IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
MIDLAND-ODESSA DIVISION

XUESHAN TECHNOLOGIES, INC., Plaintiff, v. QUALCOMM INCORPORATED and QUALCOMM TECHNOLOGIES, INC., Defendants	CIVIL ACTION NO. 7:25-CV-00083 **JURY TRIAL DEMANDED**

PLAINTIFF'S COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Xueshan Technologies Inc. files this Complaint against Defendants Qualcomm Incorporated and Qualcomm Technologies, Inc. (together, "Qualcomm" or "Defendants") for infringement of U.S. Patent No. 8,391,089 (the "'089 patent"), U.S. Patent No. 8,395,946 (the "'946 patent"), U.S. Patent No. 8,451,211 (the "'211 patent"), U.S. Patent No. 8,462,846 (the "'846 patent"), U.S. Patent No. 9,066,013 (the "'013 patent"), and U.S. Patent No. 9,813,730 (the "'730 patent"), collectively, the "Asserted Patents."

THE PARTIES

1. Xueshan Technologies Inc. ("XTI") is a Delaware corporation having a principal place of business in the Eastern District of Texas.

2. Defendant Qualcomm Incorporated ("QCI") is a corporation organized and existing under the laws of Delaware and maintains established places of business at 9600 N. Mopac, Suite 900, Stonebridge Plaza II, Austin, Texas 78759 and 13929 Center Lake Drive, Parmer Building 1

Austin, Texas 78753. QCI may be served in Texas via its registered agent Prentice Hall Corp. System, 211 E. 7th Street, Suite 620, Austin, TX 78701-3218.

3. Defendant Qualcomm Technologies, Inc. ("QTI") is a corporation organized and existing under the laws of Delaware and maintains established places of business at 9600 N. Mopac, Suite 900, Stonebridge Plaza II, Austin, Texas 78759 and 13929 Center Lake Drive, Parmer Building 1, Austin, Texas 78753. QTI may be served in Texas via its registered agent Corporation Service Company d/b/a CSC-Lawyers Incorporating Service Company, 211 E. 7th Street, Suite 620, Austin, TX 78701.

4. QTI is a wholly-owned subsidiary of QCI and, together with its affiliates, serves and performs substantially all of Qualcomm's research and development efforts, its engineering operations, and its products and services businesses. *See* https://www.qualcomm.com/company. Relevant QTI-affiliated companies include, at least, Qualcomm CDMA Technologies and Qualcomm CDMA Technologies Asia Pacific Pte. Ltd.

5. Qualcomm is one of the world's largest manufacturers of integrated circuits for the wireless device industry. Its website states that "[r]eferences to 'Qualcomm' may mean Qualcomm Incorporated, or subsidiaries or business units within the Qualcomm corporate structure, as applicable." *Id*. Qualcomm's website further states that "Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of our engineering, research and development functions, and substantially all of our products and services businesses, including our QCT semiconductor business." *Id*.

6. QCI, QTI, and their subsidiaries and related companies share the same management, common ownership, advertising platforms, facilities, distribution and sales channels, and accused products and product lines. In this way, QCI, QTI, and their subsidiaries and related

companies operate as a singular, unitary business enterprise and are, thus, jointly, severally and communally liable for the acts of patent infringement detailed below.

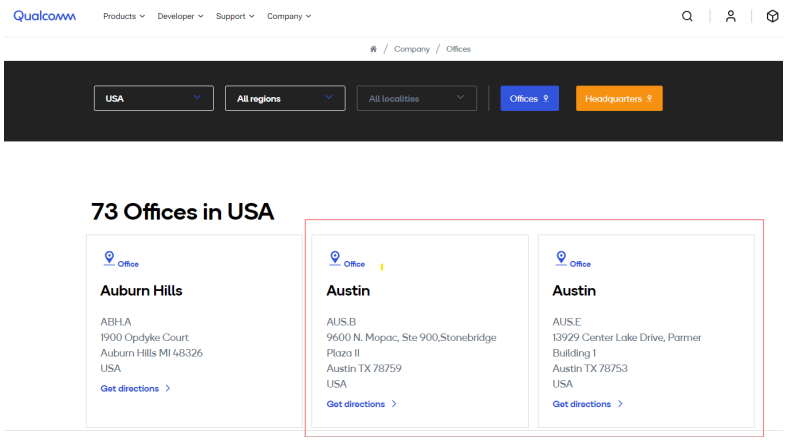
7. QCI, QTI, and their subsidiaries and related companies are doing business collectively, directly and through agents, on a persistent and ongoing basis in this District and elsewhere in the United States, and they each have regular and established places of business here.

JURISDICTION AND VENUE

8. This is an action for patent infringement arising under the patent laws of the United States, 35 U.S.C. §§ 1, et seq. This Court has jurisdiction over this action pursuant to 28 U.S.C. §§ 1331 and 1338(a).

9. This Court has personal jurisdiction over Qualcomm because it has engaged, and continues to engage, in continuous, systematic, and substantial activities within this State, including the substantial marketing and sale of products and services within this State and this District. Indeed, this Court has personal jurisdiction over Qualcomm because it has committed acts giving rise to XTI's claims for patent infringement within and directed to this District, has derived substantial revenue from its goods and services provided to individuals and entities in this State and this District, and maintains regular and established places of business in this District, including at least its two brick-and-mortar locations in Austin, Texas:[1]

[1] *See* https://www.qualcomm.com/company/facilities/offices?country=USA&page=2.

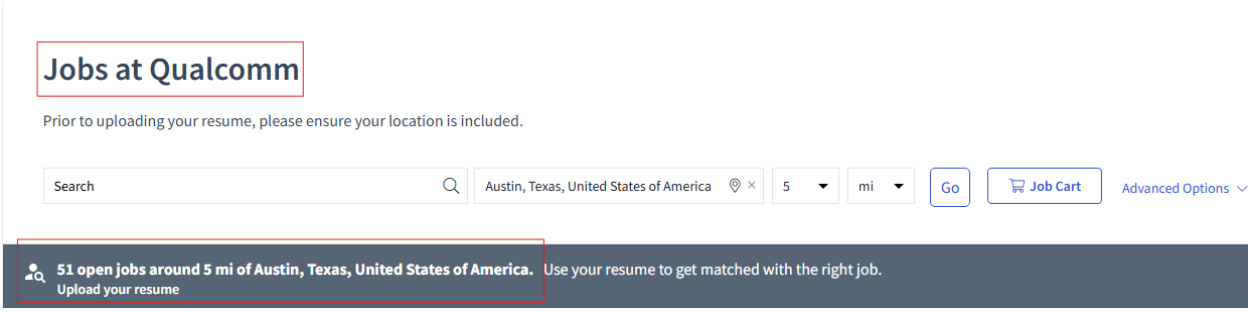


10. Relative to patent infringement, Qualcomm has committed and continues to commit acts in violation of 35 U.S.C. § 271, and has made, used, offered for sale, sold, and imported infringing products, systems, and services in this State, including this District, and has otherwise engaged in infringing conduct within and directed at, or from, this District. Infringing products, systems, and services (collectively, the "Accused Instrumentalities") include Qualcomm processors such as the Qualcomm Snapdragon 4, 6, 7, 8, and X Series products and other processors and platforms offered and sold by Qualcomm as described further below.

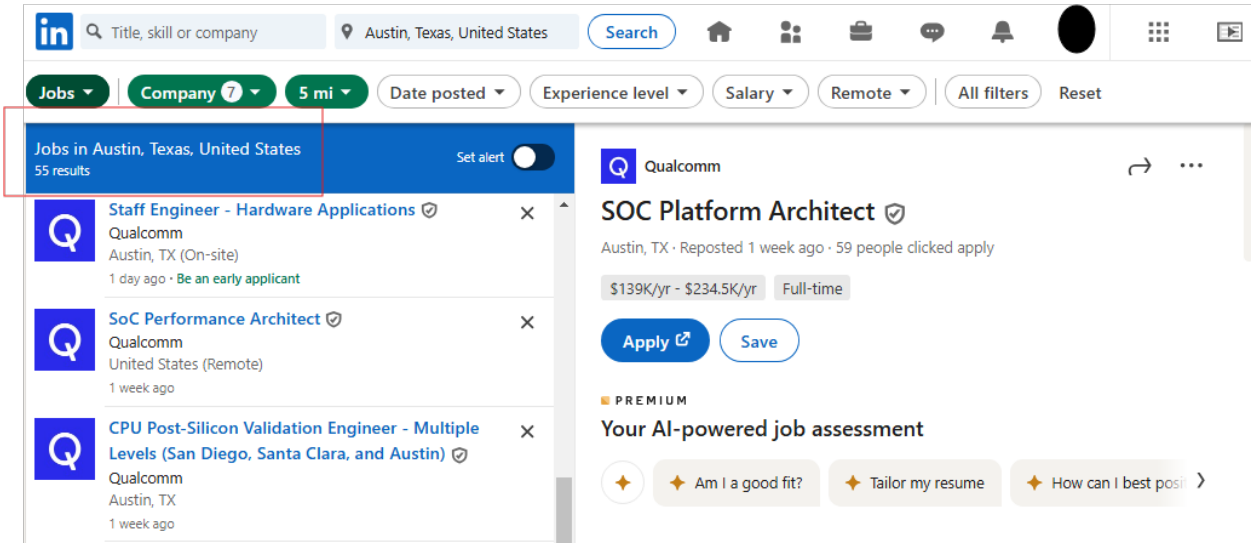
11. Qualcomm's infringing activities have caused harm to XTI in this District. Qualcomm and/or its partners and agents offer to sell and sell the Accused Instrumentalities within this District, and on information and belief, Qualcomm, its partners and agents, and/or their customers use the Accused Instrumentalities in this District in infringing ways. These are purposeful acts and transactions in this State and this District such that Qualcomm reasonably should know and expect that it can be haled into this Court to answer for its actions.

12. Moreover, this Court maintains personal jurisdiction over Qualcomm because Qualcomm conducts business in this State by, among other things, "recruit[ing] Texas residents, directly or through an intermediary located in this State, for employment inside or outside this

State." Tex. Civ. Prac. & Rem. Code § 17.042(3). For instance, Qualcomm lists dozens of job openings in Texas (as of Feb. 20, 2025):[2]



13. Qualcomm also lists its job openings in Texas on LinkedIn (as of Feb. 20, 2025):[3]

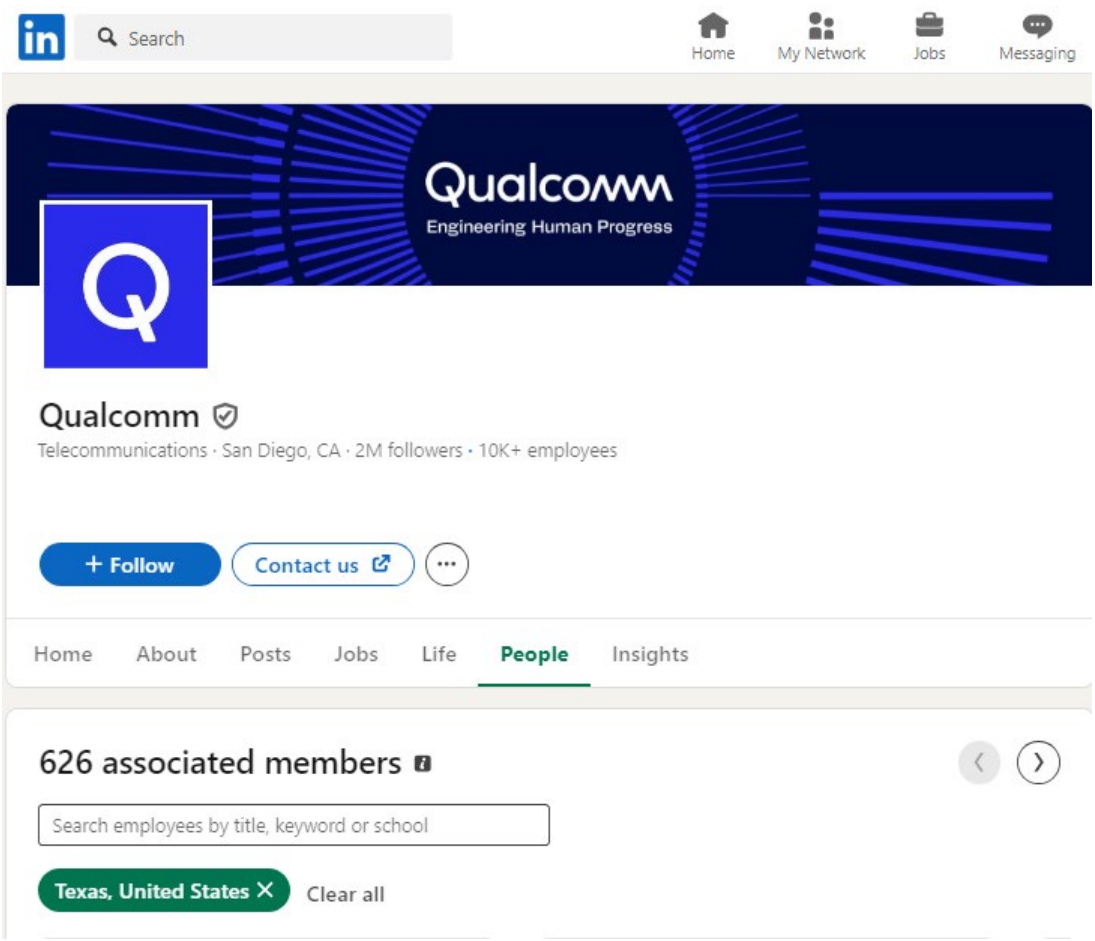


14. Further, on Qualcomm's LinkedIn page, it boasts 603 "associated members" in its Texas offices (as of Feb. 20, 2025):[4]

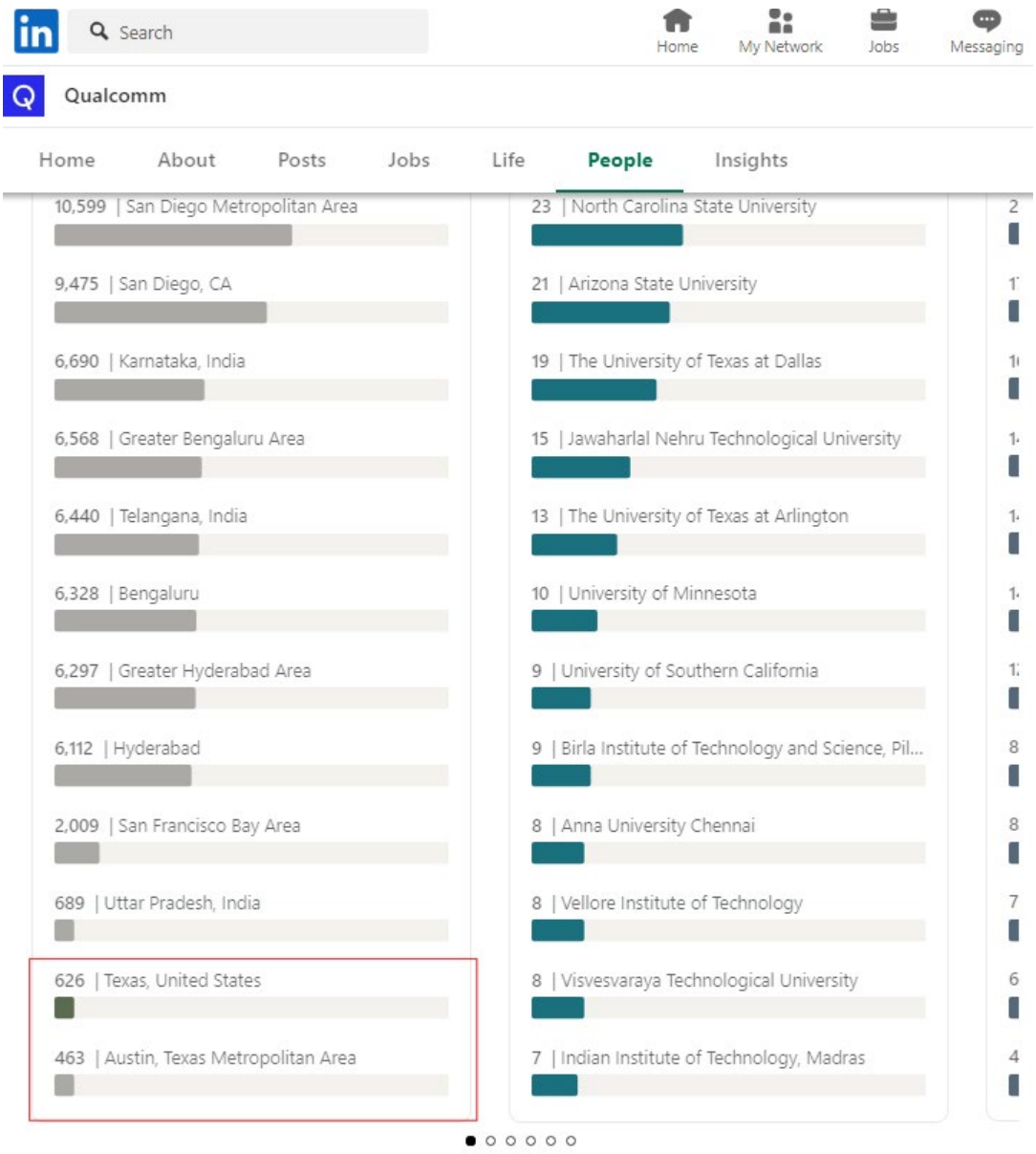
[2] https://careers.qualcomm.com/careers?location=Austin%2C%20Texas%2C%20United%20States%20of%20America&pid=446697682796&domain=qualcomm.com&sort_by=relevance&location_distance_km=8&triggerGoButton=true

[3] https://www.linkedin.com/jobs/search/?currentJobId=3991694727&distance=5&f_C=2017%2C154985%2C162572%2C2923434%2C38387%2C595224%2C75115234&f_CR=103644278&geoId=104472865&origin=JOB_SEARCH_PAGE_JOB_FILTER&refresh=true&sortBy=R

[4] https://www.linkedin.com/company/qualcomm/people/?facetGeoRegion=102748797


Search
Home
My Network
Jobs
Messaging
Qualcomm
Engineering Human Progress
Qualcomm
Telecommunications · San Diego, CA · 2M followers · 10K+ employees
+ Follow
Contact us
Home
About
Posts
Jobs
Life
People
Insights
626 associated members
Search employees by title, keyword or school
Texas, United States
Clear all

. . .



15. Venue is proper in this District under 28 U.S.C. §§ 1391 and 1400(b) because Qualcomm has at least two regular and established places of business in Austin, which is in this District. Venue is further proper in this District because Qualcomm has directly infringed and/or induced the infringements of others, including its customers, in this District by offering for sale and selling Accused Instrumentalities in this District, using Accused Instrumentalities in infringing ways in this District, and inducing infringing customer use of Accused Instrumentalities in this District.

THE ASSERTED PATENTS

16. XTI is the sole and exclusive owner of all right, title, and interest in the '089 patent, the '946 patent, the '211 patent, the '846 patent, the '013 patent, and the '730 patent, and holds the exclusive right to take all actions necessary to enforce its rights in, and to, the Asserted Patents, including the filing of this patent infringement lawsuit. XTI also has the right to recover all damages for past, present, and future infringements of the Asserted Patents and to seek injunctive relief as appropriate under the law.

17. The '089 patent is titled, "Method and circuit of calibrating data strobe signal in memory controller." The '089 patent lawfully issued on March 5, 2013 and stems from U.S. Patent Application No. 12/718,865, which was filed on March 5, 2010.

18. The '946 patent is titled, "Data access apparatus and associated method for accessing data using internally generated clocks." The '946 patent lawfully issued on March 12, 2013 and stems from U.S. Patent Application No. 12/968,719, which was filed on December 15, 2010.

19. The '211 patent is titled, "Dimming control apparatus and method for generating dimming control signal by referring to distribution information/multiple characteristic values derived from pixel values." The '211 patent lawfully issued on May 28, 2013 and stems from U.S. Patent Application No. 12/686,396, which was filed on January 13, 2010.

20. The '846 patent is titled, "Video encoder and method for performing intra-prediction and video data compression." The '846 patent lawfully issued on June 11, 2013 and stems from U.S. Patent Application No. 13/005,321, which was filed on January 12, 2011.

21. The '013 patent is titled, "Content-adaptive image resizing method and related apparatus thereof." The '013 patent lawfully issued on June 23, 2015 and stems from U.S. Patent Application No. 13/891,201, which was filed on May 10, 2013.

22. The ’730 patent is titled, “Method and apparatus for fine-grained motion boundary processing.” The ’730 patent lawfully issued on November 7, 2017 and stems from U.S. Patent Application No. 14/555,901, which was filed on November 28, 2014.

23. XTI and its predecessors complied with the requirements of 35 U.S.C. § 287, to the extent necessary, such that XTI may recover pre-suit damages.

24. The claims of the patents-in-suit are directed to patent-eligible subject matter under 35 U.S.C. § 101. They are not directed to an abstract idea, and the technologies covered by the claims comprise systems and/or consist of ordered combinations of features and functions that, at the time of invention, were not, alone or in combination, well-understood, routine, or conventional.

DEFENDANT’S PRE-SUIT KNOWLEDGE OF ITS INFRINGEMENT

25. Prior to the filing of the Complaint, XTI repeatedly attempted to engage Qualcomm and/or its agents in licensing discussions related to its portfolio including the Asserted Patents. For example, XTI sent Qualcomm an introductory letter on November 30, 2023. The letter identified specific XTI patents, including the ’089 patent, the ’211 patent, the ’846 patent, and the ’730 patent. The letter also included exemplary charts detailing Qualcomm’s infringement of these patents. On May 30, 2024, Qualcomm informed XTI that it was not interested in a license to the patents and had no interest in discussions.

26. Similarly, on February 20, 2025, XTI sent additional correspondence to Qualcomm via email. The correspondence identified specific XTI patents, including the ’946 patent and the ’013 patent. The correspondence also included exemplary charts detailing Qualcomm’s infringement of these patents. Qualcomm did not respond to this correspondence.

27. Qualcomm's refusal to discuss licensing the Asserted Patents left XTI with no choice but to seek relief through patent enforcement litigation and the filing of this lawsuit in this District.

28. The Accused Products addressed in the Counts below include, but are not limited to, the exemplary products identified in XTI's letters to Qualcomm. Qualcomm's past and continuing sales of the Accused Products (i) willfully infringe the Asserted Patents and (ii) impermissibly usurp the significant benefits of XTI's patented technologies without fairly compensating XTI.

COUNT I

(INFRINGEMENT OF U.S. PATENT NO. 8,391,089)

29. Plaintiff incorporates the preceding paragraphs herein by reference.

30. This cause of action arises under the patent laws of the United States, and, in particular, 35 U.S.C. §§ 271, *et seq*.

31. XTI is the owner of all substantial rights, title, and interest in and to the '089 patent including the right to exclude others and to enforce, sue, and recover damages for past and future infringements.

32. The '089 patent is valid, enforceable, and was duly and legally issued by the United States Patent and Trademark Office on March 5, 2013, after full and fair examination.

33. Qualcomm has and continues to directly and/or indirectly infringe (by inducing infringement) one or more claims of the '089 patent in this District and elsewhere in Texas and the United States by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import, Qualcomm products, their components and processes, and/or products containing the same that incorporate the fundamental technologies covered by the '089 patent, including, but not limited to, the Snapdragon 888, 870,

865, X Plus, X Elite, 8 Gen 1, 8 Gen 2, 8 Gen 3 Processors, and any products employing a LPDDR5/5X memory controller (collectively, the "'089 Accused Products").

Direct Infringement (35 U.S.C. § 271(a))

34. Qualcomm has directly infringed and continues to directly infringe one or more claims of the '089 patent in this District and elsewhere in Texas and the United States.

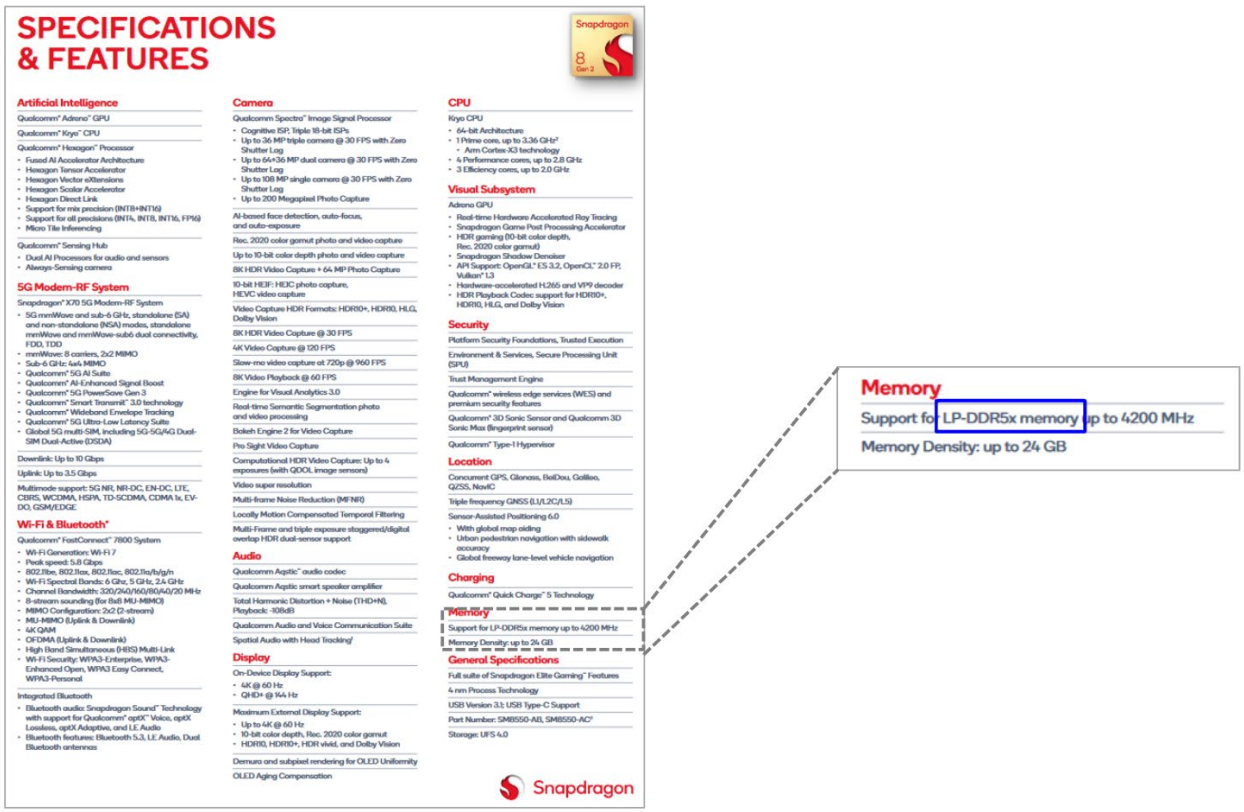
35. Qualcomm has directly infringed and continues to directly infringe, either by itself or via its agent(s), at least Claims 1, 2, 4, 5, 7, and 8 of the '089 patent[5] as set forth under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing the '089 Accused Products. Furthermore, Qualcomm makes and sells the '089 Accused Products outside of the United States and either delivers those products to its customers, distributors, and/or subsidiaries in the United States, or, in the case that it delivers the '089 Accused Products outside of the United States, it does so intending and/or knowing that those products are destined for the United States and/or designed and designated for sale in the United States, thereby directly infringing the '089 patent. *See, e.g., Lake Cherokee Hard Drive Techs., L.L.C. v. Marvell Semiconductor, Inc.*, 964 F. Supp. 2d 653, 658 (E.D. Tex. 2013).

36. Furthermore, Qualcomm directly infringes the '089 patent through its direct involvements in, and control of, the activities of subsidiaries and agents. Subject to Qualcomm's direction and control, the subsidiaries and agents conduct activities that constitute direct infringement of the '089 patent under 35 U.S.C. § 271(a) by making, using, offering for sale,

[5] Throughout this Complaint, wherever XTI identifies specific claims of the Asserted Patents infringed by Qualcomm, XTI expressly reserves the right to identify additional claims and products in its infringement contentions in accordance with applicable local rules and the Court's case management order. Specifically identified claims throughout this Complaint are provided for notice pleading only.

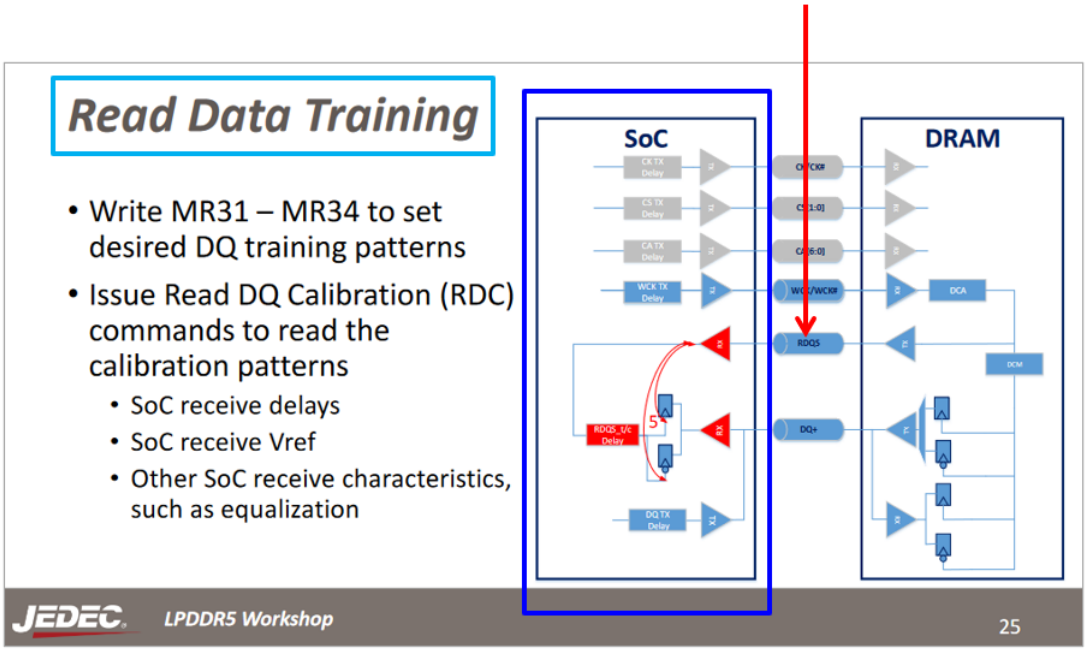
selling, and/or importing the '089 Accused Products. Qualcomm receives direct financial benefit from such infringements by its U.S.-based subsidiaries and agents.

37. By way of illustration only, the '089 Accused Products perform a method for calibrating a strobe signal in a memory controller, as set forth by claim 1 of the '089 patent. For example, the '089 Accused Products support LPDDR5/5X memory:



Source: https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/Snapdragon-8-Gen-2-Product-Brief.pdf.

38. The '089 Accused Products comprise a memory controller (dark blue box) configured to calibrate a strobe signal (red arrow) by performing read DQ calibration training (light blue box):



Source: https://picture.iczhiku.com/resource/eetop/wHiohHUqdiuDQcCn.pdf, page 25.

4.2.9.1 READ DQ Calibration Training Procedure

The procedure for executing READ DQ Calibration is:

- Issue MRW commands to write MR33 (first eight bits), MR34 (second eight bits), MR20 (selection of either inverted or output fix0), MR31/32 (eight-bit invert mask or output data fix0 for byte0/1).
  - Optionally this step could be skipped to use the default patterns.
    - MR31 default = 55_H
    - MR32 default = 55_H
    - MR33 default = $5A_H$
    - MR34 default = $3C_H$
- RD DQ Calibration is initiated by issuing Read DQ Calibration (RDC) command while in a WCK2CK SYNC state.
  - Each time an RDC command is received by the LPDDR5 SDRAM, a 16-bit data burst will, after the currently set RL, drive the eight bits programmed in MR33 followed by the eight bits programmed in MR34 on all I/O pins. CAS command (WS_RD = 1) is not required as long as WCK2CK-sync state is kept.
  - When MR20 OP[7] = 0_B, the data pattern will be inverted for I/O pins with a '1' programmed in the corresponding invert mask mode register bit.
  - When MR20 OP[7] = 1_B, the data pattern will be low-fixed for IO pins with a '1' programmed in the corresponding output data fix0 mode register bit (see 4.2.9.1 READ DQ Calibration Training Procedure (cont'd)
  - Table 37 and Table 38). The DMI pattern will be low-fixed when MR20 OP[6] = 1_B.
  - Note that the pattern is driven on the DMI pins, but no data bus inversion function is enabled, even if Read DBI is enabled in the SDRAM mode register.
  - The RDC command can be issued every 2nCK @ CKR=1:4/ 4nCK @ CKR=1:2 seamlessly, and tRTRRD delay is required between Array Read command and the RDC command as well the delay required between the RDC command and an array read.
  - The operands received with the CAS command must be driven LOW except WS_RD.
  - The function set by previous CAS operands is ignored. (DC0~3 and B3 are ignored.)
- DQ Read Training can be performed with any or no banks active, during Refresh, or during SREF without Power Down.

Source: JEDEC JESD209-5C – LPDDR5/5X, page 89.

39. As outlined and annotated below, the '089 Accused Products perform "detecting a delay calibrating parameter during a first period." For example, the memory controller detects a delay calibrating parameter shown in purple below:

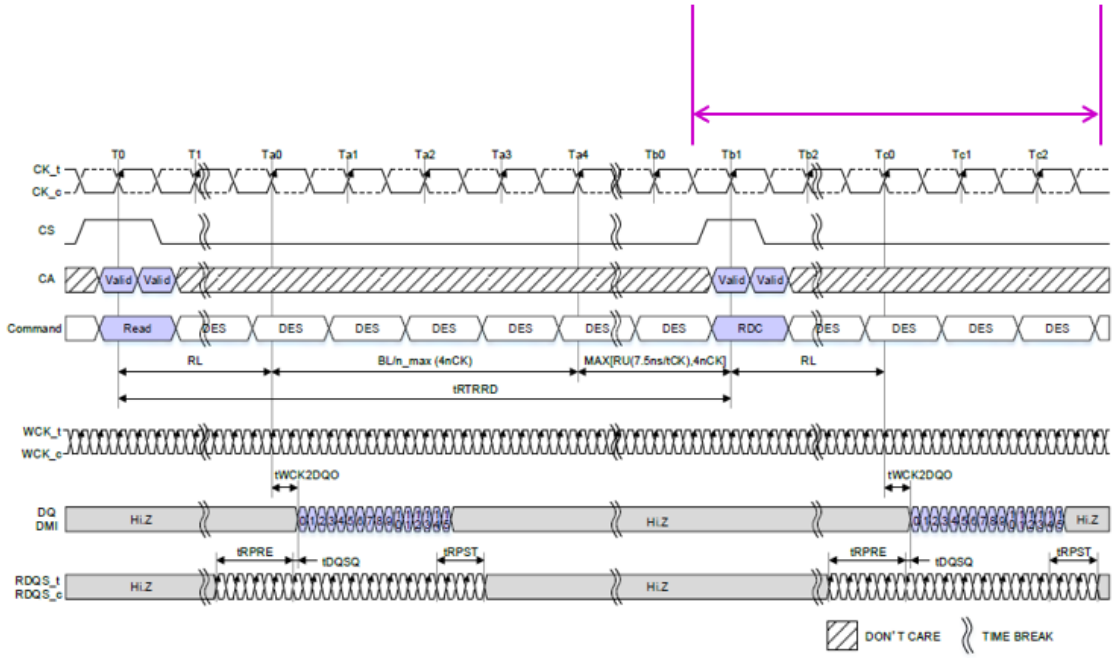
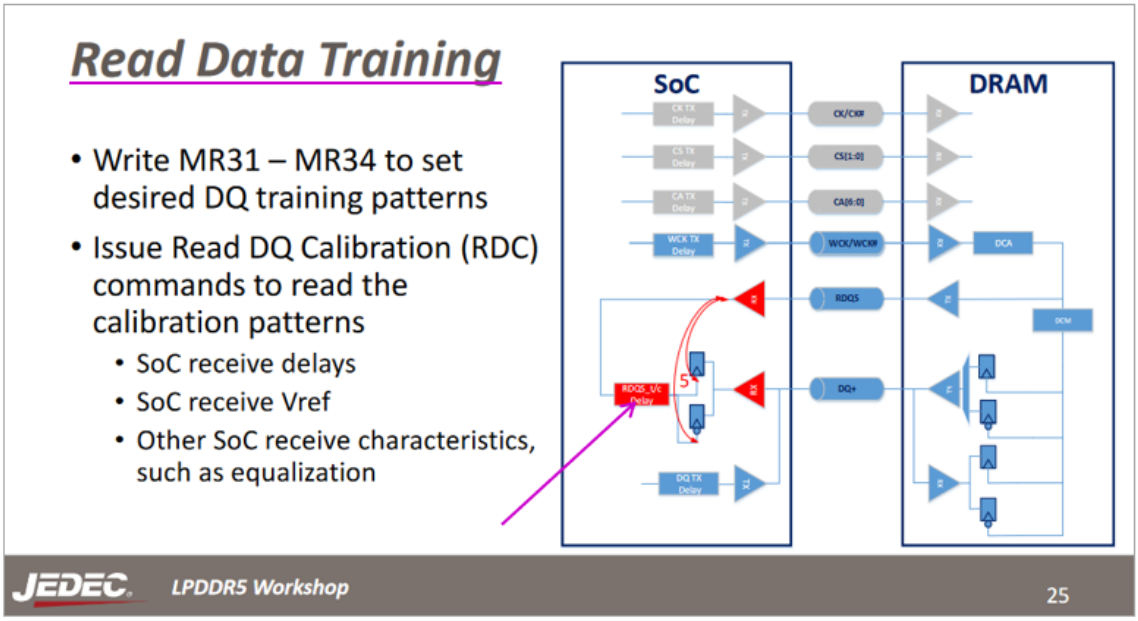


Figure 48 — Read to Read DQ Calibration Timing: BG Mode, CKR=4:1, BL=16, tRPST=2.5nWCK

Source: JEDEC JESD209-5C – LPDDR5/5X, page 89.



Source: https://picture.iczhiku.com/resource/eetop/wHiohHUqdiuDQcCn.pdf, page 25.

40. As outlined and annotated below, the '089 Accused Products perform "delaying the strobe signal by a predetermined phase according to the delay calibrating parameter during a second period." For example, as shown in light blue below, the '089 Accused Products support burst read operation which comprises a read during a second period where the RDQS within the controller has previously been calibrated:

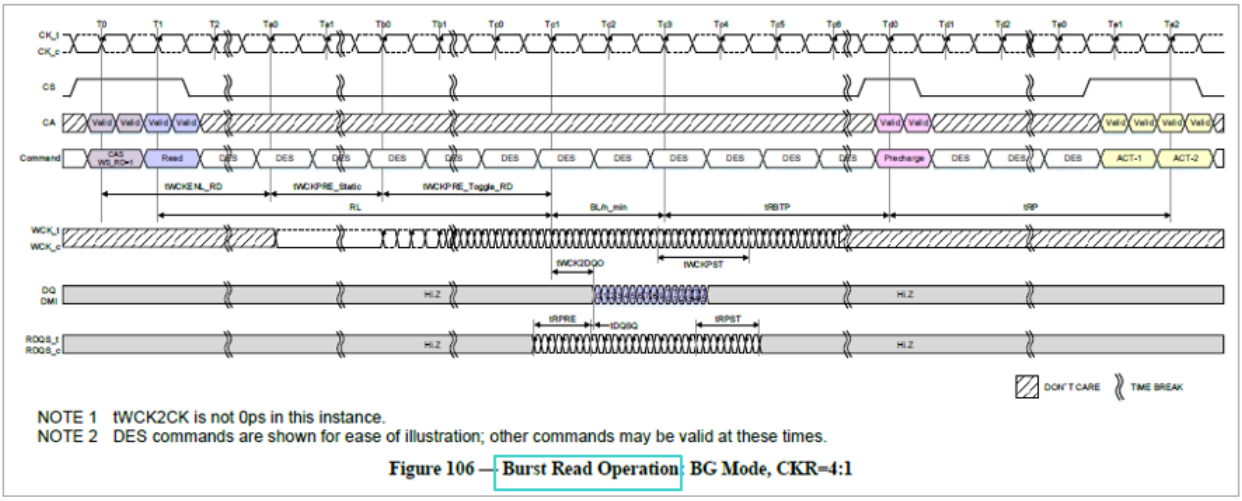


Figure 106 — Burst Read Operation: BG Mode, CKR=4:1

Source: JEDEC JESD209-5C – LPDDR5/5X, page 240.

41. Further, Qualcomm directs or controls performance of the claimed methods, including the steps discussed above, by including instructions and directives, such as firmware and source code, in the '089 Accused Products that cause this to occur.

Indirect Infringement (Inducement – 35 U.S.C. § 271(b))

42. In addition and/or in the alternative to its direct infringements, Qualcomm has indirectly infringed and continues to indirectly infringe one or more claims of the '089 patent by knowingly and intentionally inducing others, including its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers, to directly infringe by

making, using, offering to sell, selling and/or importing into the United States the '089 Accused Products.

43. At a minimum, Qualcomm has knowledge of the '089 patent since being served with this Complaint. Qualcomm also has knowledge of the '089 patent since receiving detailed correspondence from XTI prior to the filing of the Complaint, alerting Qualcomm to its infringements. Since receiving notice of its infringements, Qualcomm has actively induced the direct infringements of its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers as set forth under U.S.C. § 271(b). Such inducements have been committed with the knowledge, or with willful blindness to the fact, that the acts induced constitute infringement of the '089 patent. Indeed, Qualcomm has intended to cause, continues to intend to cause, and has taken, and continues to take affirmative steps to induce infringement by, among other things, creating and disseminating advertisements and instructive materials that promote the infringing use of the '089 Accused Products (e.g., use of such products with LPDDR5/5X memory, which (as outlined above) results in infringement); creating and/or maintaining established distribution channels for the '089 Accused Products into and within the United States; manufacturing the '089 Accused Products in conformity with U.S. laws and regulations; providing technical documentation and tools for the '089 Accused Products,[6] incorporating into the '089 Accused Products instructions in the form executable code or logic that causes performance of claimed methods, and promoting the incorporation of the '089 Accused Products into end-user products.

[6] *See, e.g.*, https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/Snapdragon-8-Gen-2-Product-Brief.pdf.

Damages

44. On information and belief, despite having knowledge of the '089 patent and knowledge that it is directly and/or indirectly infringing one or more claims of the '089 patent, Qualcomm has nevertheless continued its infringing conduct and disregarded an objectively high likelihood of infringement. Qualcomm's infringing activities relative to the '089 patent have been, and continue to be, willful, wanton, malicious, in bad-faith, deliberate, consciously wrongful, flagrant, characteristic of a pirate, and an egregious case of misconduct beyond typical infringement such that XTI is entitled to enhanced damages under 35 U.S.C. § 284 up to three times the amount found or assessed.

45. XTI has been damaged as a result of Qualcomm's infringing conduct described in this Count. Qualcomm is, thus, liable to XTI in an amount that adequately compensates XTI for Qualcomm's infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

COUNT II

(INFRINGEMENT OF U.S. PATENT NO. 8,395,946)

46. Plaintiff incorporates the preceding paragraphs herein by reference.

47. This cause of action arises under the patent laws of the United States, and, in particular, 35 U.S.C. §§ 271, *et seq*.

48. XTI is the owner of all substantial rights, title, and interest in and to the '946 patent including the right to exclude others and to enforce, sue, and recover damages for past and future infringements.

49. The '946 patent is valid, enforceable, and was duly and legally issued by the United States Patent and Trademark Office on March 12, 2013, after full and fair examination.

50. Qualcomm has and continues to directly and/or indirectly infringe (by inducing infringement) one or more claims of the '946 patent in this District and elsewhere in Texas and the United States by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import, Qualcomm products, their components and processes, and/or products containing the same that incorporate the fundamental technologies covered by the '946 patent, including, but not limited to, the Snapdragon 888, 870, 865, X Plus, X Elite, 8 Gen 1, 8 Gen 2, 8 Gen 3 Processors, and any products employing a LPDDR5/5X memory controller (collectively, the "'946 Accused Products").

Direct Infringement (35 U.S.C. § 271(a))

51. Qualcomm has directly infringed and continues to directly infringe one or more claims of the '946 patent in this District and elsewhere in Texas and the United States.

52. Qualcomm has directly infringed and continues to directly infringe, either by itself or via its agent(s), at least Claims 1, 2, 3, 7, 8, and 9 of the '946 patent as set forth under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing, the '946 Accused Products. Furthermore, Qualcomm makes and sells the '946 Accused Products outside of the United States and either, delivers those products to its customers, distributors, and/or subsidiaries in the United States, or, in the case that it delivers the '946 Accused Products outside of the United States, it does so intending and/or knowing that those products are destined for the United States and/or designed and designated for sale in the United States, thereby directly infringing the '946 patent. *See, e.g., Lake Cherokee Hard Drive Techs., L.L.C. v. Marvell Semiconductor, Inc.*, 964 F. Supp. 2d 653, 658 (E.D. Tex. 2013).

53. Furthermore, Qualcomm directly infringes the '946 patent through its direct involvements in, and control of, the activities of its subsidiaries. Subject to Qualcomm's direction

and control, such subsidiaries conduct activities that constitute direct infringement of the '946 patent under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing '946 Accused Products. Qualcomm receives direct financial benefit from such infringements of its U.S.-based sales subsidiaries.

54. By way of illustration only, the '946 Accused Products include each and every element of claim 1 of the '946 patent.

55. As illustrated and annotated below, the '946 Accused Products comprise "[a] data access apparatus [the red box], for accessing a memory [the blue box] that provides a data signal [the purple arrow] to the data access apparatus":

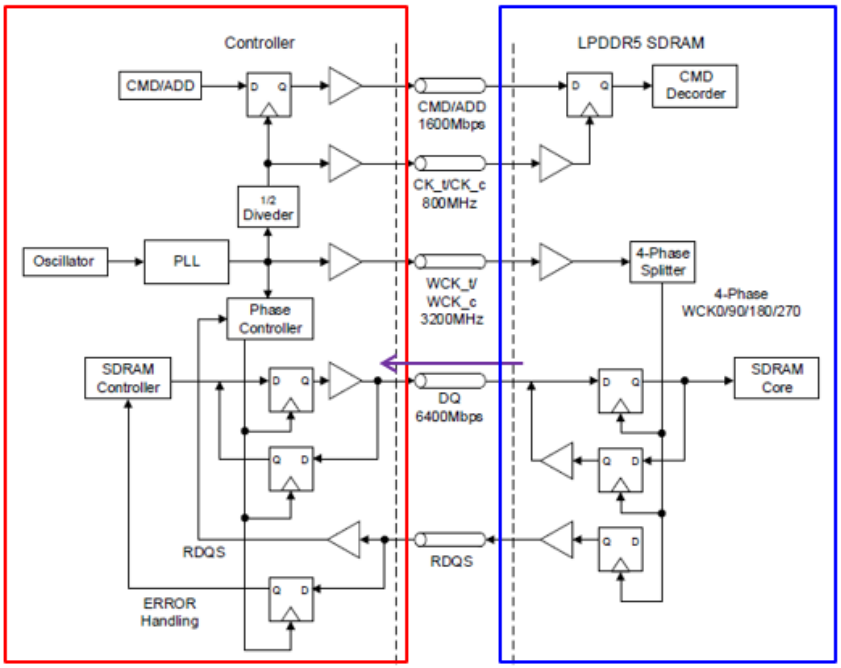


Figure 11 — Block Diagram of an Example System: CKR=4:1

Source: JEDEC JESD209-5C – LPDDR5/5X, page 25.

56. The '946 Accused Products further comprise "a phase locked loop (PLL) [gold box] that provides a plurality of internal clocks [green arrow and underlining] and selects a strobe clock from the plurality of internal clocks [light blue arrows and underlining] according to a phase selection signal [orange underlining]." This limitation is demonstrated below:

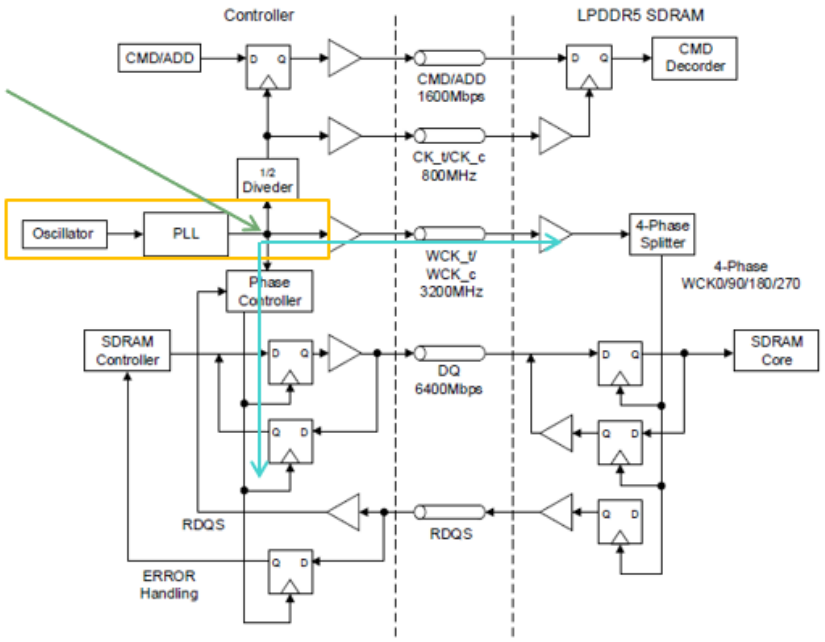


Figure 11 — Block Diagram of an Example System: CKR=4:1

Source: JEDEC JESD209-5C – LPDDR5/5X, page 25.

4.2.5.2 WCK2CK Leveling Procedure and Related AC Parameters (cont'd)

Specific descriptions for Figure 42 and Figure 43.

1. Start to drive WCK_t LOW and WCK_c High.
2. Enter into WCK2CK Leveling mode by setting MR18-OP[6]=1_B. In WCK2CK leveling mode, the WCK to CK frequency ratio must be 2:1, because the frequency of WCK preamble is 2 times of CK regardless of WCK2CK mode (4:1 or 2:1). NT-ODT will be disabled even though NT-ODT is enabled by MR11 OP[3] and MR41 OP[7:5]: NT DQ ODT.
3. Wait for a time tWLMRD before providing the first WCK signal toggle input. The delay time tWLMRD(MAX) is controller dependent.
4. Toggle WCK signal 7.5 cycles for WCK2CK phase detection. SDRAM may or may not capture the first rising edge of WCK_t due to an unstable first rising edge. Hence, providing exactly 7.5 cycles of WCK signal input is required in every WCK input signal during WCK2CK training mode. SDRAM provides asynchronous feedback of the last captured WCK2CK phase information during WCK toggles, on all the DQ bits after time tWLO. DQ output is low if WCK phase is earlier than CK phase and high if WCK phase is later than CK phase. The controller must sample the phase relation result on DQ after satisfying tWLO.
5. The feedback provided by the SDRAM is referenced by the controller to increment or decrement the WCK_t and WCK_c delay setting. The controller can adjust the WCK delay setting only when it drives WCK_t LOW and WCK_c HIGH to prevent any glitches in WCK signal. WCK search range from controller is defined as tWCK2CK_leveling ac parameter. Refer to the tWCK2CK_leveling value in Table 32.
6. Repeat steps 4 through step 5 until the proper WCK_t/WCK_c delay is established.
7. Exit from WCK2CK Leveling mode by setting MR18-OP[6]=0_B. NT-ODT will come back to enable if NT-ODT is enabled by MR11 OP[3] and MR41 OP[7:5]: NT DQ ODT.

Source: JEDEC JESD209-5C – LPDDR5/5X, page 78.

57. As annotated below, the ’946 Accused Products also comprise “a data receiving circuit coupled to the PLL”:

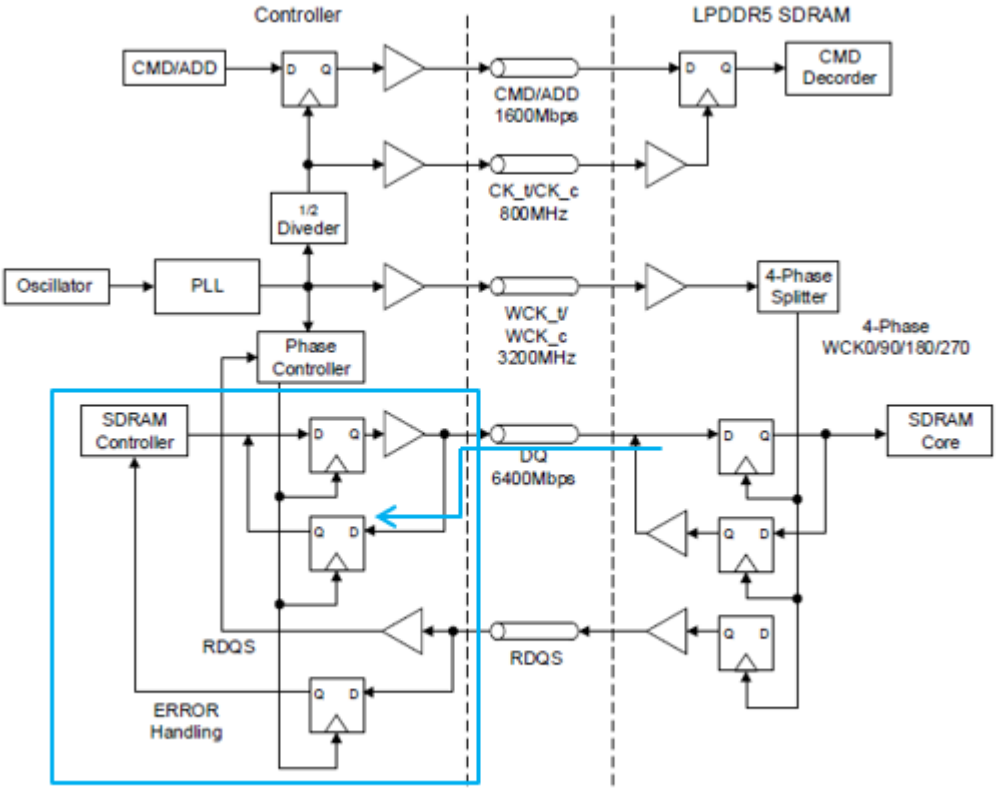


Figure 11 — Block Diagram of an Example System: CKR=4:1

Source: JEDEC JESD209-5C – LPDDR5/5X, page 25.

58. As annotated below, the ’946 Accused Products also comprise “a latching module that latches [purple box] the data signal [blue arrow] according to a plurality of triggers [pink arrow] of the strobe clock [light blue arrow]”:

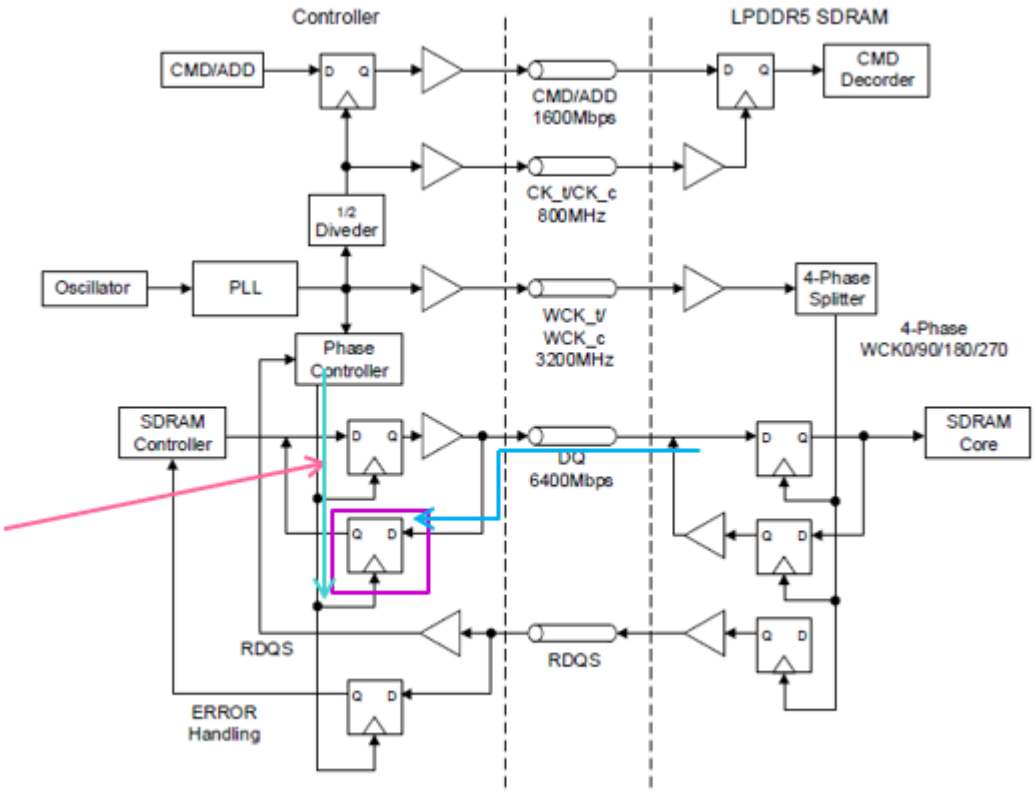


Figure 11 — Block Diagram of an Example System: CKR=4:1

Source: JEDEC JESD209-5C – LPDDR5/5X, page 25.

59. The ’946 Accused Products also comprise “a calibrating circuit [green arrow] that generates the phase selection signal for comparing a training data [brown underlining] with a predetermined data [blue underlining] in response to the plurality of internal clocks in a training mode, and determines whether the phase selection signal corresponds to a preferred clock in a normal mode [red arrow and underlining].” as demonstrated below:

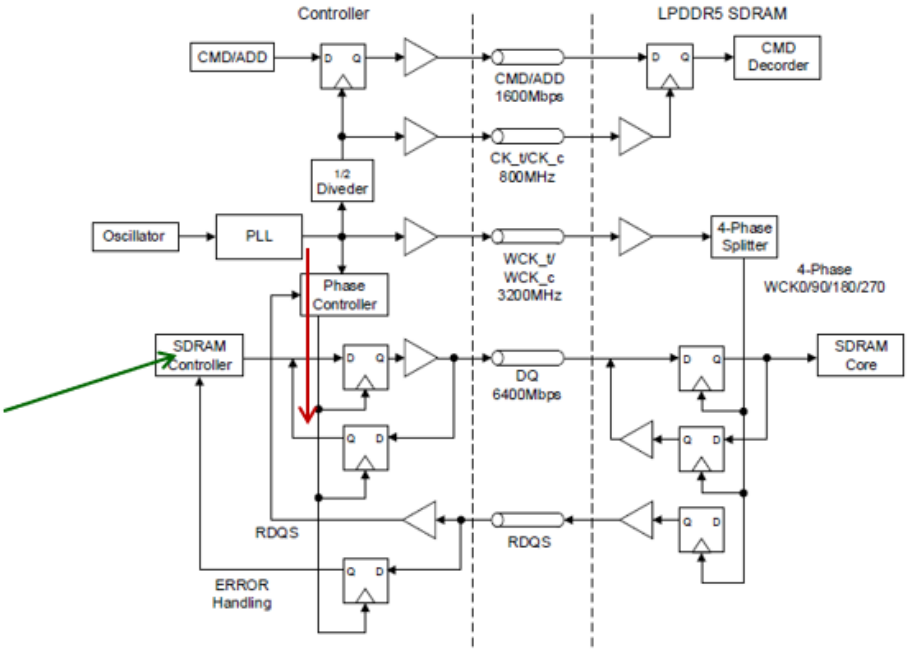


Figure 11 — Block Diagram of an Example System: CKR=4:1

Source: JEDEC JESD209-5C – LPDDR5/5X, page 25.

4.2.5.2 WCK2CK Leveling Procedure and Related AC Parameters (cont'd)

Specific descriptions for Figure 42 and Figure 43.

1. Start to drive WCK_t LOW and WCK_c High.
2. Enter into WCK2CK Leveling mode by setting MR18-OP[6]=1_B. In WCK2CK leveling mode, the WCK to CK frequency ratio must be 2:1, because the frequency of WCK preamble is 2 times of CK regardless of WCK2CK mode (4:1 or 2:1). NT-ODT will be disabled even though NT-ODT is enabled by MR11 OP[3] and MR41 OP[7:5]: NT DQ ODT.
3. Wait for a time tWLMRD before providing the first WCK signal toggle input. The delay time tWLMRD(MAX) is controller dependent.
4. Toggle WCK signal 7.5 cycles for WCK2CK phase detection. SDRAM may or may not capture the first rising edge of WCK_t due to an unstable first rising edge. Hence, providing exactly 7.5 cycles of WCK signal input is required in every WCK input signal during WCK2CK training mode. SDRAM provides asynchronous feedback of the last captured WCK2CK phase information during WCK toggles, on all the DQ bits after time tWLO. DQ output is low if WCK phase is earlier than CK phase and high if WCK phase is later than CK phase. The controller must sample the phase relation result on DQ after satisfying tWLO.
5. The feedback provided by the SDRAM is referenced by the controller to increment or decrement the WCK_t and WCK_c delay setting. The controller can adjust the WCK delay setting only when it drives WCK_t LOW and WCK_c HIGH to prevent any glitches in WCK signal. WCK search range from controller is defined as tWCK2CK_leveling ac parameter. Refer to the tWCK2CK_leveling value in Table 32.
6. Repeat steps 4 through step 5 until the proper WCK_t/WCK_c delay is established.
7. Exit from WCK2CK Leveling mode by setting MR18-OP[6]=0_B. NT-ODT will come back to enable if NT-ODT is enabled by MR11 OP[3] and MR41 OP[7:5]: NT DQ ODT.

Source: JEDEC JESD209-5C – LPDDR5/5X, page 78.

Indirect Infringement (Inducement – 35 U.S.C. § 271(b))

60. In addition and/or in the alternative to its direct infringements, Qualcomm has indirectly infringed and continues to indirectly infringe one or more claims of the ’946 patent by knowingly and intentionally inducing others, including its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers, to directly infringe by making, using, offering to sell, selling and/or importing into the United States the ’946 Accused Product.

61. At a minimum, Qualcomm has knowledge of the ’946 patent since being served with this Complaint. Qualcomm also has knowledge of the ’946 patent since receiving detailed correspondence from XTI prior to the filing of the Complaint, alerting Qualcomm to its infringements. Since receiving notice of its infringements, Qualcomm has actively induced the direct infringements of its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers as set forth under U.S.C. § 271(b). Indeed, Qualcomm has intended to cause, continues to intend to cause, and has taken, and continues to take affirmative steps to induce infringement by, among other things, creating and disseminating advertisements and instructive materials that promote the infringing use of the ’946 Accused Products; creating and/or maintaining established distribution channels for the ’946 Accused Products into and within the United States; manufacturing the ’946 Accused Products in conformity with U.S. laws and regulations; distributing or making available videos, training, tools and resources supporting use of the ’946 Accused Products that promote their features, specifications, and applications;

providing technical documentation and tools for the '946 Accused Products,[7] and promoting the incorporation of the '946 Accused Products into end-user products; and by providing technical support and/or related services for these products to purchasers in the United States.

Damages

62. On information and belief, despite having knowledge of the '946 patent and knowledge that it is directly and/or indirectly infringing one or more claims of the '946 patent, Qualcomm has nevertheless continued its infringing conduct and disregarded an objectively high likelihood of infringement. Qualcomm's infringing activities relative to the '946 patent have been, and continue to be, willful, wanton, malicious, in bad-faith, deliberate, consciously wrongful, flagrant, characteristic of a pirate, and an egregious case of misconduct beyond typical infringement such that XTI is entitled to enhanced damages under 35 U.S.C. § 284 up to three times the amount found or assessed.

63. XTI has been damaged as a result of Qualcomm's infringing conduct described in this Count. Qualcomm is, thus, liable to XTI in an amount that adequately compensates XTI for Qualcomm's infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

COUNT III

(INFRINGEMENT OF U.S. PATENT NO. 8,451,211)

64. Plaintiff incorporates the preceding paragraphs herein by reference.

65. This cause of action arises under the patent laws of the United States, and, in particular, 35 U.S.C. §§ 271, *et seq*.

[7] *See, e.g.*, https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/Snapdragon-8-Gen-2-Product-Brief.pdf.

66. XTI is the owner of all substantial rights, title, and interest in and to the '211 patent including the right to exclude others and to enforce, sue, and recover damages for past and future infringements.

67. The '211 patent is valid, enforceable, and was duly and legally issued by the United States Patent and Trademark Office on May 28, 2013, after full and fair examination.

68. Qualcomm has and continues to directly and/or indirectly infringe (by inducing infringement) one or more claims of the '211 patent in this District and elsewhere in Texas and the United States by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import, Qualcomm products, their components and processes, and/or products containing the same that incorporate the fundamental technologies covered by the '211 patent, including, but not limited to, the Snapdragon 855, 855+, 865, X Plus, X Elite, 8 Gen 1, 8 Gen 2, 8 Gen 3 Processors, and any products employing similar dimming control functionality, including products that support HDR10+ (collectively, the "'211 Accused Products").

Direct Infringement (35 U.S.C. § 271(a))

69. Qualcomm has directly infringed and continues to directly infringe one or more claims of the '211 patent in this District and elsewhere in Texas and the United States.

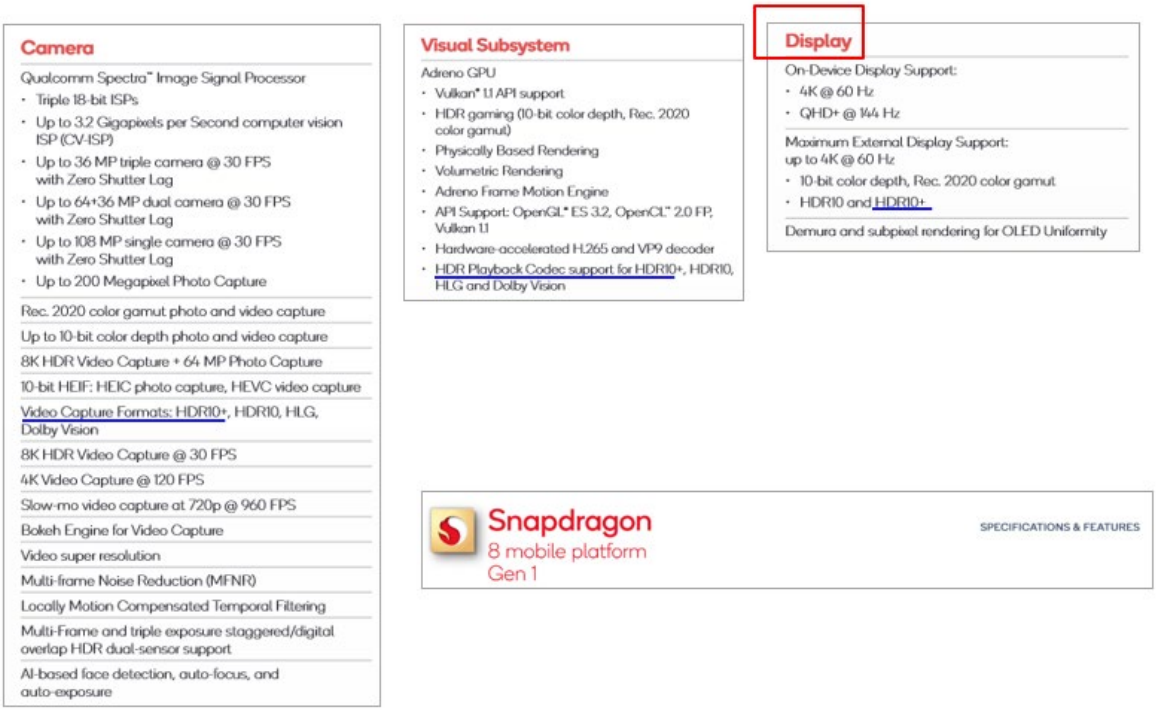
70. Qualcomm has directly infringed and continues to directly infringe, either by itself or via its agent(s), at least Claims 5, 14, and 15 of the '211 patent as set forth under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing, the '211 Accused Products. Furthermore, Qualcomm makes and sells the '211 Accused Products outside of the United States and either, delivers those products to its customers, distributors, and/or subsidiaries in the United States, or, in the case that it delivers the '211 Accused Products outside of the United States, it

does so intending and/or knowing that those products are destined for the United States and/or designed and designated for sale in the United States, thereby directly infringing the ’211 patent. *See, e.g., Lake Cherokee Hard Drive Techs., L.L.C. v. Marvell Semiconductor, Inc.*, 964 F. Supp. 2d 653, 658 (E.D. Tex. 2013).

71. Furthermore, Qualcomm directly infringes the ’211 patent through its direct involvements in, and control of, the activities of subsidiaries and agents. Subject to Qualcomm’s direction and control, such subsidiaries conduct activities that constitute direct infringement of the ’211 patent under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing ’211 Accused Products. Qualcomm receives direct financial benefit from such infringements of its U.S.-based sales subsidiaries.

72. By way of illustration only, the ’211 Accused Products include each and every element of claim 5 of the ’211 patent.

73. As illustrated, annotated, and explained below, the ’211 Accused Products comprise “[a] dimming control apparatus [blue underlining] of generating a dimming control signal for a display area including a plurality of pixels [red box].” For example, the ’211 Accused Products support the HDR10+ codec for both capture and playback that issues a dimming control signal to the display which comprises pixels:



Camera

Qualcomm Spectra™ Image Signal Processor
- Triple 18-bit ISPs
- Up to 3.2 Gigapixels per Second computer vision ISP (CV-ISP)
- Up to 36 MP triple camera @ 30 FPS with Zero Shutter Lag
- Up to 64+36 MP dual camera @ 30 FPS with Zero Shutter Lag
- Up to 108 MP single camera @ 30 FPS with Zero Shutter Lag
- Up to 200 Megapixel Photo Capture

Rec. 2020 color gamut photo and video capture

Up to 10-bit color depth photo and video capture

8K HDR Video Capture + 64 MP Photo Capture

10-bit HEIF: HEIC photo capture, HEVC video capture

Video Capture Formats: HDR10+, HDR10, HLG, Dolby Vision

8K HDR Video Capture @ 30 FPS

4K Video Capture @ 120 FPS

Slow-mo video capture at 720p @ 960 FPS

Bokeh Engine for Video Capture

Video super resolution

Multi-frame Noise Reduction (MFNR)

Locally Motion Compensated Temporal Filtering

Multi-Frame and triple exposure staggered/digital overlap HDR dual-sensor support

AI-based face detection, auto-focus, and auto-exposure

Visual Subsystem

Adreno GPU
- Vulkan® 1.1 API support
- HDR gaming (10-bit color depth, Rec. 2020 color gamut)
- Physically Based Rendering
- Volumetric Rendering
- Adreno Frame Motion Engine
- API Support: OpenGL® ES 3.2, OpenCL™ 2.0 FP, Vulkan 1.1
- Hardware-accelerated H.265 and VP9 decoder
- HDR Playback Codec support for HDR10+, HDR10, HLG and Dolby Vision

Display

On-Device Display Support:
- 4K @ 60 Hz
- QHD+ @ 144 Hz

Maximum External Display Support: up to 4K @ 60 Hz
- 10-bit color depth, Rec. 2020 color gamut
- HDR10 and HDR10+

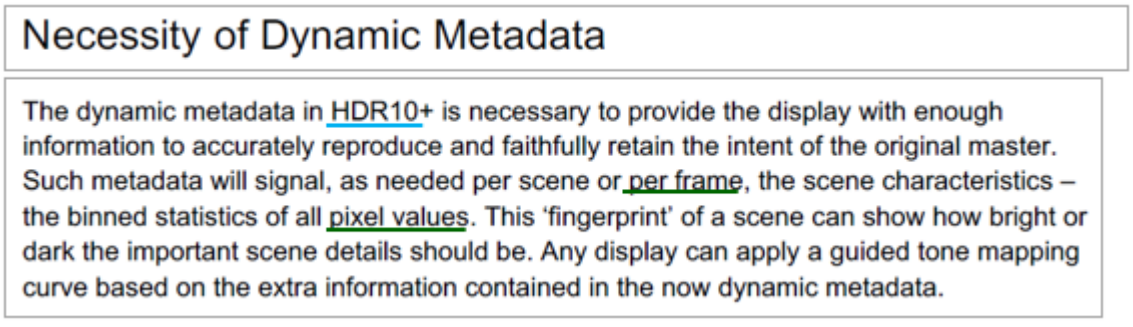
Demura and subpixel rendering for OLED Uniformity

Snapdragon 8 mobile platform Gen 1

SPECIFICATIONS & FEATURES

Source: https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/snapdragon-8-gen-1-mobile-platform-product-brief.pdf.

74. The '211 Accused Products further comprise "a data analysis module [blue underlining], for receiving a plurality of first pixel values corresponding to the pixels, respectively, where the first pixel values correspond to a first frame [green underlining]." This limitation is demonstrated below:



Necessity of Dynamic Metadata

The dynamic metadata in HDR10+ is necessary to provide the display with enough information to accurately reproduce and faithfully retain the intent of the original master. Such metadata will signal, as needed per scene or per frame, the scene characteristics – the binned statistics of all pixel values. This 'fingerprint' of a scene can show how bright or dark the important scene details should be. Any display can apply a guided tone mapping curve based on the extra information contained in the now dynamic metadata.

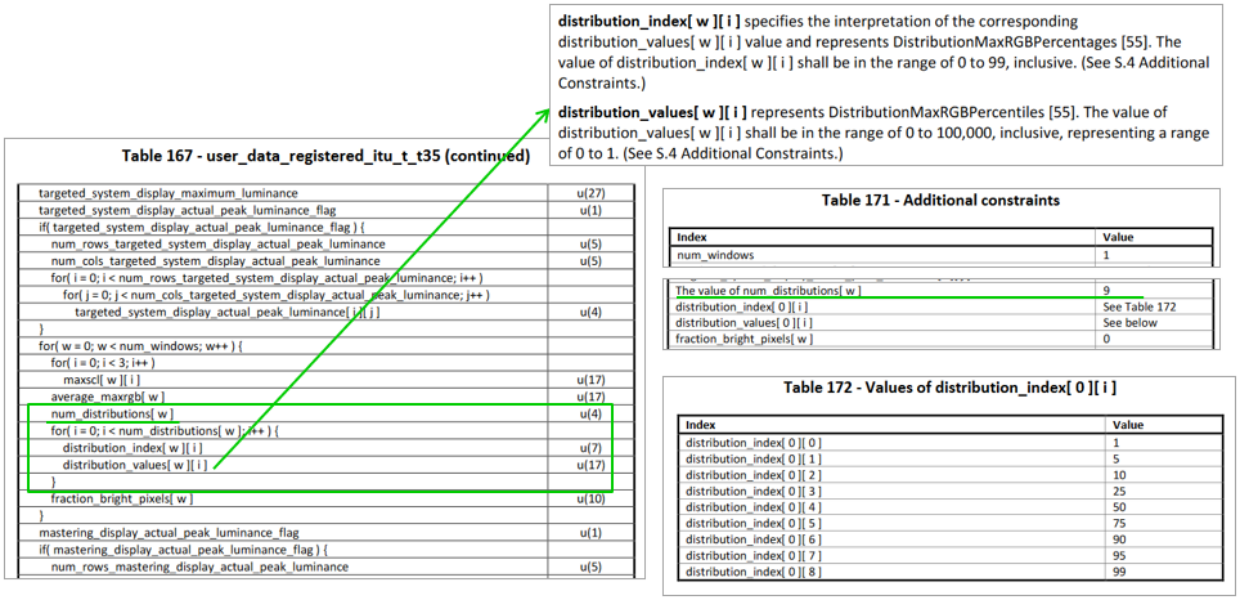
Source: https://hdr10plus.org/wp-content/uploads/2019/08/HDR10_WhitePaper.pdf, page 5.

75. The ’211 Accused Products further comprise a data analysis module for “deriving a first characteristic value corresponding to the first frame [pink underlining] by referring to a distribution of the first pixel values [green underlining and annotations].” This limitation is demonstrated below:

Necessity of Dynamic Metadata

The dynamic metadata in HDR10+ is necessary to provide the display with enough information to accurately reproduce and faithfully retain the intent of the original master. Such metadata will signal, as needed per scene or per frame, the scene characteristics – the binned statistics of all pixel values. This ‘fingerprint’ of a scene can show how bright or dark the important scene details should be. Any display can apply a guided tone mapping curve based on the extra information contained in the now dynamic metadata.

Source: https://hdr10plus.org/wp-content/uploads/2019/08/HDR10_WhitePaper.pdf, page 5.



distribution_index[w][i] specifies the interpretation of the corresponding distribution_values[w][i] value and represents DistributionMaxRGBPercentages [55]. The value of distribution_index[w][i] shall be in the range of 0 to 99, inclusive. (See S.4 Additional Constraints.)

distribution_values[w][i] represents DistributionMaxRGBPercentiles [55]. The value of distribution_values[w][i] shall be in the range of 0 to 100,000, inclusive, representing a range of 0 to 1. (See S.4 Additional Constraints.)

Table 167 - user_data_registered_itu_t_t35 (continued)

targeted_system_display_maximum_luminance	u(27)
targeted_system_display_actual_peak_luminance_flag	u(1)
if(targeted_system_display_actual_peak_luminance_flag) {	
num_rows_targeted_system_display_actual_peak_luminance	u(5)
num_cols_targeted_system_display_actual_peak_luminance	u(5)
for(i = 0; i < num_rows_targeted_system_display_actual_peak_luminance; i++)	
for(j = 0; j < num_cols_targeted_system_display_actual_peak_luminance; j++)	
targeted_system_display_actual_peak_luminance[i][j]	u(4)
}	
for(w = 0; w < num_windows; w++) {	
for(i = 0; i < 3; i++)	
maxscl[w][i]	u(17)
average_maxrgb[w]	u(17)
num_distributions[w]	u(4)
for(i = 0; i < num_distributions[w]; i++) {	
distribution_index[w][i]	u(7)
distribution_values[w][i]	u(17)
}	
fraction_bright_pixels[w]	u(10)
}	
mastering_display_actual_peak_luminance_flag	u(1)
if(mastering_display_actual_peak_luminance_flag) {	
num_rows_mastering_display_actual_peak_luminance	u(5)

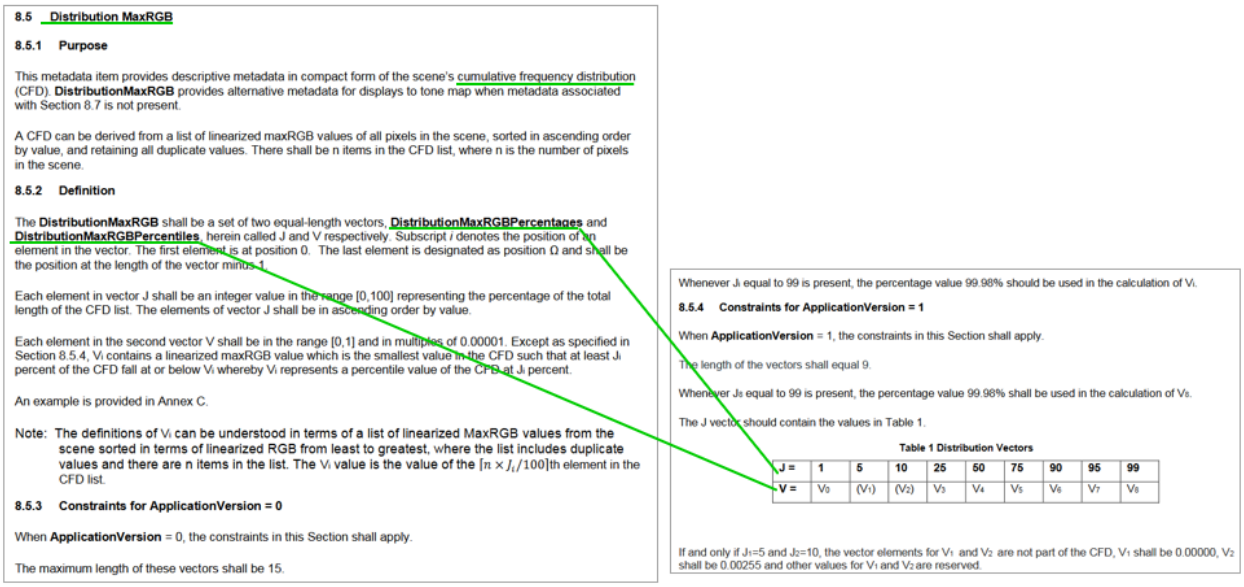
Table 171 - Additional constraints

Index	Value
num_windows	1
The value of num_distributions[w]	9
distribution_index[0][i]	See Table 172
distribution_values[0][i]	See below
fraction_bright_pixels[w]	0

Table 172 - Values of distribution_index[0][i]

Index	Value
distribution_index[0][0]	1
distribution_index[0][1]	5
distribution_index[0][2]	10
distribution_index[0][3]	25
distribution_index[0][4]	50
distribution_index[0][5]	75
distribution_index[0][6]	90
distribution_index[0][7]	95
distribution_index[0][8]	99

Source: ANSI CTI-861-H, Annex S, pages 254, 259, 260.



8.5 Distribution MaxRGB

8.5.1 Purpose

This metadata item provides descriptive metadata in compact form of the scene's cumulative frequency distribution (CFD). **DistributionMaxRGB** provides alternative metadata for displays to tone map when metadata associated with Section 8.7 is not present.

A CFD can be derived from a list of linearized maxRGB values of all pixels in the scene, sorted in ascending order by value, and retaining all duplicate values. There shall be n items in the CFD list, where n is the number of pixels in the scene.

8.5.2 Definition

The **DistributionMaxRGB** shall be a set of two equal-length vectors, **DistributionMaxRGBPercentages** and **DistributionMaxRGBPercentiles**, herein called J and V respectively. Subscript *i* denotes the position of an element in the vector. The first element is at position 0. The last element is designated as position Ω and shall be the position at the length of the vector minus 1.

Each element in vector J shall be an integer value in the range [0,100] representing the percentage of the total length of the CFD list. The elements of vector J shall be in ascending order by value.

Each element in the second vector V shall be in the range [0,1] and in multiples of 0.00001. Except as specified in Section 8.5.4, V_i contains a linearized maxRGB value which is the smallest value in the CFD such that at least J_i percent of the CFD fall at or below V_i whereby V_i represents a percentile value of the CFD at J_i percent.

An example is provided in Annex C.

Note: The definitions of V_i can be understood in terms of a list of linearized MaxRGB values from the scene sorted in terms of linearized RGB from least to greatest, where the list includes duplicate values and there are n items in the list. The V_i value is the value of the $[n \times J_i/100]$th element in the CFD list.

8.5.3 Constraints for ApplicationVersion = 0

When **ApplicationVersion** = 0, the constraints in this Section shall apply.

The maximum length of these vectors shall be 15.

Whenever J_i equal to 99 is present, the percentage value 99.98% should be used in the calculation of V_i.

8.5.4 Constraints for ApplicationVersion = 1

When **ApplicationVersion** = 1, the constraints in this Section shall apply.

The length of the vectors shall equal 9.

Whenever J_8 equal to 99 is present, the percentage value 99.98% shall be used in the calculation of V_8.

The J vector should contain the values in Table 1.

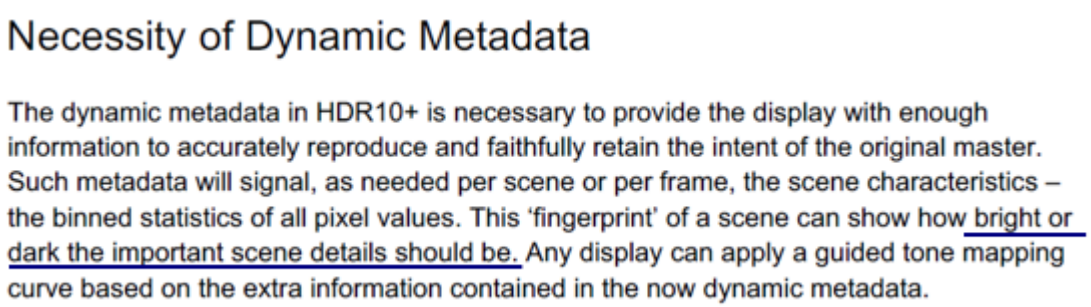
Table 1 Distribution Vectors

J =	1	5	10	25	50	75	90	95	99
V =	V_0	(V_1)	(V_2)	V_3	V_4	V_5	V_6	V_7	V_8

If and only if J_1=5 and J_2=10, the vector elements for V_1 and V_2 are not part of the CFD, V_1 shall be 0.00000, V_2 shall be 0.00255 and other values for V_1 and V_2 are reserved.

Source: ST2094-40-2020.pdf, pages 9-10.

76. The '211 Accused Products further comprise a data analysis module for "generating a first dimming value according to at least the first characteristic value [blue underlining]." This limitation is demonstrated below:

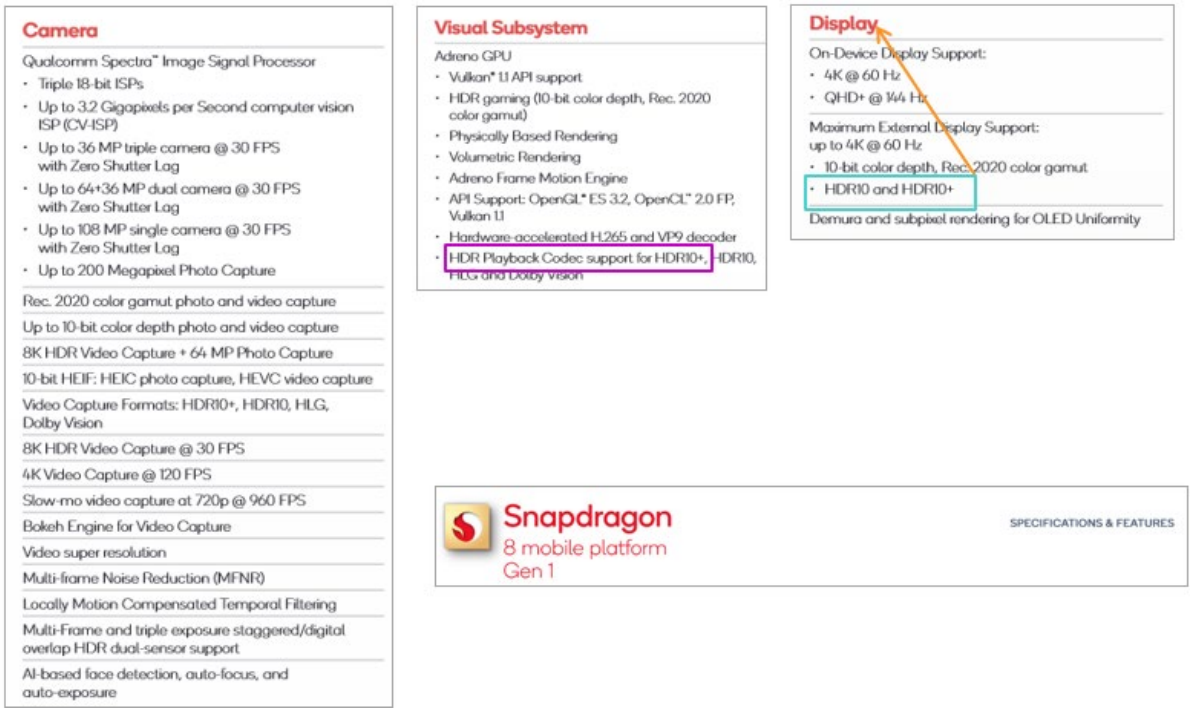


Necessity of Dynamic Metadata

The dynamic metadata in HDR10+ is necessary to provide the display with enough information to accurately reproduce and faithfully retain the intent of the original master. Such metadata will signal, as needed per scene or per frame, the scene characteristics – the binned statistics of all pixel values. This 'fingerprint' of a scene can show how bright or dark the important scene details should be. Any display can apply a guided tone mapping curve based on the extra information contained in the now dynamic metadata.

Source: https://hdr10plus.org/wp-content/uploads/2019/08/HDR10_WhitePaper.pdf, page 5.

77. The '211 Accused Products further comprise a "an output module [blue box], coupled to the data analysis module [purple box], for generating the dimming control signal corresponding to the first frame according to at least the first dimming value [orange arrow]." This limitation is demonstrated below:



Camera

Qualcomm Spectra™ Image Signal Processor
- Triple 18-bit ISPs
- Up to 3.2 Gigapixels per Second computer vision ISP (CV-ISP)
- Up to 36 MP triple camera @ 30 FPS with Zero Shutter Lag
- Up to 64+36 MP dual camera @ 30 FPS with Zero Shutter Lag
- Up to 108 MP single camera @ 30 FPS with Zero Shutter Lag
- Up to 200 Megapixel Photo Capture

Rec. 2020 color gamut photo and video capture

Up to 10-bit color depth photo and video capture

8K HDR Video Capture + 64 MP Photo Capture

10-bit HEIF: HEIC photo capture, HEVC video capture

Video Capture Formats: HDR10+, HDR10, HLG, Dolby Vision

8K HDR Video Capture @ 30 FPS

4K Video Capture @ 120 FPS

Slow-mo video capture at 720p @ 960 FPS

Bokeh Engine for Video Capture

Video super resolution

Multi-frame Noise Reduction (MFNR)

Locally Motion Compensated Temporal Filtering

Multi-Frame and triple exposure staggered/digital overlap HDR dual-sensor support

AI-based face detection, auto-focus, and auto-exposure

Visual Subsystem

Adreno GPU
- Vulkan® 1.1 API support
- HDR gaming (10-bit color depth, Rec. 2020 color gamut)
- Physically Based Rendering
- Volumetric Rendering
- Adreno Frame Motion Engine
- API Support: OpenGL® ES 3.2, OpenCL™ 2.0 FP, Vulkan 1.1
- Hardware-accelerated H.265 and VP9 decoder
- HDR Playback Codec support for HDR10+, HDR10, HLG and Dolby Vision

Display

On-Device Display Support:
- 4K @ 60 Hz
- QHD+ @ 144 Hz

Maximum External Display Support: up to 4K @ 60 Hz
- 10-bit color depth, Rec. 2020 color gamut
- HDR10 and HDR10+

Demura and subpixel rendering for OLED Uniformity

Snapdragon 8 mobile platform Gen 1

SPECIFICATIONS & FEATURES

Source: https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/snapdragon-8-gen-1-mobile-platform-product-brief.pdf.

Indirect Infringement (Inducement – 35 U.S.C. § 271(b))

78. In addition and/or in the alternative to its direct infringements, Qualcomm has indirectly infringed and continues to indirectly infringe one or more claims of the ’211 patent by knowingly and intentionally inducing others, including its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers, to directly infringe by making, using, offering to sell, selling and/or importing into the United States the ’211 Accused Product.

79. At a minimum, Qualcomm has knowledge of the ’211 patent since being served with this Complaint. Qualcomm also has knowledge of the ’211 patent since receiving detailed correspondence from XTI prior to the filing of the Complaint, alerting Qualcomm to its infringements. Since receiving notice of its infringements, Qualcomm has actively induced the

direct infringements of its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers as set forth under U.S.C. § 271(b). Indeed, Qualcomm has intended to cause, continues to intend to cause, and has taken, and continues to take affirmative steps to induce infringement by, among other things, creating and disseminating advertisements and instructive materials that promote the infringing use of the '211 Accused Products; creating and/or maintaining established distribution channels for the '211 Accused Products into and within the United States; manufacturing the '211 Accused Products in conformity with U.S. laws and regulations; distributing or making available videos, training, tools and resources supporting use of the '211 Accused Products that promote their features, specifications, and applications; providing technical documentation and tools for the '211 Accused Products,[8] and promoting the incorporation of the '211 Accused Products into end-user products; and by providing technical support and/or related services for these products to purchasers in the United States.

Damages

80. On information and belief, despite having knowledge of the '211 patent and knowledge that it is directly and/or indirectly infringing one or more claims of the '211 patent, Qualcomm has nevertheless continued its infringing conduct and disregarded an objectively high likelihood of infringement. Qualcomm's infringing activities relative to the '211 patent have been, and continue to be, willful, wanton, malicious, in bad-faith, deliberate, consciously wrongful, flagrant, characteristic of a pirate, and an egregious case of misconduct beyond typical infringement such that XTI is entitled to enhanced damages under 35 U.S.C. § 284 up to three times the amount found or assessed.

[8] *See, e.g.*, https://www.qualcomm.com/content/dam/qcomm-martech/dm-assets/documents/Snapdragon-8-Gen-2-Product-Brief.pdf.

81. XTI has been damaged as a result of Qualcomm's infringing conduct described in this Count. Qualcomm is, thus, liable to XTI in an amount that adequately compensates XTI for Qualcomm's infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

COUNT IV

(INFRINGEMENT OF U.S. PATENT NO. 8,462,846)

82. Plaintiff incorporates the preceding paragraphs herein by reference.

83. This cause of action arises under the patent laws of the United States, and, in particular, 35 U.S.C. §§ 271, *et seq*.

84. XTI is the owner of all substantial rights, title, and interest in and to the '846 patent including the right to exclude others and to enforce, sue, and recover damages for past and future infringements.

85. The '846 patent is valid, enforceable, and was duly and legally issued by the United States Patent and Trademark Office on June 11, 2013, after full and fair examination.

86. Qualcomm has and continues to directly and/or indirectly infringe (by inducing infringement) one or more claims of the '846 patent in this District and elsewhere in Texas and the United States by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import, Qualcomm products, their components and processes, and/or products containing the same that incorporate the fundamental technologies covered by the '846 patent, including, but not limited to, the Snapdragon X Plus, X Elite, 8 Gen 2, 8 Gen 3 Processors, and any products employing similar dimming control

functionality, including products that support the AV1 standard[9] (collectively, the "'846 Accused Products").

Direct Infringement (35 U.S.C. § 271(a))

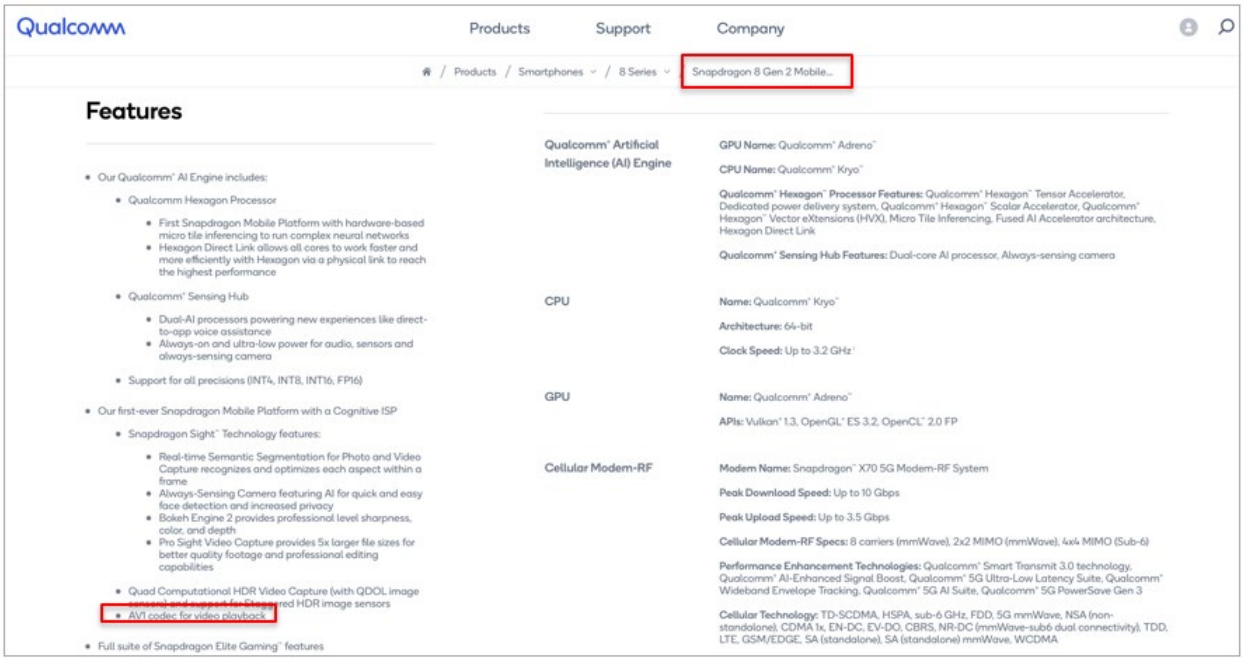
87. Qualcomm has directly infringed and continues to directly infringe one or more claims of the '846 patent in this District and elsewhere in Texas and the United States.

88. Qualcomm has directly infringed and continues to directly infringe, either by itself or via its agent(s), at least Claims 1, 2, 3, 5, and 8 of the '846 patent as set forth under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing, the '846 Accused Products. Furthermore, Qualcomm makes and sells the '846 Accused Products outside of the United States and either, delivers those products to its customers, distributors, and/or subsidiaries in the United States, or, in the case that it delivers the '846 Accused Products outside of the United States, it does so intending and/or knowing that those products are destined for the United States and/or designed and designated for sale in the United States, thereby directly infringing the '846 patent. *See, e.g., Lake Cherokee Hard Drive Techs., L.L.C. v. Marvell Semiconductor, Inc.*, 964 F. Supp. 2d 653, 658 (E.D. Tex. 2013).

89. Furthermore, Qualcomm directly infringes the '846 patent through its direct involvements in, and control of, the activities of its subsidiaries. Subject to Qualcomm's direction and control, such subsidiaries conduct activities that constitute direct infringement of the '846 patent under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing '846 Accused Products. Qualcomm receives direct financial benefit from such infringements of its U.S.-based sales subsidiaries.

[9] This also includes any current and future generations of Qualcomm products employing the AV1 standard.

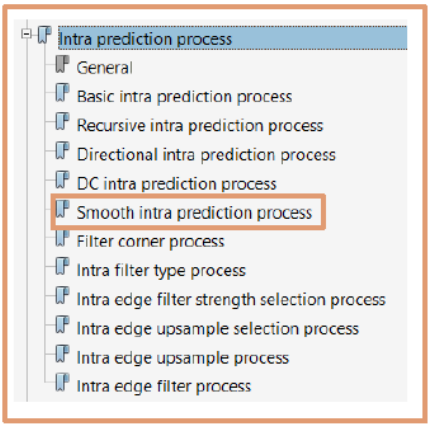
90. By way of illustration only, the ’846 Accused Products perform each and every element of claim 1 of the ’846 patent. As an initial matter, the ’846 Accused Products support AV1 video decoding:



Source: https://www.qualcomm.com/products/application/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform.

91. The AV1 video decoding standard used by the ’846 Accused Products has been described in detail in J. Han, et al., “A Technical Overview of AV1,” *Proceedings of the IEEE*, IEEE, Vol. 109, Issue 9, pp.1435-1462, 2021 (“Han”), https://arxiv.org/pdf/2008.06091.pdf.

92. The ’846 Accused Products perform a method for intra-prediction comprising “determining a first intra-prediction mode of a left block and a second intra prediction mode of an up block, wherein the left block is on the left of a current block, and the up block is on top of the current block,” as indicated in the annotated descriptions below:



2) Non-directional Smooth Intra Prediction: VP9 has 2 non-directional intra smooth prediction modes: DC_PRED and TM_PRED. AV1 adds 3 new smooth prediction modes that estimate pixels using a distance weighted linear combination, namely SMOOTH_V_PRED, SMOOTH_H_PRED, and SMOOTH_PRED. They use the bottom-left (BL) and top-right (TR) reference pixels to fill the right-most column and bottom-row, thereby forming a closed loop boundary condition for interpolation. We use the notations in Figure 4 to demonstrate their computation procedures:

- SMOOTH_H_PRED: $P_H = w(x)L + (1 - w(x))TR$;
- SMOOTH_V_PRED: $P_V = w(y)T + (1 - w(y))BL$;
- SMOOTH_PRED: $P = (P_H + P_V)/2$.

where $w(x)$ represents the weight based on distance x from the boundary, whose values are preset.

Han at pp. 4-5.

93. As noted above, Figure 4 specifies a first intra-prediction mode (pink box) of a left block (red box) and a second intra-prediction mode (orange box) of an up block (blue box) wherein the left block is on the left of the current block (black box), and the up block is on top of the current block:

2) Non-directional Smooth Intra Prediction: VP9 has 2 non-directional intra smooth prediction modes: DC_PRED and TM_PRED. AV1 adds 3 new smooth prediction modes that estimate pixels using a distance weighted linear combination, namely SMOOTH_V_PRED, SMOOTH_H_PRED, and SMOOTH_PRED. They use the bottom-left (BL) and top-right (TR) reference pixels to fill the right-most column and bottom-row, thereby forming a closed loop boundary condition for interpolation. We use the notations in Figure 4 to demonstrate their computation procedures:

- SMOOTH_H_PRED: $P_H = w(x)L + (1 - w(x))TR$;
- SMOOTH_V_PRED: $P_V = w(y)T + (1 - w(y))BL$;
- SMOOTH_PRED: $P = (P_H + P_V)/2$.

where $w(x)$ represents the weight based on distance x from the boundary, whose values are preset.

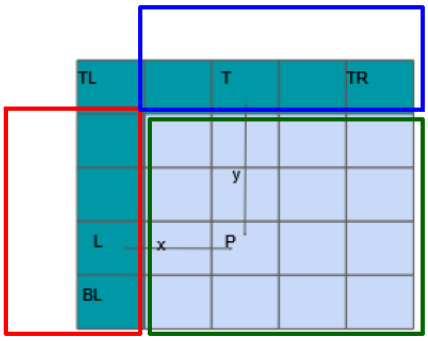


Fig. 4: An illustration of the distance weighted smooth intra prediction. The dark green pixels are the reference and the light blue ones are the prediction. The variables x and y are the distance from left and top boundaries, respectively.

Han at pp. 4-5.

94. The '846 Accused Products further includes "selecting a target pixel (blue arrow) from a plurality of pixels of the current block (green box):

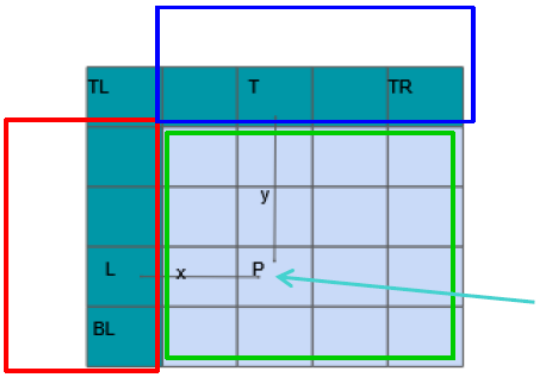


Fig. 4: An illustration of the distance weighted smooth intra prediction. The dark green pixels are the reference and the light blue ones are the prediction. The variables x and y are the distance from left and top boundaries, respectively.

Han at pp. 4-5.

95. The '846 Accused Products further include the steps of "calculating a first prediction value (red box) of the target pixel (blue arrow) assuming that the current block is in the first intra-prediction mode" and "calculating a second prediction value (black box) of the target pixel (blue arrow) assuming that the current block is in the second intra-prediction mode":

2) Non-directional Smooth Intra Prediction: VP9 has 2 non-directional intra smooth prediction modes: DC_PRED and TM_PRED. AV1 adds 3 new smooth prediction modes that estimate pixels using a distance weighted linear combination, namely SMOOTH_V_PRED, SMOOTH_H_PRED, and SMOOTH_PRED. They use the bottom-left (BL) and top-right (TR) reference pixels to fill the right-most column and bottom-row, thereby forming a closed loop boundary condition for interpolation. We use the notations in Figure 4 to demonstrate their computation procedures:

- SMOOTH_H_PRED: $P_H = w(x)L + (1 - w(x))TR$;
- SMOOTH_V_PRED: $P_V = w(y)T + (1 - w(y))BL$;
- SMOOTH_PRED: $P = (P_H + P_V)/2$.

where $w(x)$ represents the weight based on distance x from the boundary, whose values are preset.

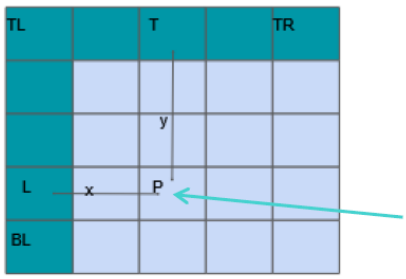


Fig. 4: An illustration of the distance weighted smooth intra prediction. The dark green pixels are the reference and the light blue ones are the prediction. The variables x and y are the distance from left and top boundaries, respectively.

Han at pp. 4-5.

96. The ’846 Accused Products further include the step of “weight-averaging the first prediction value and the second prediction value (purple boxes) to obtain a weight-average prediction value (dotted red line box):

2) Non-directional Smooth Intra Prediction: VP9 has 2 non-directional intra smooth prediction modes: DC_PRED and TM_PRED. AV1 adds 3 new smooth prediction modes that estimate pixels using a distance weighted linear combination, namely SMOOTH_V_PRED, SMOOTH_H_PRED, and SMOOTH_PRED. They use the bottom-left (BL) and top-right (TR) reference pixels to fill the right-most column and bottom-row, thereby forming a closed loop boundary condition for interpolation. We use the notations in Figure 4 to demonstrate their computation procedures:

- SMOOTH_H_PRED: $P_H = w(x)L + (1 - w(x))TR$;
- SMOOTH_V_PRED: $P_V = w(y)T + (1 - w(y))BL$;
- SMOOTH_PRED: $P = (P_H + P_V)/2$.

where $w(x)$ represents the weight based on distance x from the boundary, whose values are preset.

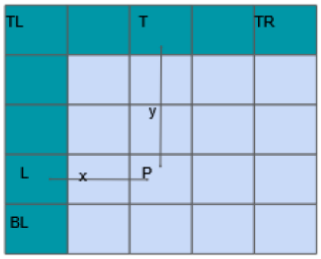


Fig. 4: An illustration of the distance weighted smooth intra prediction. The dark green pixels are the reference and the light blue ones are the prediction. The variables x and y are the distance from left and top boundaries, respectively.

Han at pp. 4-5.

97. Further, Qualcomm directs or controls performance of the claimed methods, including the steps discussed above, by including instructions and directives, such as firmware and source code, in the ’846 Accused Products that cause this to occur.

Indirect Infringement (Inducement – 35 U.S.C. § 271(b))

98. In addition and/or in the alternative to its direct infringements, Qualcomm has indirectly infringed and continues to indirectly infringe one or more claims of the ’846 patent by knowingly and intentionally inducing others, including its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers, to directly infringe by making, using, offering to sell, selling and/or importing into the United States the ’846 Accused Products.

99. At a minimum, Qualcomm has knowledge of the ’846 patent since being served with this Complaint. Qualcomm also has knowledge of the ’846 patent since receiving detailed

correspondence from XTI prior to the filing of the Complaint, alerting Qualcomm to its infringements. Since receiving notice of its infringements, Qualcomm has actively induced the direct infringements of its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers as set forth under U.S.C. § 271(b). Indeed, Qualcomm has intended to cause, continues to intend to cause, and has taken, and continues to take affirmative steps to induce infringement by, among other things, creating and disseminating advertisements and instructive materials that promote the infringing use of the '846 Accused Products (e.g., use of such products to implement AV1, which (as outlined above) results in infringement); creating and/or maintaining established distribution channels for the '846 Accused Products into and within the United States; manufacturing the '846 Accused Products in conformity with U.S. laws and regulations; distributing or making available videos, training, tools and resources supporting use of the '846 Accused Products that promote their features, specifications, and applications; providing technical documentation and tools for the '846 Accused Products,[10] promoting the incorporation of the '846 Accused Products into end-user products; and by providing technical support and/or related services for these products to purchasers in the United States.

Damages

100. On information and belief, despite having knowledge of the '846 patent and knowledge that it is directly and/or indirectly infringing one or more claims of the '846 patent, Qualcomm has nevertheless continued its infringing conduct and disregarded an objectively high likelihood of infringement. Qualcomm's infringing activities relative to the '846 patent have been, and continue to be, willful, wanton, malicious, in bad-faith, deliberate, consciously wrongful,

[10] *See, e.g.,* https://www.qualcomm.com/products/application/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform.

flagrant, characteristic of a pirate, and an egregious case of misconduct beyond typical infringement such that XTI is entitled to enhanced damages under 35 U.S.C. § 284 up to three times the amount found or assessed.

101. XTI has been damaged as a result of Qualcomm's infringing conduct described in this Count. Qualcomm is, thus, liable to XTI in an amount that adequately compensates XTI for Qualcomm's infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

COUNT V

(INFRINGEMENT OF U.S. PATENT NO. 9,066,013)

102. Plaintiff incorporates the preceding paragraphs herein by reference.

103. This cause of action arises under the patent laws of the United States, and, in particular, 35 U.S.C. §§ 271, *et seq*.

104. XTI is the owner of all substantial rights, title, and interest in and to the '013 patent including the right to exclude others and to enforce, sue, and recover damages for past and future infringements.

105. The '013 patent is valid, enforceable, and was duly and legally issued by the United States Patent and Trademark Office on June 23, 2015, after full and fair examination.

106. Qualcomm has and continues to directly and/or indirectly infringe (by inducing infringement) one or more claims of the '013 patent in this District and elsewhere in Texas and the United States by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import, Qualcomm products, their components and processes, and/or products containing the same that incorporate the fundamental technologies covered by the '013 patent, including, but not limited to, the Snapdragon X Plus, X Elite, 8 Gen 2, 8 Gen 3 Processors, and any products employing similar dimming control

functionality, including products that support the AV1 standard[11] (collectively, the "'013 Accused Products").

Direct Infringement (35 U.S.C. § 271(a))

107. Qualcomm has directly infringed and continues to directly infringe one or more claims of the '013 patent in this District and elsewhere in Texas and the United States.

108. Qualcomm has directly infringed and continues to directly infringe, either by itself or via its agent(s), at least Claims 7 and 18 of the '013 patent as set forth under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing, the '013 Accused Products. Furthermore, Qualcomm makes and sells the '013 Accused Products outside of the United States and either, delivers those products to its customers, distributors, and/or subsidiaries in the United States, or, in the case that it delivers the '013 Accused Products outside of the United States, it does so intending and/or knowing that those products are destined for the United States and/or designed and designated for sale in the United States, thereby directly infringing the '013 patent. *See, e.g., Lake Cherokee Hard Drive Techs., L.L.C. v. Marvell Semiconductor, Inc.*, 964 F. Supp. 2d 653, 658 (E.D. Tex. 2013).

109. Furthermore, Qualcomm directly infringes the '013 patent through its direct involvements in, and control of, the activities of its subsidiaries. Subject to Qualcomm's direction and control, such subsidiaries conduct activities that constitute direct infringement of the '013 patent under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing '013 Accused Products. Qualcomm receives direct financial benefit from such infringements of its U.S.-based sales subsidiaries.

[11] This also includes any current and future generations of Qualcomm products employing the AV1 standard.

110. By way of illustration only, the ’013 Accused Products include each and every element of claim 7 of the ’013 patent. As an initial matter, the ’013 Accused Products support AV1 video encoding:

Features

- Best-in-class CPU with high performance and remarkable power efficiency
- Snapdragon X Series are the only processors today that power Copilot+ PCs for the fastest, most intelligent Windows PCs
- Delivers exceptional energy savings and up to multiple days of battery life**
- Industry-leading NPU, with up to 45 TOPS AI performance
- Integrated GPU delivers dazzling graphics performance
- Lightning-fast downloading, streaming, and syncing of files with 5G* and Wi-Fi 7 connectivity, including HBS Multi-Link for minimized latency and jitter-free entertainment
- Robust security for enhanced protection from chip to cloud
- Support for AV1 encode and decode for up to 4K HDR video streaming
- Immersive, lossless audio for high-fidelity music and entertainment with your wireless headphones with Snapdragon Sound Technology Suite
- Support for up to three external UHD monitors running at 60 Hz, delivering snappier and smoother display experiences
- LPDDR5x memory with 135 GB/s bandwidth for faster AI experiences and efficient multitasking
- Advanced MIPI camera support for high-quality imaging and intelligent features, such as auto-framing, background blur, and facial authentication at lower power consumption

Specifications

CPU	**Name:** Qualcomm® Oryon™
	Number of Cores: 10[1], 8[2]
	Architecture: 64-bit
	Clock Speed: Multi-Core Max Frequency up to 3.4 GHz[3], Single-Core up to 4 GHz[4]
GPU	**Name:** Qualcomm® Adreno™
	Tera Floating Point Operations Per Second: Up to 3.8 TFLOPS[5]
	APIs: DirectX® 12
NPU	**Name:** Qualcomm® Hexagon™
	Tera Operations Per Second: Up to 45 TOPS
Memory	**Type:** LPDDR5x
	Bit Width: 16-bit
	Number of Channels: 8
	Transfer Rate: 8448 MT/s
	Bandwidth: 135 GB/s
	Capacity: Up to 64 GB
Storage	**SD:** SD 3.0
	SSD/NVMe Interface: NVMe, over PCIe 4.0
	UFS: UFS 4.0

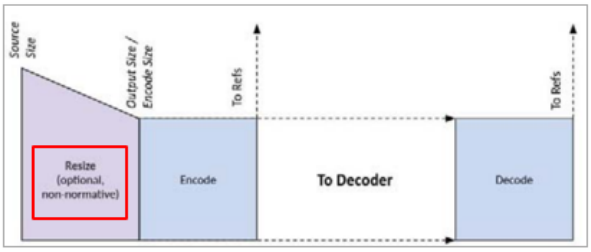
Source: https://www.qualcomm.com/products/mobile/snapdragon/laptops-and-tablets/snapdragon-x-plus.

111. The AV1 video encoding standard used by the ’013 Accused Products performs “[a]n image resizing method.” For example, the super-resolution process comprises image resizing:

In-loop Frame Super-resolution in AV1

Urvang Joshi, Debargha Mukherjee, Yue Chen, Sarah Parker, Adrian Grange
Google, USA.
Emails: {urvang, debargha, yuec, sarahparker, agrange}@google.com

Abstract— **AV1 is a recently standardized royalty-free video codec from the industry consortium Alliance for Open Media. One of the most innovative coding tools supported in AV1 is an in-loop frame super-resolution mode, that allows an encoder to code any frame at a horizontally reduced spatial resolution by one of several levels, followed by upsampling and super-resolving to full resolution, before replacing reference buffers. This mode is partly enabled by a feature in AV1 that natively allows the motion compensated prediction loop to operate across scales between a coded frame and the available references, thereby allowing on-the-fly resolution change mid-stream within a sequence. For the actual super-resolving process a normative**



Source: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8954553.

enable_superres equal to 1 specifies that the use_superres syntax element will be present in the uncompressed header. enable_superres equal to 0 specifies that the use_superres syntax element will not be present (instead use_superres will be set to 0 in the uncompressed header without being read).

Note: It is allowed to set enable_superres equal to 1 even when use_superres is not equal to 1 for any frame in the coded video sequence.

6.8.7. Superres params semantics

use_superres equal to 0 indicates that no upscaling is needed. use_superres equal to 1 indicates that upscaling is needed.

coded_denom is used to compute the amount of upscaling.

SuperresDenom is the denominator of a fraction that specifies the ratio between the superblock width before and after upscaling. The numerator of this fraction is equal to the constant SUPERRES_NUM.

Source: https://aomediacodec.github.io/av1-spec/av1-spec.pdf, pages 116, 161.

112. The AV1 video encoding standard used by the ’013 Accused Products performs “receiving at least one input image [the purple box and underlining]”:

B. Frame Super-resolution Mode

Now that we know that the motion compensation loop in AV1 can predict across scales, we can proceed to describing the super-resolution coding mode in the context of the overall in-loop filtering pipeline in AV1.

B.1 Framework At a Glance

Fig. 4 depicts the overall in-loop filtering pipeline in AV1 and the super-resolution framework. According to this framework, on the encoder side, a source frame may be first downscaled non-normatively and encoded at a lower resolution. The deblocking filter, and another filter called Constrained Directional Enhancement Filter (CDEF) [17] supported in AV1, are then used to remove blocking and ringing artifacts while preserving edges, at the lower resolution. This is followed by a normative Linear Upsampling

The super-resolution mode is a special mode signaled at the frame level to indicate whether the Linear Upscaler in particular, is to be used, and what upscaling ratio if used is to be applied. The other filters stay optional, but LR, if used in addition, will enable smart super-resolving instead of just upscaling. Even though the original super-resolution mode proposal in AV1 allowed downscaling and upscaling a frame in both dimensions, in the final AV1 standard, the upscaler is restricted to operate only horizontally in order to enable cost-effective hardware decoding without extra line buffer usage. In Fig. 4, we have annotated the frame resolution at different stages for an example source of resolution 4K x 2K, with down-scaling ratio of ½ horizontally.

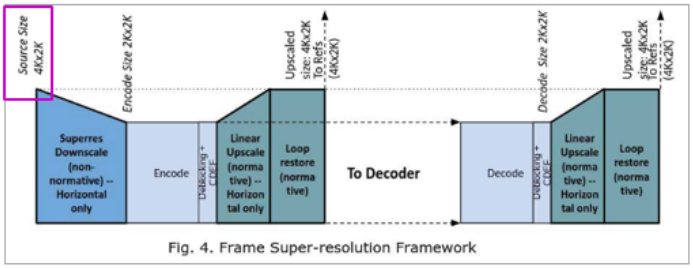


Fig. 4. Frame Super-resolution Framework

Source: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8954553.

113. The AV1 video encoding standard used by the ’013 Accused Products performs “performing an image content analysis [dark green underlining] upon at least one image selected from the at least one input image [pink underlining] to obtain an image content analysis result [light green underlining]”:

***Abstract*— AV1 is a recently standardized royalty-free video codec from the industry consortium Alliance for Open Media. One of the most innovative coding tools supported in AV1 is an in-loop frame super-resolution mode, that allows an encoder to code any frame at a horizontally reduced spatial resolution by one of several levels, followed by upsampling and super-resolving to full resolution, before replacing reference buffers. This mode is partly enabled by a feature in AV1 that natively allows the motion compensated prediction loop to operate across scales between a coded frame and the available references, thereby allowing on-the-fly resolution change mid-stream within a sequence. For the actual super-resolving process a normative**

B. Full-resolution vs Super-resolution: Image Coding

In this test, we demonstrate the benefit of using super-resolution for image coding scenario. For this, we encode 20 frames of hdres set, all encoded as keyframe. The baseline run uses these parameters in the libaom encoder to encode at full-resolution: '*--cpu-used=0 --kf-min-dist=0 --kf-max-dist=0*'. The test run additionally uses '*--superres-mode=4*', which adaptively chooses which frames should use super-resolution and the appropriate scaling factor, based on horizontal frequency analysis. Overall coding improvement and clips with largest improvements are shown in Table 2.

Source: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8954553.

SVT-AV1 / Docs / **Appendix-Super-Resolution.md**

SuperresMode	Value
0	None, no frame super-resolution allowed
1	All frames are encoded at the specified scale of 8/`denom`, thus a `denom` of 8 means no scaling, and 16 means half-scaling
2	All frames are coded at a random scale
3	Super-resolution scale for a frame is determined based on the q_index, a qthreshold of 63 means no scaling
4	Automatically select the super-resolution mode for appropriate frames

Source: https://gitlab.com/AOMediaCodec/SVT-AV1/-/blob/edbd880426181df551efcb86d5587a888b1c56d1/Docs/svt-av1_encoder_user_guide.md.

```
// Compute the horizontal frequency components' energy in a frame
// by calculuating the 16x4 Horizontal DCT. This is to be used to
// decide the superresolution parameters.
static void analyze_hor_freq(const AV1_COMP *cpi, double *energy) {
  uint64_t freq_energy[16] = { 0 };
  const YV12_BUFFER_CONFIG *buf = cpi->source;
```

```
static uint8_t get_superres_denom_for_qindex(const AV1_COMP *cpi, int qindex,
                                             int sr_kf, int sr_arf) {
  // Use superres for Key-frames and Alt-ref frames only
  const GF_GROUP *gf_group = &cpi->ppi->gf_group;
  if (gf_group->update_type[cpi->gf_frame_index] != KF_UPDATE &&
      gf_group->update_type[cpi->gf_frame_index] != ARF_UPDATE) {
    return SCALE_NUMERATOR;
  }
  if (gf_group->update_type[cpi->gf_frame_index] == KF_UPDATE && !sr_kf) {
    return SCALE_NUMERATOR;
  }
  if (gf_group->update_type[cpi->gf_frame_index] == ARF_UPDATE && !sr_arf) {
    return SCALE_NUMERATOR;
  }

  double energy[16];
  analyze_hor_freq(cpi, energy);
```

```
static uint8_t calculate_next_superres_scale(AV1_COMP *cpi) {
  // Choose an arbitrary random number
  static unsigned int seed = 34567;
  const AV1EncoderConfig *oxcf = &cpi->oxcf;
  const SuperResCfg *const superres_cfg = &oxcf->superres_cfg;
  const FrameDimensionCfg *const frm_dim_cfg = &oxcf->frm_dim_cfg;
  const RateControlCfg *const rc_cfg = &oxcf->rc_cfg;
```

```
    case AOM_SUPERRES_AUTO: {
      if (cpi->common.features.allow_screen_content_tools) break;
      if (rc_cfg->mode == AOM_VBR || rc_cfg->mode == AOM_CQ)
        av1_set_target_rate(cpi, frm_dim_cfg->width, frm_dim_cfg->height);
```

```
        if (sr_search_type == SUPERRES_AUTO_ALL) {
          if (cpi->common.current_frame.frame_type == KEY_FRAME)
            new_denom = superres_cfg->superres_kf_scale_denominator;
          else
            new_denom = superres_cfg->superres_scale_denominator;
        } else {
          new_denom = get_superres_denom_for_qindex(cpi, q, 1, 1);
        }
      }
      break;
    }
    default: assert(0);
  }
  return new_denom;
}
```

Source: https://aomedia.googlesource.com/aom/+/refs/heads/main/av1/encoder/superres_scale.c.

114. The AV1 video encoding standard used by the '013 Accused Products performs "creating a target image with a target image resolution by scaling the at least one input image [blue underlining] according to the image content analysis result [green underlining], wherein the target image resolution is smaller than an image resolution of the at least one input image [yellow underlining].":

In AV1, we adopt a fundamentally different approach, where we natively support predicting across scales in the motion compensation loop. Note that VP9 also supported across-scale prediction, but the mechanism has been significantly improved in AV1. With this feature, at any point in the encoding process, the encoder may choose to step down or up on-the-fly to lower or higher resolution without requiring a keyframe. Consequently, each reference buffer may be at a different resolution from a coded frame, and the motion compensation process handles the scale difference naturally. This feature by itself allows AV1 to support on-the-fly resolution change that most other codecs do not support. In addition, this feature provides a mechanism for supporting a frame-level in-loop super-resolution mode in the bit-stream syntax. Specifically, if the super-resolution mode is enabled for a frame, the frame is non-normatively downsampled to a lower resolution and coded at lower resolution using higher resolution references in the motion compensation loop, followed by normative upsampling and super-resolving to generate a full resolution output frame that is displayed and that updates a reference frame store slot for use in subsequent frames. Note also that high-performant CNN based and/or

In order to enable the codec to switch frame resolutions mid-stream, both AV1 and its predecessor VP9 support the ability to predict across scales in the inter prediction loop. As shown schematically in Fig. 1, this allows any frame or frames to be non-normatively downscaled or upscaled (Fig. 1 shows downscaling only) on-the-fly before encoding at a different resolution. The

B. Full-resolution vs Super-resolution: Image Coding

In this test, we demonstrate the benefit of using super-resolution for image coding scenario. For this, we encode 20 frames of hdres set, all encoded as keyframe. The baseline run uses these parameters in the libaom encoder to encode at full-resolution: '*--cpu-used=0 --kf-min-dist=0 --kf-max-dist=0*'. The test run additionally uses '*--superres-mode=4*', which adaptively chooses which frames should use super-resolution and the appropriate scaling factor, based on horizontal frequency analysis. Overall coding improvement and clips with largest improvements are shown in Table 2.

cost-effective hardware decoding without extra line buffer usage. In Fig. 4, we have annotated the frame resolution at different stages for an example source of resolution 4K x 2K, with down-scaling ratio of ½ horizontally.

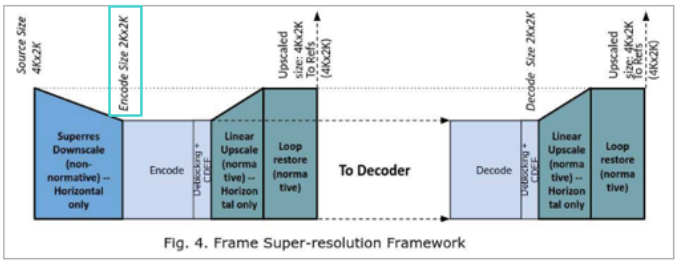


Fig. 4. Frame Super-resolution Framework

Source: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8954553.

115. Further, Qualcomm directs or controls performance of the claimed methods, including the steps discussed above, by including instructions and directives, such as firmware and source code, in the ’013 Accused Products that cause this to occur.

Indirect Infringement (Inducement – 35 U.S.C. § 271(b))

116. In addition and/or in the alternative to its direct infringements, Qualcomm has indirectly infringed and continues to indirectly infringe one or more claims of the ’013 patent by knowingly and intentionally inducing others, including its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers, to directly infringe by making, using, offering to sell, selling and/or importing into the United States the ’013 Accused Product.

117. At a minimum, Qualcomm has knowledge of the ’013 patent since being served with this Complaint. Qualcomm also has knowledge of the ’013 patent since receiving detailed correspondence from XTI prior to the filing of the Complaint, alerting Qualcomm to its infringements. Since receiving notice of its infringements, Qualcomm has actively induced the direct infringements of its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers as set forth under U.S.C. § 271(b). Indeed, Qualcomm has intended to cause, continues to intend to cause, and has taken, and continues to take affirmative steps to induce infringement by, among other things, creating and disseminating advertisements and instructive materials that promote the infringing use of the ’013 Accused Products (e.g., use of such products to implement AV1, which (as outlined above) results in infringement); creating and/or maintaining established distribution channels for the ’013 Accused Products into and within the United States; manufacturing the ’013 Accused Products in conformity with U.S. laws and

regulations; distributing or making available videos, training, tools and resources supporting use of the '013 Accused Products that promote their features, specifications, and applications; providing technical documentation and tools for the '013 Accused Products,[12] promoting the incorporation of the '013 Accused Products into end-user products; and by providing technical support and/or related services for these products to purchasers in the United States.

Damages

118. On information and belief, despite having knowledge of the '013 patent and knowledge that it is directly and/or indirectly infringing one or more claims of the '013 patent, Qualcomm has nevertheless continued its infringing conduct and disregarded an objectively high likelihood of infringement. Qualcomm's infringing activities relative to the '013 patent have been, and continue to be, willful, wanton, malicious, in bad-faith, deliberate, consciously wrongful, flagrant, characteristic of a pirate, and an egregious case of misconduct beyond typical infringement such that XTI is entitled to enhanced damages under 35 U.S.C. § 284 up to three times the amount found or assessed.

119. XTI has been damaged as a result of Qualcomm's infringing conduct described in this Count. Qualcomm is, thus, liable to XTI in an amount that adequately compensates XTI for Qualcomm's infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

COUNT VI

(INFRINGEMENT OF U.S. PATENT NO. 9,813,730)

120. Plaintiff incorporates the preceding paragraphs herein by reference.

[12] *See, e.g.,* https://www.qualcomm.com/products/mobile/snapdragon/laptops-and-tablets/snapdragon-x-plus.

121. This cause of action arises under the patent laws of the United States, and, in particular, 35 U.S.C. §§ 271, *et seq*.

122. XTI is the owner of all substantial rights, title, and interest in and to the '730 patent including the right to exclude others and to enforce, sue, and recover damages for past and future infringements.

123. The '730 patent is valid, enforceable, and was duly and legally issued by the United States Patent and Trademark Office on November 7, 2017, after full and fair examination.

124. Qualcomm has and continues to directly and/or indirectly infringe (by inducing infringement) one or more claims of the '730 patent in this District and elsewhere in Texas and the United States by making, using, selling, offering to sell, and/or importing, and by actively inducing others to make, use, sell, offer to sell, and/or import, Qualcomm products, their components and processes, and/or products containing the same that incorporate the fundamental technologies covered by the '730 patent, including, but not limited to, the Snapdragon X Plus, X Elite, 8 Gen 2, 8 Gen 3 Processors, and any products employing similar dimming control functionality, including products that support the AV1 standard[13] (collectively, the "'730 Accused Products").

Direct Infringement (35 U.S.C. § 271(a))

125. Qualcomm has directly infringed and continues to directly infringe one or more claims of the '730 patent in this District and elsewhere in Texas and the United States.

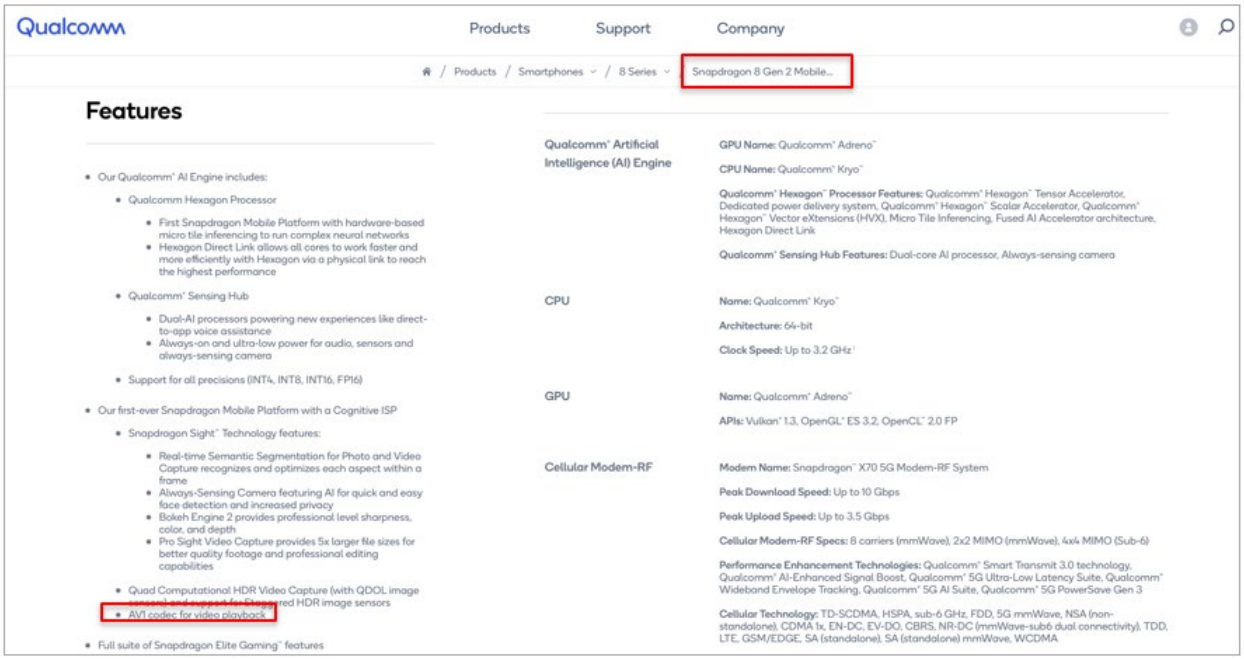
126. Qualcomm has directly infringed and continues to directly infringe, either by itself or via its agent(s), at least Claims 9, 10, 11, 16, and 18 of the '730 patent as set forth under 35

[13] This also includes any current and future generations of Qualcomm products employing the AV1 standard.

U.S.C. § 271(a) by making, offering for sale, selling, and/or importing, the '730 Accused Products. Furthermore, Qualcomm makes and sells the '730 Accused Products outside of the United States and either, delivers those products to its customers, distributors, and/or subsidiaries in the United States, or, in the case that it delivers the '730 Accused Products outside of the United States, it does so intending and/or knowing that those products are destined for the United States and/or designed and designated for sale in the United States, thereby directly infringing the '730 patent. *See, e.g., Lake Cherokee Hard Drive Techs., L.L.C. v. Marvell Semiconductor, Inc.*, 964 F. Supp. 2d 653, 658 (E.D. Tex. 2013).

127. Furthermore, Qualcomm directly infringes the '730 patent through its direct involvements in, and control of, the activities of its subsidiaries. Subject to Qualcomm's direction and control, such subsidiaries conduct activities that constitute direct infringement of the '730 patent under 35 U.S.C. § 271(a) by making, offering for sale, selling, and/or importing '730 Accused Products. Qualcomm receives direct financial benefit from such infringements of its U.S.-based sales subsidiaries.

128. By way of illustration only, the '730 Accused Products include each and every element of claim 9 of the '730 patent. As an initial matter, the '730 Accused Products support AV1 video decoding:



Source: https://www.qualcomm.com/products/application/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform.

129. The AV1 video decoding standard used by the ’730 Accused Products has been described in detail in P. Rivas, et al, “AV1 Bitstream & Decoding Process Specification,” Ver. 1.0.0 with Errata 1, 2019, (“AV1 Spec.”) https://aomediacodec.github.io/av1-spec/av1-spec.pdf.

130. By way of illustration only, the ’730 Accused Products include each and every element of claim 9 of the ’730 patent.

131. The ’730 Accused Products include “[a]n apparatus of fine-grained motion compensated prediction for boundary pixels in a video coding system, the apparatus comprising one or more electric circuits” as annotated from the AV1 Specification below:

AV1 Bitstream & Decoding Process Specification

Last modified: 2019-01-08 11:48 PT

7.11.3. Inter prediction process

7.11.3.1. General

The inter prediction process is invoked for inter coded blocks and interintra blocks. The inputs to this process are:

- a variable plane specifying which plane is being predicted,
- variables x and y specifying the location of the top left sample in the CurrFrame[plane] array of the region to be predicted,
- variables w and h specifying the width and height of the region to be predicted,
- variables candRow and candCol specifying the location (in units of 4x4 blocks) of the motion vector information to be used.

The outputs of this process are predicted samples in the current frame CurrFrame.

If motion_mode is equal to OBMC, the overlapped motion compensation in section 7.11.3.9 is invoked with plane, w, h as inputs.

AV1 Spec. at 7.11.3.

132. The ’730 Accused Products further perform the step to “determine one or more neighboring coding units (CUs) associated with a current coding unit (CU), wherein each of said one or more neighboring CUs is associated with a neighboring motion vector (MV)” as annotated from the AV1 Specification below:

7.11.3.9. Overlapped motion compensation process

This process blends the inter predicted samples for the current block with inter predicted samples based on motion vectors from the above and left blocks.

Variable **AvailU** is equal to 0 if the information from the block above cannot be used on the luma plane; AvailU is equal to 1 if the information from the block above can be used on the luma plane.

Variable **AvailL** is equal to 0 if the information from the block to the left can not be used on the luma plane; AvailL is equal to 1 if the information from the block to the left can be used on the luma plane.

- variables candRow and candCol specifying the location (in units of 4x4 blocks) of the motion vector information to be used.

The process is specified as:

```
if ( AvailU ) {
    if ( get_plane_residual_size( MiSize, plane ) >= BLOCK_8X8 ) {
        pass = 0
        w4 = Num_4x4_Blocks_Wide[ MiSize ]
        x4 = MiCol
        y4 = MiRow
        nCount = 0
        nLimit = Min(4, Mi_Width_Log2[ MiSize ])
        while ( nCount < nLimit && x4 < Min( MiCols, MiCol + w4 ) ) {
            candRow = MiRow - 1
            candCol = x4 | 1
            candSz = MiSizes[ candRow ][ candCol ]
            step4 = Clip3( 2, 16, Num_4x4_Blocks_Wide[ candSz ] )
            if ( RefFrames[ candRow ][ candCol ][ 0 ] > INTRA_FRAME ) {
                nCount += 1
                predW = Min( w, ( step4 * MI_SIZE ) >> subX )
                predH = Min( h >> 1, 32 >> subY )
                mask = get_obmc_mask( predH )
                predict_overlap( )
            }
            x4 += step4
        }
    }
}
if ( AvailL ) {
    pass = 1
    h4 = Num_4x4_Blocks_High[ MiSize ]
    x4 = MiCol
    y4 = MiRow
    nCount = 0
    nLimit = Min(4, Mi_Height_Log2[ MiSize ])
    while ( nCount < nLimit && y4 < Min( MiRows, MiRow + h4 ) ) {
        candCol = MiCol - 1
        candRow = y4 | 1
        candSz = MiSizes[ candRow ][ candCol ]
        step4 = Clip3( 2, 16, Num_4x4_Blocks_High[ candSz ] )
        if ( RefFrames[ candRow ][ candCol ][ 0 ] > INTRA_FRAME ) {
            nCount += 1
            predW = Min( w >> 1, 32 >> subX )
            predH = Min( h, ( step4 * MI_SIZE ) >> subY )
            mask = get_obmc_mask( predW )
            predict_overlap( )
        }
        y4 += step4
    }
}
```

AV1 Spec. at 6.10.5 and 7.11.3.

133. The ’730 Accused Products further perform the step of “motion compensated prediction using the neighboring MV for each of said one or more neighboring CUs to derive pre

generated predictors, wherein the pre generated predictors correspond to one or more boundary lines or columns in a boundary region of the current CU" as annotated from Han below:

e) Overlapped block motion compensation:

their scan order. The motion vector of each selected reference block is employed to generate a motion-compensated block that extends from the top boundary toward the center of the current block. Its width is the same as the reference block's width, and its height is half of the current block's height, as shown in Fig. 14(a). An intermediate

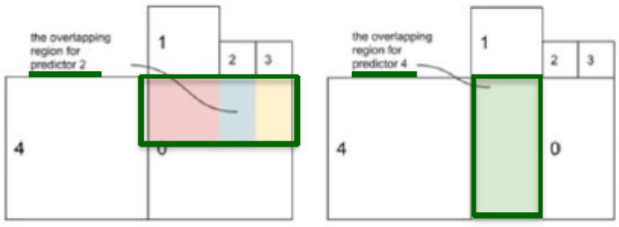


Fig. 6. Overlapping regions defined for AV1 OBMC.

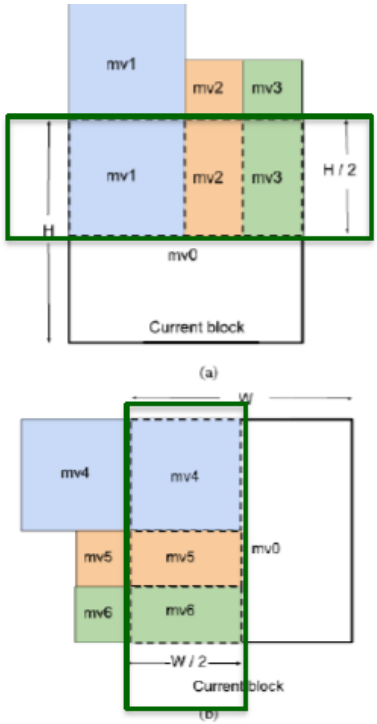


Fig. 14. Overlapped block motion compensation using (a) top and (b) left neighboring blocks' motion information, respectively.

Han at pp. 5, 10.

134. The '730 Accused Products further comprise "performing motion-compensated prediction using the neighboring MV for each of said one or more neighboring CUs to derive pre-generated predictors, wherein the pre-generated predictors correspond to one or more boundary lines or columns in a boundary region of the current CU" and the '730 Accused Products also "store the pre-generated predictors" as indicated in the annotated AV1 Specification below:

7.11.3.9. Overlapped motion compensation process

This process blends the inter predicted samples for the current block with inter predicted samples based on motion vectors from the above and left blocks.

1. The motion vector mv is set equal to Mvs[candRow][candCol][0].
2. The variable refIdx is set equal to ref_frame_idx[RefFrames[candRow][candCol][0] - LAST_FRAME].
3. The variable predX is set equal to (x4 * 4) >> subX.
4. The variable predY is set equal to (y4 * 4) >> subY.
5. The motion vector scaling process in section 7.11.3.3 is invoked with plane, refIdx, predX, predY, mv as inputs and the output being the initial location startX, startY, and the step sizes stepX, stepY.
6. The block inter prediction process in section 7.11.3.4 is invoked with plane, refIdx, startX, startY, stepX, stepY, predW, predH, candRow, candCol as inputs and the output is assigned to the 2D array obmcPred.
7. obmcPred[i][j] is set equal to Clip1(obmcPred[i][j]) for i = 0..predH-1 and j = 0..predW-1.
8. The blending process in section 7.11.3.10 is invoked with plane, predX, predY, predW, predH, pass, obmcPred, and mask as inputs.

```
if ( AvailU ) {
    if ( get_plane_residual_size( MiSize, plane ) >= BLOCK_8X8 ) {
        pass = 0
        w4 = Num_4x4_Blocks_Wide[ MiSize ]
        x4 = MiCol
        y4 = MiRow
        nCount = 0
        nLimit = Min(4, Mi_Width_Log2[ MiSize ])
        while ( nCount < nLimit && x4 < Min( MiCols, MiCol + w4 ) ) {
            candRow = MiRow - 1
            candCol = x4 | 1
            candSz = MiSizes[ candRow ][ candCol ]
            step4 = Clip3( 2, 16, Num_4x4_Blocks_Wide[ candSz ] )
            if ( RefFrames[ candRow ][ candCol ][ 0 ] > INTRA_FRAME ) {
                nCount += 1
                predW = Min( w, ( step4 * MI_SIZE ) >> subX )
                predH = Min( h >> 1, 32 >> subY )
                mask = get_obmc_mask( predH )
                predict_overlap( )
            }
            x4 += step4
        }
    }
}
if ( AvailL ) {
    pass = 1
    h4 = Num_4x4_Blocks_High[ MiSize ]
    x4 = MiCol
    y4 = MiRow
    nCount = 0
    nLimit = Min(4, Mi_Height_Log2[ MiSize ])
    while ( nCount < nLimit && y4 < Min( MiRows, MiRow + h4 ) ) {
        candCol = MiCol - 1
        candRow = y4 | 1
        candSz = MiSizes[ candRow ][ candCol ]
        step4 = Clip3( 2, 16, Num_4x4_Blocks_High[ candSz ] )
        if ( RefFrames[ candRow ][ candCol ][ 0 ] > INTRA_FRAME ) {
            nCount += 1
            predW = Min( w >> 1, 32 >> subX )
            predH = Min( h, ( step4 * MI_SIZE ) >> subY )
            mask = get_obmc_mask( predW )
            predict_overlap( )
        }
        y4 += step4
    }
}
```

AV1 Spec. at 7.11.3.

135. The '730 Accused Products also "receive input data associated with the current CU having a current MV" as annotated from the AV1 Specification below:

7.11.3. Inter prediction process

7.11.3.1. General

The inter prediction process is invoked for inter coded blocks and interintra blocks. The inputs to this process are:

- a variable plane specifying which plane is being predicted,
- variables x and y specifying the location of the top left sample in the CurrFrame[plane] array of the region to be predicted,
- variables w and h specifying the width and height of the region to be predicted,
- variables candRow and candCol specifying the location (in units of 4x4 blocks) of the motion vector information to be used.

The outputs of this process are predicted samples in the current frame CurrFrame.

AV1 Spec. at 7.11.3.

136. The '730 Accused Products also "generate a first predictor for a current boundary pixel in the boundary region by applying motion compensation based on the current MV," as annotated from the AV1 Specification below:

7.11.3. Inter prediction process

7.11.3.1. General

The inter prediction process is invoked for inter coded blocks and interintra blocks. The inputs to this process are:

- variables candRow and candCol specifying the location (in units of 4x4 blocks) of the motion vector information to be used.

The outputs of this process are predicted samples in the current frame CurrFrame.

The prediction arrays are formed by the following ordered steps:

8. The motion vector array mv is set equal to Mvs[candRow][candCol][refList].
10. The motion vector scaling process in section 7.11.3.3 is invoked with plane, refIdx, x, y, mv as inputs and the output being the initial location startX, startY, and the step sizes stepX, stepY.
13. If useWarp is equal to 0, the block inter prediction process in section 7.11.3.4 is invoked with plane, refIdx, startX, startY, stepX, stepY, w, h, candRow, candCol as inputs and the output is assigned to the 2D array preds[refList].

The inter predicted samples are then derived as follows:

- If isCompound is equal to 0 and IsInterIntra is equal to 0, CurrFrame[plane][y + i][x + j] is set equal to Clip1(preds[0][i][j]) for i = 0..h-1 and j = 0..w-1.

If motion_mode is equal to OBMC, the overlapped motion compensation in section 7.11.3.9 is invoked with plane, w, h as inputs.

AV1 Spec. at 7.11.3.

137. The ’730 Accused Products further generate a first predictor “compensation based on the current MV, wherein pixels at boundaries of the current CU utilize the current MV and at least one MV from at least one of: an upper side MV and a left side MV to form a weighted sum of motion prediction when performing motion compensation;” as annotated from the AV1 Specification below:

7.11.3.9. Overlapped motion compensation process

The inputs to this process are:

- a variable plane specifying which plane is being predicted,
- variables w and h specifying the width and height of the region to be predicted.

The outputs of this process are modified inter predicted samples in the current frame CurrFrame.

This process blends the inter predicted samples for the current block with inter predicted samples based on motion vectors from the above and left blocks.

When the function predict_overlap is invoked, the following ordered steps apply to form the overlap prediction for a region

1. The motion vector mv is set equal to Mvs[candRow][candCol][0].
2. The variable refIdx is set equal to ref_frame_idx[RefFrames[candRow][candCol][0] - LAST_FRAME].
3. The variable predX is set equal to (x4 * 4) >> subX.
4. The variable predY is set equal to (y4 * 4) >> subY.
5. The motion vector scaling process in section 7.11.3.3 is invoked with plane, refIdx, predX, predY, mv as inputs and the output being the initial location startX, startY, and the step sizes stepX, stepY.
6. The block inter prediction process in section 7.11.3.4 is invoked with plane, refIdx, startX, startY, stepX, stepY, predW, predH, candRow, candCol as inputs and the output is assigned to the 2D array obmcPred.
7. obmcPred[i][j] is set equal to Clip1(obmcPred[i][j]) for i = 0..predH-1 and j = 0..predW-1.
8. The blending process in section 7.11.3.10 is invoked with plane, predX, predY, predW, predH, pass, obmcPred, and mask as inputs.

7.11.3.10. Overlap blending process

The inputs to this process are:

- a variable plane specifying which plane is being predicted,
- variables predX and predY specifying the location of the top left sample in the CurrFrame[plane] array of the region to be predicted,
- variables predW and predH specifying the width and height of the region to be predicted,
- a variable pass equal to 0 if blending above samples, or equal to 1 if blending left samples,
- a 2d array obmcPred containing the samples predicted from a neighboring motion vector,
- an array mask containing the blending weights.

The outputs of this process are modified inter predicted samples in the current frame CurrFrame.

For i = 0..(predH - 1) and j = 0..(predW - 1), the following ordered steps apply:

1. The variable m specifying the blending factor is specifed as follows:
    - If pass is equal to 0 (blend from above), m is set equal to mask[i].
    - Otherwise (pass is equal to 1 meaning blend from left), m is set equal to mask[j].
2. CurrFrame[plane][predY + i][predX + j] is set equal to Round2(m * CurrFrame[plane][predY + i][predX + j] + (64 - m) * obmcPred[i][j], 6)

AV1 Spec. at 7.11.3.

138. The ’730 Accused Products further “generate a current boundary pixel predictor for the current boundary pixel using a weighted sum of the first predictor and one or more corresponding pre-generated predictors according to weighting factors” as annotated from the AV1 Specification below:

7.11.3.10. Overlap blending process

The inputs to this process are:

- a variable plane specifying which plane is being predicted,
- variables predX and predY specifying the location of the top left sample in the CurrFrame[plane] array of the region to be predicted,
- variables predW and predH specifying the width and height of the region to be predicted,
- a variable pass equal to 0 if blending above samples, or equal to 1 if blending left samples,
- a 2d array obmcPred containing the samples predicted from a neighboring motion vector,
- an array mask containing the blending weights.

The outputs of this process are modified inter predicted samples in the current frame CurrFrame.

For i = 0..(predH - 1) and j = 0..(predW - 1), the following ordered steps apply:

1. The variable m specifying the blending factor is specifed as follows:
    - If pass is equal to 0 (blend from above), m is set equal to mask[i].
    - Otherwise (pass is equal to 1 meaning blend from left), m is set equal to mask[j].
2. CurrFrame[plane][predY + i][predX + j] is set equal to Round2(m * CurrFrame[plane][predY + i][predX + j] + (64 - m) * obmcPred[i][j], 6)

AV1 Spec. at 7.11.3.

139. The ’730 Accused Products further “apply encoding or decoding to the current CU using prediction data including the current boundary pixel predictor,” as annotated from the AV1 Specification below:

Decoded frame

The frame reconstructed out of the bitstream by the decoder.

7.11.3.9. Overlapped motion compensation process

The inputs to this process are:

- a variable plane specifying which plane is being predicted,
- variables w and h specifying the width and height of the region to be predicted.

The outputs of this process are modified inter predicted samples in the current frame CurrFrame.

This process blends the inter predicted samples for the current block with inter predicted samples based on motion vectors from the above and left blocks.

7.12.3. Reconstruct process

The reconstruct process is invoked to perform dequantization, inverse transform and reconstruction. This process is triggered at a point defined by a function call to reconstruct in the transform block syntax table described in section 5.11.35.

The inputs to this process are:

- a variable plane specifying which plane is being reconstructed,
- variables x and y specifying the location of the top left sample in the CurrFrame[plane] array of the current transform block,
- a variable txSz, specifying the size of the transform block.

The outputs of this process are reconstructed samples in the current frame CurrFrame.

The reconstruction and dequantization process is defined as follows:

The following ordered steps apply:

3. For i = 0..(h-1), for j = 0..(w-1), the following applies:
    - The variable xx is set equal to flipLR ? (w - j - 1) : j.
    - The variable yy is set equal to flipUD ? (h - i - 1) : i.
    - CurrFrame[plane][y + yy][x + xx] is set equal to Clip1(CurrFrame[plane][y + yy][x + xx] + Residual[i][j]).

AV1 Spec. at 7.11.3 and 7.12.3.

140. The '730 Accused Products further specify "wherein said pre-generated predictors are at a bottom side or a right side of each of said one or more neighboring CUs on a smallest CU (SCU) basis, and wherein said pre-generated predictors are stored on a SCU basis," as annotated from the AV1 Specification and Han below:

e) Overlapped block motion compensation:

their scan order. The motion vector of each selected reference block is employed to generate a motion-compensated block that extends from the top boundary toward the center of the current block. Its width is the same as the reference block's width, and its height is half of the current block's height, as shown in Fig. 14(a). An intermediate

Note that the minimum coding block size in AV1 is 4×4. Hence, an 8×8 unit has up to four different motion

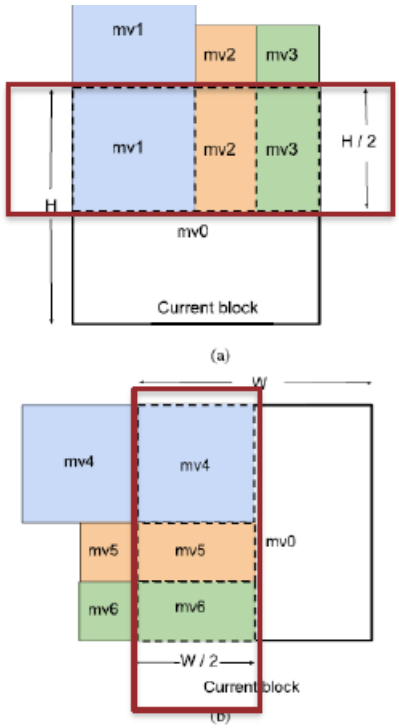


Fig. 14. *Overlapped block motion compensation using (a) top and (b) left neighboring blocks' motion information, respectively.*

Han at pp. 10-11.

7.11.3.9. Overlapped motion compensation process

This process blends the inter predicted samples for the current block with inter predicted samples based on motion vectors from the above and left blocks.

MiRow is a variable holding the vertical location of the block in units of 4x4 luma samples.

MiCol is a variable holding the horizontal location of the block in units of 4x4 luma samples.

- variables candRow and candCol specifying the location (in units of 4x4 blocks) of the motion vector information to be used.

When the function predict_overlap is invoked, the following ordered steps apply to form the overlap prediction for a region of size predW by predH based on the candidate motion vector:

1. The motion vector mv is set equal to Mvs[candRow][candCol][0].
2. The variable refIdx is set equal to ref_frame_idx[RefFrames[candRow][candCol][0] - LAST_FRAME].
3. The variable predX is set equal to (x4 * 4) >> subX.
4. The variable predY is set equal to (y4 * 4) >> subY.
5. The motion vector scaling process in section 7.11.3.3 is invoked with plane, refIdx, predX, predY, mv as inputs and the output being the initial location startX, startY, and the step sizes stepX, stepY.
6. The block inter prediction process in section 7.11.3.4 is invoked with plane, refIdx, startX, startY, stepX, stepY, predW, predH, candRow, candCol as inputs and the output is assigned to the 2D array obmcPred.
7. obmcPred[i][j] is set equal to Clip1(obmcPred[i][j]) for i = 0..predH-1 and j = 0..predW-1.
8. The blending process in section 7.11.3.10 is invoked with plane, predX, predY, predW, predH, pass, obmcPred, and mask as inputs.

```
if ( AvailU ) {
    if ( get_plane_residual_size( MiSize, plane ) >= BLOCK_8X8 ) {
        pass = 0
        w4 = Num_4x4_Blocks_Wide[ MiSize ]
        x4 = MiCol
        y4 = MiRow
        nCount = 0
        nLimit = Min(4, Mi_Width_Log2[ MiSize ])
        while ( nCount < nLimit && x4 < Min( MiCols, MiCol + w4 ) ) {
            candRow = MiRow - 1
            candCol = x4 | 1
            candSz = MiSizes[ candRow ][ candCol ]
            step4 = Clip3( 2, 16, Num_4x4_Blocks_Wide[ candSz ] )
            if ( RefFrames[ candRow ][ candCol ][ 0 ] > INTRA_FRAME ) {
                nCount += 1
                predW = Min( w, ( step4 * MI_SIZE ) >> subX )
                predH = Min( h >> 1, 32 >> subY )
                mask = get_obmc_mask( predH )
                predict_overlap( )
            }
            x4 += step4
        }
    }
}
if ( AvailL ) {
    pass = 1
    h4 = Num_4x4_Blocks_High[ MiSize ]
    x4 = MiCol
    y4 = MiRow
    nCount = 0
    nLimit = Min(4, Mi_Height_Log2[ MiSize ])
    while ( nCount < nLimit && y4 < Min( MiRows, MiRow + h4 ) ) {
        candCol = MiCol - 1
        candRow = y4 | 1
        candSz = MiSizes[ candRow ][ candCol ]
        step4 = Clip3( 2, 16, Num_4x4_Blocks_High[ candSz ] )
        if ( RefFrames[ candRow ][ candCol ][ 0 ] > INTRA_FRAME ) {
            nCount += 1
            predW = Min( w >> 1, 32 >> subX )
            predH = Min( h, ( step4 * MI_SIZE ) >> subY )
            mask = get_obmc_mask( predW )
            predict_overlap( )
        }
        y4 += step4
    }
}
```

AV1 Spec. at 6.10.5 and 7.11.3.

Indirect Infringement (Inducement – 35 U.S.C. § 271(b))

141. In addition and/or in the alternative to its direct infringements, Qualcomm has indirectly infringed and continues to indirectly infringe one or more claims of the ’730 patent by knowingly and intentionally inducing others, including its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers, to directly infringe by making, using, offering to sell, selling and/or importing into the United States the ’730 Accused Product.

142. At a minimum, Qualcomm has knowledge of the ’730 patent since being served with this Complaint. Qualcomm also has knowledge of the ’730 patent since receiving detailed correspondence from XTI prior to the filing of the Complaint, alerting Qualcomm to its infringements. Since receiving notice of its infringements, Qualcomm has actively induced the direct infringements of its subsidiaries, distributors, affiliates, retailers, suppliers, integrators, importers, customers, and/or consumers as set forth under U.S.C. § 271(b). Indeed, Qualcomm has intended to cause, continues to intend to cause, and has taken, and continues to take affirmative steps to induce infringement by, among other things, creating and disseminating advertisements and instructive materials that promote the infringing use of the ’730 Accused Products (e.g., use of such products to implement AV1, which (as outlined above) results in infringement); creating and/or maintaining established distribution channels for the ’730 Accused Products into and within the United States; manufacturing the ’730 Accused Products in conformity with U.S. laws and regulations; distributing or making available videos, training, tools and resources supporting use of the ’730 Accused Products that promote their features, specifications, and applications;

providing technical documentation and tools for the '730 Accused Products[14], promoting the incorporation of the '730 Accused Products into end-user products; and by providing technical support and/or related services for these products to purchasers in the United States.

Damages

143. On information and belief, despite having knowledge of the '730 patent and knowledge that it is directly and/or indirectly infringing one or more claims of the '730 patent, Qualcomm has nevertheless continued its infringing conduct and disregarded an objectively high likelihood of infringement. Qualcomm's infringing activities relative to the '730 patent have been, and continue to be, willful, wanton, malicious, in bad-faith, deliberate, consciously wrongful, flagrant, characteristic of a pirate, and an egregious case of misconduct beyond typical infringement such that XTI is entitled to enhanced damages under 35 U.S.C. § 284 up to three times the amount found or assessed.

144. XTI has been damaged as a result of Qualcomm's infringing conduct described in this Count. Qualcomm is, thus, liable to XTI in an amount that adequately compensates XTI for Qualcomm's infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

CONCLUSION

145. XTI is entitled to recover from Qualcomm the damages sustained by XTI as a result of Qualcomm's wrongful acts, and willful infringements, in an amount subject to proof at trial, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court.

[14] *See, e.g.,* https://www.qualcomm.com/products/application/smartphones/snapdragon-8-series-mobile-platforms/snapdragon-8-gen-2-mobile-platform.

146. XTI has incurred and will incur attorneys' fees, costs, and expenses in the prosecution of this action. The circumstances of this dispute may give rise to an exceptional case within the meaning of 35 U.S.C. § 285, and XTI is entitled to recover its reasonable and necessary attorneys' fees, costs, and expenses.

JURY DEMAND

147. XTI hereby requests a trial by jury pursuant to Rule 38 of the Federal Rules of Civil Procedure.

PRAYER FOR RELIEF

148. XTI respectfully requests that the Court find in its favor and against Qualcomm, and that the Court grant XTI the following relief:

(i) Judgment that one or more claims of the Asserted Patents have been infringed, either literally and/or under the doctrine of equivalents, by Qualcomm;

(ii) Judgment that one or more claims of the Asserted Patents have been willfully infringed, either literally and/or under the doctrine of equivalents, by Qualcomm;

(iii) Judgment that Qualcomm account for and pay to XTI all damages and costs incurred by Plaintiff because of Qualcomm's infringing activities and other conduct complained of herein, including an accounting for any sales or damages not presented at trial;

(iv) Judgment that Qualcomm account for and pay to XTI a reasonable, ongoing, post judgment royalty because of Qualcomm's infringing activities, including continuing infringing activities, and other conduct complained of herein;

(v) Judgment that XTI be granted pre-judgment and post judgment interest on the damages caused by Qualcomm's infringing activities and other conduct complained of herein;

(vi) Judgment that this case is exceptional under the provisions of 35 U.S.C. § 285 and award enhanced damages; and

(vii) Such other and further relief as the Court deems just and equitable.

Dated: February 21, 2025

Respectfully submitted,

/s/ Edward R. Nelson III
Edward R. Nelson III
State Bar No. 00797142
Nelson Bumgardner Conroy PC
3131 West 7th Street, Suite 300
Fort Worth, Texas 76107
Tel: (817) 377-9111
ed@nelbum.com

Ryan P. Griffin
State Bar No. 24053687
Jonathan H. Rastegar
State Bar No. 24064043
David T. DeZern
State Bar No. 24059677
Nelson Bumgardner Conroy PC
2727 N. Harwood St., Suite 250
Dallas, TX 75201
Tel: (817) 377-9111
ryan@nelbum.com
jon@nelbum.com
david@nelbum.com

Attorneys for Plaintiff
Xueshan Technologies, Inc.