UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

XR COMMUNICATIONS, LLC, dba VIVATO TECHNOLOGIES, Plaintiff, v. GOOGLE LLC Defendant.	Case No. 6:21-cv-625 **JURY TRIAL DEMANDED**

COMPLAINT FOR PATENT INFRINGEMENT AGAINST
<u>GOOGLE LLC</u>

This is an action for patent infringement arising under the Patent Laws of the United States of America, 35 U.S.C. § 1 *et seq.*, in which Plaintiff XR Communications LLC d/b/a Vivato Technologies ("Plaintiff" or "Vivato") makes the following allegations against Defendant Google LLC ("Defendant"):

<u>INTRODUCTION</u>

1. This complaint arises from Defendant's unlawful infringement of the following United States patents owned by Vivato, each of which generally relate to wireless communications technology: United States Patent Nos. 10,594,376 (the "'376 Patent") and 10,715,235 (the "'235 Patent") (collectively, the "Asserted Patents").

2. Countless electronic devices today connect to the Internet wirelessly. Beyond just connecting our devices together, wireless networks have become an inseparable part of our lives in our homes, our offices, and our neighborhood coffee shops. In even our most crowded spaces, today's wireless technology allows all of us to communicate with each other, on our own devices,

at virtually the same time. Our connected world would be unrecognizable without the ubiquity of sophisticated wireless networking technology.

3. Just a few decades ago, wireless technology of this kind could only be found in science fiction. The underlying science behind wireless communications can be traced back to the development of "wireless telegraphy" in the nineteenth century. Guglielmo Marconi is credited with developing the first practical radio, and in 1896, Guglielmo Marconi was awarded British patent 12039, *Improvements in transmitting electrical impulses and signals and in apparatus there-for*, the first patent to issue for a Herzian wave-based wireless telegraphic system. Marconi would go on to win the Nobel Prize in Physics in 1909 for his contributions to the field.

4. One of Marconi's preeminent contemporaries was Dr. Karl Ferdinand Braun, who shared the 1909 Nobel Prize in Physics with Marconi. In his Nobel lecture dated December 11, 1909, Braun explained that he was inspired to work on wireless technology by Marconi's own experiments. Braun had observed that the signal strength in Marconi's radio was limited beyond a certain distance, and wondered why increasing the voltage on Marconi's radio did not result in a stronger transmission at greater distances. Braun thus dedicated himself to developing wireless devices with a stronger, more effective transmission capability.

5. In 1905, Braun invented the first phased array antenna. This phased array antenna featured three antennas carefully positioned relative to one another with a specific phase relationship so that the radio waves output from each antenna could add together to increase radiation in a desired direction. This design allowed Braun's phased array antenna to transmit a directed signal.

6. Building on the fundamental breakthrough that radio transmissions can be *directed* according to a specific radiation pattern through the use of a phased array antenna, directed

wireless communication technology has developed many applications over the years. Braun's invention of the phased array antenna led to the development of radar, smart antennas, and, eventually, to a technology known as "MIMO," or "multiple-input, multiple-output," which would ultimately allow a single radio channel to receive and transmit multiple data signals simultaneously. Along the way, engineers have worked tirelessly to overcome limitations and roadblocks directed wireless communication technology.

7. At the beginning of the twenty-first century, the vast majority of wireless networks still did not yet take advantage of directed wireless communications. Instead, "omnidirectional" access points were ubiquitous. Omnidirectional access points transmit radio waves uniformly around the access point in every direction and do not steer the signal in particular directions. Omnidirectional antennas access points do typically achieve 360 degrees of coverage around the access point, but with a reduced coverage distance. Omnidirectional access points also lack sophisticated approaches to overcome certain types of interference in the environment. As only one example, the presence of solid obstructions, such as a concrete wall, ceiling, or pillar, can limit signal penetration. As another example, interference arises when radio waves are reflected, refracted, or diffracted based on obstacles present between the transmitter and receiver. The multiple paths that radio waves can travel between the transmitter and receiver often result in signal interference that decreases performance, and omnidirectional access points lack advanced solutions to overcome these "multipath" effects.

8. Moving from omnidirectional networks to modern networks has required an additional series of advancements that harness the capabilities of directed wireless technology. These advancements range from conceiving various ways to steer and modify radiation patterns, to enhancing the transmission signal power in a desired direction, to suppressing radiation in

undesired directions, to minimizing signal "noise," and then applying these new approaches into communications networks with multiple, heterogenous transmitters and receivers.

9. Harnessing the capabilities of directed wireless technology resulted in a significant leap forward in the signal strength, reliability, concurrent users, and/or data transmission capability of a wireless network. One of the fundamental building blocks of this latest transition was the development of improvements to MIMO and "beamforming," which are the subject matter of patents in this infringement action. The patents in this action resulted from the investment of tens of millions of dollars and years of tireless effort by a group of engineers who built a technology company slightly ahead of its time. Their patented innovations laid the groundwork for today's networks, and are infringed by Defendant's accused products.

PARTIES

10. Plaintiff XR Communications, LLC, d/b/a Vivato Technologies ("Vivato" or "Plaintiff") is a limited liability company organized and existing under the laws of the State of Delaware with its principal place of business at 2809 Ocean Front Walk, Venice, California 90291. Vivato is the sole owner by assignment of all right, title, and interest in each Asserted Patent.

11. Vivato was founded in 2000 as a $80+ million venture-backed company with several key innovators in the wireless communication field including Siavash Alamouti, Ken Biba, William Crilly, James Brennan, Edward Casas, and Vahid Tarokh, among many others. At that time, and as remains the case today, "Wi-Fi" or "802.11" had become the ubiquitous means of wireless connection to the Internet, integrated into hundreds of millions of mobile devices globally. Vivato was founded to leverage its talent to generate intellectual property and deliver Wi-Fi/802.11 wireless connectivity solutions to service the growing demand for bandwidth.

12. Vivato has accomplished significant innovations in the field of wireless communications technology. One area of focus at Vivato was the development of advanced wireless systems with sophisticated antenna designs to improve wireless speed, coverage, and reliability. Vivato also focused on designing wireless systems that maximize the efficient use of spectrum and wireless resources for large numbers of connected mobile devices.

13. Among many fundamental breakthroughs achieved by Vivato are inventions that allow for intelligent and adaptive beamforming based on up-to-date information about the wireless medium. Through these and many other inventions, Vivato's engineers pioneered a wireless technology that provides for simultaneous transmission and reception, a significant leap forward over conventional wireless technology.

14. Over the years, Vivato has developed proven technology, with over 400

deployments globally, including private, public and government, and it has become a recognized provider of extended range Wi-Fi network infrastructure solutions. Vivato's wireless base stations integrate beamforming phased array antenna design with packet steering technology to deliver high-bandwidth extended range connections to serve multiple users and multiple devices.

15. Vivato's patent portfolio includes over 17 issued patents and pending patent applications. The patents at issue in this case are directed to specific aspects of wireless communication, including adaptively steered antenna technology and beam switching technology.

16. Defendant Google LLC ("Defendant" or "Google") is a wholly owned subsidiary of Alphabet Inc. and is a Delaware limited liability company with a principal place of business at 1600 Ampitheatre Parkway, Mountain View, California 94043. Google LLC designs and manufactures, among other things, Wi-Fi-compatible products and systems. Defendant designs and manufactures and/or has manufactured on its behalf abroad the Accused Products that are then sold for importation into the United States, imported into the United States, and/or sold, offered for sale, and/or used within the United States after importation. Google LLC may be served with process through its registered agent, the Corporation Service Company at 211 East 7th Street, Suite 620, Austin, Texas 78701. Google LLC is registered to do business in the State of Texas and has been since at least November 17, 2006. By registering to conduct business in Texas and by having facilities where it regularly conducts business in this District, Google LLC has a permanent and continuous presence in Texas and a regular and established place of business in the Western District of Texas.

JURISDICTION AND VENUE

17. This action arises under the patent laws of the United States, Title 35 of the United States Code § 1, *et seq*, including 35 U.S.C. §§ 271, 281, 283, 284, and 285. This Court has original

subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

18. This Court has personal jurisdiction over Defendant in this action because Defendant has committed acts within this District giving rise to this action, and has established minimum contacts with this forum such that the exercise of jurisdiction over Defendant would not offend traditional notions of fair play and substantial justice. Defendant, directly and/or through subsidiaries or intermediaries, has committed and continues to commit acts of infringement in this District by, among other things, importing, offering to sell, and selling products that infringe the asserted patents, and inducing others to infringe the asserted patents in this District. Defendant is directly and through intermediaries making, using, selling, offering for sale, distributing, advertising, promoting, and otherwise commercializing its infringing products in this District. Defendant regularly conducts and solicits business in, engages in other persistent courses of conduct in, and/or derives substantial revenue from goods and services provided to the residents of this District and the State of Texas. Google LLC is subject to jurisdiction pursuant to due process and/or the Texas Long Arm Statute due to its substantial business in this State and District including at least its infringing activities, regularly doing or soliciting business at its Austin facilities, and engaging in persistent conduct and deriving substantial revenues from goods and services provided to residents in the State of Texas including the Western District of Texas.

19. Venue is proper in this District pursuant to 28 U.S.C. § 1391(b), (c), (d), and 1400(b) because Google LLC has a permanent and continuous presence in, has committed acts of infringement in, and maintains regular and established places of business in this district. Google LLC has committed acts of direct and indirect infringement in this judicial district including using and purposefully transacting business involving the Accused Products in this judicial district such as by sales to one or more customers in the State of Texas including in the Western District of

Texas, and maintaining regular and established places of business in this district. For example, Google invested $20 million to build a corporate office at 500 West 2nd Street, Austin, Texas 78701, which is a regular and established place of business in this district.

COUNT I

INFRINGEMENT OF U.S. PATENT NO. 10,594,376

20. Vivato realleges and incorporates by reference the foregoing paragraphs as if fully set forth herein.

21. On March 17, 2020, United States Patent No. 10,594,376 ("the '376 Patent") was duly and legally issued for inventions entitled "Directed Wireless Communication." Vivato owns the '376 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the '376 Patent is attached hereto as Exhibit A.

22. Defendant has directly infringed and continues to directly infringe numerous claims of the '376 Patent, including at least claim 1, by manufacturing, using, selling, offering to sell, and/or importing into the United States Wi-Fi access points and routers supporting MU-MIMO, including without limitation access points and routers utilizing the IEEE 802.11ac standard (e.g. Google Nest Wifi Router, Google Nest Wifi point, Google Wifi) (collectively, "'376 Accused Products"). Defendant is liable for infringement of the '376 Patent pursuant to 35 U.S.C. § 271(a).

23. The Accused Products satisfy all claim limitations of numerous claims of the '376 Patent, including Claim 1. The following paragraphs compare limitations of Claim 1 to an exemplary '376 Accused Product, the Google Nest Wifi Router. *See, e.g.,* Google Nest Wifi Data

Sheet.[1] *See also* Google Wifi Data Sheet.[2]

24. Each of the '376 Accused Products comprises a data-communications networking apparatus. For example, as with each '376 Accused Product, the Google Nest Wifi Router is an apparatus for communication data on an IEEE 802.11ac data communications network. *See, e.g.,* Google Nest Wifi Data Sheet, which explains that Google Nest Wifi Router includes "IEEE 802.11ac" Network Standard support. *See, e.g.,* Google Nest Wifi Data Sheet (Google Nest Wifi Router supports "AC2200 MU-MIMO Wi-Fi" with 4x4 (5GHz) and 2x2 (2.4 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac." Google Nest Wifi point supports "AC1200 MU-MIMO Wi-Fi" with 2x2 (2.4 GHz / 5 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac."). In addition, the data sheet also confirms that the Google Nest Wifi "Router and point can each handle up to 100 connected devices."

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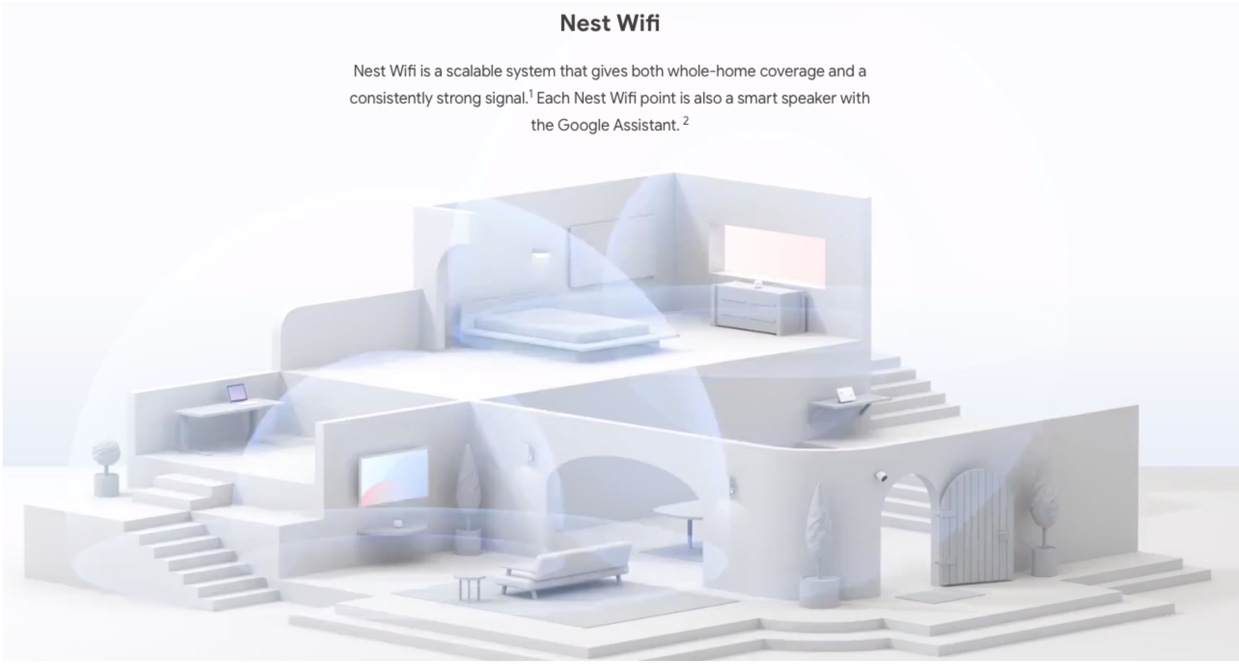
[1] Google Nest Wifi Data Sheet is available at https://store.google.com/us/product/nest_wifi?hl=en-US. Google Nest Wifi Router supports "AC2200 MU-MIMO Wi-Fi" with 4x4 (5GHz) and 2x2 (2.4 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac." Google Nest Wifi point supports "AC1200 MU-MIMO Wi-Fi" with 2x2 (2.4 GHz / 5 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac."

[2] Google Wifi Data Sheet is available at https://store.google.com/us/product/google_wifi_specs. Google Wifi supports "AC1200 MU-MIMO Wi-Fi" with "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac." According to Google's web page, the Google Wifi is the best-selling mesh Wifi system in the United States. *See* Google Wifi Store Homepage, footnote 5, available at https://store.google.com/us/product/google_wifi_2nd_gen.



25. Each of the ’376 Accused Products comprises a processor configured to generate a probing signal for transmission to at least a first client device and a second client device. For example, as with each ’376 Accused Product, the Google Nest Wifi Router has at least one processor (*e.g.,* one or more central processing units (CPUs), Wi-Fi processors, a baseband processor in the Wi-Fi radio, as examples) for generating signals for transmission. *See, e.g.,* Google Nest Wifi Data Sheet, which explains that Google Nest Wifi Router includes “Quad-core 64-bit ARRM CPU 1.4 GHz” with “High-performance ML hardware engine.” *See, e.g.,* Google Nest Wifi Data Sheet (Google Nest Wifi Router supports “AC2200 MU-MIMO Wi-Fi” with 4x4 (5GHz) and 2x2 (2.4 GHz) and “Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac.” Google Nest Wifi point supports “AC1200 MU-MIMO Wi-Fi” with 2x2 (2.4 GHz / 5 GHz) and “Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac.”). In addition, the data sheet also confirms that the Google Nest Wifi “Router and point can each handle up to 100 connected devices.” For a further example, as with each ’376 Accused Product, the Google Nest Wifi Router generates a probing signal for transmission (*e.g.,*

a probing signal transmission that triggers or elicits a responsive transmission from each of a first client device and a second client device, such as NDP Announcement, NDP, beamforming report polling pursuant to Very High Throughput VHT channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO) to at least a first client device and a second client device (*e.g.,* a first non-AP STA / VHT beamformee and a second non-AP STA / VHT beamformee). See, e.g., IEEE 802.11ac Standard Clause 9.31.5.2 ("A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field."); id. ("A non-AP VHT beamformee that receives a VHT NDP Announcement frame… shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer."); *id*. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); *id*. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) ("Each SNR value per tone in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined at the beamformee"); *id*. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); *id*. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.8.3.5; id. Clause 22.3.11.2.

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,\upsilon)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.

After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering matrix Q_k. For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \leq u \leq N_{user} - 1$) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

26. Each of the '376 Accused Products comprises a processor configured to generate a first data stream for transmission to the first client device and generate a second data stream for transmission to the second client device. For example, as with each '376 Accused Product, the Google Nest Wifi Router has at least one processor and Wi-Fi radio functionality (*e.g.,* the CPU(s) and/or Wi-Fi processors and/or baseband processor(s) in the Wi-Fi radio) configured to generate a first data stream for transmission to the first client device ("non-AP STA" or "non-Access Point Station") and a second data stream for transmission to a second client device (non-AP STA) pursuant to MU-MIMO transmissions. *See, e.g.,* Google Nest Wifi Data Sheet (Google Nest Wifi Router supports "AC2200 MU-MIMO Wi-Fi" with 4x4 (5GHz) and 2x2 (2.4 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac." Google Nest Wifi point supports "AC1200 MU-MIMO Wi-Fi" with 2x2 (2.4 GHz / 5 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac."). *See, e.g.,* Google Nest Wifi Data Sheet, which explains that Google Nest Wifi Router includes "Quad-core 64-bit ARRM CPU 1.4 GHz" with "High-performance ML hardware engine." *See, e.g.,* 802.11ac Standard Clause 9.31.5.1 ("Transmit beamforming and DL-MU-MIMO require knowledge of the

channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix."); id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) ("Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1."); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1, 22.3.11.2.

27. Each of the '376 Accused Products comprises a transceiver operatively coupled to the processor and configured to: transmit the probing signal to at least the first client device and the second client device via a smart antenna; wherein the smart antenna is operatively coupled to the transceiver and comprises a first antenna element and a second antenna element. For example, as with each '376 Accused Product, the Google Nest Wifi Router has a Wi-Fi radio with a transceiver operatively coupled to the processor (*e.g.,* the Wi-Fi radio generates signals for transmission and processes received signals with, *e.g.,* the CPU, Wi-Fi processors, and/or baseband processor in the Wi-Fi radio, and the radio comprises a transceiver that transmits and receives signals via a smart antenna); and, as with each '376 Accused Product, the Google Nest Wifi Router has a Wi-Fi radio transceiver operatively coupled to the processor and to a smart antenna, wherein the smart antenna is operatively coupled to the Wi-Fi radio and comprises a first antenna element and a second antenna element. For a further example, as with each '376 Accused

Product, the Google Nest Wifi Router transmits the probing signal (*e.g.,* a probing signal transmission that triggers or elicits a responsive transmission from each of a first client device and a second client device, such as NDP Announcement, NDP, beamforming report poll frames pursuant to Very High Throughput (VHT) channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO) to at least the first client device and the second client device (*e.g.,* the first non-AP STA and the second non-AP STA) via the smart antenna. *See, e.g.,* Google Nest Wifi Data Sheet (Google Nest Wifi Router supports "AC2200 MU-MIMO Wi-Fi" with 4x4 (5GHz) and 2x2 (2.4 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac." Google Nest Wifi point supports "AC1200 MU-MIMO Wi-Fi" with 2x2 (2.4 GHz / 5 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac."). *See, e.g.,* Google Nest Wifi Data Sheet, which explains that Google Nest Wifi Router includes "Quad-core 64-bit ARRM CPU 1.4 GHz" with "High-performance ML hardware engine." See, e.g., 802.11ac Standard Clause 9.31.5.2 ("A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field."); id. ("A non-AP VHT beamformee that receives a VHT NDP Announcement frame… shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer."); id. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed

Beamforming frame); id. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) ("Each SNR value per tone in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined at the beamformee"); id. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); id. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.8.3.5; id. Clause 22.3.11.2.

28. Each of the '376 Accused Products comprises a data-communications networking apparatus wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: receive a first feedback information from the first client device in response to the transmission of the probing signal; receive a second feedback information from the second client device in response to transmission of the probing signal. For example, as with each '376 Accused Product, the Google Nest Wifi Router comprises one or more of the processor, the transceiver, or the smart antenna further configured to receive channel state information and estimates of the channel state and MU MIMO-related feedback information from each of the first non-AP STA and the second non-AP STA pursuant to MU-MIMO sounding procedures. This feedback information, carried in one or more compressed beamforming frames, is in response to the transmission of the probing signal (*e.g.,* a probing signal transmission that triggers or elicits a responsive transmission from each of a first client device and a second client device, such as NDP Announcement, NDP, beamforming report polling pursuant to Very High Throughput (VHT) channel sounding, including preamble training fields allowing an estimate of the channel for MU-MIMO). *See, e.g.,* Google Nest Wifi Data Sheet (Google Nest Wifi Router supports "AC2200 MU-MIMO Wi-Fi" with 4x4 (5GHz) and 2x2 (2.4 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac." Google Nest Wifi point supports "AC1200 MU-MIMO Wi-Fi" with 2x2 (2.4 GHz / 5 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz)

Wi-Fi supporting IEEE 802.11a/b/g/n/ac."). *See, e.g.,* Google Nest Wifi Data Sheet, which explains that Google Nest Wifi Router includes "Quad-core 64-bit ARRM CPU 1.4 GHz" with "High-performance ML hardware engine." *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 ("A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field."); *id*. ("A non-AP VHT beamformee that receives a VHT NDP Announcement frame… shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer."); *id*. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); *id*. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) ("Each SNR value per tone in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined at the beamformee"); *id*. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); *id*. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.8.3.5; id. Clause 22.3.11.2:

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,\upsilon)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.

After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering matrix Q_k. For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ $(0 \leq u \leq N_{user} - 1)$ in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

29. Each of the '376 Accused Products comprises a data-communications networking apparatus wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information. For example, as with each '376 Accused Product, the Google Nest Wifi Router comprises one or more of the processor, the transceiver, or the smart antenna further configured to determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information, including, *e.g.,* where it determines where to place transmission peaks and transmission nulls through a beamforming steering matrix pursuant to beamforming and MU-MIMO spatial multiplexing, which beamforming steering matrix is determined based on the received CSI (channel state information) and MIMO-related feedback from the first client device (first non-AP STA) and the second client device (second non-AP STA) pursuant to VHT MU-MIMO sounding. *See, e.g.,* Google Nest Wifi Data Sheet (Google Nest Wifi Router supports "AC2200 MU-MIMO Wi-Fi" with 4x4 (5GHz) and 2x2 (2.4 GHz) and "Simultaneous dual-band

(2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac." Google Nest Wifi point supports "AC1200 MU-MIMO Wi-Fi" with 2x2 (2.4 GHz / 5 GHz) and "Simultaneous dual-band (2.4 GHz / 5 GHz) Wi-Fi supporting IEEE 802.11a/b/g/n/ac."). *See, e.g.,* Google Nest Wifi Data Sheet, which explains that Google Nest Wifi Router includes "Quad-core 64-bit ARRM CPU 1.4 GHz" with "High-performance ML hardware engine." *See, e.g.*, 802.11ac Standard Clause 9.31.5.1 ("Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix."); id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) ("Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1."); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; *id*. Clause 22.3.11.1:

> The DL-MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ can be determined by the beamformer using the beamforming feedback matrices for subcarrier k from beamformee u, $V_{k,u,}$ and SNR information for subcarrier k from beamformee u, $SNR_{k,u}$, where $u = 0, 1, \ldots, N_{user} - 1$. The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL-MU-MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

; *id.* Clause 22.3.11.2:

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,u)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.

After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering matrix Q_k. For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ $(0 \le u \le N_{user} - 1)$ in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

30. Each of the '376 Accused Products comprises a data-communications networking apparatus wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: transmit the first data stream to the first client device via the one or more spatially distributed patterns of electromagnetic signals; and transmit the second data stream to the second client device via the one or more spatially distributed patterns of electromagnetic signals; wherein transmission of the first data stream and transmission of at least part of the second data stream occur at the same time; and wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device and a second transmission peak at a location of the second client device. For example, as with each '376 Accused Product, the Google Nest Wifi Router comprises one or more of the processor, the transceiver, or the smart antenna further configured to transmit the first data stream to the first client device (*e.g.,* the first non-AP STA) via the one or more spatially distributed patterns of electromagnetic signals (*e.g.,* transmission of data to the first non-AP STA pursuant to VHT MU-MIMO beamforming where a beamforming steering matrix is applied); and transmit the second data stream to the second client device (*e.g.,* the second non-AP STA) via the one or more

spatially distributed patterns of electromagnetic signals (*e.g.,* transmission of data to the second non-AP STA pursuant to VHT MU-MIMO beamforming where a beamforming steering matrix is applied); wherein transmission of the first data stream and transmission of at least part of the second data stream occur at the same time (*e.g.,* simultaneous VHT DL MU-MIMO transmissions); and wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device and a second transmission peak at a location of the second client device (*e.g.,* through VHT MU-MIMO beamforming, radio energy is directed at each of the first client device and the second client device to form a transmission peak at the location of each device, and including, *e.g.,* where the beamforming steering matrix is applied, a first space-time stream ("STS") intended for reception at the first client device and a second STS intended for reception at the second client device is representative of a first transmission peak being placed at the location of the first client device and a second transmission peak being placed at the location of second client device). *See, e.g.,* IEEE 802.11ac Standard Clause 9.31.5.1 ("Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix."); id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) ("Spatial mapping: Apply the Q matrix as described in

22.3.10.11.1."); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1:

> The DL-MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ can be determined by the beamformer using the beamforming feedback matrices for subcarrier k from beamformee u, $V_{k,u,}$ and SNR information for subcarrier k from beamformee u, $SNR_{k,u}$, where $u = 0, 1, \ldots, N_{user} - 1$. The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL-MU-MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

; *id.* Clause 22.3.11.2:

> Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,\upsilon)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.
>
> The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.
>
> After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering matrix Q_k. For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ $(0 \le u \le N_{user} - 1)$ in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

31. Defendant also has been and is now knowingly and intentionally inducing infringement of at least claim 1 of the '376 Patent in violation of 35 U.S.C. § 271(b). Through the filing and service of this Complaint, Defendant has had knowledge of the '376 Patent and the infringing nature of the '376 Accused Products.

32. Despite this knowledge of the '376 Patent, Defendant continues to actively encourage and instruct its customers and end users (for example, through user manuals and online instruction materials on its website) to use the '376 Accused Products in ways that directly infringe the '376 Patent. For example, Defendant's website provided, and continues to provide, instructions for using the '376 Accused Products on wireless communications systems, and to utilize their

802.11ax beamforming and MU-MIMO functionalities. Defendant does so knowing and intending that its customers and end users will commit these infringing acts. Defendant also continues to make, use, offer for sale, sell, and/or import the ’376 Accused Products, despite its knowledge of the ’376 Patent, thereby specifically intending for and inducing its customers to infringe the ’376 Patent through the customers’ normal and customary use of the ’376 Accused Products. Defendant also knew or was willfully blind that its actions would induce direct infringement by others and intended that its actions would induce direct infringement by others. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of Vivato’s ’376 Patent in the United States because Defendant had knowledge of the ’376 Patent and actively induced others (*e.g.,* its customers) to directly infringe the ’376 Patent.

33. Defendant also contributorily infringes pursuant to 35 U.S.C. § 271(c) by making, using, selling, offering to sell, commercially distributing, and/or importing the ’376 Accused Products, knowing they constitute a material part of the invention, are especially made or adapted for use in infringing, and that they are not staple articles of commerce capable of substantial non-infringing use.

34. By making, using, offering for sale, selling and/or importing into the United States the ’376 Accused Products, Defendant has injured Vivato and is liable for infringement of the ’376 Patent pursuant to 35 U.S.C. § 271.

35. Defendant also infringes numerous additional claims of the ’376 Patent, including Claims 2 – 34, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 1.

36. Vivato’s ’376 Patent is valid and enforceable.

37. As a result of Defendant's infringement of the '376 Patent, Defendant has damaged Vivato, and Vivato is entitled to monetary damages in an amount to be determined at trial that is adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

38. Defendant's infringing activities have injured and will continue to injure Vivato, unless and until this Court enters an injunction prohibiting further infringement of the '376 Patent, and, specifically, enjoining further manufacture, use, sale, importation, and/or offers for sale that come within the scope of the patent claims.

COUNT II

INFRINGEMENT OF U.S. PATENT NO. 10,715,235

39. Vivato realleges and incorporates by reference the foregoing paragraphs as if fully set forth herein.

40. On July 14, 2020, United States Patent No. 10,715,235 duly and legally issued for inventions entitled "Directed Wireless Communication." Vivato owns the '235 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the '235 Patent is attached hereto as Exhibit B.

41. Defendant has directly infringed and continues to directly infringe numerous claims of the '235 Patent, including at least claim 8, by manufacturing, using, selling, offering to sell, and/or importing into the United States certain products supporting MU-MIMO technologies (e.g., Defendant's Google Nest Cam IQ Outdoor, Google Nest Cam IQ Indoor, Pixel 5, Pixel 4a (5G), Pixel 4a, Google Pixelbook Go, Nest Hello Doorbell) (collectively, the "'235 Accused Products"). Defendant is liable for infringement of the '235 Patent pursuant to 35 U.S.C. § 271(a).

42. The ’235 Accused Products satisfy all claim limitations of numerous claims of the ’235 Patent, including Claim 8. The following paragraphs compare limitations of Claim 8 to an exemplary Accused Product, Google Pixel 5. *See, e.g.,* Google Pixel 5 Data Sheet.[3]

43. Each ’235 Accused Product performs a method for use in a wireless communications system, the method comprising receiving a first signal transmission from a remote station via a first antenna element of an antenna and a second signal transmission from the remote station via a second antenna element of the antenna simultaneously, wherein the first signal transmission and the second signal transmission comprise electromagnetic signals comprising one or more transmission peaks and one or more transmission nulls. For example, as with each ’235 Accused Product, the Google Pixel 5 receives a first signal transmission from a remote station, such as a Wi-Fi Access Point, via a first antenna element of an antenna and a second signal transmission from the remote station via a second antenna element of the antenna simultaneously, such as when the Google Pixel 5 receives first and second signals with its first and second antenna elements that contain training fields of a null data packet used for MU-MIMO sounding and channel estimation procedures. *See, e.g.,* Google Pixel 5 Data Sheet (“Wi-Fi 2.4 GHz + 5 GHz 802.11a/b/g/n/ac 2x2 MIMO”; “Qualcomm Snapdragon 765G 2.4 GHz + 2.2GHz + 1.8GHz 64-bit Octa-Core Adreno 620”). *See, e.g.,* IEEE 802.11ac Standard Clause 9.31.5.1 (“Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used

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[3] Google Pixel 5 Data Sheet including “Tech Specs” available at https://store.google.com/us/product/pixel_5_specs?hl=en-US.

where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix."); *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 ("A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field."); *id*. ("A non-AP VHT beamformee that receives a VHT NDP Announcement frame… shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer."); *id*. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); *id*. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) ("Each SNR value per tone in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined at the beamformee"); *id*. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); *id*. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) ("Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1."); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1:

> The DL-MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ can be determined by the beamformer using the beamforming feedback matrices for subcarrier k from beamformee u, $V_{k,u,}$ and SNR information for subcarrier k from beamformee u, $SNR_{k,u}$, where $u = 0, 1, \ldots, N_{user} - 1$. The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL-MU-MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

; *id.* Clause 22.3.11.2:

> Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,\upsilon)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.
>
> The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.
>
> After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering matrix Q_k. For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ $(0 \le u \le N_{user} - 1)$ in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

44. Each ’235 Accused Product performs a method for use in a wireless communications system, the method comprising determining first signal information for the first signal transmission and determining second signal information for the second signal transmission, wherein the second signal information is different than the first signal information. For example, as with each ’235 Accused Product, the Google Pixel 5 determines different signal information for the first signal transmission than it does for the second signal transmission, by using the training fields of a null data packet for MU-MIMO sounding and channel estimation to determine the parameters in the beamforming feedback matrix. *See, e.g.,* Google Pixel 5 Data Sheet (“Wi-Fi 2.4 GHz + 5 GHz 802.11a/b/g/n/ac 2x2 MIMO”; “Qualcomm Snapdragon 765G 2.4 GHz + 2.2GHz + 1.8GHz 64-bit Octa-Core Adreno 620”). *See, e.g.,* IEEE 802.11ac Standard Clause 9.31.5.1

("Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix."); *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 ("A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field. The VHT NDP Announcement frame shall include at least one STA Info field."); *id*. ("A non-AP VHT beamformee that receives a VHT NDP Announcement frame… shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer."); *id*. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); *id*. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) ("Each SNR value per tone in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined at the beamformee"); *id*. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); *id*. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clauses

22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) ("Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1."); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1:

> The DL-MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ can be determined by the beamformer using the beamforming feedback matrices for subcarrier k from beamformee u, $V_{k,u}$, and SNR information for subcarrier k from beamformee u, $SNR_{k,u}$, where $u = 0, 1, \ldots, N_{user} - 1$. The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL-MU-MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

; *id.* Clause 22.3.11.2:

> Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,\upsilon)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.
>
> The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.
>
> After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering matrix Q_k. For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ $(0 \le u \le N_{user} - 1)$ in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

45. Each '235 Accused Product performs a method for use in a wireless communications system, the method comprising determining a set of weighting values based on the first signal information and the second signal information, wherein the set of weighting values is configured to be used by the remote station to construct one or more beam-formed transmission signals, and transmitting to the remote station a third signal comprising content based on the set of weighting values. For example, as with each '235 Accused Product, the Google Pixel 5 determines

a set of weighting values based on the first signal information and the second signal information, wherein the set of weighting values is configured to be used by the remote station to construct one or more beam-formed transmission signals, and transmits to the remote station a third signal comprising content based on the set of weighting values, by determining the parameters of the beamforming feedback matrix, which include weighting values configured to be used by the remote station (*e.g.,* a Wi-Fi access point) to construct one or more beamformed transmission signals, and transmitting to the remote station (*e.g.,* a Wi-Fi access point) a signal that includes the beamforming feedback matrix. *See, e.g.,* Google Pixel 5 Data Sheet ("Wi-Fi 2.4 GHz + 5 GHz 802.11a/b/g/n/ac 2x2 MIMO"; "Qualcomm Snapdragon 765G 2.4 GHz + 2.2GHz + 1.8GHz 64-bit Octa-Core Adreno 620"). *See, e.g.,* IEEE 802.11ac Standard Clause 9.31.5.1 ("Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmitted signal to optimize reception at one or more receivers. The STA transmitting using the steering matrix is called the VHT beamformer and a STA for which reception is optimized is called a VHT beamformee. An explicit feedback mechanism is used where the VHT beamformee directly measures the channel from the training symbols transmitted by the VHT beamformer and sends back a transformed estimate of the channel state to the VHT beamformer. The VHT beamformer then uses this estimate, perhaps combining estimates from multiple VHT beamformees, to derive the steering matrix."); *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 ("A VHT beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP Announcement frame one STA Info field for each VHT beamformee that is expected to prepare VHT Compressed Beamforming feedback and shall identify the VHT beamformee by including the VHT beamformee's AID in the AID subfield of the STA Info field.

The VHT NDP Announcement frame shall include at least one STA Info field."); *id*. ("A non-AP VHT beamformee that receives a VHT NDP Announcement frame… shall transmit its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA matching its MAC address and a non-bandwidth signaling TA obtained from the TA field matching the MAC address of the VHT beamformer."); *id*. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming frame); *id*. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) ("Each SNR value per tone in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined at the beamformee"); *id*. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive Beamforming Report information); *id*. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m), 22.3.4.9.2(m), 22.3.4.10.4(a) ("Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1."); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause 22.3.11.1:

> The DL-MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ can be determined by the beamformer using the beamforming feedback matrices for subcarrier k from beamformee u, $V_{k,u,}$ and SNR information for subcarrier k from beamformee u, $SNR_{k,u}$, where $u = 0, 1, \ldots, N_{user} - 1$. The steering matrix that is computed (or updated) using new beamforming feedback matrices and new SNR information from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL-MU-MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

; *id.* Clause 22.3.11.2:

Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer. The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,\upsilon)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22 beamforming feedback format defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.

After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering matrix Q_k. For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ $(0 \le u \le N_{user} - 1)$ in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

46. Defendant also has been and is now knowingly and intentionally inducing infringement of at least claim 1 of the ’235 Patent in violation of 35 U.S.C. § 271(b). Through at least the filing and service of this Complaint, Defendant has had knowledge of the ’235 Patent and the infringing nature of the ’235 Accused Products.

47. Despite this knowledge of the ’235 Patent, Defendant continues to actively encourage and instruct its customers and end users (for example, through user manuals and online instruction materials on its website) to use the ’235 Accused Products in ways that directly infringe the ’235 Patent. For example, Defendant’s websites provided, and continues to provide, instructions for using the ’235 Accused Products on wireless communications systems, to utilize their 802.11ac beamforming and/or MU-MIMO functionalities. Defendant does so knowing and intending that its customers and end users will commit these infringing acts. Defendant also continue to make, use, offer for sale, sell, and/or import the ’235 Accused Products, despite its knowledge of the ’235 Patent, thereby specifically intending for and inducing its customers to infringe the ’235 Patent through the customers’ normal and customary use of the ’235 Accused Products. Defendant also knew or was willfully blind that its actions would induce direct

infringement by others and intended that its actions would induce direct infringement by others. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of Vivato's '235 Patent in the United States because Defendant had knowledge of the '235 Patent and actively induced others (*e.g.,* its customers) to directly infringe the '235 Patent.

48. Defendant also contributorily infringes under 35 U.S.C. § 271(c) by making, using, selling, offering to sell, and/or importing the '235 Accused Products, knowing they constitute a material part of the invention, are especially made or adapted for use in infringing, and that they are not staple articles of commerce capable of substantial non-infringing use.

49. By making, using, offering for sale, selling and/or importing into the United States the '235 Accused Products, Defendant has injured Vivato and is liable for infringement of the '235 Patent pursuant to 35 U.S.C. § 271.

50. Defendant also infringes numerous additional claims of the '235 Patent, including Claim 12, for example, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 1.

51. Vivato's '235 Patent is valid and enforceable.

52. Vivato has complied with 35 U.S.C. § 287 where applicable (*i.e.,* non-method claims) at least because there are no unmarked patented articles subject to a duty to mark.

53. As a result of Defendant's infringement of the '235 Patent, Defendant has damaged Vivato, and Vivato is entitled to monetary damages in an amount to be determined at trial that is adequate to compensate for Defendant's infringement, but in no event less than a reasonable royalty for the use made of the invention by Defendant, together with interest and costs as fixed by the Court.

54. Defendant's infringing activities have injured and will continue to injure Vivato, unless and until this Court enters an injunction prohibiting further infringement of the '235 Patent, and, specifically, enjoining further manufacture, use, sale, importation, and/or offers for sale that come within the scope of the patent claims.

PRAYER FOR RELIEF

WHEREFORE, Vivato respectfully requests that this Court enter:

a. A judgment in favor of Vivato that Defendant has infringed, either literally and/or under the doctrine of equivalents the '376 Patent and the '235 patent;

b. A permanent injunction prohibiting Defendant from further acts of infringement of the '376 Patent and the '235 patent;

c. A judgment and order requiring Defendant to pay Vivato its damages, costs, expenses, and pre-judgment and post-judgment interest for Defendant's infringement of the '376 Patent and the '235 patent;

d. A judgment and order requiring Defendant to provide an accounting and to pay supplemental damages to Vivato, including without limitation, pre-judgment and post-judgment interest and an award of an ongoing royalty for Defendant's post-judgment infringement in an amount according to proof;

e. A judgment and order finding that this is an exceptional case within the meaning of 35 U.S.C. § 285 and awarding to Vivato its reasonable attorneys' fees and costs against Defendant, and enhanced damages pursuant to 35 U.S.C. § 284; and

f. Any and all other relief as the Court may deem appropriate and just under the circumstances.

DEMAND FOR JURY TRIAL

Vivato, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

Dated: June 16, 2021

Respectfully submitted,

/s/ Reza Mirzaie

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