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dba VIVATO TECHNOLOGIES

UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

XR COMMUNICATIONS, LLC, dba VIVATO TECHNOLOGIES, *Plaintiff*, *v.* ASUS COMPUTER INTERNATIONAL and ASUSTeK COMPUTER INC., *Defendants.*	Case No. 2:17-cv-2948-AG(JCGx) **AMENDED COMPLAINT FOR PATENT INFRINGEMENT**

I. JURISDICTION AND VENUE

1. This is an action for patent infringement. This Court has subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a) because this action arises under the patent laws of the United States, 35 U.S.C. §§ 101 *et seq*.

II. THE PARTIES

2. Plaintiff XR Communications LLC d/b/a Vivato Technologies ("Vivato" or "Plaintiff") is a limited liability company organized and existing under the laws of Delaware with its principal place of business at 444 S. Cedros Ave., Solana Beach, CA 92075.

3. ASUS Computer International ("ASUS US") is a corporation organized and existing under the laws of California with its principal place of business at 800 Corporate Way, Fremont, CA 94539, with a registered agent for service of process at CT Corporation System, 818 W 7th St. Ste. 930, Los Angeles, CA 90017.

4. ASUSTeK Computer Inc. ("ASUS Taiwan") is a Taiwanese corporation with its principal place of business at 15 Li-Teh Road, Beitou District, Taipei, Taiwan. On information and belief, ASUS Taiwan does substantial business on an ongoing basis, on its own behalf and for its majority-owned subsidiary ASUS US, in the United States, including in this state and in this district, through its wholly-owned subsidiary, ASUS US. On information and belief, ASUS US is ASUS Taiwan's alter ego and exclusive sales and marketing agent in California and North America. ASUS US and ASUS Taiwan are collectively referred to as "Defendant."

5. This Court has personal jurisdiction over ASUS US because ASUS US is incorporated under California law and has its principal place of business in California.

6. This Court has personal jurisdiction over ASUS Taiwan because such jurisdiction would not offend traditional notions of fair play and substantial justice.

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ASUS Taiwan, directly and through subsidiaries or intermediaries (including ASUS US, distributors, retailers, and others), has committed and continues to commit acts of infringement in this District by, among other things, making, using, importing, offering for sale, and/or selling products that infringe the asserted patent, and inducing others to infringe the asserted patent.

7. Venue is proper in this federal district pursuant to 28 U.S.C. §§ 1391(b)-(d) and 1400(b) in that ASUS US resides in this District, has its principal place of business in this District, and has regular and established places of business in this District; and both ASUS US and ASUS Taiwan have done business in this District, have committed acts of infringement in this District, and continue to commit acts of infringement in this District, entitling Plaintiff to relief.

III. BACKGROUND OF THE TECHNOLOGY

8. 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. Wi-Fi/802.11 has become the ubiquitous wireless connection to the Internet and is now 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.

9. Over the years, Vivato has developed proven technology, with over 400 deployments globally, including private, public and government, and 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.

10. Vivato’s patent portfolio includes over 17 issued patents and pending patent applications. The patents-in-suit are directed to specific aspects of wireless

communication including adaptively steered antenna technology and beam switching technology.

IV. COUNT ONE: INFRINGEMENT OF UNITED STATES PATENT NO. 7,062,296

11. On June 13, 2006, United States Patent No. 7,062,296 ("the '296 Patent") was duly and legally issued for inventions entitled "Forced Beam Switching in Wireless Communication Systems Having Smart Antennas." Vivato owns the '296 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the '296 Patent is attached hereto as Exhibit A.

12. Defendant has directly infringed and continues to directly infringe numerous claims of the '296 Patent, including at least claim 33, by manufacturing, using, selling, offering to sell, and/or importing into the United States WiFi access points and routers supporting MU-MIMO, including without limitation access points and routers utilizing the IEEE 802.11ac-2013 standard (e.g., Defendant's RT-ACRH13 AC1300 Dual-Band Gigabit Wi-Fi Router, RT-AC87U Dual-band 4x4 AC2400 Wifi 4-Port Gigabit Router with AiProtection Powered by Trend Micro, RT-AC88U AC3100 Dual-Band Wi-Fi Gigabit Router, RT-AC3100 Dual-Band 4x4 AC3100 Wifi 4-Port Gigabit Gaming Router with AiProtection Powered by Trend Micro, RT-AC3100 AC3100 Dual-Band Wi-Fi Router with Double Gaming Boost and MU-MIMO, RT-AC5300 Tri-Band 4x4 AC5300 Wi-Fi 4-Port Gigabit Gaming Router With AiProtection Powered by Trend Micro, RT-AC5300 AC5300 Tri-Band Wi-Fi Gigabit Router – For Gamers, ROG Rapture GT-AC5300 Tri-Band Gaming Router, BRT-AC828 AC2600 Dual-WAN VPN Wi-Fi Router, CM-32 AC2600 DOCSIS 3.0 Cable Modem Router, CM-32 AC2600 ASUS CM-32 Cable Modem Wifi Router, RT-AC86U AC2900 Dual-Band Gigabit Wi-Fi Router with MU-MIMO, RT-AC58U AC1300 Dual-Band Wi-Fi Router with MU-MIMO and Parental Controls, and EA-AC87 5 GHz Wireless-AC 1800 Media Bridge/ Access Point) (collectively the "Accused Products"). Defendant is liable

for infringement of the '296 Patent pursuant to 35 U.S.C. § 271(a).

13. Each of the Accused Products comprises an apparatus for use in a wireless communication system. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is an apparatus for use in a wireless communication system.

14. Each of the Accused Products comprises at least one smart antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router has at least one smart antenna.

15. Each of the Accused Products comprises at least one transceiver operatively coupled to said smart antenna and configured to send and receive electromagnetic signals using said smart antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router has a Broadcom BCM4366 WiFi radio coupled to the smart antenna to send and receive signals. *See, e.g.*, IEEE 802.11ac-2013 ("802.11ac Standard") Clauses 22.3.4.5(j), 22.3.4.6(g), 22.3.4.7(h), 22.3.4.8(p), 22.3.4.9.1(q), 22.3.4.9.2(q), 22.3.4.10.4(e) ("Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit."); *id.* Clauses 22.3.7.4, 22.3.8; *id.* Clause 22.3.3 and Figure 22-7:

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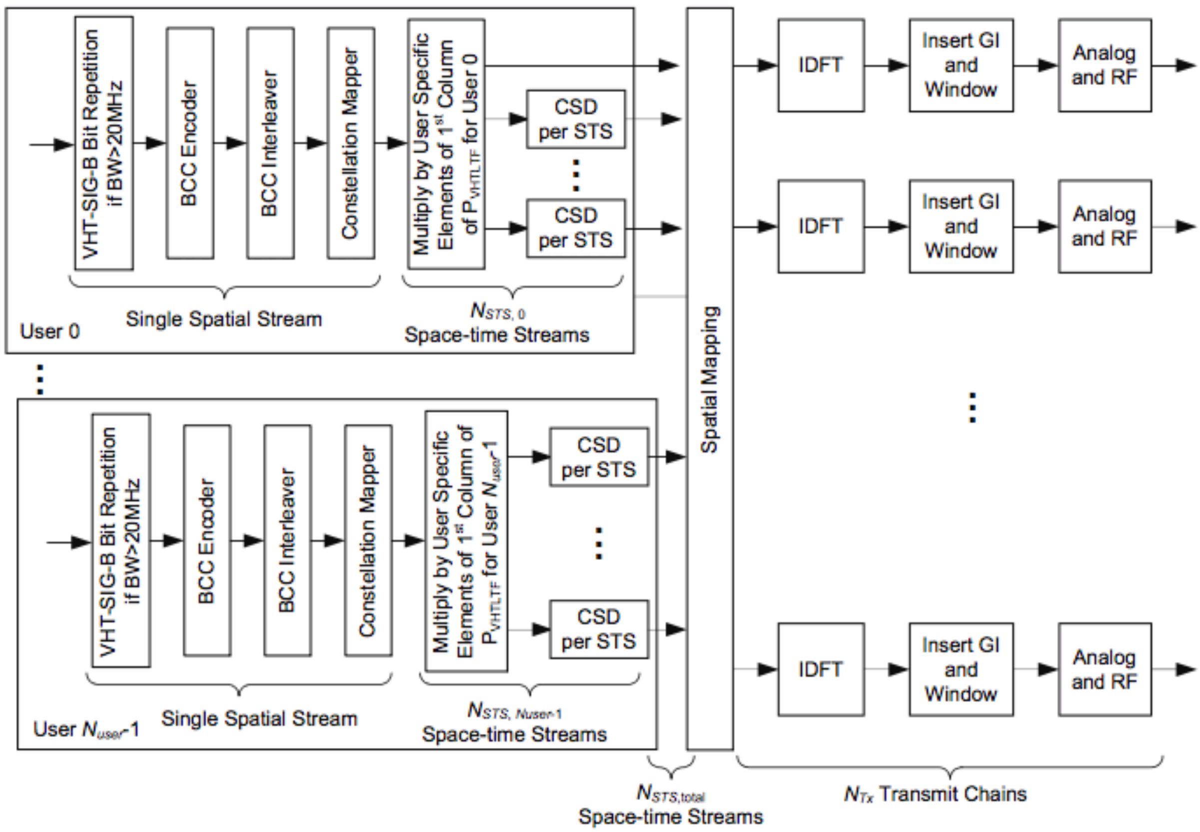

Figure 22-7—Transmitter block diagram for the VHT-SIG-B field of a 20 MHz, 40 MHz, and 80 MHz VHT MU PPDU

16. Each of the Accused Products comprises logic operatively coupled to said transceiver and configured to selectively allow a second device to operatively associate with a beam downlink transmittable to said second device using said smart antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router allows a client device to operatively associate with a beam downlink transmittable to that client device using the smart antenna. *See, e.g.*, 802.11ac Standard Clause 8.5.23.3 ("The Group ID Management frame is an Action frame of category VHT. It is transmitted by the AP to assign or change the user position of a STA for one or more group IDs. The Action field of a Group ID Management frame contains the information shown in Table 8-281aj"); *id.* Clause 8.4.1.51 ("The Membership Status Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 8 octets. An 8 octet Membership Status Array field (indexed by the group ID) consists of a 1-bit Membership Status

subfield for each of the 64 group IDs, as shown in Figure 8-80f. * * * Within the 8 octet Membership Status Array field, the 1-bit Membership Status subfield for each group ID is set as follows: — Set to 0 if the STA is not a member of the group — Set to 1 if STA is a member of the group The Membership Status subfields for group ID 0 (transmissions to AP) and group ID 63 (downlink SU transmissions) are reserved."); *id.* Clause 8.4.1.52 ("The User Position Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 16 octets. A 16 octet User Position Array field (indexed by the Group ID) consists of a 2-bit User Position subfield for each of the 64 group IDs, as shown in Figure 8-80g. * * * If the Membership Status subfield for a particular group ID is 1, then the corresponding User Position subfield is encoded as shown in Table 8-53l."); *id.* Table 8-53*l*:

Table 8-53l—Encoding of User Position subfield

User Position subfield value	User position
00	0
01	1
10	2
11	3

Id. Clause 22.3.8.3.3 ("The VHT-SIG-A field carries information required to interpret VHT PPDUs. The structure of the VHT-SIG-A field for the first part (VHT-SIG-A1) is shown in Figure 22-18 and for the second part (VHT-SIG-A2) is shown in Figure 22-19."); *id.* Figure 22-18:

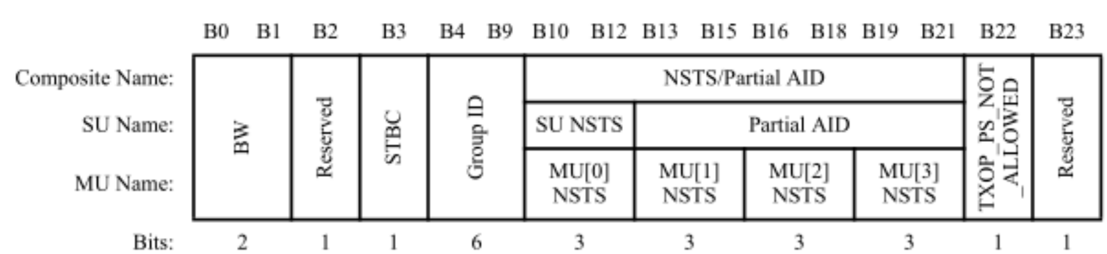

Figure 22-18—VHT-SIG-A1 structure

Id. Clause 22.3.11.4:

When a STA receives a VHT MU PPDU where the Group ID field in VHT-SIG-A has the value *k* and where MembershipStatusInGroupID[*k*] is equal to 1, then the number of space-time streams for that STA is indicated in the MU[UserPositionInGroupID[*k*]] NSTS field in VHT-SIG-A. The space-time streams of different users are ordered in accordance to user position values, i.e., the space-time streams for the user in user position 0 come first, followed by the space-time streams for the user in position 1, followed by the space-time streams for the user in position 2, and followed by the space-time streams for the user in position 3.

A STA is also able to identify the space-time streams intended for other STAs that act as interference. VHT-LTF symbols in the VHT MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, the STA may use the channel state information for all space-time streams to reduce the effect of interfering space-time streams.

Id. 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.* 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.* Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *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.* Clauses 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

17. Each of the Accused Products comprises logic configured to determine information from at least one uplink transmission receivable from said second device through said smart antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router determines information from a VHT Compressed Beamforming frame received from a client device through its smart antenna. *See, e.g.*, 802.11ac Standard Clauses 8.4.1.24, 8.4.1.49, 8.5.23.2, 9.31.5.1, 9.31.5.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

18. Each of the Accused Products comprises logic configured to determine if said associated second device should operatively associate with a different beam downlink transmittable using said smart antenna based on said determined information. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router determines, based on the information received in a VHT Compressed Beamforming frame, if the client device should operatively associate with a different beam downlink transmittable using the smart antenna. *See, e.g.*, 802.11ac Standard Clauses 8.4.1.24, 8.4.1.49, 8.5.23.2, 9.31.5.1, 9.31.5.2; *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.

RUSS, AUGUST & KABAT

19. Each of the Accused Products comprises logic configured to allow said second device to operatively associate with said different beam if said associated second device should operatively associate with a different beam and selectively identify that said second device is not allowed to operatively associate with said beam. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router allows a client device to operatively associate with a beam that is different from the beam with which the client was associated previously, and to identify that the client device is not allowed to operatively associate with the prior beam. *See, e.g.*, 802.11ac Standard Clause 10.40 ("An AP determines the possible combinations of STAs that can be addressed by a VHT MU PPDU by assigning STAs to groups and to specific user positions within those groups. Assignments or changes of user positions corresponding to one or more Group IDs shall be performed using a Group ID Management frame defined in 8.5.23.3…A VHT MU PPDU shall be transmitted to a STA based on the content of the Group ID Management frame most recently transmitted to the STA and for which an acknowledgement was received."); *id.* Clause 8.5.23.3 ("The Group ID Management frame is an Action frame of category VHT. It is transmitted by the AP to assign or change the user position of a STA for one or more group IDs. The Action field of a Group ID Management frame contains the information shown in Table 8-281aj"); *id.* Clause 8.4.1.51 ("The Membership Status Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 8 octets. An 8 octet Membership Status Array field (indexed by the group ID) consists of a 1-bit Membership Status subfield for each of the 64 group IDs, as shown in Figure 8-80f. * * * Within the 8 octet Membership Status Array field, the 1-bit Membership Status subfield for each group ID is set as follows: — Set to 0 if the STA is not a member of the group — Set to 1 if STA is a member of the group The Membership Status subfields for group ID 0 (transmissions to AP) and group ID 63 (downlink SU transmissions) are reserved."); *id.* Clause 8.4.1.52 ("The User

Position Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 16 octets. A 16 octet User Position Array field (indexed by the Group ID) consists of a 2-bit User Position subfield for each of the 64 group IDs, as shown in Figure 8-80g. * * * If the Membership Status subfield for a particular group ID is 1, then the corresponding User Position subfield is encoded as shown in Table 8-53l."); *id.* Table 8-53*l*:

Table 8-53l—Encoding of User Position subfield

User Position subfield value	User position
00	0
01	1
10	2
11	3

Id. Clause 22.3.8.3.3 ("The VHT-SIG-A field carries information required to interpret VHT PPDUs. The structure of the VHT-SIG-A field for the first part (VHT-SIG-A1) is shown in Figure 22-18 and for the second part (VHT-SIG-A2) is shown in Figure 22-19."); *id.* Figure 22-18:

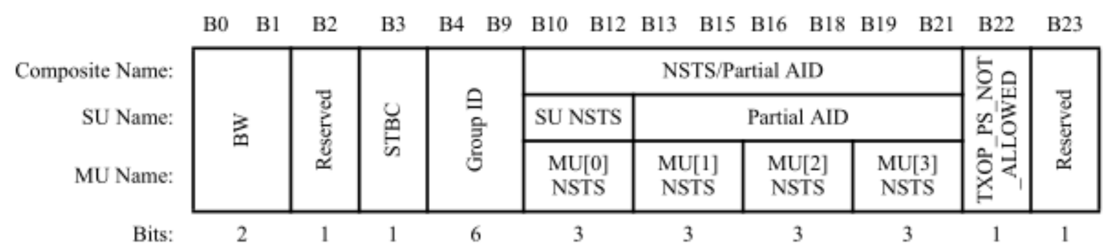

Figure 22-18—VHT-SIG-A1 structure

Id. Clause 22.3.11.4:

> When a STA receives a VHT MU PPDU where the Group ID field in VHT-SIG-A has the value *k* and where MembershipStatusInGroupID[*k*] is equal to 1, then the number of space-time streams for that STA is indicated in the MU[UserPositionInGroupID[*k*]] NSTS field in VHT-SIG-A. The space-time streams of different users are ordered in accordance to user position values, i.e., the space-time streams for the user in user position 0 come first, followed by the space-time streams for the user in position 1, followed by the space-time streams for the user in position 2, and followed by the space-time streams for the user in position 3.
>
> A STA is also able to identify the space-time streams intended for other STAs that act as interference. VHT-LTF symbols in the VHT MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, the STA may use the channel state information for all space-time streams to reduce the effect of interfering space-time streams.

Id. 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.* 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*. Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *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.* Clauses 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

20. Defendant has been and is now indirectly infringing at least one claim of the '296 Patent in accordance with 35 U.S.C. § 271(b) in this district and elsewhere in the United States. More specifically, Defendant has been and is now

RUSS, AUGUST & KABAT

actively inducing direct infringement by other persons (e.g., Defendant's customers who use, sell or offer for sale the Accused Products).

21. By at least the filing of the original Complaint on April 19, 2017, and the service of the original Complaint on ASUS US on May 3, 2017, and the waiver of service of the original Complaint by ASUS Taiwan on May 24, 2017, Defendant had knowledge of the '296 Patent, and that its actions resulted in a direct infringement of the '296 Patent. 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.

22. Defendant actively induced, and continues to induce, such infringement by, among other things, providing user manuals and other instruction material for its Accused Products that induce its customers to use the Accused Products in their normal and customary way to infringe the '296 Patent. For example, Defendant's website provided, and continues to provide, instructions for using the Accused Products on wireless communication systems, and to utilize their beamforming and MU-MIMO functionalities. Defendant sold, and continues to sell, the Accused Products to customers despite its knowledge of the '296 Patent. Defendant manufactured and imported into the United States, and continues to do so, the Accused Products for sale and distribution to its customers, despite its knowledge of the '296 Patent. Through its continued manufacture, importation, and sales of its Accused Products, Defendant specifically intended for its customers to infringe claims of the '296 Patent. Further, Defendant was aware that these normal and customary activities would infringe the '296 Patent. Defendant performed, and continues to perform, acts that constitute induced infringement, and that would induce actual infringement, with knowledge of the '296 Patent and with the knowledge or willful blindness that the induced acts would constitute direct infringement.

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23. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of the ’296 Patent in the United States because Defendant had knowledge of the ’296 Patent and actively induced others (e.g., its customers) to directly infringe the ’296 Patent by using, selling, or offering to sell the Accused Products and the MU-MIMO functionality within the Accused Products.

24. Defendant also infringes other claims of the ’296 Patent, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 33.

25. The ’296 Patent is valid and enforceable.

26. Defendant’s infringement of the ’296 Patent has damaged Vivato, and Defendant is liable to Vivato in an amount to be determined at trial that compensates Vivato for the infringement, which by law can be no less than a reasonable royalty.

27. As a result of Defendant’s infringement of the ’296 Patent, Vivato has suffered irreparable harm and will continue to suffer loss and injury.

V. COUNT TWO: INFRINGEMENT OF UNITED STATES PATENT NO. 7,729,728

28. On June 1, 2010, United States Patent No. 7,729,728 (“the ’728 Patent”) was duly and legally issued for inventions entitled “Forced Beam Switching in Wireless Communication Systems Having Smart Antennas.” Vivato owns the ’728 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the ’728 Patent is attached hereto as Exhibit B.

29. Defendant has directly infringed and continues to directly infringe numerous claims of the ’728 Patent, including at least claim 16, by manufacturing, using, selling, offering to sell, and/or importing into the United States the Accused Products. Defendant is liable for infringement of the ’728 Patent pursuant to 35 U.S.C. § 271(a).

RUSS, AUGUST & KABAT

30. Each of the Accused Products comprises a wireless communication system. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is a wireless access point for use in a Wi-Fi network.

31. Each of the Accused Products comprises a phased array antenna configured to transmit beam downlinks. *See, e.g.*: 802.11ac Standard Clause 8.4.2.58.6, Table 8-128.

32. Each of the Accused Products comprises a transceiver operatively coupled to the phased array antenna and configured to send and receive electromagnetic signals via the phased array antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router has a Broadcom BCM4366 WiFi radio that is configured to send and receive electromagnetic signals via the phased array antenna. *See, e.g.*, 802.11ac Standard Clauses 22.3.4.5(j), 22.3.4.6(g), 22.3.4.7(h), 22.3.4.8(p), 22.3.4.9.1(q), 22.3.4.9.2(q), 22.3.4.10.4(e) ("Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit."); *id.* Clauses 22.3.7.4, 22.3.8; *id.* Clause 22.3.3 and Figure 22-7:

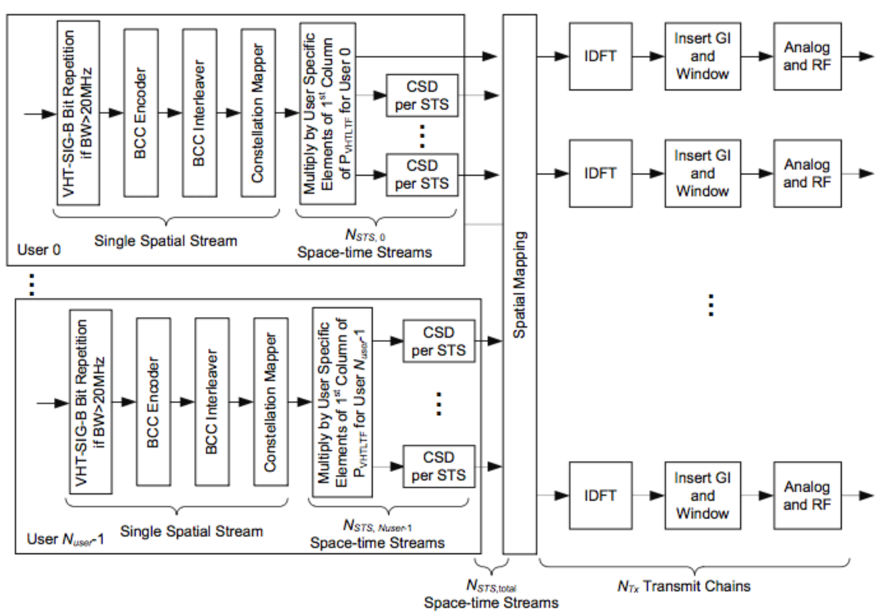

Figure 22-7—Transmitter block diagram for the VHT-SIG-B field of a 20 MHz, 40 MHz, and 80 MHz VHT MU PPDU

33. Each of the Accused Products comprises an access point that includes the phased array antenna and the transceiver. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router comprises an access point that includes a phased antenna array and a Broadcom BCM4366 WiFi radio.

34. Each of the Accused Products comprises an access point that includes the phased array antenna and the transceiver that is configured to selectively allow a receiving device to operatively associate with a beam downlink transmitted to the receiving device via the phased array antenna. *See, e.g.*, 802.11ac Standard Clause 8.5.23.3 ("The Group ID Management frame is an Action frame of category VHT. It is transmitted by the AP to assign or change the user position of a STA for one or more group IDs. The Action field of a Group ID Management frame contains the information shown in Table 8-281aj"); *id.* Clause 8.4.1.51 ("The Membership Status Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 8 octets. An 8 octet Membership Status Array field (indexed by the group ID) consists of a 1-bit Membership Status subfield for each of the 64 group IDs, as shown in Figure 8-80f. * * * Within the 8 octet Membership Status Array field, the 1-bit Membership Status subfield for each group ID is set as follows: — Set to 0 if the STA is not a member of the group — Set to 1 if STA is a member of the group The Membership Status subfields for group ID 0 (transmissions to AP) and group ID 63 (downlink SU transmissions) are reserved."); *id.* Clause 8.4.1.52 ("The User Position Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 16 octets. A 16 octet User Position Array field (indexed by the Group ID) consists of a 2-bit User Position subfield for each of the 64 group IDs, as shown in Figure 8-80g. * * * If the Membership Status subfield for a particular group ID is 1, then the corresponding User Position subfield is encoded as shown in Table 8-53l."); *id.* Table 8-53*l*:

/ / /

Table 8-53l—Encoding of User Position subfield

User Position subfield value	User position
00	0
01	1
10	2
11	3

Id. Clause 22.3.8.3.3 ("The VHT-SIG-A field carries information required to interpret VHT PPDUs. The structure of the VHT-SIG-A field for the first part (VHT-SIG-A1) is shown in Figure 22-18 and for the second part (VHT-SIG-A2) is shown in Figure 22-19."); *id.* Figure 22-18:

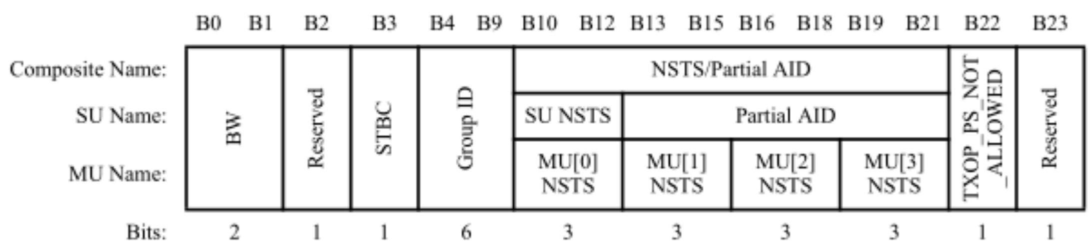

Figure 22-18—VHT-SIG-A1 structure

Id. Clause 22.3.11.4:

When a STA receives a VHT MU PPDU where the Group ID field in VHT-SIG-A has the value *k* and where MembershipStatusInGroupID[*k*] is equal to 1, then the number of space-time streams for that STA is indicated in the MU[UserPositionInGroupID[*k*]] NSTS field in VHT-SIG-A. The space-time streams of different users are ordered in accordance to user position values, i.e., the space-time streams for the user in user position 0 come first, followed by the space-time streams for the user in position 1, followed by the space-time streams for the user in position 2, and followed by the space-time streams for the user in position 3.

A STA is also able to identify the space-time streams intended for other STAs that act as interference. VHT-LTF symbols in the VHT MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, the STA may use the channel state information for all space-time streams to reduce the effect of interfering space-time streams.

Id. 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.* 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.* Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *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.* Clauses 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

35. Each of the Accused Products comprises an access point that includes the phased array antenna and the transceiver that is configured to receive an uplink transmission from the receiving device through the phased array antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is configured to receive a VHT Compressed Beamforming Feedback frame from a "receiving device" such as a connected laptop or smartphone through its phased-array antenna. *See, e.g.*, 802.11ac Standard Clauses 8.4.1.24, 8.4.1.49, 8.5.23.2, 9.31.5.1, 9.31.5.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

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36. Each of the Accused Products comprises an access point that includes the phased array antenna and the transceiver that is configured to determine from the uplink transmission if the receiving device should operatively associate with a different beam downlink transmission. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is configured to determine from information contained in the VHT Compressed Beamforming Feedback frame if the receiving device that sent the VHT Compressed Beamforming Feedback frame should operatively associate with a different beam downlink transmission. *See, e.g.*, 802.11ac Standard Clauses 3.2, 8.4.1.24, 8.4.1.49, 8.5.23.2, 9.31.5, 9.31.5.1, 9.31.5.2; *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.

37. Each of the Accused Products comprises an access point that includes the phased array antenna and the transceiver that is configured to at least one of: (i) allow the receiving device to operatively associate with the different beam downlink if determined that the receiving device should operatively associate with the different beam downlink; (ii) force the receiving device to operatively associate with the different beam downlink if determined that the receiving device should be operatively associated with the different beam downlink. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is configured to transmit a Group ID Management frame or VHT MU PPDU VHT-SIG-A or combination

thereof to allow the receiving device to operatively associate with the different beam downlink if determined that the receiving device should operatively associate with the different beam downlink; (ii) force the receiving device to operatively associate with the different beam downlink if determined that the receiving device should be operatively associated with the different beam downlink. *See, e.g.*, 802.11ac Standard Clause 10.40 ("An AP determines the possible combinations of STAs that can be addressed by a VHT MU PPDU by assigning STAs to groups and to specific user positions within those groups. Assignments or changes of user positions corresponding to one or more Group IDs shall be performed using a Group ID Management frame defined in 8.5.23.3…A VHT MU PPDU shall be transmitted to a STA based on the content of the Group ID Management frame most recently transmitted to the STA and for which an acknowledgement was received."); *id*. Clause 8.5.23.3 ("The Group ID Management frame is an Action frame of category VHT. It is transmitted by the AP to assign or change the user position of a STA for one or more group IDs. The Action field of a Group ID Management frame contains the information shown in Table 8-281aj"); *id.* Clause 8.4.1.51 ("The Membership Status Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 8 octets. An 8 octet Membership Status Array field (indexed by the group ID) consists of a 1-bit Membership Status subfield for each of the 64 group IDs, as shown in Figure 8-80f. * * * Within the 8 octet Membership Status Array field, the 1-bit Membership Status subfield for each group ID is set as follows: — Set to 0 if the STA is not a member of the group — Set to 1 if STA is a member of the group The Membership Status subfields for group ID 0 (transmissions to AP) and group ID 63 (downlink SU transmissions) are reserved."); *id.* Clause 8.4.1.52 ("The User Position Array field is used in the Group ID Management frame (see 8.5.23.3). The length of the field is 16 octets. A 16 octet User Position Array field (indexed by the Group ID) consists of a 2-bit User Position subfield for each of the 64 group IDs, as shown in

Figure 8-80g. * * * If the Membership Status subfield for a particular group ID is 1, then the corresponding User Position subfield is encoded as shown in Table 8-53l."); *id.* Table 8-53*l*:

Table 8-53l—Encoding of User Position subfield

User Position subfield value	User position
00	0
01	1
10	2
11	3

Id. Clause 22.3.8.3.3 ("The VHT-SIG-A field carries information required to interpret VHT PPDUs. The structure of the VHT-SIG-A field for the first part (VHT-SIG-A1) is shown in Figure 22-18 and for the second part (VHT-SIG-A2) is shown in Figure 22-19."); *id.* Figure 22-18:

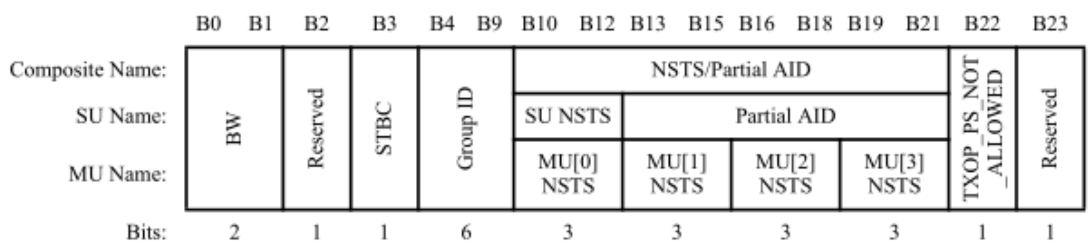

Figure 22-18—VHT-SIG-A1 structure

Id. Clause 22.3.11.4:

When a STA receives a VHT MU PPDU where the Group ID field in VHT-SIG-A has the value *k* and where MembershipStatusInGroupID[*k*] is equal to 1, then the number of space-time streams for that STA is indicated in the MU[UserPositionInGroupID[*k*]] NSTS field in VHT-SIG-A. The space-time streams of different users are ordered in accordance to user position values, i.e., the space-time streams for the user in user position 0 come first, followed by the space-time streams for the user in position 1, followed by the space-time streams for the user in position 2, and followed by the space-time streams for the user in position 3.

A STA is also able to identify the space-time streams intended for other STAs that act as interference. VHT-LTF symbols in the VHT MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, the STA may use the channel state information for all space-time streams to reduce the effect of interfering space-time streams.

Id. 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.* 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.* Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *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.* Clauses 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

38. Each of the Accused Products comprises an access point that includes the phased array antenna and the transceiver that is configured to actively probe the receiving device by generating a signal to initiate that the phased array antenna transmit at least one downlink transmittable message over the beam downlinks, and gather signal parameter information from uplink transmittable messages

received from the receiving device through the phased array antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is configured to actively probe the receiving device by generating a signal to initiate that the phased array antenna transmit a signal, e.g. a VHT null data packet announcement frame over the beam downlinks, and to gather signal parameter information from uplink transmittable messages received from the receiving device through the phased array antenna, e.g. one or more VHT Compressed Beamforming Feedback frames. *See, e.g.,* 802.11ac Standard Clause 9.31.5, 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 8.4.1.24; IEEE 802.11-2012 Clause 20.3.12.3.6; 802.11ac Standard 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.

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39. Defendant has been and is now indirectly infringing at least one claim of the ’728 Patent in accordance with 35 U.S.C. § 271(b) in this district and elsewhere in the United States. More specifically, Defendant has been and is now actively inducing direct infringement by other persons (e.g., Defendant’s customers who use, sell or offer for sale the Accused Products).

40. Defendant had knowledge of Vivato’s ’728 Patent by at least the citation of the application that led to the ’728 Patent, during the prosecution of Defendant’s U.S. Patent Application No. 12/138,449, “Method for setting smart antenna and system thereof.” On December 22, 2010, during prosecution of Defendant’s U.S. Patent Application No. 12/138,449, the USPTO examiner cited U.S. Patent Application Publication No. 2006/0238400A1 to Brennan, which is the application that led to Vivato’s ’728 Patent. Vivato’s ’728 Patent, however, had already issued on June 1, 2010. Accordingly, a reasonable inference is that Defendant had knowledge of the ’728 Patent, and its issued claims, by at least as early as December 22, 2010. Further, by at least the filing of the original Complaint on April 19, 2017, and the service of the original Complaint on ASUS US on May 3, 2017, and the waiver of service of the original Complaint by ASUS Taiwan on May 24, 2017, Defendant had knowledge of the ’728 Patent.

41. Based on this knowledge of Vivato’s ’728 Patent, Defendant also knew that its actions resulted in a direct infringement of the ’728 Patent. 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.

42. Defendant actively induced, and continues to induce, such infringement by, among other things, providing user manuals and other instruction material for its Accused Products that induce its customers to use the Accused Products in their normal and customary way to infringe the ’728 Patent. For example, Defendant’s website provided, and continues to provide, instructions for using the Accused Products on wireless communication systems, and to utilize

their beamforming and MU-MIMO functionalities. Defendant sold, and continues to sell, the Accused Products to customers despite its knowledge of the ’728 Patent. Defendant manufactured and imported into the United States, and continues to do so, the Accused Products for sale and distribution to its customers, despite its knowledge of the ’728 Patent. Through its continued manufacture, importation, and sales of its Accused Products, Defendant specifically intended for its customers to infringe claims of the ’728 Patent. Further, Defendant was aware that these normal and customary activities would infringe the ’728 Patent. Defendant performed, and continues to perform, acts that constitute induced infringement, and that would induce actual infringement, with knowledge of the ’728 Patent and with the knowledge or willful blindness that the induced acts would constitute direct infringement.

43. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of the ’728 Patent in the United States because Defendant had knowledge of the ’728 Patent and actively induced others (e.g., its customers) to directly infringe the ’728 Patent by using, selling, or offering to sell the Accused Products and the MU-MIMO functionality within the Accused Products.

44. Defendant also infringes other claims of the ’728 Patent, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 16.

45. The ’728 Patent is valid and enforceable.

46. Defendant’s infringement of the ’728 Patent has damaged Vivato, and Defendant is liable to Vivato in an amount to be determined at trial that compensates Vivato for the infringement, which by law can be no less than a reasonable royalty.

47. As a result of Defendant’s infringement of the ’728 Patent, Vivato has suffered irreparable harm and will continue to suffer loss and injury.

VI. COUNT THREE: INFRINGEMENT OF UNITED STATES PATENT NO. 6,611,231

48. On August 26, 2003, United States Patent No. 6,611,231 ("the '231 Patent") was duly and legally issued for inventions entitled "Wireless Packet Switched Communication Systems and Networks Using Adaptively Steered Antenna Arrays." Vivato owns the '231 Patent and holds the right to sue and recover damages for infringement thereof. A copy of the '231 Patent is attached hereto as Exhibit C.

49. Defendant has directly infringed and continues to directly infringe numerous claims of the '231 Patent, including at least claim 1, by manufacturing, using, selling, offering to sell, and/or importing into the United States the Accused Products. Defendant is liable for infringement of the '231 Patent pursuant to 35 U.S.C. § 271(a).

50. Each of the Accused Products comprises an apparatus for use in a wireless routing network. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is an apparatus for use in a wireless routing network.

51. Each of the Accused Products comprises an adaptive antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router has at least one adaptive antenna. *See, e.g.*: 802.11ac Standard Clause 8.4.2.58.6, Table 8-128:

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RUSS, AUGUST & KABAT

8.4.2.58.6 Transmit Beamforming Capabilities

Change the following rows in Table 8-128:

Table 8-128—Subfields of the Transmit Beamforming Capabilities field

Subfield	Definition	Encoding
CSI Number of Beamformer Antennas Supported	Indicates the maximum number of beamformer antennas the HT beamformee can support when CSI feedback is required	Set to 0 for single Tx antenna sounding Set to 1 for 2 Tx antenna sounding Set to 2 for 3 Tx antenna sounding Set to 3 for 4 Tx antenna sounding
Noncompressed Steering Number of Beamformer Antennas Supported	Indicates the maximum number of beamformer antennas the HT beamformee can support when noncompressed beamforming feedback matrix is required	Set to 0 for single Tx antenna sounding Set to 1 for 2 Tx antenna sounding Set to 2 for 3 Tx antenna sounding Set to 3 for 4 Tx antenna sounding
Compressed Steering Number of Beamformer Antennas Supported	Indicates the maximum number of beamformer antennas the HT beamformee can support when compressed beamforming feedback matrix is required	Set to 0 for single Tx antenna sounding Set to 1 for 2 Tx antenna sounding Set to 2 for 3 Tx antenna sounding Set to 3 for 4 Tx antenna sounding
CSI Max Number of Rows Beamformer Supported	Indicates the maximum number of rows of CSI explicit feedback from the HT beamformee or calibration responder or transmit ASEL responder that an HT beamformer or calibration initiator or transmit ASEL initiator can support when CSI feedback is required.	Set to 0 for a single row of CSI Set to 1 for 2 rows of CSI Set to 2 for 3 rows of CSI Set to 3 for 4 rows of CSI

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52. Each of the Accused Products comprises at least one transmitter operatively coupled to said adaptive antenna and at least one receiver operatively coupled to said adaptive antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router has a Broadcom BCM4366 WiFi radio operatively coupled to the adaptive antenna. *See, e.g.*, 802.11ac Standard Clauses 22.3.4.5(j), 22.3.4.6(g), 22.3.4.7(h), 22.3.4.8(p), 22.3.4.9.1(q), 22.3.4.9.2(q), 22.3.4.10.4(e) ("Analog and RF: Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit."); *id.* Clauses 22.3.7.4, 22.3.8; *id.* Clause 22.3.3 and Figure 22-7:

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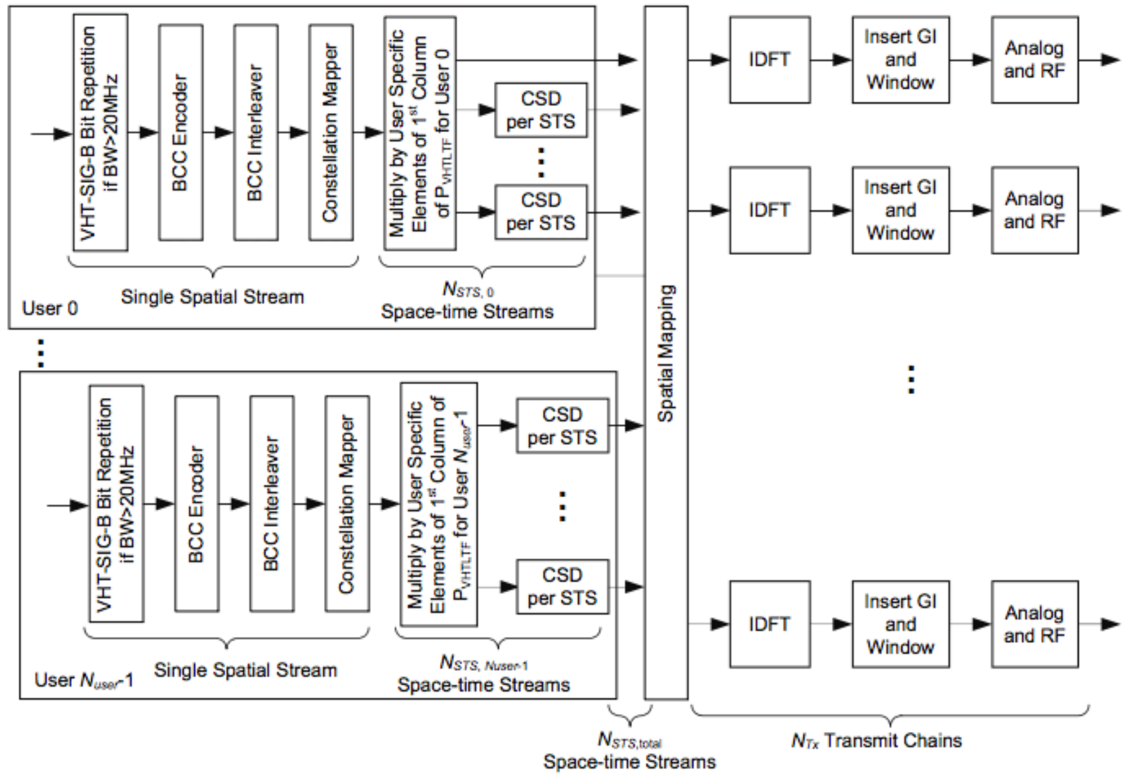

Figure 22-7—Transmitter block diagram for the VHT-SIG-B field of a 20 MHz, 40 MHz, and 80 MHz VHT MU PPDU

53. Each of the Accused Products comprises a control logic operatively coupled to said transmitter and configured to cause said at least one transmitter to output at least one transmission signal to said adaptive antenna to transmit corresponding outgoing multi-beam electromagnetic signals exhibiting a plurality of selectively placed transmission peaks and transmission nulls within a far field region of a coverage area based on routing information. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is configured to output at least one transmission signal to said adaptive antenna. For a further example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is configured to cause said at least one transmitter to output at least one transmission signal to said adaptive antenna to transmit corresponding outgoing multi-beam electromagnetic signals exhibiting a plurality of selectively placed transmission peaks and transmission nulls within a far field region of a coverage area based on routing information. *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, $\phi(k,\upsilon)$ 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.

54. Each of the Accused Products comprises search receiver logic operatively coupled to said control logic and said at least one receiver and configured to update said routing information based at least in part on cross-correlated signal information that is received by said receiver using said adaptive antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router updates the routing information based at least in part on cross-correlated signal information received in a VHT Compressed Beamforming frame. *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:

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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.

55. Defendant has been and is now indirectly infringing at least one claim of the ’231 Patent in accordance with 35 U.S.C. § 271(b) in this district and elsewhere in the United States. More specifically, Defendant has been and is now actively inducing direct infringement by other persons (e.g., Defendant’s customers who use, sell or offer for sale the Accused Products).

56. By at least the filing of the original Complaint on April 19, 2017, and the service of the original Complaint on ASUS US on May 3, 2017, and the waiver of service of the original Complaint by ASUS Taiwan on May 24, 2017, Defendant had knowledge of the ’231 Patent, and that its actions resulted in a direct infringement of the ’231 Patent. 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.

57. Defendant actively induced, and continues to induce, such infringement by, among other things, providing user manuals and other instruction material for its Accused Products that induce its customers to use the Accused Products in their normal and customary way to infringe the ’231 Patent. For example, Defendant’s website provided, and continues to provide, instructions for using the Accused Products on wireless communication systems, and to utilize their beamforming and MU-MIMO functionalities. Defendant sold, and continues

to sell, the Accused Products to customers despite its knowledge of the ’231 Patent. Defendant manufactured and imported into the United States, and continues to do so, the Accused Products for sale and distribution to its customers, despite its knowledge of the ’231 Patent. Through its continued manufacture, importation, and sales of its Accused Products, Defendant specifically intended for its customers to infringe claims of the ’231 Patent. Further, Defendant was aware that these normal and customary activities would infringe the ’231 Patent. Defendant performed, and continues to perform, acts that constitute induced infringement, and that would induce actual infringement, with knowledge of the ’231 Patent and with the knowledge or willful blindness that the induced acts would constitute direct infringement.

58. Accordingly, a reasonable inference is that Defendant specifically intended for others, such as its customers, to directly infringe one or more claims of the ’231 Patent in the United States because Defendant had knowledge of the ’231 Patent and actively induced others (e.g., its customers) to directly infringe the ’231 Patent by using, selling, or offering to sell the Accused Products and the MU-MIMO functionality within the Accused Products.

59. Defendant also infringes other claims of the ’231 Patent, directly and through inducing infringement, for similar reasons as explained above with respect to Claim 1.

60. The ’231 Patent is valid and enforceable.

61. Defendant’s infringement of the ’231 Patent has damaged Vivato, and Defendant is liable to Vivato in an amount to be determined at trial that compensates Vivato for the infringement, which by law can be no less than a reasonable royalty.

62. As a result of Defendant’s infringement of the ’231 Patent, Vivato has suffered irreparable harm and will continue to suffer loss and injury.

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VII. WILLFUL INFRINGEMENT

63. Defendant had knowledge of Vivato's '728 Patent by at least the citation of the application that led to the '728 Patent, during the prosecution of Defendant's U.S. Patent Application No. 12/138,449 ("'449 Application"), titled "Method for setting smart antenna and system thereof." U.S. Patent Application Publication No. 2008/0309555A1 ("'555 Publication"), attached hereto as Exhibit D, is the publication of Defendant's '449 Application. Defendant's '449 Application concerns "a method for setting a smart antenna," where "[t]he pattern of the smart antenna is set to be the optimal antenna configuration dynamically to improve the communication quality and reduce the multi-path fading or interference caused by other communication equipment" in order to "maintain a high transmission rate." ('449 Application ¶ 0006). Like the '449 Application, the '728 Patent teaches the use of smart antennas and methods of controlling smart antennas to improve communication quality and transmission rates. The Accused Products also use smart antennas and employ software and/or hardware that controls smart antennas to improve communication quality and transmission rates.

64. On December 22, 2010, during prosecution of Defendant's '449 Application, the USPTO examiner cited U.S. Patent Application Publication No. 2006/0238400A1 to Brennan, which is the application that led to Vivato's '728 Patent. Vivato's '728 Patent, however, had already issued on June 1, 2010. Accordingly, a reasonable inference is that Defendant had knowledge of the '728 Patent, and its issued claims, by at least as early as December 22, 2010. Further, by at least the filing of the original Complaint on April 19, 2017, and the service of the original Complaint on ASUS US on May 3, 2017, and the waiver of service of the original Complaint by ASUS Taiwan on May 24, 2017, Defendant had knowledge of the '728 Patent.

65. Despite Defendant's knowledge of the '728 Patent, Defendant infringed and continues to infringe the '728 Patent with full and complete

knowledge of the ’728 Patent’s applicability to Defendant’s MU-MIMO WiFi access point and router products without taking a license and without a good faith belief that the ’728 Patent is invalid and not infringed. Defendant’s infringement of the ’ 728 Patent occurred, and continues to occur, with knowledge of infringement and objective recklessness. Defendant’s infringement was, and continues to be, willful, deliberate, and flagrant. Upon information and belief, Defendant’s employees, contractors, agents, and attorneys responsible for the procurement and management of Defendant’s ’449 Application informed Defendant’s employees, contractors, and agents responsible for the research, development, and manufacturing of its Accused Products about the ’728 Patent and its relevance to the research, development, and manufacturing of the Accused Products. Further, upon information and belief, Defendant’s employees, contractors, agents, and attorneys responsible for the procurement and management of Defendant’s ’449 Application collaborated with Defendant’s employees, contractors, and agents responsible for the research, development, and manufacturing of its Accused Products and as a result, Defendant deliberately and flagrantly copied and incorporated into its Accused Products the invention claimed in the ’728 Patent. Upon information and belief, it is Defendant’s regular practice for its employees, contractors, and agents responsible for the research, development, and manufacturing of its products to collaborate with Defendant’s employees, contractors, agents, and attorneys responsible for the procurement and management of Defendant’s patent portfolio during the development process of Defendant’s products.

66. Defendant sold, and continues to sell its Accused Products (e.g., RT-AC88U Wireless-AC3100 Dual Band Gigabit Router) to customers despite its knowledge of the ’728 Patent, such as on Amazon.com. Defendant also manufactured and imported into the United States, and continues to do so, the Accused Products for sale and distribution to its customers, despite its knowledge

of the ’728 Patent.

67. Defendant’s infringement of the ’728 Patent is egregious because despite its knowledge of the ’728 Patent, Defendant deliberately and flagrantly copied the invention claimed in the ’728 Patent and implemented that patented invention in its Accused Products. Further, despite Defendant’s knowledge of the ’728 Patent, Defendant sold, offered for sale, manufactured, and imported, the Accused Products—and continues to do so—without investigating the scope of the ’728 Patent and without forming a good-faith belief that its Accused Products do not infringe or that the ’728 Patent is invalid. Defendant has not taken any steps to remedy its infringement of the ’728 Patent (e.g., by removing the Accused Products from its sales channels). Instead, Defendant continues to sell its Accused Products to customers, such as its continued sale of its RT-AC88U Wireless-AC3100 Dual Band Gigabit Router on Amazon.com. Defendant’s behavior is egregious because it engaged, and continues to engage, in misconduct beyond that of typical infringement. For example, in a typical infringement, an infringer would investigate the scope of the asserted patents and develop a good-faith belief that it does not infringe the asserted patents or that the asserted patents are invalid before selling (and continuing to sell) its accused products. An infringer would also remove its accused products from its sales channels and discontinue further sales.

68. Thus, Defendant’s infringement of the ’728 Patent is willful, deliberate, and flagrant, entitling Vivato to increased damages under 35 U.S.C. § 284 and to attorneys’ fees and costs incurred in prosecuting this action under 35 U.S.C. § 285.

PRAYER FOR RELIEF

WHEREFORE, Vivato prays for the following relief:

(a) A judgment in favor of Vivato that Defendant has infringed and is infringing U.S. Patent Nos. 7,062,296, 7,729,728, and 6,611,231;

(b) An award of damages to Vivato arising out of Defendant's infringement of U.S. Patent Nos. 7,062,296, 7,729,728, and 6,611,231, together with prejudgment and post-judgment interest, in an amount according to proof;

(c) An award of an ongoing royalty for Defendant's post-judgment infringement in an amount according to proof;

(d) Declaring that Defendant's infringement of the '728 Patent is willful and that this is an exceptional case under 35 U.S.C. § 285, and awarding enhanced damages pursuant to 35 U.S.C. § 284 and attorneys' fees and costs in this action.

(e) Granting Vivato its costs and further relief as the Court may deem just and proper.

DEMAND FOR JURY TRIAL

Vivato demands a trial by jury of any and all issues triable of right before a jury.

DATED: July 27, 2017

Respectfully submitted,

RUSS AUGUST & KABAT

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