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

XR COMMUNICATIONS, LLC, dba VIVATO TECHNOLOGIES, Plaintiff, v. DELL TECHNOLOGIES INC. AND DELL INC. Defendant.	Case No. 6:21-cv-646 **JURY TRIAL DEMANDED**

COMPLAINT FOR PATENT INFRINGEMENT AGAINST
DELL TECHNOLOGIES INC. AND DELL INC.

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 Defendants Dell Technologies Inc. and Dell Inc. ("Defendants"):

INTRODUCTION

1. This complaint arises from Defendants' unlawful infringement of the following United States patent owned by Vivato, which generally relates to wireless communications technology: United States Patent No. 10,715,235 (the "'235 Patent") (the "Asserted Patent").

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 Dell Technologies Inc. is a Delaware corporation with its principal place of business at One Dell Way, Round Rock, Texas 78762. Defendant Dell Technologies Inc. distributes, markets, and sells electronic devices in the United States. Defendant Dell Technologies Inc. is authorized to do business in Texas and may be served through its registered agent Corporation Service Company, 251 Little Falls Drive, Wilmington, Delaware 19808.

17. Defendant Dell Inc. is a Delaware corporation with its principal placeo f business at One Dell Way, Round Rock, Texas 78762. Defendant Dell Inc. distributes, markets, and sells electronic devices in the United States. Defendant Dell Inc. may be served through its registered agent Corporation Service Company, 211 E. 7th Street Suite 620, Austin, Texas 78701.

18. Defendants Dell Technologies Inc. and Dell Inc. offer for sale, sell, design and manufacture and/or have manufactured on their behalf abroad certain 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. By registering to conduct business in Texas and by having facilities where it regularly conducts business in this District, Defendants have a permanent and continuous presence in Texas and a regular and established place of business in the Western District of Texas.

JURISDICTION AND VENUE

19. 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).

20. This Court has personal jurisdiction over Defendants in this action because Defendants have committed acts within this District giving rise to this action, and have established minimum contacts with this forum such that the exercise of jurisdiction over Defendants would not offend traditional notions of fair play and substantial justice. Defendants, directly and/or through subsidiaries or intermediaries, have committed and continue 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. Defendants are directly and through intermediaries making, using, selling, offering for sale, distributing, advertising, promoting, and otherwise commercializing their infringing products in this District. Defendants regularly conduct and solicit business in, engage in other persistent courses of conduct in, and/or derive substantial revenue from goods and services provided to the residents of this District and the State of Texas. Defendants are subject to jurisdiction pursuant to due process and/or the Texas Long Arm Statute due to their 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.

21. Venue is proper in this District pursuant to 28 U.S.C. § 1391(b), (c), (d), and 1400(b) because Defendants have a permanent and continuous presence in, have committed acts

of infringement in, and maintain regular and established places of business in this district. Defendants have 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, Defendants maintain regular and established places of business their shared offices at One Dell Way, Round Rock, Texas 78682.

COUNT I

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

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

23. 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 A.

24. Defendants have directly infringed and continue 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 MIMO and/or MU-MIMO technologies (*e.g.*, Defendants' XPS, Latitude, Inspiron, G-Series, Rugged, Chromebook, Alienware laptops, tablets and 2-in-1s, and desktops, including for example, the Latitude 9410 2-in-1, 9510, 9520, 9420, 7410, 7320 Detachable, 7420, 7320, 7520, 7310, 7210 2-in-1, 5410, 5510, 5520, 5320, 5420, 5411, 5310 2-in-1, 5511, 5310, 3510, 3410, 3420, 3310 2-in-1, 3320, 3520, the Vostro 5402, 5502, 5510, 5410, 5310, 5301, 7500, the Inspiron 13 2-in-1, Inspiron 14 2-in-1,

Inspiron 14 7000, New Inspiron 14, New Inspiron 15 AMD, New Inspiron 15, Inspiron 15 2-in-1, Inspiron 16 Plus, Inspiron 17 2-in-1, the XPS 13, New XPS 13, XPS 15, XPS 13 2-in-1, New XPS 15, New XPS 17, XPS 17, the Precision 3550 Workstation, Precision 3560 Workstation, Precision 3551 Workstation, New Precision 5760 Workstation, Precision 5550 Workstation, New Precision 5560 Workstation, Precision 5750 Workstation, Precision 7750 Workstation, New Precision 7560 Workstation, New Precision 7760 Workstation, Precision 7550 Workstation, the Latitude 5400 Chromebook Enterprise, Latitude 5300 2-in-1 Chromebook Enterprise, Latitude 7410 Chromebook Enterprise, the Latitude 5420 Rugged, Latitude 5424 Rugged, Latitude 12 7220 Rugged Extreme, Latitude 7424 Rugged Extreme, Latitude 7220EX Rugged Extreme Tablet, the Alienware m15 Ryzen R5 Gaming Laptops, the OptiPlex 7090 Ultra, 7090 Tower, 7090 Micro, 7080 Tower, 5090 Micro, 5090 Tower, 5080 Tower, 3090 Ultra, 7490 All-in-One, 7780 All-in-One, 5490 All-in-One, 3280 All-in-One, 7090 Ultra, 7080 XE Teams Solution desktops, the Inspiron 27 7000 All-in-One desktop, the Inspiron 24 5000 All-in-One desktop, the New Inspiron Dekstop, the XPS Desktop, the XPS Desktop Special Edition, the Alienware Aurora R12 Gaming Desktop, the) (collectively, the "'235 Accused Products"). Defendant is liable for infringement of the '235 Patent pursuant to 35 U.S.C. § 271(a).

25. 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, the Dell XPS 13 Laptop. *See, e.g.,* Compare Dell models, Dell XPS 13 Laptop Webpage.[1] Like the Dell XPS 13 Laptop, each Accused Product supports MIMO

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[1] Compare Dell models, XPS 13 Laptop configurations available at https://www.dell.com/en-us/work/shop/dell-laptops-and-notebooks/xps-13-laptop/spd/xps-13-9305-laptop/smx139w10p1c1500 and https://www.dell.com/en-us/work/shop/dell-laptops-and-notebooks/xps-13-laptop/spd/xps-13-9305-laptop#configurations_section.

or MU-MIMO technology. For example, the Dell XPS 13 Laptop includes "Killer™ Wi-Fi 6 AX1650 (2 x 2)" wireless technology. *See* Dell XPS 13 Laptop Webpage.

26. 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 Dell XPS 13 Laptop 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 Dell XPS 13 Laptop 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. For example, the Dell XPS 13 Laptop includes "Killer™ Wi-Fi 6 AX1650 (2 x 2)" wireless technology that allows it to receive wireless signals simultaneously. *See* Dell XPS 13 Laptop Webpage. *See, e.g.,* IEEE 802.11ax Standard, Section 27.3.1.1 ("The transmission within an RU in a PPDU may be single stream to one user, spatially multiplexed to one user (SU-MIMO), or spatially multiplexed to multiple users (MU-MIMO)."); Section 27.3.2.5 ("The number of users in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A. The allocated spatial streams for each user and the total number of spatial streams are indicated in the Spatial Configuration field of User field in HE-SIG-B containing the STA-ID of the designated MU-MIMO STA as defined in Table 27-29 (Spatial Configuration subfield encoding)…[i]f there is only one User field (see Table 27-27 (User field

format for a non-MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of spatial streams for the user in the RU is indicated by the NSTS field in the User field. If there is more than one User field (see Table 27-28 (User field for an MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of allocated spatial streams for each user in the RU is indicated by the Spatial Configuration field of the User field in HE-SIG-B."); Section 27.3.2.6 ("UL MU transmissions are preceded by a Trigger frame or frame carrying a TRS Control subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield indicates the parameters, such as the duration of the HE TB PPDU, RU allocation, target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control) and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit an HE TB PPDU"); Section 27.3.10.8 (HE-SIG-B) ("The HE-SIG-B field provides the OFDMA and DL MU-MIMO resource allocation information to allow the STAs to look up the corresponding resources to be used in the data portion of the frame."); Section 27.3.15 ("SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs in an RU of size greater than or equal to 106-tones"); Section 27.3.10.8.5 (HE-SIG-B per user content) ("The User Specific field consists of multiple User fields. The User fields follow the Common field of HE-SIG-B. The RU Allocation field in the Common field and the position of the User field in the User Specific field together identify the RU used to transmit a STA's data…"). *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.
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> 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.

27. 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 Dell XPS 13 Laptop 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. For example, the Dell XPS 13

Laptop includes "Killer™ Wi-Fi 6 AX1650 (2 x 2)" wireless technology. *See* Dell XPS 13 Laptop Webpage. *See, e.g.,* IEEE 802.11ax Standard, Section 26.7 (HE sounding protocol) ("Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. The HE sounding protocol provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-based (TB) sounding, where the HE beamformee measures the channel using a training signal (i.e., an HE sounding NDP) transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix. The HE beamformee returns an estimate of the channel state in an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames."); Section 26.7.3 ("An HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee's MAC address in the RA field and also receives an HE sounding NDP a SIFS after the HE NDP Announcement frame shall transmit its HE compressed beamforming/CQI report a SIFS after the HE sounding NDP. The TXVECTOR parameter CH_BANDWIDTH for the PPDU containing the HE compressed beamforming/CQI report shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH_BANDWIDTH of the HE sounding NDP. An HE beamformee that receives an HE NDP Announcement frame as part of an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or MU feedback shall generate an HE compressed beamforming/CQI report using the feedback type, Ng and codebook size indicated in the STA Info field. If the HE beamformee then receives a BFRP Trigger frame with a User Info field addressed to it, the HE beamformee transmits an HE TB PPDU containing the HE compressed beamforming/CQI report following the rules defined in 26.5.3.3 (Non-AP STA behavior for UL MU operation)."); Section 26.5.3 (UL MU operation) ("UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP HE STAs"); Section 27.3.10.10 (HE-LTF) ("The HE-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter provides training for NSTS space-time streams (spatial mapper inputs) used for the transmission of the PSDU. In an HE MU PPDU, the transmitter provides training for NSTS,r,total space-time streams used for the transmission of the PSDU(s) in the r-th RU. In an HE TB PPDU, the transmitter of user u in the r-th RU provides training for NSTS,r,u space-time streams used for the transmission of the PSDU. For each tone in the r-th RU, the MIMO channel that can be estimated is an NRX x NSTS,r,total matrix. An HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix PHE-LTF, to enable channel estimation at the receiver…. In an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF type and GI duration is indicated in the Trigger frame that triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-LTF types and GI durations are listed in 27.3.4 (HE PPDU formats."); Section 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) ("The DL MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k}, N_{user,r-1}]$ can be detected by the beamformer using the beamforming feedback for subcarrier k from beamformee u, where $u = 0,1,\ldots N_{user,r-1}$. The feedback report format is described in 9.4.1.65 (HE Compressed

Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL MU-MIMO data transmission. For SU-MIMO beamforming, the steering matrix Q_k can be determined from the beamforming feedback matrix V_k that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field."). *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.

28. 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 Dell XPS 13 Laptop 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. For example, the Dell XPS 13 Laptop includes

"Killer™ Wi-Fi 6 AX1650 (2 x 2)" wireless technology. *See* Dell XPS 13 Laptop Webpage. *See, e.g.,* IEEE 802.11ax Standard, Section 26.7 (HE sounding protocol) ("Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. The HE sounding protocol provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-based (TB) sounding, where the HE beamformee measures the channel using a training signal (i.e., an HE sounding NDP) transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix. The HE beamformee returns an estimate of the channel state in an HE compressed beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI frames."); Section 26.7.3 ("An HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee's MAC address in the RA field and also receives an HE sounding NDP a SIFS after the HE NDP Announcement frame shall transmit its HE compressed beamforming/CQI report a SIFS after the HE sounding NDP. The TXVECTOR parameter CH_BANDWIDTH for the PPDU containing the HE compressed beamforming/CQI report shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH_BANDWIDTH of the HE sounding NDP. An HE beamformee that receives an HE NDP Announcement frame as part of an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or MU feedback shall generate an HE compressed beamforming/CQI report using the feedback type, Ng and codebook size indicated in the STA Info field. If the HE beamformee then receives a BFRP Trigger frame with a User Info field addressed to it, the HE beamformee transmits an HE TB PPDU containing the HE compressed beamforming/CQI report following the rules defined in 26.5.3.3 (Non-AP STA behavior for UL MU operation).”); Section 26.5.3 (UL MU operation) (“UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP HE STAs”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter provides training for NSTS space-time streams (spatial mapper inputs) used for the transmission of the PSDU. In an HE MU PPDU, the transmitter provides training for NSTS,r,total space-time streams used for the transmission of the PSDU(s) in the r-th RU. In an HE TB PPDU, the transmitter of user u in the r-th RU provides training for NSTS,r,u space-time streams used for the transmission of the PSDU. For each tone in the r-th RU, the MIMO channel that can be estimated is an NRX x NSTS,r,total matrix. An HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix PHE-LTF, to enable channel estimation at the receiver…. In an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF type and GI duration is indicated in the Trigger frame that triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”); Section 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1},\ldots,Q_{k,N_{user,r-1}}]$ can be detected by the beamformer using the beamforming feedback for subcarrier k from beamformee u, where u = $0,1,\ldots N_{user,r-1}$. The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL MU-MIMO data transmission. For SU-MIMO beamforming, the steering matrix Q_k can be determined from the beamforming feedback matrix V_k that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.65 (HE Compressed Beamforming Report field."). *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.

29. Defendants also have been and are now knowingly and intentionally inducing infringement of at least claim 8 of the ’235 Patent in violation of 35 U.S.C. § 271(b). Through at least the filing and service of this Complaint, Defendants have had knowledge of the ’235 Patent and the infringing nature of the ’235 Accused Products.

30. Despite this knowledge of the ’235 Patent, Defendants continue to actively encourage and instruct their 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, Defendants’ websites provided, and continues to provide, instructions for using the ’235 Accused Products on wireless communications systems, to utilize their 802.11ac and/or 802.11ax beamforming and/or MIMO or MU-MIMO functionalities. Defendants do so knowing and intending that its customers and end users will commit these infringing acts. Defendants 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 their customers to infringe the ’235 Patent through the customers’ normal and customary use of the ’235 Accused Products. Defendants also know or were willfully blind that their actions

would induce direct infringement by others and intended that its actions would induce direct infringement by others. Accordingly, a reasonable inference is that Defendants 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 Defendants had knowledge of the '235 Patent and actively induced others (*e.g.,* its customers) to directly infringe the '235 Patent.

31. Defendants also contributorily infringe 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.

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

33. Defendants also infringe 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 8.

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

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

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

37. Defendants' 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 '235 patent;

b. A permanent injunction prohibiting Defendants from further acts of infringement of the '235 patent;

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

d. A judgment and order requiring Defendants 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 Defendants' 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 Defendants, 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 22, 2021

Respectfully submitted,

/s/ Reza Mirzaie

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