformation and array construction process prior to deblocking filter process;" "8.5.2 Inter prediction process;" "8.5.3 Decoding process for prediction units in inter prediction mode;" and "8.7.2 Deblocking filter process;" "8.7.3 Sample adaptive offset process.").

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

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

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

344. Alternatively, Samsung has had knowledge of the '112 patent since at least June 19, 2015, when Korean Patent No. KR101530284B1, which is owned by Samsung and cites the '112 patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the

‘112 patent since at least June 18, 2014, when European Patent Application No. EP2744204A4, which is owned by Samsung and cites the ‘112 patent as relevant prior art, was filed.

345. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung ‘112 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the ‘112 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the ‘112 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung ‘112 Products that have the capability of operating in a manner that infringe one or more of the claims of the ‘112 patent, including at least claim 11, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung ‘112 Products to utilize the products in a manner that directly infringe one or more claims of the ‘112 patent.[30] By providing instruction and training to customers and end-users on how to use the Samsung ‘112 Products in a manner that directly infringes one or more claims of the ‘112 patent, including at least claim 11, Samsung specifically intended to induce

[30] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Galaxy Note9*, SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World’s First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Exynos 5 Series (7872): Diffusion of Prime Performance*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-5-series-7872/ (last visited Nov. 2018).

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

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

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

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

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

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

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

351. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung products that comply with the H.265 video encoding standard. By way of example, the following Samsung Products perform encoding pursuant to the H.265 standard: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy S8, Galaxy S8+; and Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), Exynos 7 Series (7885), Exynos 7 Series (7880), Exynos 5 Series (7872), Exynos 8 Octa (8890), Exynos 7 Octa (7420), Exynos 7 Octa (7870), Exynos 7 Dual (7270) (collectively, the "Samsung '529 Product(s)").

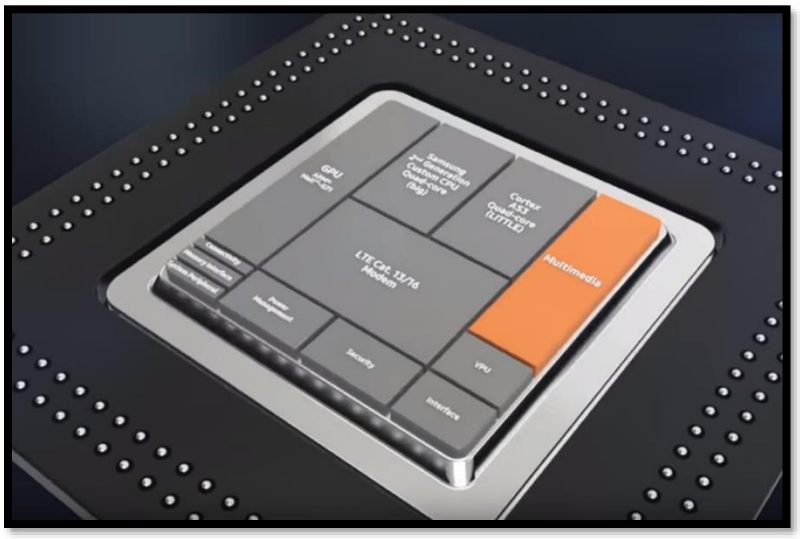
352. The Samsung '529 Products perform video processing compliant with the H.265 standard. Specifically, the Samsung '529 products perform HEVC encoding. *See e.g.*, SAMSUNG S9 | S9+ THE PHONE REIMAGINED, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895) Specification*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing specifications for the Exynos processors showing the accused Exynos Devices support HEVC encoding).

353. The Samsung ‘529 Products contain a hardware-based decoder on their system on chip (“SoC”) processors.

> By fully supporting a 64-bit architecture in both hardware and software, the Exynos 7420 enables running performance intensive tasks without any buffering. . . . With a newly added HEVC (H.265) encoder to its advanced Multi Format Codec (MFC) that features H.265 (HEVC) decoder and VP9 decoder, the processor can record and playback 4K video at 30fps.

Exynos 7 Octa (7420), SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-7-octa-7420/.

354. The following image of the Samsung Exynos 9 Series processor shows two central processing units and two graphics processing units that process pixel information by receiving video data comprising a first and second image block.



Introducing the Samsung Exynos 9 Series (8995) processor, SAMSUNG YOUTUBE CHANNEL (April 11, 2017), *available at*: https://www.youtube.com/watch?v=ZayD-rzml-4.

355. The Samsung ‘529 Products contain a processor for decoding the received encoded frame-based encoded video data. Further, the Samsung ‘529 Products apply a remapping policy to the first frame of decoded video data using a region-based luma analysis. As part of the decoding process performed by Samsung ‘529 Products, a reference picture (first frame) is

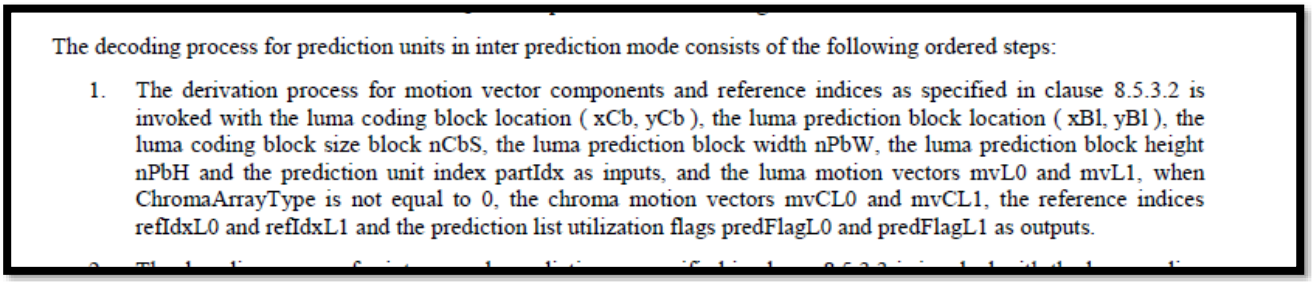
decoded and two in-loop filters (deblocking and a sample adaptive offset) are applied to the reference picture.

356. The Samsung '529 Products contain video processing functionality that complies with the HEVC standard.

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

358. On information and belief, by complying with the HEVC standard, the Samsung devices – such as the Samsung '529 Products - necessarily infringe the '529 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '529 patent, including but not limited to claim 1. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018). The following sections of the HEVC Standard are relevant to Samsung's infringement of the '529 patent: "3.110 Prediction Unit Definition;" "6.3.2 Block and quadtree structures;" "6.3.3 Spatial or component-wise partitioning;" "6.4.2 Derivation process for prediction block availability;" "7.3.8.5 Coding unit syntax;" "7.3.8.6 Prediction unit syntax;" "8.3.2 Decoding process for reference picture set;" "8.5.4 Decoding process for the residual signal of coding units coded in inter prediction mode;" "8.6 Scaling, transformation and array construction process prior to deblocking filter process;" "8.5.2 Inter prediction process;" "8.5.3 Decoding process for prediction units in inter prediction mode;" and "8.7.2 Deblocking filter process."

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



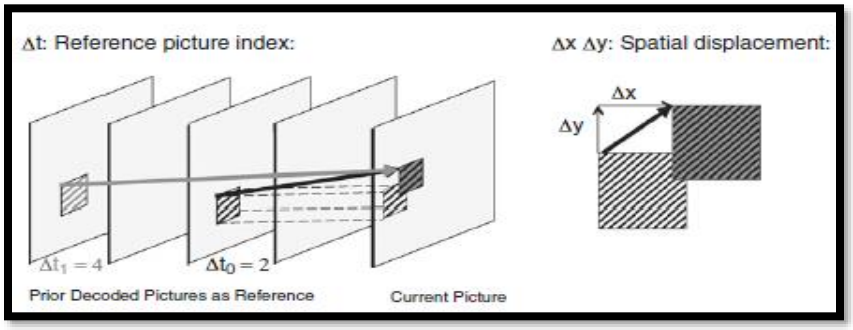
The decoding process for prediction units in inter prediction mode consists of the following ordered steps:

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

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

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

361. On information and belief, the encoded video stream received by the Samsung '529 Products is encoded using inter-picture prediction that makes use of the temporal correlation between pictures to derive a motion-compensated prediction (MCP) for a block of image samples. For this block-based motion compensated prediction, a video picture is divided into rectangular blocks. Assuming homogeneous motion inside one block, and that moving objects are larger than one block, for each block, a corresponding block in a previously decoded picture can be found that serves as a predictor. The general concept of inter-frame-based encoding using motion-compensated prediction based on a translational motion model is illustrated below.



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

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

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

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

363. On information and belief, the Samsung '529 Products receive encoded video data that is encoded using inter-frame coding. Specifically, the encoded video stream received by the Samsung '529 Products is coded using its predecessor frame. Inter-prediction used in the encoded

video data received by the Samsung '529 Products allows a transform block to span across multiple prediction blocks for inter-picture predicted coding units to maximize the potential coding efficiency benefits of the quadtree-structured transform block partitioning.

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

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

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

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

Mehul Tikekar, *et al.*, *Decoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) (September 2014).

365. On information and belief, any implementation of the HEVC standard infringes the '529 patent as every implementation of the standard requires: determining at least a second image block through which the motion vector assigned to the first image block at least partially passes; generating the modified motion vector as a function of a motion vector assigned to at least the second image block; and assigning the modified motion vector as the motion vector to the first image block. Further, the functionality of the motion estimation process in HEVC uses "motion vector[s]: A two-dimensional vector used for *inter prediction* that provides an offset from the

coordinates in the decoded picture to the coordinates in a reference picture," as defined in definition 3.83 of the *ITU-T H.265 Series H: Audiovisual and Multimedia Systems* (2018) (emphasis added); *see also, e.g.,* Gary J. Sullivan, Jens-Rainer Ohm, Woo-Jin Han, and Thomas Wiegand, *Overview of the High Efficiency Video Coding (HEVC) Standard*, published in IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, Vol. 22, No. 12 at 1650 (December 2012) ("The encoder and decoder generate identical inter picture prediction signals by applying motion compensation (MC) using the MV and mode decision data.").

366. The motion estimation done by the Samsung '529 Products is done through a PU matching method where the motion vector represents the displacement between the current PU in the current frame and the matching PU in the reference frame.

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

Sung-Fang Tsai, *et al., Encoder Hardware Architecture for HEVC*, HIGH EFFICIENCY VIDEO CODING (HEVC) at 347 (September 2014) (emphasis added).

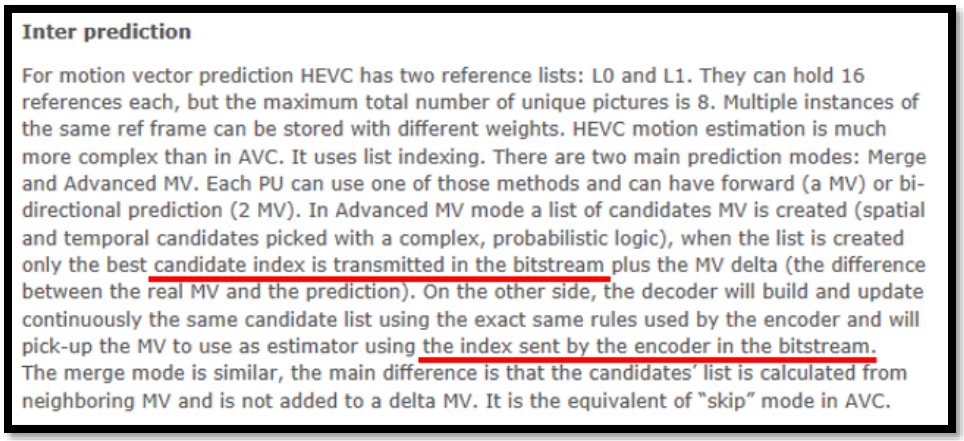
367. On information and belief, the Samsung '529 Products perform the step of assigning the modified motion vector as the motion vector to the first image block. Specifically, the Samsung '529 Products, through the use of AMVP and Merge Mode, select the modified motion vector and assign it to a first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

> A block-wise prediction residual is computed from corresponding regions of previously decoded pictures (inter-picture motion compensated prediction) or neighboring previously decoded samples from the same picture (intra-picture spatial prediction). The residual is then processed by a block transform, and the

> transform coefficients are quantized and entropy coded. Side information data such as motion vectors and mode switching parameters are also encoded and transmitted.

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

368. On information and belief, the Samsung '529 Products transmit into the bitstream the candidate index of motion vectors. HEVC documentation states that the coding process will "pick up the MV [motion vector] to use as an estimator using the index sent by the encoder in the bitstream."



Inter prediction

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

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

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

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

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

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

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

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

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

376. Alternatively, Samsung has had knowledge of the '529 patent since at least June 28, 2012, when United States Patent Application No. 13/313,626, which is owned by Samsung and cites the '529 patent as relevant prior art, was published.

377. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '529 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '529 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '529 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '529 Products that have the capability of operating

in a manner that infringe one or more of the claims of the '529 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '529 Products to utilize the products in a manner that directly infringe one or more claims of the '529 patent.[31] By providing instruction and training to customers and end-users on how to use the Samsung '529 Products in a manner that directly infringes one or more claims of the '529 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '529 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '529 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '529 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '529 patent, knowing that such use constitutes infringement of the '529 patent.

378. The '529 patent is well-known within the industry as demonstrated by multiple citations to the '529 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '529 patent without paying a reasonable royalty. Samsung is infringing the '529 patent in a manner

[31] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Galaxy Note9*, SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Exynos 5 Series (7872): Diffusion of Prime Performance*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-5-series-7872/ (last visited Nov. 2018).

best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

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

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

COUNT VIII
INFRINGEMENT OF U.S. PATENT NO. 7,519,230

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

382. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for selecting a background motion vector for a pixel in an occlusion region of an image.

383. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung Exynos System-on-Chip (SOC) processors that contain VP9 encoding functionality, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), and Exynos 8 Octa (8890) (collectively, the "Samsung '230 Product(s)").

384. The Samsung '230 Products perform video processing compliant with the VP9 standard. Specifically, the Samsung '230 products perform VP9 encoding. *See e.g., Samsung Exynos 9 Series (8895) Specification*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-

series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors,* SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing specifications for the Exynos processors showing the accused Exynos Devices support HEVC encoding).

385. On information and belief, one or more Samsung subsidiaries and/or affiliates use the Samsung '230 Products in regular business operations.

386. On information and belief, one or more of the Samsung '230 Products include technology for selecting a background motion vector for a pixel in an occlusion region of an image.

387. On information and belief, one or more of the Samsung '230 Products use a processor to 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 an image.

388. On information and belief, one or more of the Samsung '230 Products use a processor to compare the model-based motion vector with each of the motion vectors of the set of motion vectors.

389. On information and belief, one or more of the Samsung '230 Products use a processor to select a particular motion vector of the set of motion vectors on the basis of the comparing and for assigning the particular motion vector as the background motion vector.

390. The Samsung ‘230 Products enable the use of segmentation where it is used to “identify background and foreground areas in encoded video content.”

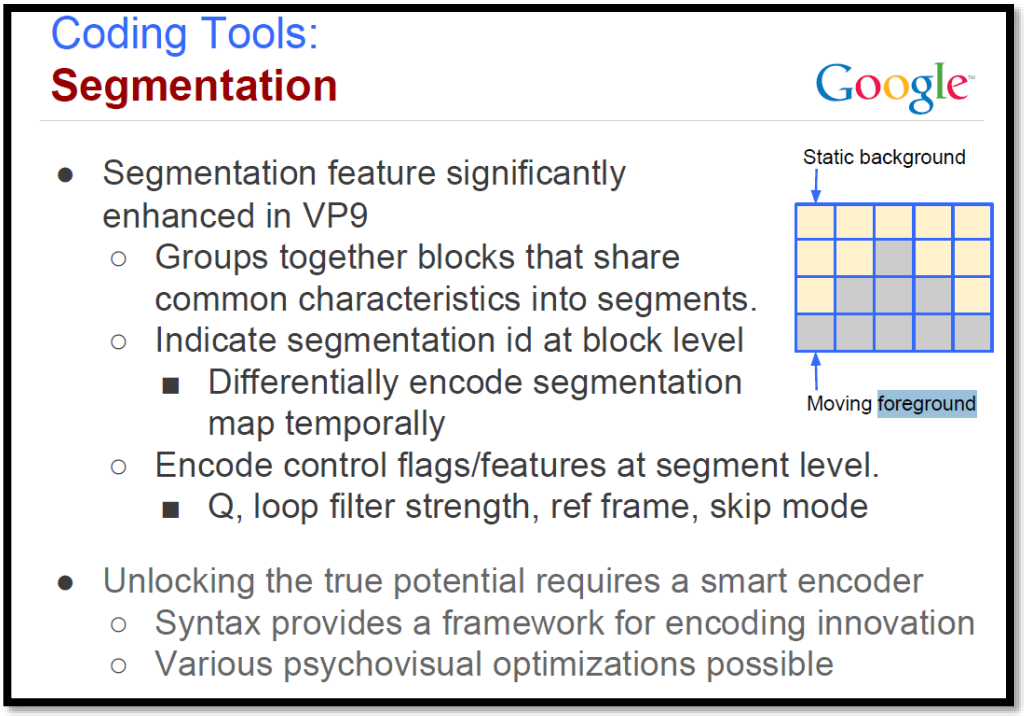
> In the reference implementation, segmentation is currently used to identify background and foreground areas in encoded video content. The (static) background is then coded at a higher quality compared to the rest of the frame in certain reference frames (such as the alt-ref frame) that provides prediction 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).

391. On information and belief, the Samsung ‘230 Products are available to businesses and individuals throughout the United States.

392. On information and belief, the Samsung ‘230 Products are provided to businesses and individuals located in the Eastern District of Texas.

393. On information and belief, Samsung has directly infringed and continues to directly infringe the ‘230 patent by, among other things, making, using, offering for sale, and/or selling technology for selecting a background motion vector for a pixel in an occlusion region of an image, including but not limited to the Samsung ‘230 Products.



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

394. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the Samsung '230 Products, Samsung has injured Dynamic Data and is liable for directly infringing one or more claims of the '230 patent, including at least claim 6, pursuant to 35 U.S.C. § 271(a).

395. On information and belief, Samsung also indirectly infringes the '230 patent by actively inducing infringement under 35 USC § 271(b).

396. On information and belief, Samsung has had knowledge of the '230 patent since at least service of the Original Complaint in this case or shortly thereafter, and on information and belief, Samsung knew of the '230 patent and knew of its infringement, including by way of this lawsuit.

397. Alternatively, Samsung has had knowledge of the '230 patent since at least August 2, 2011, when United States Patent No. 7,990,476, which is owned by Samsung and cites the '230

patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the '230 patent since at least February 2, 2007, when Korean Patent No. 100677562B1, which is owned by Samsung and cites the '230 patent as relevant prior art, was issued.

398. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '230 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. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '230 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '230 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '230 Products that have the capability of operating in a manner that infringe one or more of the claims of the '230 patent, including at least claim 6, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '230 Products to utilize the products in a manner that directly infringe one or more claims of the '230 patent.[32] By providing instruction and training to customers and end-users on how to use the Samsung '230 Products in a manner that directly infringes one or more claims of the '230 patent, including at least claim 6, Samsung specifically intended to induce infringement of the '230 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '230 Products, e.g., through Samsung user manuals, product

[32] *See, e.g.*, *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018).

support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '230 patent. Accordingly, Samsung 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 '230 patent, knowing that such use constitutes infringement of the '230 patent.

399. The '230 patent is well-known within the industry as demonstrated by multiple citations to the '230 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '230 patent without paying a reasonable royalty. Samsung is infringing the '230 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

400. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '230 patent.

401. As a result of Samsung's infringement of the '230 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

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

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

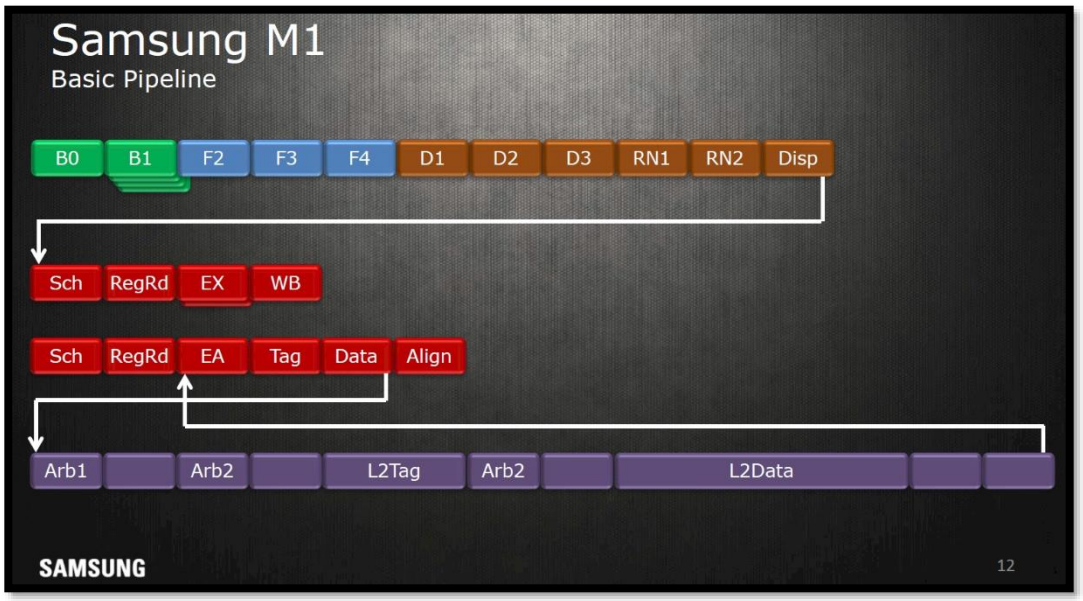
403. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for dynamically configuring a multi-pipe pipeline system.

404. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 7 Dual (7270), Exynos 7 Octa (7420), Exynos 7 Octa (7580), Exynos 7 Octa (7870), Exynos 7 Quad (7570), Exynos 7 Series (7880), Exynos 7 Series (7885), Exynos 7 Series (9610), Exynos 8 Octa (8890), Exynos 9 Series (8895), and Exynos 9 Series (9810); and Samsung Mobile Galaxy products, including: Galaxy Note8, Galaxy Note9, Galaxy S7, Galaxy S7 Active, Galaxy S7 Edge, Galaxy S8, Galaxy S8+, Galaxy S9, Galaxy S9+ (collectively, the "Samsung '041 Product(s)").

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

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

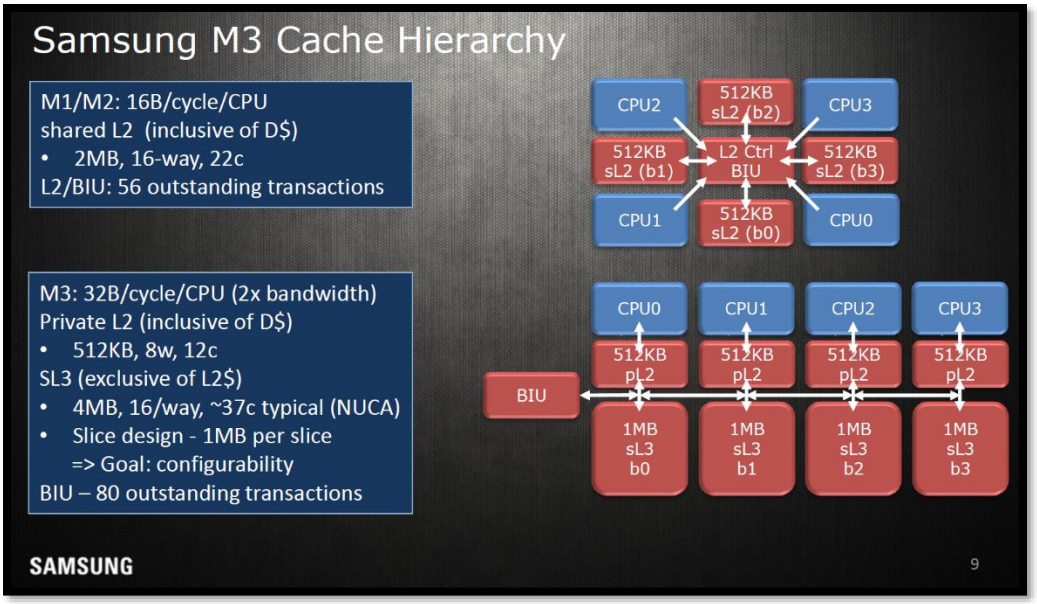
407. The below image shows the Basic Pipeline structure in the Samsung M1 product. The Samsung M1 is a microarchitecture for a subset of the accused Samsung Exynos SoC processors.



Brad Burgess, SAMSUNG EXYNOS M1 PROCESSOR, HOTCHIPS 2016 PRESENTATION at 12 (2016) (showing the basic pipelines structure in the Samsung Exynos M1 microarchitecture).

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

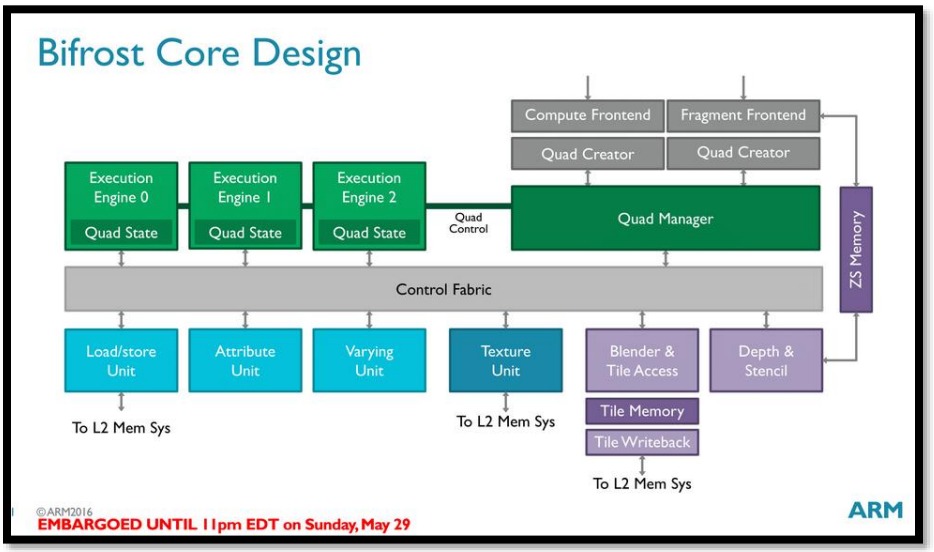
409. On information and belief, the '041 Products have various memory structures including an L2 and L1 cache that are connected to the processing unit. These connections between cache memory structures and the processing unit are shown below.



Jeff Rupley, Samsung M3 Processor, HOTCHIPS 2018 PRESENTATION at 9 (2018).

410. One or more of the infringing Exynos products contains a GPU based on the Mali architecture. The units of work in the Mali GPU pipeline are scheduled on a per render-target basis, where a render target may be a window surface or an off-screen render buffer. A single render target is processed in a two-step process. First, the GPU processes the vertex shading[2] for all draw calls in the render target, and second, the fragment shading for the entire render target is processed. The logical rendering pipeline for Mali is therefore a three-stage pipeline of: CPU processing, geometry processing, and fragment processing stages.

411. The infringing Exynos chips are based on Mali microarchitecture. Specifically, chips such as the Exynos 7885 have Mali-G71 (Bifrost) architecture. These GPUs contain a control fabric as shown in the below slide from ARM entitled Bifrost Core Design.



Alan Tsai, Bifrost – The GPU Architecture For The Next Five Billion, ARM TRech Foujm Presentation at 21 (July 1, 2016).

412. On information and belief, the Samsung '041 Products are provided to businesses and individuals located in the United States.

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

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

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

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

417. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '041 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '041 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '041 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '041 Products that have the capability of operating in a manner that infringe one or more of the claims of the '041 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '041 Products to utilize the products in a manner that directly infringe one or more claims of the '041 patent.[33] By providing instruction and training to customers and end-users on how to use the Samsung '041 Products in a manner that directly infringes one or more claims of the '041 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '041 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '041 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused

[33] *See, e.g.*, *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL; *Galaxy Note9*, SAMSUNG SPEC SHEET.

products to infringe the '041 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '041 patent, knowing that such use constitutes infringement of the '041 patent.

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

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

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

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

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

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

423. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung products containing H.265-compliant decoding functionality, including but not limited to: Galaxy

Note9, Galaxy S9, Galaxy S9+, Galaxy Note8, Galaxy S8, Galaxy S8+, Galaxy S7, Galaxy S7 Edge, Galaxy S7 Active; Samsung Smart TVs, including model groups: 18TV_Premium (UHD), 18TV_STANDARD1 (UHD), 18TV_STANDARD2 (UHD), 18TV_STANDARD3 (FHD), 2017 - 17TV_PREMIUM (UHD), 17TV_STANDARD (FHD), 17AV_BD (UHD), 16TV_PREMIUM (UHD), 16TV_STANDARD1 (UHD), 16TV_STANDARD2 (FHD), 15TV_PREMIUM (UHD), 15TV_STANDARD1 (UHD), 15TV_STANDARD2 (FHD); and Samsung Tablet products, including: Galaxy Tab S2, Galaxy Tab S3, Galaxy Tab E, Galaxy Tab S, Galaxy Tab S4, Galaxy Tab A 10.1 (2016), Galaxy Tab A 7.0 (2016), Galaxy TabPro S, Galaxy Tab A (collectively, the "Samsung '450 Product(s)").

424. The Samsung '450 Products perform video processing compliant with the H.265 standard. Specifically, the Samsung '450 products perform HEVC decoding. *See e.g.*, *Samsung S9 | S9+ The Phone Reimagined*, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895)*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos 8895 Specifications*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors Listing*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing

specifications for the Exynos processors showing the accused Exynos Devices support HEVC decodinmg); *Samsung S8 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s8/specs/; *Samsung S7 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s7/; Samsung SmartTV Specifications 2015-2019, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications (containing links to the accused Samsung TV's showing that they support HEVC decoding).

425. On information and belief, by complying with the HEVC standard, the Samsung devices – such as the Samsung '450 Products - necessarily infringe the '450 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '450 patent, including but not limited to claim 8. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018). The following sections of the HEVC Standard are relevant to Samsung's infringement of the '450 patent: "5.3 Logical operators;" "5.10 Variables, syntax elements and tables;" "5.11 Text description of logical operations;" "7.2 Specification of syntax functions and descriptors;" "7.3.1 NAL unit syntax;" "7.3.2 Raw byte sequence payloads, trailing bits and byte alignment syntax;" "7.3.5 Supplemental enhancement information message syntax;" "7.4.2 NAL unit semantics;" and "7.4.6 Supplemental enhancement information message semantics."

426. On information and belief, the Samsung '450 Products receive data that is segmented into Network Abstraction Layer ("NAL") Units. NAL Units are segments of data that can include video data and overlay data (such as captions and overlay images). The Samsung '450 Products support the receipt of VCL and non-VCL NAL units. The VCL NAL units contain the

data that represents the values of the samples in the video pictures, and the non-VCL NAL units contain any associated additional information such as parameter sets or overlay data.

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

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

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

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

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

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

> HEVC uses a NAL unit based bitstream structure. A coded bitstream is partitioned into NAL units which, when conveyed over lossy

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

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

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

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

High Efficiency Video Coding, SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 at § 7.3.5 (February 2018).

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

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

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

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

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

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

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

437. On information and belief, one or more of the Samsung ‘450 Products perform a method of displaying information on a display device wherein switching from the first one of the services to a second one of the services, characterized in comprising a second step of filtering to select a second data-element of the second one of the services, on the basis of the user selection is performed.

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

439. On information and belief, the Samsung ‘450 Products are available to businesses and individuals throughout the United States.

440. On information and belief, the Samsung ‘450 Products are provided to businesses and individuals located in the Eastern District of Texas.

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

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

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

444. Alternatively, Samsung has had knowledge of the ‘450 patent since at least January 10, 2012, when United States Patent No. 8,095,887, which is owned by Samsung and cites the ‘450 patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the ‘450 patent since at least November 11, 2009, when European Patent Application No. EP1935174A4, which is owned by Samsung and cites the ‘450 patent as relevant prior art, was published. Alternatively, Samsung has had knowledge of the ‘450 patent since at least January 29, 2009, when Japanese Patent Application No. JP2009503604A, which is owned by Samsung and cites the ‘450 patent as relevant prior art, was published.

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

or more claims of the '450 patent.[34] By providing instruction and training to customers and end-users on how to use the Samsung '450 Products in a manner that directly infringes one or more claims of the '450 patent, including at least claim 8, Samsung specifically intended to induce infringement of the '450 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '450 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '450 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '450 patent, knowing that such use constitutes infringement of the '450 patent.

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

[34] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL; *2018 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2018-tv-video-specifications (last visited Nov. 2018); *2017 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2017-tv-video-specifications (last visited Nov. 2018); *2016 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2016-tv-video-specifications (last visited Nov. 2018); *2015 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2015-tv-video-specifications (last visited Nov. 2018); *Galaxy Tab S2 Tablet*, SAMSUNG USER MANUAL (2016); *Galaxy Tab E Android Tablet*, SAMSUNG USER MANUAL (2015); *Galaxy Tab S4*, SAMSUNG USER MANUAL (2018); *Galaxy Tab A Tablet*, SAMSUNG USER MANUAL (2016).

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

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

COUNT XI
INFRINGEMENT OF U.S. PATENT NO. 7,750,979

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

450. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for motion compensation in video signal processing.

451. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 7 Dual (7270), Exynos 7 Octa (7420), Exynos 7 Octa (7580), Exynos 7 Octa (7870), Exynos 7 Quad (7570), Exynos 7 Series (7880), Exynos 7 Series (7885), Exynos 7 Series (9610), Exynos 8 Octa (8890), Exynos 9 Series (8895), and Exynos 9 Series (9810); and Samsung Mobile Galaxy products, including: Galaxy Note8, Galaxy Note9, Galaxy S7, Galaxy S7 Active, Galaxy S7 Edge, Galaxy S8, Galaxy S8+, Galaxy S9, Galaxy S9+ (collectively, the "Samsung '979 Product(s)").

452. On information and belief, one or more Samsung subsidiaries and/or affiliates use the Samsung '979 Products in regular business operations.

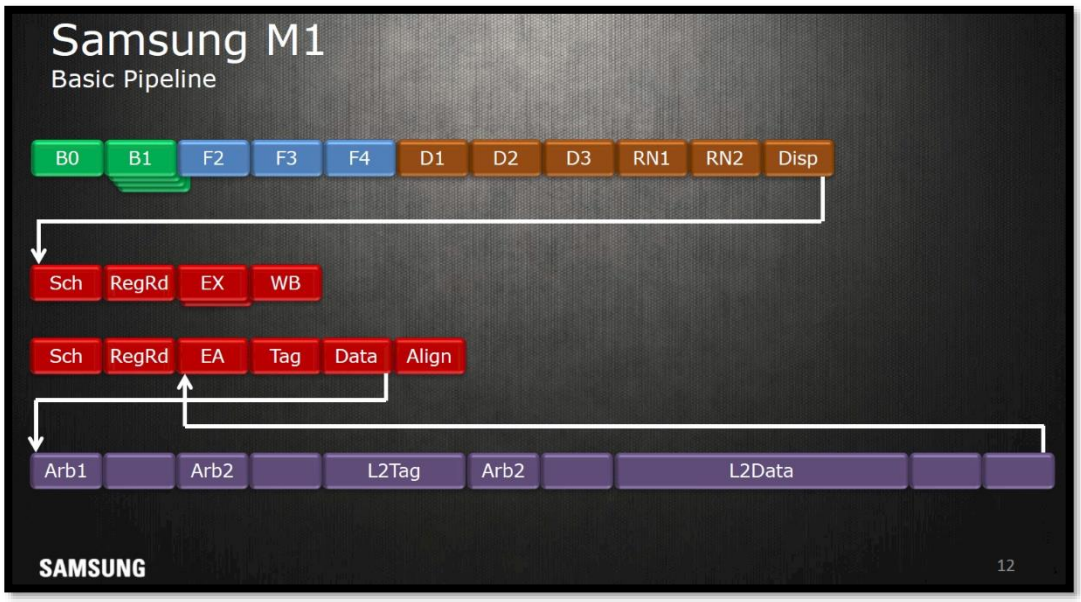
453. On information and belief, one or more of the Samsung '979 Products include technology for motion compensation in video signal processing.

454. On information and belief, Samsung has directly infringed and continues to directly infringe the '979 patent by, among other things, making, using, offering for sale, and/or selling technology for motion compensation in video signal processing, including but not limited to the Samsung '979 Products.

455. On information and belief, the Samsung '979 Products have an input stream of pixels corresponding to an array of video pixels, having a variable window size for sampling subsets of the array as a two-dimensional window that spans the pixels in the array.

456. On information and belief, the Samsung '979 Products perform a method for delivering the input stream of pixels to the video processing stage.

457. The below image shows the Basic Pipeline structure in the Samsung M1 product. The Samsung M1 is a microarchitecture for a subset of the accused Samsung Exynos SoC processors.



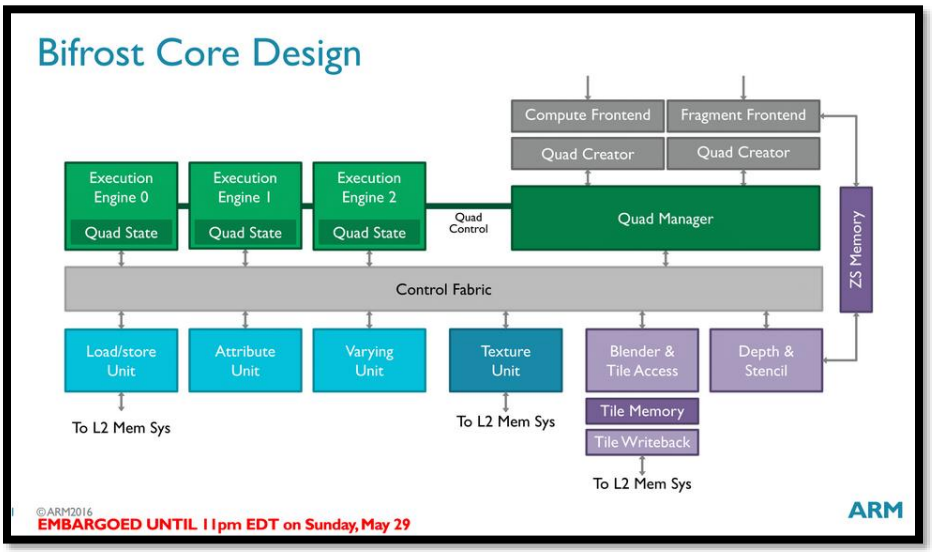
Brad Burgess, SAMSUNG EXYNOS M1 PROCESSOR, HOTCHIPS 2016 PRESENTATION at 12 (2016) (showing the basic pipelines structure in the Samsung Exynos M1 microarchitecture).

458. On information and belief, the Samsung ‘979 Products establish a window size and a sampling-window size, such that the window size is a multiple of the sampling-window size and the sampling-window size defines the fixed number of pixels.

459. On information and belief, the Samsung ‘979 Products store pixels from the input stream into a first set of line buffers.

460. One or more of the infringing Exynos products contain a GPU based on the Mali architecture. The units of work in the Mali GPU pipeline are scheduled on a per render-target basis, where a render target may be a window surface or an off-screen render buffer. A single render target is processed in a two-step process. First, the GPU processes the vertex shading for all draw calls in the render target, and second, the fragment shading for the entire render target is processed. The logical rendering pipeline for Mali is therefore a three-stage pipeline of: CPU processing, geometry processing, and fragment processing stages.

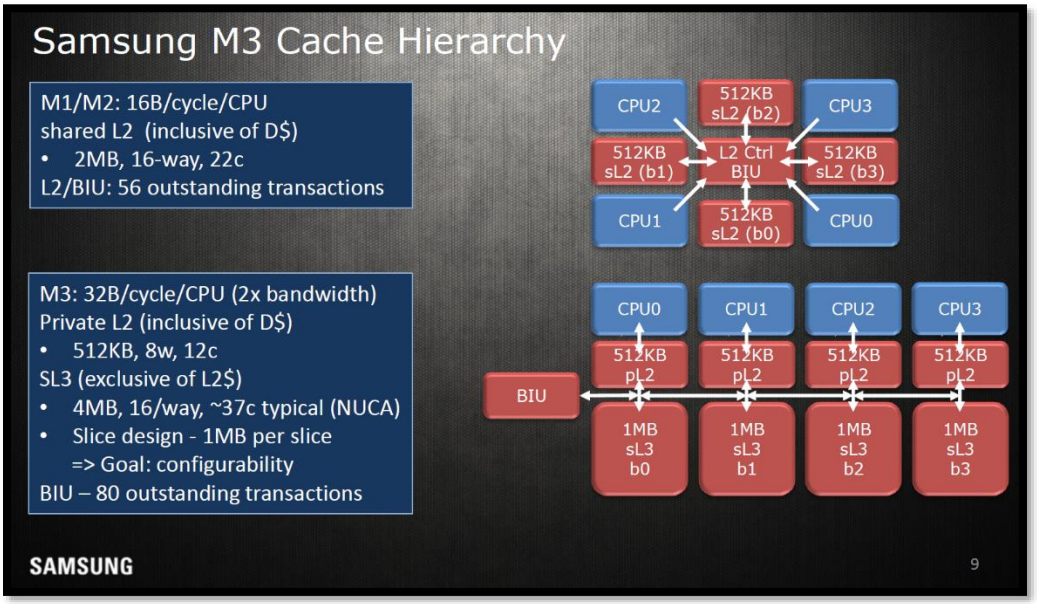
461. The infringing Exynos chips are based on Mali microarchitecture. Specifically, chips such as the Exynos 7885 have Mali-G71 (Bifrost) architecture. These GPUs contain a control fabric as shown in the below slide from ARM entitled Bifrost Core Design.



Alan Tsai, Bifrost – The GPU Architecture For The Next Five Billion, ARM TRech Foujm Presentation at 21 (July 1, 2016).

462. On information and belief, the pixels are stored in the first set of line buffers include pixels for the established window size.

463. On information and belief, the '979 Products have various memory structures including an L2 and L1 cache that are connected to the processing unit. These connections between cache memory structures and the processing unit are shown below.



Jeff Rupley, Samsung M3 Processor, HOTCHIPS 2018 PRESENTATION at 9 (2018).

464. On information and belief, the Samsung '979 Products prefetch the stored pixels from the first set of line buffers into a second set of line buffers, the second set of line buffers being sufficiently long to store at least the pixels corresponding to the established sampling-window size.

465. On information and belief, the Samsung '979 Products fetch the fixed number of pixels from the second set of line buffers.

466. On information and belief, the Samsung '979 Products are available to businesses and individuals throughout the United States.

467. On information and belief, the Samsung '979 Products are provided to businesses and individuals located in the Eastern District of Texas.

468. By making, using, testing, offering for sale, and/or selling products and services for motion compensation in video signal processing, including but not limited to the Samsung '979 Products, Samsung has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '979 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

469. On information and belief, Samsung also indirectly infringes the '979 patent by actively inducing infringement under 35 USC § 271(b).

470. Samsung has had knowledge of the '979 patent since at least service of the Original Complaint in this case or shortly thereafter, and on information and belief, Samsung knew of the '979 patent and knew of its infringement, including by way of this lawsuit.

471. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '979 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. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '979 patent. Samsung performed the

acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '979 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '979 Products that have the capability of operating in a manner that infringe one or more of the claims of the '979 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '979 Products to utilize the products in a manner that directly infringe one or more claims of the '979 patent.[35] By providing instruction and training to customers and end-users on how to use the Samsung '979 Products in a manner that directly infringes one or more claims of the '979 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '979 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '979 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '979 patent. Accordingly, Samsung 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 '979 patent, knowing that such use constitutes infringement of the '979 patent.

472. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '979 patent.

[35] *See, e.g.*, *Galaxy Note9*, SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL.

473. As a result of Samsung's infringement of the '979 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

COUNT XII
INFRINGEMENT OF U.S. PATENT NO. 7,532,216

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

475. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for scaling alphanumeric characters.

476. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung Mobile Galaxy products, including: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy Note8, Galaxy S8, Galaxy S8+, Galaxy S7, Galaxy S7 Edge, and Galaxy S7 Active (collectively, the "Samsung '216 Product(s)").

477. On information and belief, one or more Samsung subsidiaries and/or affiliates use the Samsung '216 Products in regular business operations.

478. On information and belief, one or more of the Samsung '216 Products include technology for scaling alphanumeric characters.

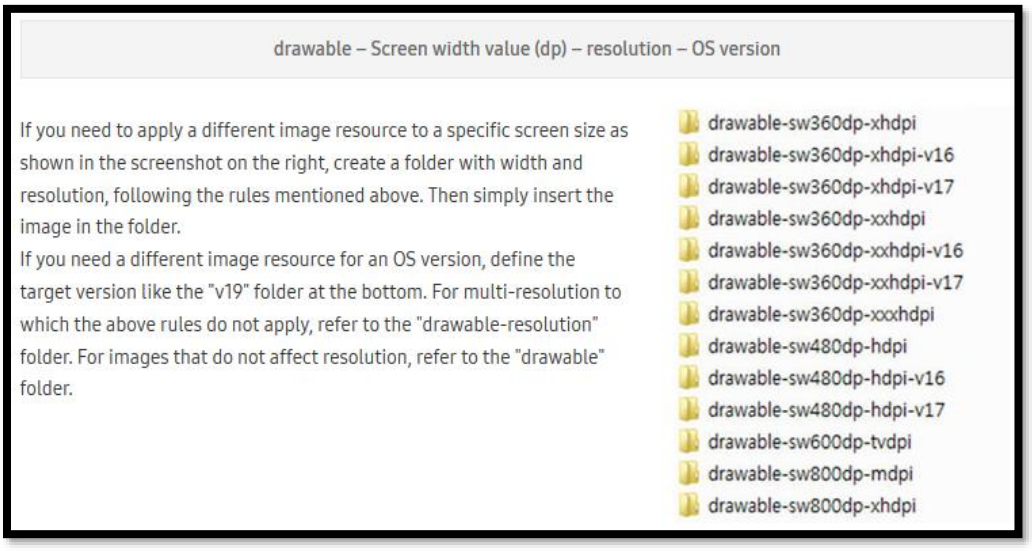
479. On information and belief, the Samsung '216 Products contain functionality for dividing the character matrix into a first character segment and at least one second character segment, each character segment including at least one of the character units.

480. On information and belief, the Samsung '216 Products contain functionality for symmetrically scaling the first character segment using a first scaling factor.

481. On information and belief, the Samsung '216 Products contain functionality within the processor such that at least one second character segment using a second scaling factor different from the first scaling factor to provide a scaled character matrix.

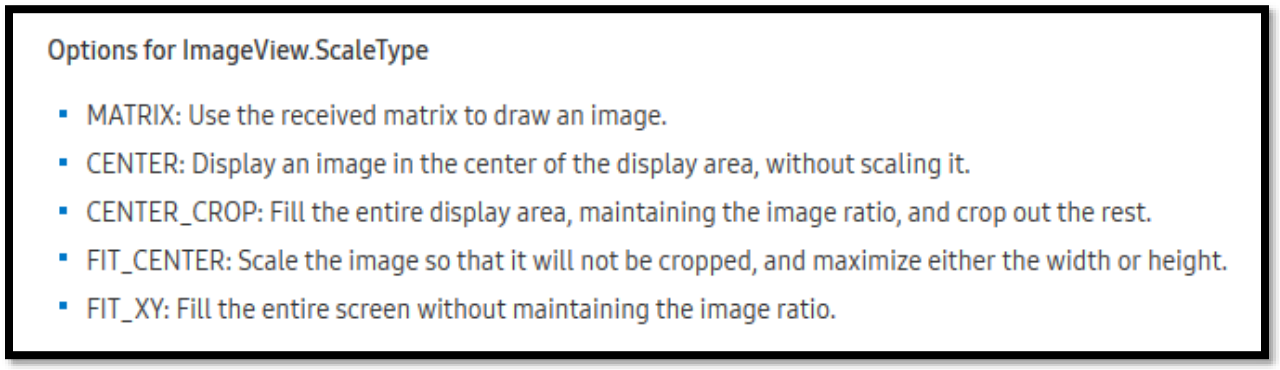
Samsung Galaxy: Supporting Multiple Resolutions, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/galaxy/others/supporting-multiple-resolutions

482. The Samsung '216 Products enable the scaling of resources such as text and images using specific resolutions or widths that would create an asymmetric scaling.



Samsung Galaxy: Supporting Multiple Resolutions, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/galaxy/others/supporting-multiple-resolutions

483. On information and belief, the Samsung '216 Products contain functionality for filtering the scaled character matrix to provide a filtered scaled character matrix.



Samsung Galaxy: Supporting Multiple Resolutions, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/galaxy/others/supporting-multiple-resolutions.

484. On information and belief, the Samsung '216 Products are available to businesses and individuals throughout the United States.

485. On information and belief, the Samsung '216 Products are provided to businesses and individuals located in the Eastern District of Texas.

486. On information and belief, Samsung has directly infringed and continues to directly infringe the '216 patent by, among other things, making, using, offering for sale, and/or selling technology for scaling alphanumeric characters, including but not limited to the Samsung '216 Products.

487. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the Samsung '216 Products, Samsung has injured Dynamic Data and is liable for directly infringing one or more claims of the '216 patent, including at least claim 1, pursuant to 35 U.S.C. § 271(a).

488. On information and belief, Samsung also indirectly infringes the '216 patent by actively inducing infringement under 35 USC § 271(b).

489. On information and belief, Samsung has had knowledge of the '216 patent since at least service of the Original Complaint in this case or shortly thereafter, and on information and belief, Samsung knew of the '216 patent and knew of its infringement, including by way of this lawsuit.

490. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '216 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. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '216 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '216 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '216 Products that have the capability of operating in a manner that infringe one or more of the claims of the '216 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '216 Products to utilize the products in a manner that directly infringe one or more claims of the '216 patent.[36] By providing instruction and training to customers and end-users on how to use the Samsung '216 Products in a manner that directly infringes one or more claims of the '216 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '216 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '216 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused

[36] *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL.

products to infringe the '216 patent. Accordingly, Samsung 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 '216 patent, knowing that such use constitutes infringement of the '216 patent.

491. The '216 patent is well-known within the industry as demonstrated by multiple citations to the '216 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '216 patent without paying a reasonable royalty. Samsung is infringing the '216 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

492. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '216 patent.

493. As a result of Samsung's infringement of the '216 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

COUNT XIII
INFRINGEMENT OF U.S. PATENT NO. 8,385,426

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

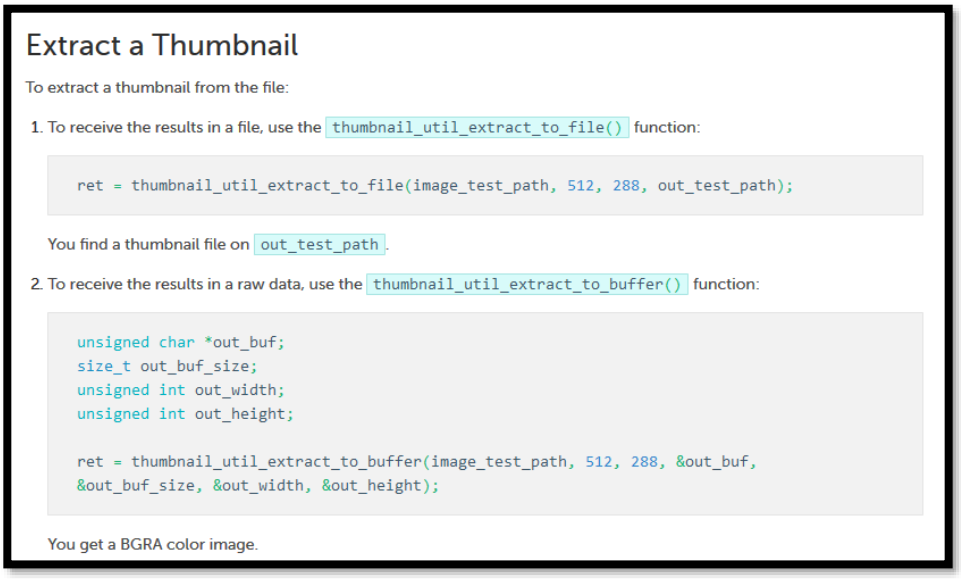
495. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for generating a mosaic program guide.

496. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung Smart TVs, including model groups: 18TV_Premium (UHD), 18TV_STANDARD1 (UHD),

18TV_STANDARD2 (UHD), 18TV_STANDARD3 (FHD), 2017 - 17TV_PREMIUM (UHD), 17TV_STANDARD (FHD), 17AV_BD (UHD), 16TV_PREMIUM (UHD), 16TV_STANDARD1 (UHD), 16TV_STANDARD2 (FHD), 15TV_PREMIUM (UHD), 15TV_STANDARD1 (UHD), and 15TV_STANDARD2 (FHD) (collectively, the "Samsung '426 Product(s)").

497. On information and belief, one or more Samsung subsidiaries and/or affiliates use the Samsung '426 Products in regular business operations.

498. On information and belief, the Samsung '426 Products contain functionality for generating a mosaic program guide in a receiver.



Extract a Thumbnail

To extract a thumbnail from the file:

1. To receive the results in a file, use the `thumbnail_util_extract_to_file()` function:

```
ret = thumbnail_util_extract_to_file(image_test_path, 512, 288, out_test_path);
```

You find a thumbnail file on `out_test_path`.

2. To receive the results in a raw data, use the `thumbnail_util_extract_to_buffer()` function:

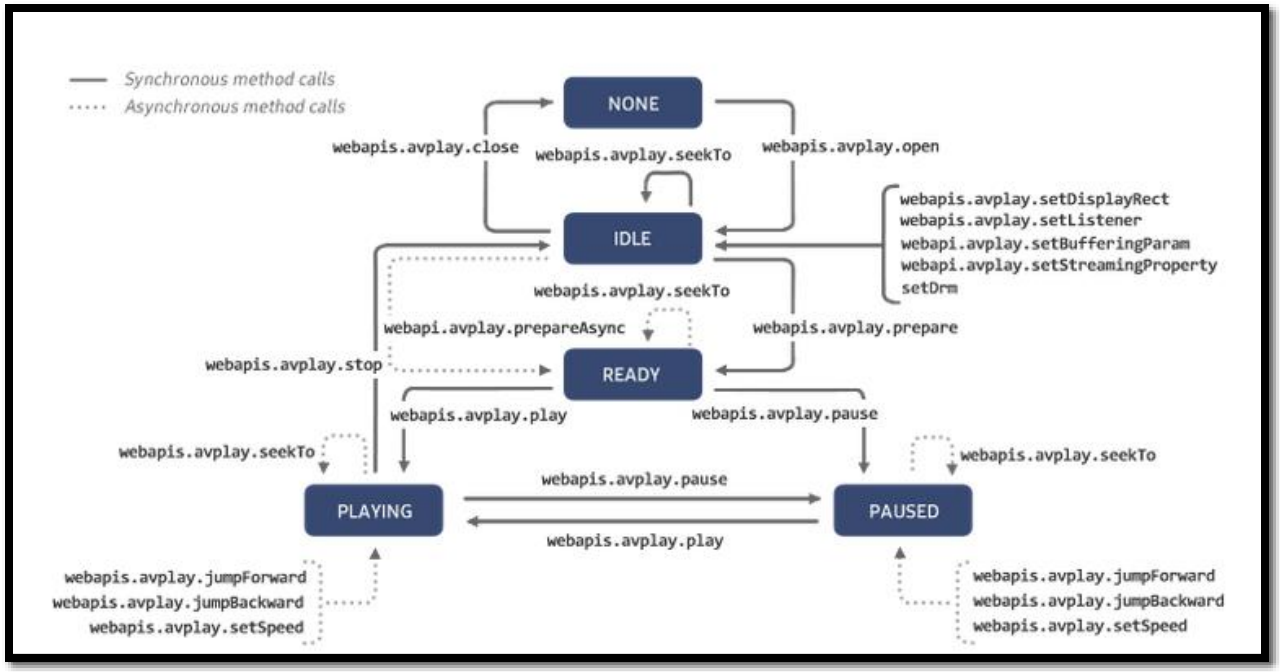
```
unsigned char *out_buf;
size_t out_buf_size;
unsigned int out_width;
unsigned int out_height;

ret = thumbnail_util_extract_to_buffer(image_test_path, 512, 288, &out_buf,
&out_buf_size, &out_width, &out_height);
```

You get a BGRA color image.

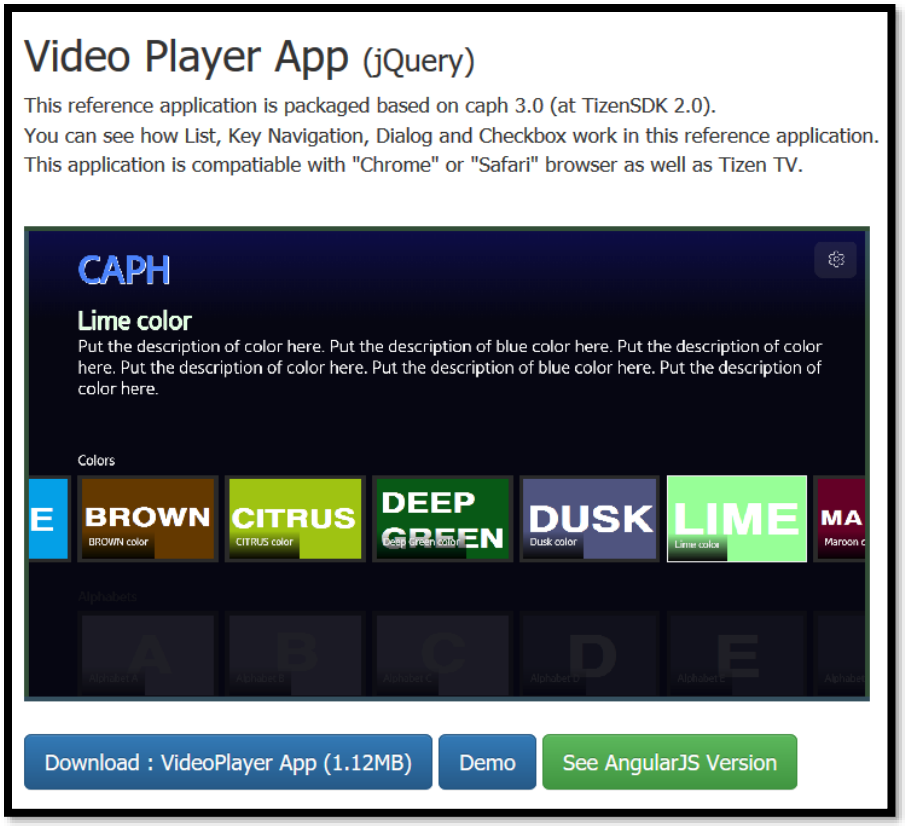
Samsung Smart TV Development Resources, Samsung TIZEN WEBSITE, *available at*: https://developer.tizen.org/development/guides/native-application/multimedia/thumbnail-images.

499. On information and belief, the Samsung '426 Products contain functionality for generating by a video decoder of a receiver I-Frames from a coded video bit stream.



Samsung Developer Guides: Media Playback Architecture, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/tv/develop/guides/multimedia/media-playback/using-avplay.

500. On information and belief, the Samsung '426 Products contain functionality for placing by the receiver each I-Frame into one of multiple mosaic windows.



Samsung Online Documentation, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/onlinedocs/tv/caphdocs/main.html?type=jquery&doc=demo&p1=2 (showing how the i-frame can be embedded into a mosaic video program guide).

501. On information and belief, the Samsung '426 Products contain functionality for combining in the receiver (e.g., Samsung TV) the multiplicity of mosaic windows into a mosaic video frame.

502. On information and belief, the Samsung '426 Products are available to businesses and individuals throughout the United States.

503. On information and belief, the Samsung '426 Products are provided to businesses and individuals located in the Eastern District of Texas.

504. On information and belief, Samsung has directly infringed and continues to directly infringe the '426 patent by, among other things, making, using, offering for sale, and/or selling

technology for generating mosaic program guides, including but not limited to the Samsung '426 Products.

505. By making, using, testing, offering for sale, and/or selling products and services, including but not limited to the Samsung '426 Products, Samsung has injured Dynamic Data and is liable for directly infringing one or more claims of the '426 patent, including at least claim 1, pursuant to 35 U.S.C. § 271(a).

506. On information and belief, Samsung also indirectly infringes the '426 patent by actively inducing infringement under 35 USC § 271(b).

507. On information and belief, Samsung has had knowledge of the '426 patent since at least service of the Original Complaint in this case or shortly thereafter, and on information and belief, Samsung knew of the '426 patent and knew of its infringement, including by way of this lawsuit.

508. Alternatively, Samsung has had knowledge of the '426 patent since at least May 17, 2007, when Korean Patent No. KR100719023B1, which is owned by Samsung and cites the '426 patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the '426 patent since at least July 30, 2007, when Korean Patent No. KR100744385B1, which is owned by Samsung and cites the '426 patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the '426 patent since at least January 9, 2009, when Korean Patent No. KR100877665B1, which is owned by Samsung and cites the '426 patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the '426 patent since at least March 11, 2016, when Korean Patent Application No. KR20160028272A, which is owned by Samsung and cites the '426 patent as relevant prior art, was published.

509. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '426 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. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '426 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '426 patent and with the knowledge that the induced acts would constitute infringement. For example, Samsung provides the Samsung '426 Products that have the capability of operating in a manner that infringe one or more of the claims of the '426 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '426 Products to utilize the products in a manner that directly infringe one or more claims of the '426 patent.[37] By providing instruction and training to customers and end-users on how to use the Samsung '426 Products in a manner that directly infringes one or more claims of the '426 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '426 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '426 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '426 patent. Accordingly, Samsung has induced and continues to induce

[37] *See, e.g.*, *2018 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2018-tv-video-specifications (last visited Nov. 2018); *2017 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2017-tv-video-specifications (last visited Nov. 2018); *2016 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2016-tv-video-specifications (last visited Nov. 2018); *2015 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2015-tv-video-specifications (last visited Nov. 2018).

users of the accused products to use the accused products in their ordinary and customary way to infringe the '426 patent, knowing that such use constitutes infringement of the '426 patent.

510. The '426 patent is well-known within the industry as demonstrated by multiple citations to the '426 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '426 patent without paying a reasonable royalty. Samsung is infringing the '426 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

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

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

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

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

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

515. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung devices capable of decoding video data in compliance with the H.265 standard. The Accused Products include, but are not limited to, Samsung smartphones, tablets, televisions, and other devices

capable of performing decoding of video data using the H.265 standard. By way of example, the following Samsung Products perform decoding pursuant to the H.265 standard: Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy Note8, Galaxy S8, Galaxy S8+, Galaxy S7, Galaxy S7 Edge, Galaxy S7 Active; Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), Exynos 7 Series (7885), Exynos 7 Series (7880), Exynos 5 Series (7872), Exynos 8 Octa (8890), Exynos 7 Octa (7420), Exynos 7 Octa (7870), Exynos 7 Octa (7580), Exynos 7 Quad (7570), Exynos 7 Dual (7270); Samsung Smart TVs, including model groups: 18TV_Premium (UHD), 18TV_STANDARD1 (UHD), 18TV_STANDARD2 (UHD), 18TV_STANDARD3 (FHD), 2017 - 17TV_PREMIUM (UHD), 17TV_STANDARD (FHD), 17AV_BD (UHD), 16TV_PREMIUM (UHD), 16TV_STANDARD1 (UHD), 16TV_STANDARD2 (FHD), 15TV_PREMIUM (UHD), 15TV_STANDARD1 (UHD), 15TV_STANDARD2 (FHD); Samsung Tablet products, including: Galaxy Tab S2, Galaxy Tab S3, Galaxy Tab E, Galaxy Tab S, Galaxy Tab S4, Galaxy Tab A 10.1 (2016), Galaxy Tab A 7.0 (2016), Galaxy TabPro S, Galaxy Tab A (8", 9.7" and 10.1" models) (2015);and Samsung 4K Blu-ray products, including: UBD-M8500/ZA, UBD-M7500/ZA, UBD-M9500/ZA, UBD-K8500/ZA, UBD-M9700/ZA (collectively, the "Samsung '799 Product(s)").

516. The Samsung '799 Products perform video processing compliant with the H.265 standard. Specifically, the Samsung '799 products perform HEVC decoding. *See e.g.*, *Samsung S9 | S9+ The Phone Reimagined*, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895)*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K

UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos 8895 Specifications*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors Listing*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing specifications for the Exynos processors showing the accused Exynos Devices support HEVC decodinmg); *Samsung S8 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s8/specs/; *Samsung S7 Specification*, SAMSUNG WEBSITE, https://www.samsung.com/global/galaxy/galaxy-s7/; Samsung SmartTV Specifications 2015-2019, SAMSUNG DEVELOPER WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications (containing links to the accused Samsung TV's showing that they support HEVC decoding).

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

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

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

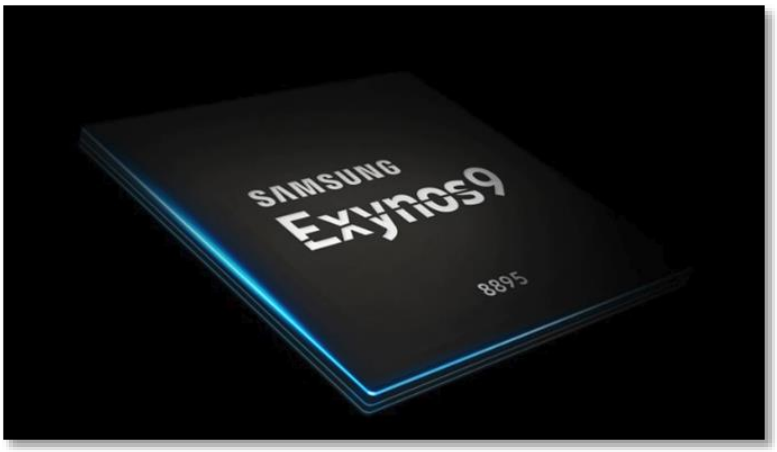
519. On information and belief, one or more of the Samsung '799 Products contain functionality for a direction quality value for an image direction.

520. The Samsung '799 Products contain a hardware-based decoder on their system on chip ("SoC") processors.

> By fully supporting a 64-bit architecture in both hardware and software, the Exynos 7420 enables running performance intensive tasks without any buffering. . . . With a newly added HEVC (H.265) encoder to its advanced Multi Format Codec (MFC) that features H.265 (HEVC) decoder and VP9 decoder, the processor can record and playback 4K video at 30fps.

Exynos 7 Octa (7420), SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-7-octa-7420/.

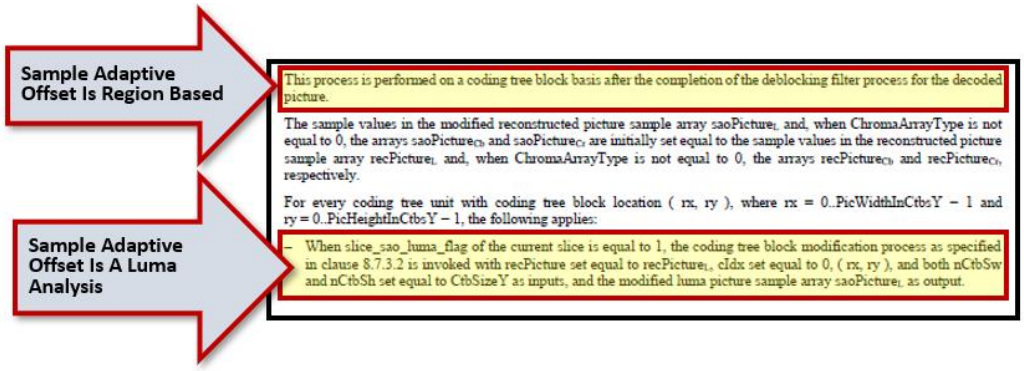
521. On information and belief, HEVC encoding support has been incorporated into the Samsung '799 Products as shown in the below excerpts from Samsung documentation.



How the Exynos 8895 enables the Samsung Galaxy S8 and S8+ to push the limit, SAMSUNG WEBSITE (April 6, 2017), *available at*: https://www.samsung.com/semiconductor/insights/tech-trends/how-the-exynos-8895-enables-the-samsung-galaxy-s8-and-s8plus-to-push-the-limit/.

Innovation is Alive. Samsung Semiconductor at CES 2018, SAMSUNG WEBSITE (Jan. 19, 2018), *available at*: https://www.samsung.com/semiconductor/insights/news-events/innovation-is-alive-samsung-semiconductor-at-ces-2018/.

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



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

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

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

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

524. On information and belief, one or more of the Samsung '799 Products reduce or prevent ambiguities in the determination of an optimal image direction by adding a single direction values of several adjacent pixels.

525. On information and belief, the Samsung '799 Products contain functionality for determining the image information value being interposed in dependence on image information

values assigned to pixels lying adjacent to the pixel being interpolated (in the direction of interpolation).

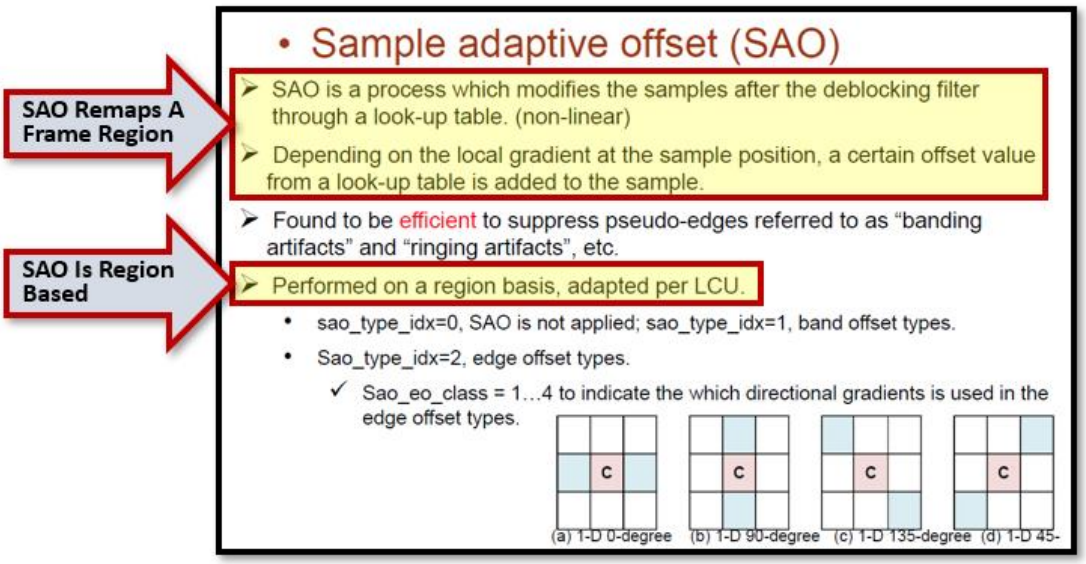
526. On information and belief, one or more of the Samsung '799 Products contain functionality for selecting a pixel group with two or more pixels as part of ascertaining a directional quality value.

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

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

527. On information and belief, one or more of the Samsung '799 Products enable a method for interpolation of an image information value for a pixel of an interline that includes selecting from a number of image directions, to each of which a direction quality value is assigned, a direction of interpolation by comparing the direction quality values. "[A]fter the deblocking filter through a look-up table . . . [and applying] a certain offset value from a look-up-table is added to the sample."[38]

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



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

528. On information and belief, one or more of the Samsung '799 Products enable a method for interpolation of an image information value for a pixel of an interline that includes determining the image information value being interpolated in dependence on image information values assigned to pixels lying adjacent to the pixel being interpolated in the direction of interpolation.

529. On information and belief, one or more of the Samsung '799 Products enable a method for interpolation of an image information value for a pixel of an interline that includes ascertaining a direction quality value for an image direction by determining a single direction quality value for each pixel of the pixel group, the single direction quality value being dependent on image information values assigned to image regions lying adjacent to the particular pixel of the group in the image direction.

> The second in-loop filter, SAO, is applied to the output of the deblocking filter and further improves the quality of the decoded picture by attenuating ringing artifacts and changes in sample intensity of some areas of a picture. The most important advantage of the in-loop filters is improved subjective quality of reconstructed

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

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

530. On information and belief, the Samsung '799 Products are available to businesses and individuals throughout the United States.

531. On information and belief, the Samsung '799 Products are provided to businesses and individuals located in the Eastern District of Texas.

532. By making, using, testing, offering for sale, and/or selling products and services for interpolating an image information value for a pixel of an interline situated between two original image lines in an image, including but not limited to the Samsung '799 Products, Samsung has injured Dynamic Data and is liable to the Plaintiff for directly infringing one or more claims of the '799 patent, including at least claim 1 pursuant to 35 U.S.C. § 271(a).

533. On information and belief, Samsung also indirectly infringes the '799 patent by actively inducing infringement under 35 USC § 271(b).

534. Samsung has had knowledge of the '799 patent since at least service of this First Amended Complaint or shortly thereafter, and on information and belief, Samsung knew of the '799 patent and knew of its infringement, including by way of this lawsuit.

535. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '799 Products and had knowledge that the inducing acts would cause infringement or was willfully blind to the possibility that its inducing acts would cause infringement. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '799 patent. Samsung performed the acts that constitute induced infringement, and would induce actual infringement, with knowledge of the '799 patent and with the knowledge that the induced acts would constitute infringement.

For example, Samsung provides the Samsung '799 Products that have the capability of operating in a manner that infringe one or more of the claims of the '799 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '799 Products to utilize the products in a manner that directly infringe one or more claims of the '799 patent.[39] By providing instruction and training to customers and end-users on how to use the Samsung '799 Products in a manner that directly infringes one or more claims of the '799 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '799 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '799 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused

[39] *See, e.g.*, *Galaxy Note9*, SAMSUNG USER MANUAL (2018); *Galaxy S9 S9+*, SAMSUNG USER MANUAL (2018); *Smartphone Galaxy Note8*, SAMSUNG USER MANUAL (2017); *Smartphone Galaxy S8 S8+*, SAMSUNG USER MANUAL (2017); *Galaxy S7 Smartphone*, SAMSUNG USER MANUAL; *Galaxy Note9*, SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Exynos 5 Series (7872): Diffusion of Prime Performance*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-5-series-7872/ (last visited Nov. 2018); *2018 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2018-tv-video-specifications (last visited Nov. 2018); *2017 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2017-tv-video-specifications (last visited Nov. 2018); *2016 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2016-tv-video-specifications (last visited Nov. 2018); *2015 TV Video Specifications*, SAMSUNG DEVELOPERS WEBSITE, *available at*: https://developer.samsung.com/tv/develop/specifications/media-specifications/2015-tv-video-specifications (last visited Nov. 2018); *Galaxy Tab S2 Tablet*, SAMSUNG USER MANUAL (2016); *Galaxy Tab E Android Tablet*, SAMSUNG USER MANUAL (2015); *Galaxy Tab S4*, SAMSUNG USER MANUAL (2018); *Galaxy Tab A Tablet*, SAMSUNG USER MANUAL (2016); *UBD-M8500*, SAMSUNG USER MANUAL (2017); *Ultra HD Blu-ray Player*, SAMSUNG USER MANUAL (2015).

products to infringe the '799 patent. Accordingly, Samsung has induced and continues to induce users of the accused products to use the accused products in their ordinary and customary way to infringe the '799 patent, knowing that such use constitutes infringement of the '799 patent.

536. The '799 patent is well-known within the industry as demonstrated by multiple citations to the '799 patent in published patents and patent applications assigned to technology companies and academic institutions. Samsung is utilizing the technology claimed in the '799 patent without paying a reasonable royalty. Samsung is infringing the '799 patent in a manner best described as willful, wanton, malicious, in bad faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate.

537. To the extent applicable, the requirements of 35 U.S.C. § 287(a) have been met with respect to the '799 patent.

538. As a result of Samsung's infringement of the '799 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for Samsung's infringement, but in no event less than a reasonable royalty for the use made of the invention by Samsung together with interest and costs as fixed by the Court.

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

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

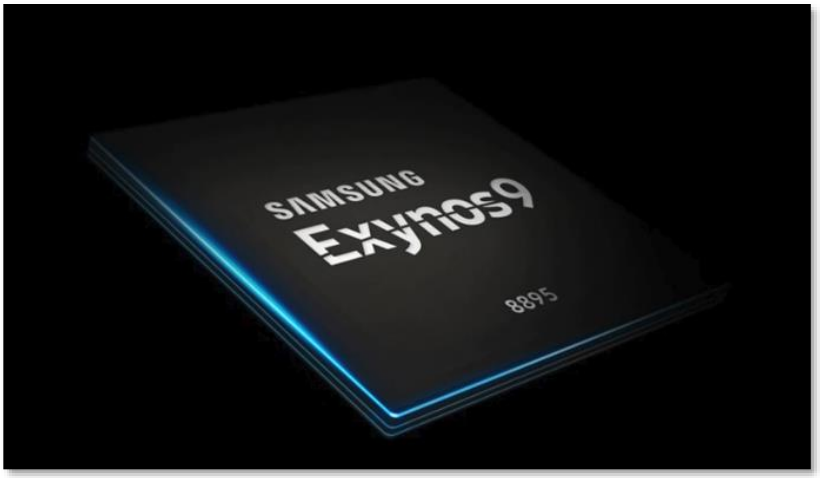
540. Samsung designs, makes, uses, sells, and/or offers for sale in the United States products and/or services for estimating a current motion vector for a group of pixels of an image.

541. Samsung designs, makes, sells, offers to sell, imports, and/or uses Samsung products that comply with the H.265 standard. By way of example, the following Samsung

Products perform encoding pursuant to the H.265 standard : Galaxy Note9, Galaxy S9, Galaxy S9+, Galaxy S8, Galaxy S8+; and Samsung Exynos System-on-Chip (SOC) processors, including: Exynos 9 Series (9810), Exynos 9 Series (8895), Exynos 7 Series (9610), Exynos 7 Series (7885), Exynos 7 Series (7880), Exynos 5 Series (7872), Exynos 8 Octa (8890), Exynos 7 Octa (7420), Exynos 7 Octa (7870), Exynos 7 Dual (7270) (collectively, the "Samsung '054 Product(s)").

542. The Samsung '054 Products perform video processing compliant with the H.265 standard. Specifically, the Samsung '054 products perform HEVC encoding. *See e.g.*, SAMSUNG S9 | S9+ THE PHONE REIMAGINED, SAMSUNG DATASHEET at 2 (2018) (stating that the Samsung S9 and S9+ support HEVC encoding and decoding); *Samsung Exynos 9 Series (8895) Specification*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ ("It supports recording and playback of video content at a maximum resolution of 4K UHD at 120fps with the latest video codecs, including HEVC(H.265), H.264, and VP9."); *Samsung Exynos Mobile Processors,* SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/all-processors/ (containing specifications for the Exynos processors showing the accused Exynos Devices support HEVC encoding).

543. The following excerpt from Samsung's documentation shows that the video captured using the Samsung Products is encoded using High Efficiency Video Coding ("HEVC"): "The powerful MFC in the Exynos 8895 allows users to not only play 4K contents but also record creative videos in 4K resolution using efficient video codec such as H.265 (HEVC)."



How the Exynos 8895 enables the Samsung Galaxy S8 and S8+ to push the limit, SAMSUNG WEBSITE (April 6, 2017), *available at*: https://www.samsung.com/semiconductor/insights/tech-trends/how-the-exynos-8895-enables-the-samsung-galaxy-s8-and-s8plus-to-push-the-limit/.

Innovation is Alive. Samsung Semiconductor at CES 2018, SAMSUNG WEBSITE (Jan. 19, 2018), *available at*: https://www.samsung.com/semiconductor/insights/news-events/innovation-is-alive-samsung-semiconductor-at-ces-2018/.

544. Samsung has explained that its inclusion of HEVC decoding and encoding functionality in its system on chip products makes them "absolute multimedia powerhouse[s] . . . allow[ing] for ultra-smooth 4K video playback capabilities . . . ." *INTERVIEW: Meizu explains why Exynos powers its flagship device*, SAMSUNG WEBSITE BLOG (Dec. 16, 2016), *available at*:

https://www.samsung.com/semiconductor/minisite/exynos/newsroom/blog/interview-meizu-explains-why-exynos-powers-its-flagship-device/.

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

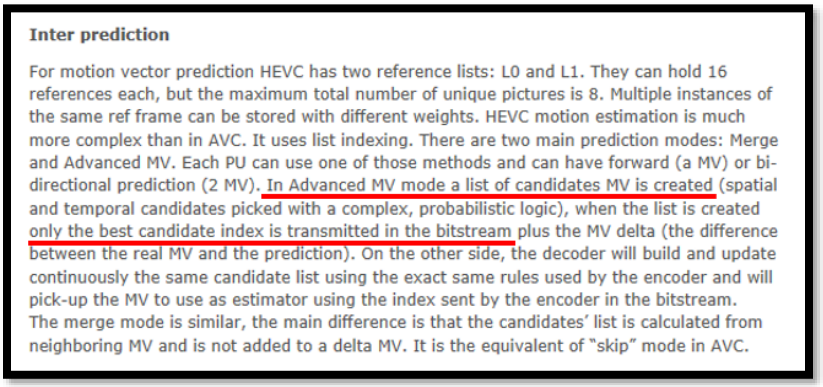
546. On information and belief, the Samsung '054 Products contain a video encoder that selects an image segment of a second video image corresponding to an image segment of a first video image. The image segment has an image segment center. On information and belief, one or more of the Samsung '054 Products include technology for estimating a current motion vector for a group of pixels of an image

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

548. On information and belief, by complying with the HEVC standard, Samsung's devices – such as the Samsung '054 Products - necessarily infringe the '054 patent. Mandatory sections of the HEVC standard require the elements required by certain claims of the '054 patent, including but not limited to claim 1. *High Efficiency Video Coding*, SERIES H: AUDIOVISUAL AND Multimedia SYSTEMS: INFRASTRUCTURE OF AUDIOVISUAL SERVICES – CODING OF MOVING VIDEO REC. ITU-T H.265 (February 2018) (The following sections of the HEVC Standard are relevant to

Samsung's infringement of the '054 patent: "7.3.4 Scaling list data syntax;" 7.3.6.1 General slice segment header syntax;" "7.3.6.3 Weighted prediction parameters syntax;" "7.3.8.14 Delta QP syntax;" "7.4.4 Profile, tier and level semantics;" and "7.4.7.3 Weighted prediction parameters semantics."

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



Inter prediction

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

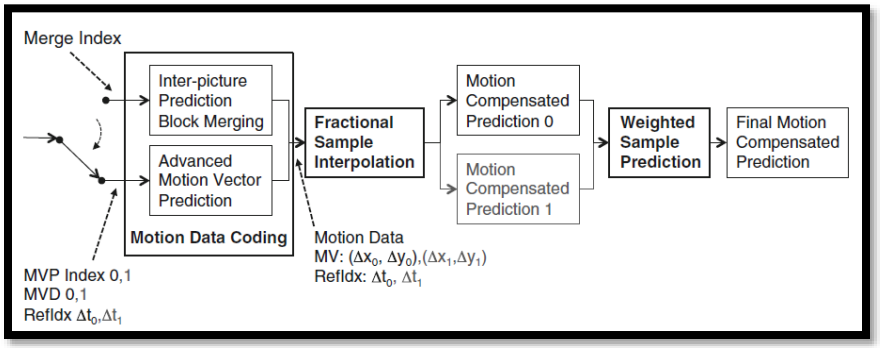
Fabio Sonnati, *H265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

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

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

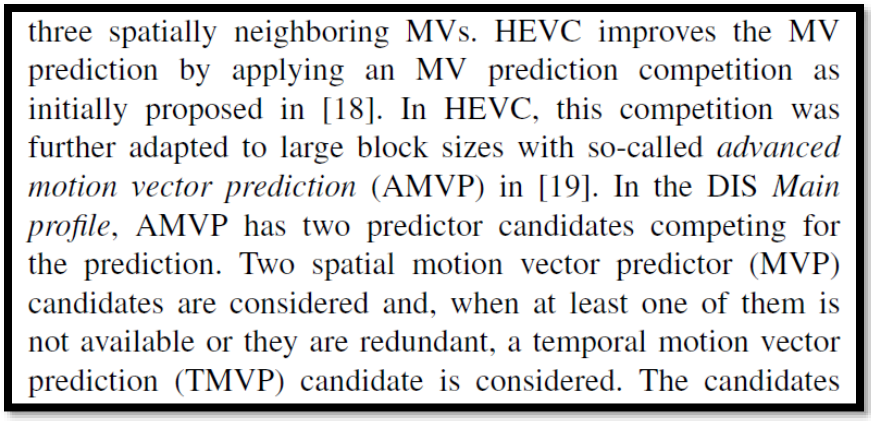
Frank Bossen, *et al*., *HEVC Complexity and Implementation Analysis*, IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY VOL. 22 NO. 12 at 1686 (December (2012).

551. On information and belief, the following block diagram illustrates the form of encoded video data received by the Samsung '054 Products. Specifically, the encoded video data received by the Samsung '054 Products is encoded using inter-picture prediction where the motion data of a block is correlated with neighboring blocks. To exploit this correlation, motion data is not directly coded in the bitstream, but predictively coded based on neighboring motion data. Further, the Samsung '054 Products receive data that is encoded using advanced motion vector prediction where the best predictor for each motion block is signaled to the decoder. In addition, inter-prediction block merging derives all motion data of a block from the neighboring blocks.



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

552. On information and belief, the Samsung '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 Samsung '054 Products generate two predictor candidate motion vectors (a spatial motion vector and temporal motion vector). The first predictor candidate motion vector is drawn from a list of spatial motion vector candidates.

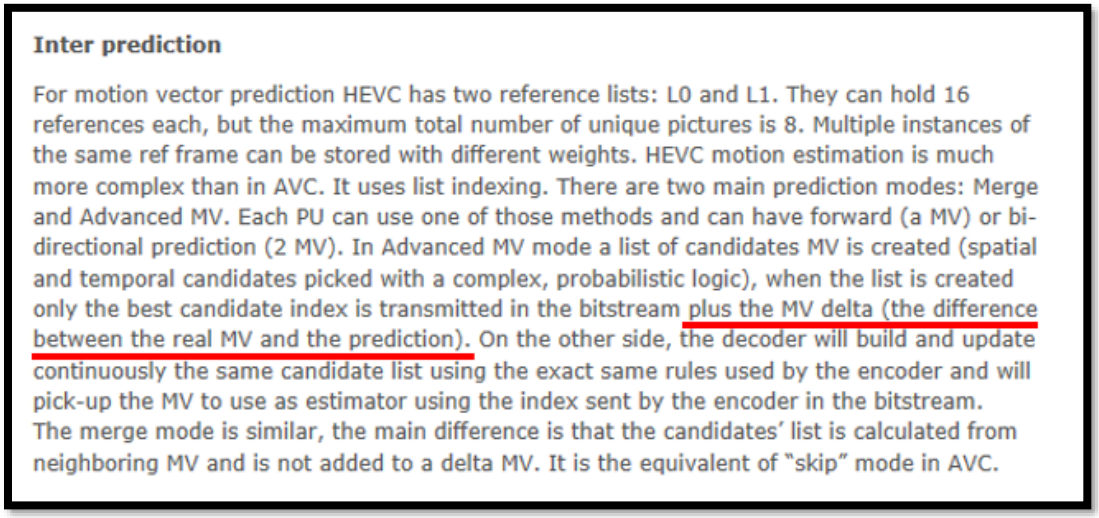


three spatially neighboring MVs. HEVC improves the MV prediction by applying an MV prediction competition as initially proposed in [18]. In HEVC, this competition was further adapted to large block sizes with so-called *advanced motion vector prediction* (AMVP) in [19]. In the DIS *Main profile*, AMVP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

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

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

554. On information and belief, the Samsung '054 Products contain functionality for generating match errors of the respective candidate motion vectors. The HEVC standard calculates match errors of respective candidate motion vectors. The match errors are referred to as the MV delta. The MV delta is the difference between the real MV and the candidate predication.



Inter prediction

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

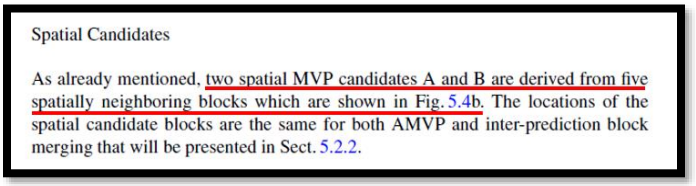
Fabio Sonnati, *H265 – Part I: Technical Overview*, VIDEO ENCODING & STREAMING TECHNOLOGIES WEBSITE (June 20, 2014) (emphasis added).

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

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

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

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

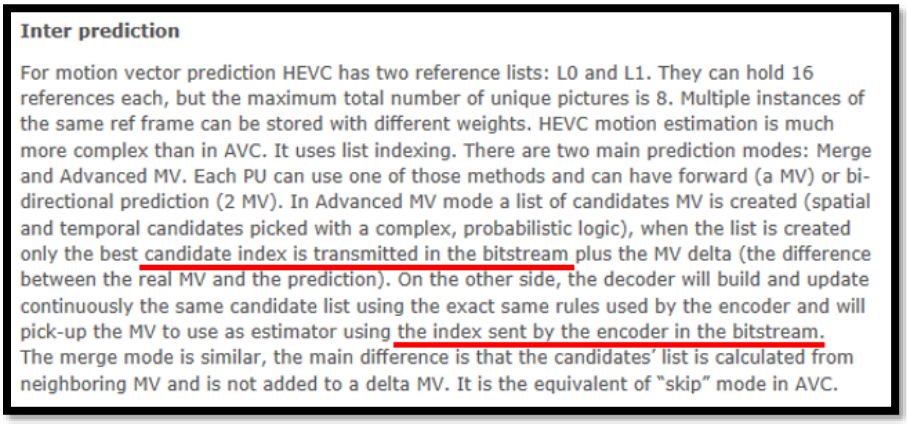


Spatial Candidates

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

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

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

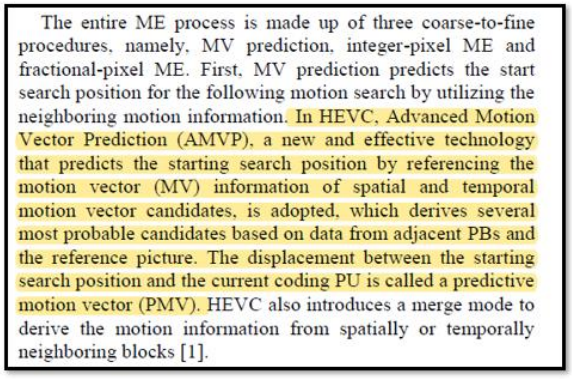


Inter prediction

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

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

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



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

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

560. On information and belief, one or more of the Samsung '054 Products include a motion estimation unit that calculates the further candidate motion vector on the basis of the first motion vector and the second motion vector, with the first motion vector belonging to a first forward motion vector field and the second motion vector belonging to a second forward motion vector field, with the first forward motion vector field and the second forward motion vector field

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

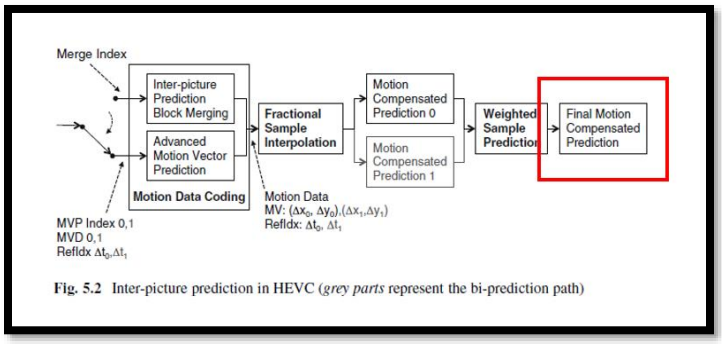


Fig. 5.2 Inter-picture prediction in HEVC (*grey parts* represent the bi-prediction path)

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

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

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

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

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

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

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

567. Alternatively, Samsung has had knowledge of the '054 patent since at least March 13, 2007, when Korean Patent No. KR100692600B1, which is owned by Samsung and cites the '054 patent as relevant prior art, was issued. Alternatively, Samsung has had knowledge of the '054 patent since at least July 3, 2007, when Korean Patent Application No. KR20070069615A, which is owned by Samsung and cites the '054 patent as relevant prior art, was issued.

568. On information and belief, Samsung intended to induce patent infringement by third-party customers and users of the Samsung '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. Samsung specifically intended and was aware that the normal and customary use of the accused products would infringe the '054 patent. Samsung 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, Samsung provides the Samsung '054 Products that have the capability of operating in a manner that infringe one or more of the claims of the '054 patent, including at least claim 1, and Samsung further provides documentation and training materials that cause customers and end users of the Samsung '054 Products to utilize the products in a manner that directly infringe one or more claims of the '054 patent.[40] By providing instruction and training to customers and end-

[40] *See, e.g.*, *Galaxy Note9*, SAMSUNG SPEC SHEET; *Samsung Launches Premium Exynos 9 Series Processor Built on the World's First 10nm FinFET Process Technology*, SAMSUNG PRESS

users on how to use the Samsung '054 Products in a manner that directly infringes one or more claims of the '054 patent, including at least claim 1, Samsung specifically intended to induce infringement of the '054 patent. On information and belief, Samsung engaged in such inducement to promote the sales of the Samsung '054 Products, e.g., through Samsung user manuals, product support, marketing materials, and training materials to actively induce the users of the accused products to infringe the '054 patent. Accordingly, Samsung 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.

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

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

571. As a result of Samsung's infringement of the '054 patent, Dynamic Data has suffered monetary damages, and seeks recovery in an amount adequate to compensate for

---

RELEASE (Feb. 23, 2017); *Exynos 9 Series (8995): A mobile processor that goes beyond mobile innovation*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-9-series-8895/ (last visited Nov. 2018); *Exynos 8 Octa (8995): The superb processor engineered for superlative mobile experiences*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-8-octa-8890/ (last visited Nov. 2018); *Exynos 5 Series (7872): Diffusion of Prime Performance*, SAMSUNG WEBSITE, *available at*: https://www.samsung.com/semiconductor/minisite/exynos/products/mobileprocessor/exynos-5-series-7872/ (last visited Nov. 2018).

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

PRAYER FOR RELIEF

WHEREFORE, Dynamic Data respectfully requests that this Court enter:

A. A judgment in favor of Dynamic Data that Samsung has infringed, either literally and/or under the doctrine of equivalents, the '105, '073, '918, '689, '177, '112, '529, '230, '041, '450, '979, '216, '426, '799, and '054 patents;

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

C. A judgment and order finding that Samsung's infringement was willful, wanton, malicious, bad-faith, deliberate, consciously wrongful, flagrant, or characteristic of a pirate within the meaning of 35 U.S.C. § 284 and awarding to Dynamic Data enhanced damages.

D. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Dynamic Data its reasonable attorneys' fees against Samsung.

E. Any and all other relief to which Dynamic Data may show themselves to be entitled.

JURY TRIAL DEMANDED

Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Dynamic Data Technologies, LLC requests a trial by jury of any issues so triable by right.

Dated: January 28, 2019

Respectfully submitted,

/s/ Daniel P. Hipskind
Elizabeth L. DeRieux
State Bar No. 05770585
Capshaw DeRieux, LLP
114 E. Commerce Ave.
Gladewater, TX 75647
Telephone: (903)235-2833
Email: ederieux@capshawlaw.com

OF COUNSEL:

Dorian S. Berger (CA SB No. 264424)
Daniel P. Hipskind (CA SB No. 266763)
Eric B. Hanson (CA SB No. 254570)
BERGER & HIPSKIND LLP
9538 Brighton Way, Ste. 320
Beverly Hills, CA 90210
Telephone: 323-886-3430
Facsimile: 323-978-5508
E-mail: dsb@bergerhipskind.com
E-mail: dph@bergerhipskind.com
E-mail: ebh@bergerhipskind.com

Attorneys for Dynamic Data Technologies, LLC

CERTIFICATE OF SERVICE

I hereby certify that counsel of record who are deemed to have consented to electronic service are being served this 28th of January, 2019 with a copy of this document via the Court's CM/ECF System per Local Rule CV-5(a)(3). Any other counsel of record will be served by electronic mail, facsimile transmission and/or first class mail on this same date.

/s/ Daniel P. Hipskind
Daniel P. Hipskind