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 19 XR COMMUNICATIONS, LLC
 20 dba VIVATO TECHNOLOGIES

21 **UNITED STATES DISTRICT COURT**
 22 **CENTRAL DISTRICT OF CALIFORNIA**

23 XR COMMUNICATIONS, LLC, dba
 24 VIVATO TECHNOLOGIES,

Case No. 2:17-cv-2948-AG(JCGx)

25 *Plaintiff,*

**AMENDED COMPLAINT FOR
 PATENT INFRINGEMENT**

26 *v.*

27 ASUS COMPUTER
 28 INTERNATIONAL and ASUSTeK
 COMPUTER INC.,

Defendants.

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1 **I. JURISDICTION AND VENUE**

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

5 **II. THE PARTIES**

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

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

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

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

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

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

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

12 **III. BACKGROUND OF THE TECHNOLOGY**

13 8. Vivato was founded in 2000 as a \$80+million venture-backed
14 company with several key innovators in the wireless communication field
15 including Siavash Alamouti, Ken Biba, William Crilly, James Brennan, Edward
16 Casas, and Vahid Tarokh among many others. Wi-Fi/802.11 has become the
17 ubiquitous wireless connection to the Internet and is now integrated into hundreds
18 of millions of mobile devices globally. Vivato was founded to leverage its talent to
19 generate intellectual property and deliver Wi-Fi/802.11 wireless connectivity
20 solutions to service the growing demand for bandwidth.

21 9. Over the years, Vivato has developed proven technology, with over
22 400 deployments globally, including private, public and government, and has
23 become a recognized provider of extended range Wi-Fi network infrastructure
24 solutions. Vivato's wireless base stations integrate beamforming phased array
25 antenna design with packet steering technology to deliver high-bandwidth
26 extended range connections to serve multiple users and multiple devices.

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

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1 communication including adaptively steered antenna technology and beam
2 switching technology.

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

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

10 12. Defendant has directly infringed and continues to directly infringe
11 numerous claims of the ’296 Patent, including at least claim 33, by manufacturing,
12 using, selling, offering to sell, and/or importing into the United States WiFi access
13 points and routers supporting MU-MIMO, including without limitation access
14 points and routers utilizing the IEEE 802.11ac-2013 standard (e.g., Defendant’s
15 RT-ACRH13 AC1300 Dual-Band Gigabit Wi-Fi Router, RT-AC87U Dual-band
16 4x4 AC2400 Wifi 4-Port Gigabit Router with AiProtection Powered by Trend
17 Micro, RT-AC88U AC3100 Dual-Band Wi-Fi Gigabit Router, RT-AC3100 Dual-
18 Band 4x4 AC3100 Wifi 4-Port Gigabit Gaming Router with AiProtection Powered
19 by Trend Micro, RT-AC3100 AC3100 Dual-Band Wi-Fi Router with Double
20 Gaming Boost and MU-MIMO, RT-AC5300 Tri-Band 4x4 AC5300 Wi-Fi 4-Port
21 Gigabit Gaming Router With AiProtection Powered by Trend Micro, RT-AC5300
22 AC5300 Tri-Band Wi-Fi Gigabit Router – For Gamers, ROG Rapture GT-AC5300
23 Tri-Band Gaming Router, BRT-AC828 AC2600 Dual-WAN VPN Wi-Fi Router,
24 CM-32 AC2600 DOCSIS 3.0 Cable Modem Router, CM-32 AC2600 ASUS CM-
25 32 Cable Modem Wifi Router, RT-AC86U AC2900 Dual-Band Gigabit Wi-Fi
26 Router with MU-MIMO, RT-AC58U AC1300 Dual-Band Wi-Fi Router with MU-
27 MIMO and Parental Controls, and EA-AC87 5 GHz Wireless-AC 1800 Media
28 Bridge/ Access Point) (collectively the “Accused Products”). Defendant is liable

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

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

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

9 15. Each of the Accused Products comprises at least one transceiver
10 operatively coupled to said smart antenna and configured to send and receive
11 electromagnetic signals using said smart antenna. For example, the RT-AC88U
12 Wireless-AC3100 Dual Band Gigabit Router has a Broadcom BCM4366 WiFi
13 radio coupled to the smart antenna to send and receive signals. *See, e.g.*, IEEE
14 802.11ac-2013 (“802.11ac Standard”) Clauses 22.3.4.5(j), 22.3.4.6(g), 22.3.4.7(h),
15 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-
16 convert the resulting complex baseband waveform associated with each transmit
17 chain to an RF signal according to the center frequency of the desired channel and
18 transmit.”); *id.* Clauses 22.3.7.4, 22.3.8; *id.* Clause 22.3.3 and Figure 22-7:

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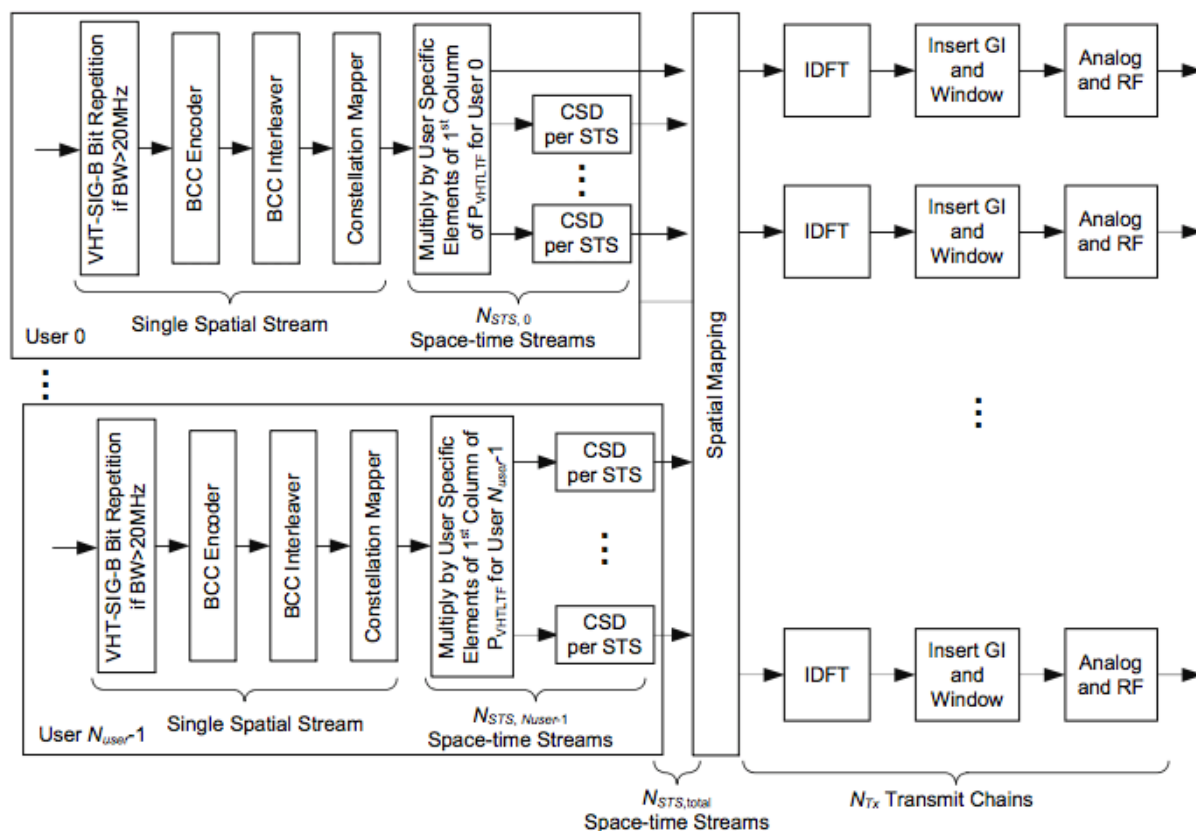


Figure 22-7—Transmitter block diagram for the VHT-SIG-B field of a 20 MHz, 40 MHz, and 80 MHz VHT MU PPDU

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

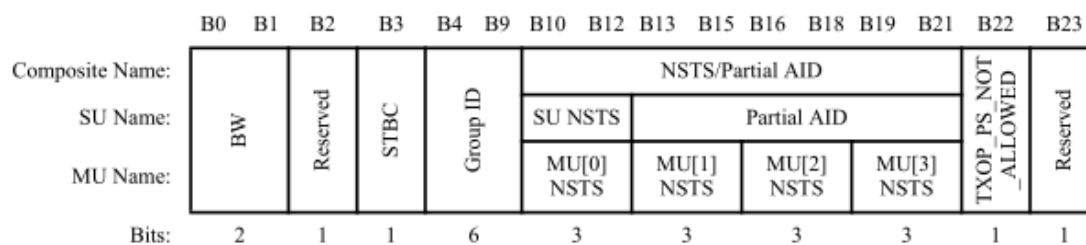
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1 subfield for each of the 64 group IDs, as shown in Figure 8-80f. * * * Within the 8
 2 octet Membership Status Array field, the 1-bit Membership Status subfield for
 3 each group ID is set as follows: — Set to 0 if the STA is not a member of the
 4 group — Set to 1 if STA is a member of the group The Membership Status
 5 subfields for group ID 0 (transmissions to AP) and group ID 63 (downlink SU
 6 transmissions) are reserved.”); *id.* Clause 8.4.1.52 (“The User Position Array field
 7 is used in the Group ID Management frame (see 8.5.23.3). The length of the field
 8 is 16 octets. A 16 octet User Position Array field (indexed by the Group ID)
 9 consists of a 2-bit User Position subfield for each of the 64 group IDs, as shown in
 10 Figure 8-80g. * * * If the Membership Status subfield for a particular group ID is
 11 1, then the corresponding User Position subfield is encoded as shown in Table 8-
 12 531.”); *id.* Table 8-531:

13 **Table 8-531—Encoding of User Position subfield**

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

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



27 **Figure 22-18—VHT-SIG-A1 structure**

28 *Id.* Clause 22.3.11.4:

1 When a STA receives a VHT MU PDU where the Group ID field in VHT-SIG-A has the value k and where
2 MembershipStatusInGroupID[k] is equal to 1, then the number of space-time streams for that STA is
3 indicated in the MU[UserPositionInGroupID[k]] NSTS field in VHT-SIG-A. The space-time streams of
4 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.

5 A STA is also able to identify the space-time streams intended for other STAs that act as interference. VHT-
6 LTF symbols in the VHT MU PDU are used to measure the channel for the space-time streams intended
7 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.

8 *Id.* Clause 9.31.5.1 (“Transmit beamforming and DL-MU-MIMO require
9 knowledge of the channel state to compute a steering matrix that is applied to the
10 transmitted signal to optimize reception at one or more receivers. The STA
11 transmitting using the steering matrix is called the VHT beamformer and a STA for
12 which reception is optimized is called a VHT beamformee. An explicit feedback
13 mechanism is used where the VHT beamformee directly measures the channel
14 from the training symbols transmitted by the VHT beamformer and sends back a
15 transformed estimate of the channel state to the VHT beamformer. The VHT
16 beamformer then uses this estimate, perhaps combining estimates from multiple
17 VHT beamformees, to derive the steering matrix.”); *id.* Clause 9.31.5.2 (“A VHT
18 beamformer shall initiate a sounding feedback sequence by transmitting a VHT
19 NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT
20 beamformer shall include in the VHT NDP Announcement frame one STA Info
21 field for each VHT beamformee that is expected to prepare VHT Compressed
22 Beamforming feedback and shall identify the VHT beamformee by including the
23 VHT beamformee’s AID in the AID subfield of the STA Info field. The VHT NDP
24 Announcement frame shall include at least one STA Info field.”); *id.* (“A non-AP
25 VHT beamformee that receives a VHT NDP Announcement frame... shall
26 transmit its VHT Compressed Beamforming feedback a SIFS after receiving a
27 Beamforming Report Poll with RA matching its MAC address and a non-
28 bandwidth signaling TA obtained from the TA field matching the MAC address of

1 the VHT beamformer.”); *id.* Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *id.* Clauses
 2 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)
 3 (“Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1.”); *id.* Clauses
 4 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

5 17. Each of the Accused Products comprises logic configured to
 6 determine information from at least one uplink transmission receivable from said
 7 second device through said smart antenna. For example, the RT-AC88U Wireless-
 8 AC3100 Dual Band Gigabit Router determines information from a VHT
 9 Compressed Beamforming frame received from a client device through its smart
 10 antenna. *See, e.g.*, 802.11ac Standard Clauses 8.4.1.24, 8.4.1.49, 8.5.23.2, 9.31.5.1,
 11 9.31.5.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

12 18. Each of the Accused Products comprises logic configured to
 13 determine if said associated second device should operatively associate with a
 14 different beam downlink transmittable using said smart antenna based on said
 15 determined information. For example, the RT-AC88U Wireless-AC3100 Dual
 16 Band Gigabit Router determines, based on the information received in a VHT
 17 Compressed Beamforming frame, if the client device should operatively associate
 18 with a different beam downlink transmittable using the smart antenna. *See, e.g.*,
 19 802.11ac Standard Clauses 8.4.1.24, 8.4.1.49, 8.5.23.2, 9.31.5.1, 9.31.5.2; *id.*
 20 Clause 22.3.11.2:

21 Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in
 22 Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer.
 23 The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in
 24 the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,v)$ 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.

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

26 After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation
 27 (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering
 28 matrix Q_k . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix
 $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \leq u \leq N_{user} - 1$) in order to suppress crosstalk
 between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k
 is implementation specific.

1 19. Each of the Accused Products comprises logic configured to allow
2 said second device to operatively associate with said different beam if said
3 associated second device should operatively associate with a different beam and
4 selectively identify that said second device is not allowed to operatively associate
5 with said beam. For example, the RT-AC88U Wireless-AC3100 Dual Band
6 Gigabit Router allows a client device to operatively associate with a beam that is
7 different from the beam with which the client was associated previously, and to
8 identify that the client device is not allowed to operatively associate with the prior
9 beam. *See, e.g.*, 802.11ac Standard Clause 10.40 (“An AP determines the possible
10 combinations of STAs that can be addressed by a VHT MU PPDU by assigning
11 STAs to groups and to specific user positions within those groups. Assignments or
12 changes of user positions corresponding to one or more Group IDs shall be
13 performed using a Group ID Management frame defined in 8.5.23.3...A VHT MU
14 PPDU shall be transmitted to a STA based on the content of the Group ID
15 Management frame most recently transmitted to the STA and for which an
16 acknowledgement was received.”); *id.* Clause 8.5.23.3 (“The Group ID
17 Management frame is an Action frame of category VHT. It is transmitted by the
18 AP to assign or change the user position of a STA for one or more group IDs. The
19 Action field of a Group ID Management frame contains the information shown in
20 Table 8-281aj”); *id.* Clause 8.4.1.51 (“The Membership Status Array field is used
21 in the Group ID Management frame (see 8.5.23.3). The length of the field is 8
22 octets. An 8 octet Membership Status Array field (indexed by the group ID)
23 consists of a 1-bit Membership Status subfield for each of the 64 group IDs, as
24 shown in Figure 8-80f. * * * Within the 8 octet Membership Status Array field, the
25 1-bit Membership Status subfield for each group ID is set as follows: — Set to 0 if
26 the STA is not a member of the group — Set to 1 if STA is a member of the group
27 The Membership Status subfields for group ID 0 (transmissions to AP) and group
28 ID 63 (downlink SU transmissions) are reserved.”); *id.* Clause 8.4.1.52 (“The User

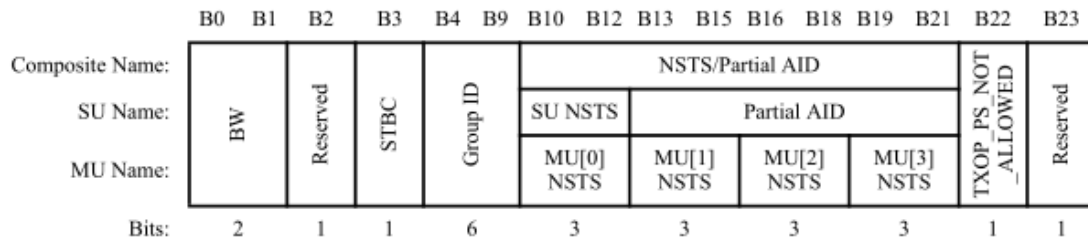
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1 Position Array field is used in the Group ID Management frame (see 8.5.23.3). The
 2 length of the field is 16 octets. A 16 octet User Position Array field (indexed by the
 3 Group ID) consists of a 2-bit User Position subfield for each of the 64 group IDs,
 4 as shown in Figure 8-80g. * * * If the Membership Status subfield for a particular
 5 group ID is 1, then the corresponding User Position subfield is encoded as shown
 6 in Table 8-531.”); *id.* Table 8-531:

7 **Table 8-531—Encoding of User Position subfield**

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

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



21 **Figure 22-18—VHT-SIG-A1 structure**

22 *Id.* Clause 22.3.11.4:

23 When a STA receives a VHT MU PPDU where the Group ID field in VHT-SIG-A has the value *k* and where
 24 MembershipStatusInGroupID[*k*] is equal to 1, then the number of space-time streams for that STA is
 25 indicated in the MU[UserPositionInGroupID[*k*]] NSTS field in VHT-SIG-A. The space-time streams of
 26 different users are ordered in accordance to user position values, i.e., the space-time streams for the user in
 27 user position 0 come first, followed by the space-time streams for the user in position 1, followed by the
 28 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.

1 *Id.* Clause 9.31.5.1 (“Transmit beamforming and DL-MU-MIMO require
2 knowledge of the channel state to compute a steering matrix that is applied to the
3 transmitted signal to optimize reception at one or more receivers. The STA
4 transmitting using the steering matrix is called the VHT beamformer and a STA for
5 which reception is optimized is called a VHT beamformee. An explicit feedback
6 mechanism is used where the VHT beamformee directly measures the channel
7 from the training symbols transmitted by the VHT beamformer and sends back a
8 transformed estimate of the channel state to the VHT beamformer. The VHT
9 beamformer then uses this estimate, perhaps combining estimates from multiple
10 VHT beamformees, to derive the steering matrix.”); *id.* Clause 9.31.5.2 (“A VHT
11 beamformer shall initiate a sounding feedback sequence by transmitting a VHT
12 NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT
13 beamformer shall include in the VHT NDP Announcement frame one STA Info
14 field for each VHT beamformee that is expected to prepare VHT Compressed
15 Beamforming feedback and shall identify the VHT beamformee by including the
16 VHT beamformee’s AID in the AID subfield of the STA Info field. The VHT NDP
17 Announcement frame shall include at least one STA Info field.”); *id.* (“A non-AP
18 VHT beamformee that receives a VHT NDP Announcement frame... shall
19 transmit its VHT Compressed Beamforming feedback a SIFS after receiving a
20 Beamforming Report Poll with RA matching its MAC address and a non-
21 bandwidth signaling TA obtained from the TA field matching the MAC address of
22 the VHT beamformer.”); *id.* Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *id.* Clauses
23 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)
24 (“Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1.”); *id.* Clauses
25 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

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

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

3 21. By at least the filing of the original Complaint on April 19, 2017, and
4 the service of the original Complaint on ASUS US on May 3, 2017, and the waiver
5 of service of the original Complaint by ASUS Taiwan on May 24, 2017, Defendant
6 had knowledge of the '296 Patent, and that its actions resulted in a direct
7 infringement of the '296 Patent. Defendant also knew or was willfully blind that its
8 actions would induce direct infringement by others and intended that its actions
9 would induce direct infringement by others.

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

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1 23. Accordingly, a reasonable inference is that Defendant specifically
2 intended for others, such as its customers, to directly infringe one or more claims
3 of the '296 Patent in the United States because Defendant had knowledge of the
4 '296 Patent and actively induced others (e.g., its customers) to directly infringe the
5 '296 Patent by using, selling, or offering to sell the Accused Products and the MU-
6 MIMO functionality within the Accused Products.

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

10 25. The '296 Patent is valid and enforceable.

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

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

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

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

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

RUSS, AUGUST & KABAT

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

4 31. Each of the Accused Products comprises a phased array antenna
 5 configured to transmit beam downlinks. *See, e.g.:* 802.11ac Standard Clause
 6 8.4.2.58.6, Table 8-128.

7 32. Each of the Accused Products comprises a transceiver operatively
 8 coupled to the phased array antenna and configured to send and receive
 9 electromagnetic signals via the phased array antenna. For example, the RT-AC88U
 10 Wireless-AC3100 Dual Band Gigabit Router has a Broadcom BCM4366 WiFi
 11 radio that is configured to send and receive electromagnetic signals via the phased
 12 array antenna. *See, e.g.,* 802.11ac Standard Clauses 22.3.4.5(j), 22.3.4.6(g),
 13 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
 14 RF: Up-convert the resulting complex baseband waveform associated with each
 15 transmit chain to an RF signal according to the center frequency of the desired
 16 channel and transmit.”); *id.* Clauses 22.3.7.4, 22.3.8; *id.* Clause 22.3.3 and Figure
 17 22-7:

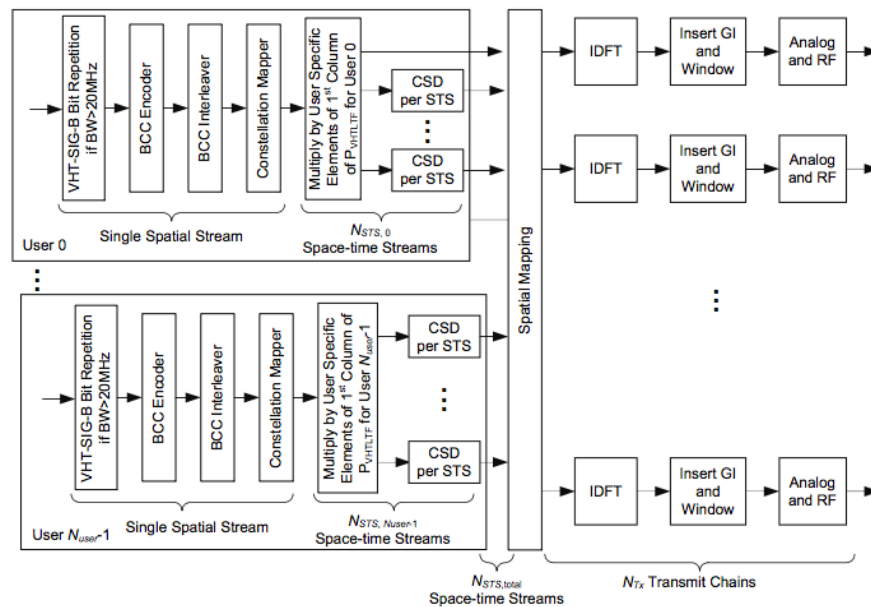


Figure 22-7—Transmitter block diagram for the VHT-SIG-B field of a 20 MHz, 40 MHz, and 80 MHz VHT MU PPDU

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

5 34. Each of the Accused Products comprises an access point that includes
6 the phased array antenna and the transceiver that is configured to selectively allow
7 a receiving device to operatively associate with a beam downlink transmitted to the
8 receiving device via the phased array antenna. *See, e.g.*, 802.11ac Standard Clause
9 8.5.23.3 (“The Group ID Management frame is an Action frame of category VHT.
10 It is transmitted by the AP to assign or change the user position of a STA for one
11 or more group IDs. The Action field of a Group ID Management frame contains
12 the information shown in Table 8-281aj”); *id.* Clause 8.4.1.51 (“The Membership
13 Status Array field is used in the Group ID Management frame (see 8.5.23.3). The
14 length of the field is 8 octets. An 8 octet Membership Status Array field (indexed
15 by the group ID) consists of a 1-bit Membership Status subfield for each of the 64
16 group IDs, as shown in Figure 8-80f. * * * Within the 8 octet Membership Status
17 Array field, the 1-bit Membership Status subfield for each group ID is set as
18 follows: — Set to 0 if the STA is not a member of the group — Set to 1 if STA is a
19 member of the group The Membership Status subfields for group ID 0
20 (transmissions to AP) and group ID 63 (downlink SU transmissions) are
21 reserved.”); *id.* Clause 8.4.1.52 (“The User Position Array field is used in the
22 Group ID Management frame (see 8.5.23.3). The length of the field is 16 octets. A
23 16 octet User Position Array field (indexed by the Group ID) consists of a 2-bit
24 User Position subfield for each of the 64 group IDs, as shown in Figure 8-
25 80g. * * * If the Membership Status subfield for a particular group ID is 1, then the
26 corresponding User Position subfield is encoded as shown in Table 8-53l.”); *id.*
27 Table 8-53l:

28 ///

RUSS, AUGUST & KABAT

Table 8-53I—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 PPDU. 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:

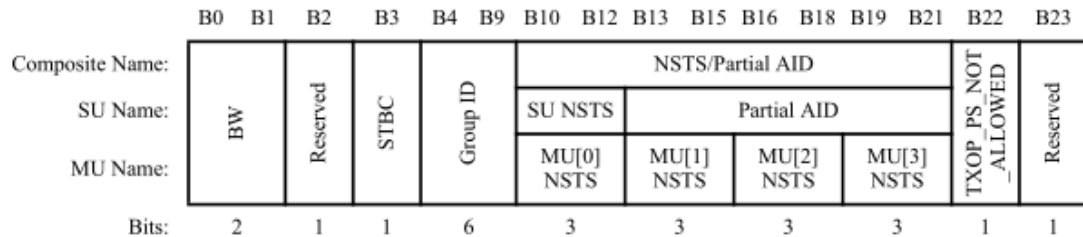


Figure 22-18—VHT-SIG-A1 structure

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

1 from the training symbols transmitted by the VHT beamformer and sends back a
2 transformed estimate of the channel state to the VHT beamformer. The VHT
3 beamformer then uses this estimate, perhaps combining estimates from multiple
4 VHT beamformees, to derive the steering matrix.”); *id.* Clause 9.31.5.2 (“A VHT
5 beamformer shall initiate a sounding feedback sequence by transmitting a VHT
6 NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT
7 beamformer shall include in the VHT NDP Announcement frame one STA Info
8 field for each VHT beamformee that is expected to prepare VHT Compressed
9 Beamforming feedback and shall identify the VHT beamformee by including the
10 VHT beamformee’s AID in the AID subfield of the STA Info field. The VHT NDP
11 Announcement frame shall include at least one STA Info field.”); *id.* (“A non-AP
12 VHT beamformee that receives a VHT NDP Announcement frame... shall
13 transmit its VHT Compressed Beamforming feedback a SIFS after receiving a
14 Beamforming Report Poll with RA matching its MAC address and a non-
15 bandwidth signaling TA obtained from the TA field matching the MAC address of
16 the VHT beamformer.”); *id.* Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *id.* Clauses
17 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)
18 (“Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1.”); *id.* Clauses
19 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

20 35. Each of the Accused Products comprises an access point that includes
21 the phased array antenna and the transceiver that is configured to receive an uplink
22 transmission from the receiving device through the phased array antenna. For
23 example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is
24 configured to receive a VHT Compressed Beamforming Feedback frame from a
25 “receiving device” such as a connected laptop or smartphone through its phased-
26 array antenna. *See, e.g.*, 802.11ac Standard Clauses 8.4.1.24, 8.4.1.49, 8.5.23.2,
27 9.31.5.1, 9.31.5.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

28 ///

1 36. Each of the Accused Products comprises an access point that includes
 2 the phased array antenna and the transceiver that is configured to determine from
 3 the uplink transmission if the receiving device should operatively associate with a
 4 different beam downlink transmission. For example, the RT-AC88U Wireless-
 5 AC3100 Dual Band Gigabit Router is configured to determine from information
 6 contained in the VHT Compressed Beamforming Feedback frame if the receiving
 7 device that sent the VHT Compressed Beamforming Feedback frame should
 8 operatively associate with a different beam downlink transmission. *See, e.g.,*
 9 802.11ac Standard Clauses 3.2, 8.4.1.24, 8.4.1.49, 8.5.23.2, 9.31.5, 9.31.5.1,
 10 9.31.5.2; *id.* Clause 22.3.11.2:

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

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

17 After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation
 18 (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering
 19 matrix Q_k . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix
 $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \leq u \leq N_{user} - 1$) in order to suppress crosstalk
 between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k
 is implementation specific.

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

1 thereof to allow the receiving device to operatively associate with the different
2 beam downlink if determined that the receiving device should operatively associate
3 with the different beam downlink; (ii) force the receiving device to operatively
4 associate with the different beam downlink if determined that the receiving device
5 should be operatively associated with the different beam downlink. *See, e.g.*,
6 802.11ac Standard Clause 10.40 (“An AP determines the possible combinations of
7 STAs that can be addressed by a VHT MU PPDU by assigning STAs to groups
8 and to specific user positions within those groups. Assignments or changes of user
9 positions corresponding to one or more Group IDs shall be performed using a
10 Group ID Management frame defined in 8.5.23.3...A VHT MU PPDU shall be
11 transmitted to a STA based on the content of the Group ID Management frame
12 most recently transmitted to the STA and for which an acknowledgement was
13 received.”); *id.* Clause 8.5.23.3 (“The Group ID Management frame is an Action
14 frame of category VHT. It is transmitted by the AP to assign or change the user
15 position of a STA for one or more group IDs. The Action field of a Group ID
16 Management frame contains the information shown in Table 8-281aj”); *id.* Clause
17 8.4.1.51 (“The Membership Status Array field is used in the Group ID
18 Management frame (see 8.5.23.3). The length of the field is 8 octets. An 8 octet
19 Membership Status Array field (indexed by the group ID) consists of a 1-bit
20 Membership Status subfield for each of the 64 group IDs, as shown in Figure 8-
21 80f. * * * Within the 8 octet Membership Status Array field, the 1-bit Membership
22 Status subfield for each group ID is set as follows: — Set to 0 if the STA is not a
23 member of the group — Set to 1 if STA is a member of the group The Membership
24 Status subfields for group ID 0 (transmissions to AP) and group ID 63 (downlink
25 SU transmissions) are reserved.”); *id.* Clause 8.4.1.52 (“The User Position Array
26 field is used in the Group ID Management frame (see 8.5.23.3). The length of the
27 field is 16 octets. A 16 octet User Position Array field (indexed by the Group ID)
28 consists of a 2-bit User Position subfield for each of the 64 group IDs, as shown in

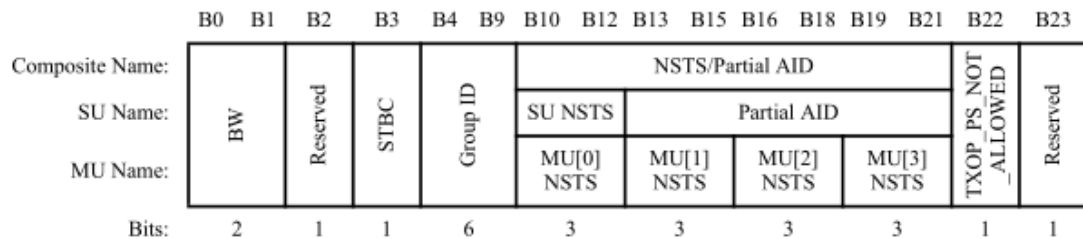
RUSS, AUGUST & KABAT

1 Figure 8-80g. * * * If the Membership Status subfield for a particular group ID is
 2 1, then the corresponding User Position subfield is encoded as shown in Table 8-
 3 531.”); *id.* Table 8-531/:

4 **Table 8-531—Encoding of User Position subfield**

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

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



14 **Figure 22-18—VHT-SIG-A1 structure**

15 *Id.* Clause 22.3.11.4:

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

23 A STA is also able to identify the space-time streams intended for other STAs that act as interference. VHT-
 24 LTF symbols in the VHT MU PPDU are used to measure the channel for the space-time streams intended
 25 for the STA and can also be used to measure the channel for the interfering space-time streams. To
 26 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.

27 *Id.* Clause 9.31.5.1 (“Transmit beamforming and DL-MU-MIMO require
 28 knowledge of the channel state to compute a steering matrix that is applied to the

1 transmitted signal to optimize reception at one or more receivers. The STA
2 transmitting using the steering matrix is called the VHT beamformer and a STA for
3 which reception is optimized is called a VHT beamformee. An explicit feedback
4 mechanism is used where the VHT beamformee directly measures the channel
5 from the training symbols transmitted by the VHT beamformer and sends back a
6 transformed estimate of the channel state to the VHT beamformer. The VHT
7 beamformer then uses this estimate, perhaps combining estimates from multiple
8 VHT beamformees, to derive the steering matrix.”); *id.* Clause 9.31.5.2 (“A VHT
9 beamformer shall initiate a sounding feedback sequence by transmitting a VHT
10 NDP Announcement frame followed by a VHT NDP after a SIFS. The VHT
11 beamformer shall include in the VHT NDP Announcement frame one STA Info
12 field for each VHT beamformee that is expected to prepare VHT Compressed
13 Beamforming feedback and shall identify the VHT beamformee by including the
14 VHT beamformee’s AID in the AID subfield of the STA Info field. The VHT NDP
15 Announcement frame shall include at least one STA Info field.”); *id.* (“A non-AP
16 VHT beamformee that receives a VHT NDP Announcement frame... shall
17 transmit its VHT Compressed Beamforming feedback a SIFS after receiving a
18 Beamforming Report Poll with RA matching its MAC address and a non-
19 bandwidth signaling TA obtained from the TA field matching the MAC address of
20 the VHT beamformer.”); *id.* Clauses 8.5.23.2, 8.4.1.48, 8.4.1.49; *id.* Clauses
21 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)
22 (“Spatial mapping: Apply the Q matrix as described in 22.3.10.11.1.”); *id.* Clauses
23 22.3.10.11.1, 22.3.11.2; IEEE 802.11-2012 Clause 20.3.12.3.6.

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

1 received from the receiving device through the phased array antenna. For example,
2 the RT-AC88U Wireless-AC3100 Dual Band Gigabit Router is configured to
3 actively probe the receiving device by generating a signal to initiate that the phased
4 array antenna transmit a signal, e.g. a VHT null data packet announcement frame
5 over the beam downlinks, and to gather signal parameter information from uplink
6 transmittable messages received from the receiving device through the phased
7 array antenna, e.g. one or more VHT Compressed Beamforming Feedback frames.
8 *See, e.g.*, 802.11ac Standard Clause 9.31.5, 9.31.5.2 (“A VHT beamformer shall
9 initiate a sounding feedback sequence by transmitting a VHT NDP Announcement
10 frame followed by a VHT NDP after a SIFS. The VHT beamformer shall include
11 in the VHT NDP Announcement frame one STA Info field for each VHT
12 beamformee that is expected to prepare VHT Compressed Beamforming feedback
13 and shall identify the VHT beamformee by including the VHT beamformee’s AID
14 in the AID subfield of the STA Info field. The VHT NDP Announcement frame
15 shall include at least one STA Info field.”); *id.* (“A non-AP VHT beamformee that
16 receives a VHT NDP Announcement frame... shall transmit its VHT Compressed
17 Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA
18 matching its MAC address and a non-bandwidth signaling TA obtained from the
19 TA field matching the MAC address of the VHT beamformer.”); *id.* Clause
20 8.4.1.24; IEEE 802.11-2012 Clause 20.3.12.3.6; 802.11ac Standard Clause
21 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming
22 frame); *id.* Clause 8.4.1.48 (including Tables 8-53(d)-(h)) (“Each SNR value per
23 tone in stream i (before being averaged) corresponds to the SNR associated with
24 the column i of the beamforming feedback matrix V determined at the
25 beamformee”); *id.* Clause 8.4.1.49 (including Table 8-53i – MU Exclusive
26 Beamforming Report information); *id.* Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; *id.*
27 Clause 22.3.8.3.5; *id.* Clause 22.3.11.2.
28 ///

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

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

19 41. Based on this knowledge of Vivato's '728 Patent, Defendant also
20 knew that its actions resulted in a direct infringement of the '728 Patent. Defendant
21 also knew or was willfully blind that its actions would induce direct infringement
22 by others and intended that its actions would induce direct infringement by others.

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

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

13 43. Accordingly, a reasonable inference is that Defendant specifically
14 intended for others, such as its customers, to directly infringe one or more claims
15 of the '728 Patent in the United States because Defendant had knowledge of the
16 '728 Patent and actively induced others (e.g., its customers) to directly infringe the
17 '728 Patent by using, selling, or offering to sell the Accused Products and the MU-
18 MIMO functionality within the Accused Products.

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

22 45. The '728 Patent is valid and enforceable.

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

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

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

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

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

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

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

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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

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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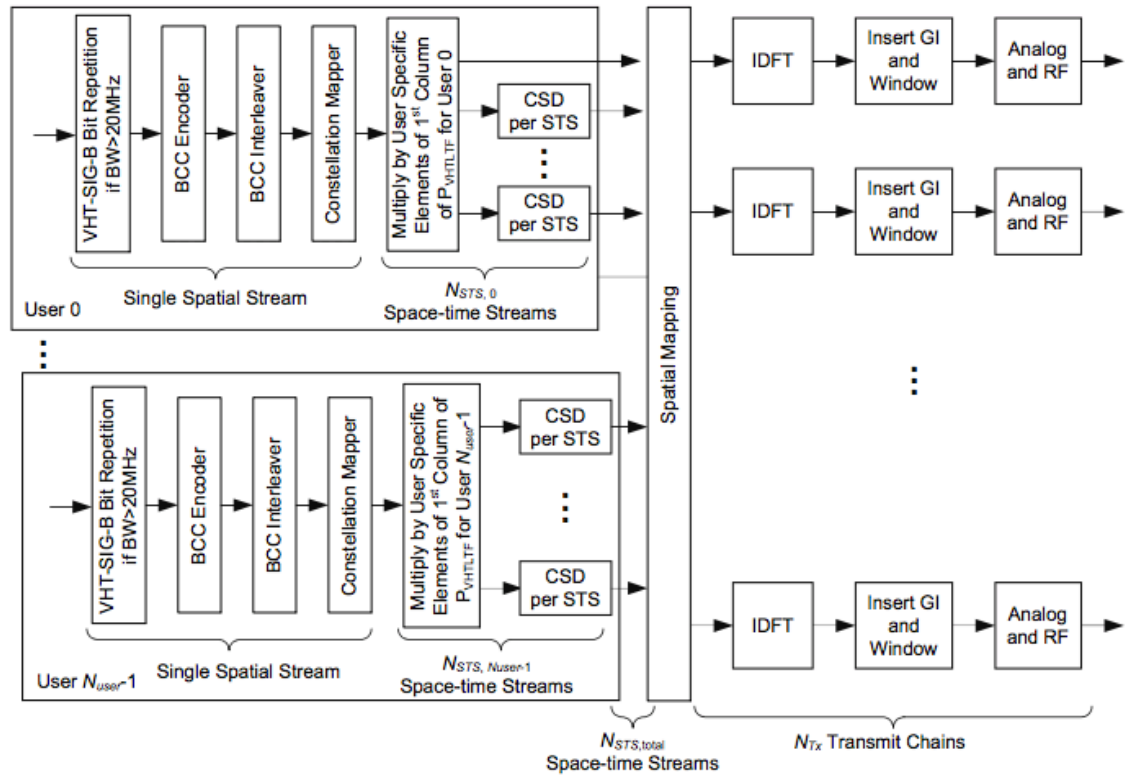


Figure 22-7—Transmitter block diagram for the VHT-SIG-B field of a 20 MHz, 40 MHz, and 80 MHz VHT MU PPDU

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

1 and DL-MU-MIMO require knowledge of the channel state to compute a steering
 2 matrix that is applied to the transmitted signal to optimize reception at one or more
 3 receivers. The STA transmitting using the steering matrix is called the VHT
 4 beamformer and a STA for which reception is optimized is called a VHT
 5 beamformee. An explicit feedback mechanism is used where the VHT beamformee
 6 directly measures the channel from the training symbols transmitted by the VHT
 7 beamformer and sends back a transformed estimate of the channel state to the VHT
 8 beamformer. The VHT beamformer then uses this estimate, perhaps combining
 9 estimates from multiple VHT beamformees, to derive the steering matrix.”); *id.*
 10 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),
 11 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in
 12 22.3.10.11.1.”); *id.* Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause
 13 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; *id.* Clause
 14 22.3.11.1:

15 The DL-MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$ can be determined by the
 16 beamformer using the beamforming feedback matrices for subcarrier k from beamformee u , $V_{k,u}$, and SNR
 17 information for subcarrier k from beamformee u , $SNR_{k,u}$, where $u = 0, 1, \dots, N_{user} - 1$. The steering matrix
 18 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).

19 *Id.* Clause 22.3.11.2:

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

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

26 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
 27 matrix Q_k . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix
 28 $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \leq u \leq N_{user} - 1$) in order to suppress crosstalk
 between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k
 is implementation specific.

1 54. Each of the Accused Products comprises search receiver logic
2 operatively coupled to said control logic and said at least one receiver and
3 configured to update said routing information based at least in part on cross-
4 correlated signal information that is received by said receiver using said adaptive
5 antenna. For example, the RT-AC88U Wireless-AC3100 Dual Band Gigabit
6 Router updates the routing information based at least in part on cross-correlated
7 signal information received in a VHT Compressed Beamforming frame. *See, e.g.*,
8 802.11ac Standard Clause 9.31.5.2 (“A VHT beamformer shall initiate a sounding
9 feedback sequence by transmitting a VHT NDP Announcement frame followed by
10 a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP
11 Announcement frame one STA Info field for each VHT beamformee that is
12 expected to prepare VHT Compressed Beamforming feedback and shall identify
13 the VHT beamformee by including the VHT beamformee’s AID in the AID
14 subfield of the STA Info field. The VHT NDP Announcement frame shall include
15 at least one STA Info field.”); *id.* (“A non-AP VHT beamformee that receives a
16 VHT NDP Announcement frame... shall transmit its VHT Compressed
17 Beamforming feedback a SIFS after receiving a Beamforming Report Poll with RA
18 matching its MAC address and a non-bandwidth signaling TA obtained from the
19 TA field matching the MAC address of the VHT beamformer.”); *id.* Clause
20 8.5.23.2 (defining format and subfields within the VHT Compressed Beamforming
21 frame); *id.* Clause 8.4.1.48 (including Tables 8-53(d)-(h)) (“Each SNR value per
22 tone in stream i (before being averaged) corresponds to the SNR associated with
23 the column i of the beamforming feedback matrix V determined at the
24 beamformee”); *id.* Clause 8.4.1.49 (including Table 8-53i – MU Exclusive
25 Beamforming Report information); *id.* Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; *id.*
26 Clause 22.3.8.3.5; *id.* Clause 22.3.11.2:

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28 ///

1 Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in
 2 Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer.
 3 The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in
 4 the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,v)$ 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.

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

7 After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation
 8 (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
 9 $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \leq u \leq N_{user} - 1$) in order to suppress crosstalk
 between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k
 is implementation specific.

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

15 56. By at least the filing of the original Complaint on April 19, 2017, and
 16 the service of the original Complaint on ASUS US on May 3, 2017, and the waiver
 17 of service of the original Complaint by ASUS Taiwan on May 24, 2017, Defendant
 18 had knowledge of the '231 Patent, and that its actions resulted in a direct
 19 infringement of the '231 Patent. Defendant also knew or was willfully blind that its
 20 actions would induce direct infringement by others and intended that its actions
 21 would induce direct infringement by others.

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

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

12 58. Accordingly, a reasonable inference is that Defendant specifically
13 intended for others, such as its customers, to directly infringe one or more claims
14 of the '231 Patent in the United States because Defendant had knowledge of the
15 '231 Patent and actively induced others (e.g., its customers) to directly infringe the
16 '231 Patent by using, selling, or offering to sell the Accused Products and the MU-
17 MIMO functionality within the Accused Products.

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

21 60. The '231 Patent is valid and enforceable.

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

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

28 ///

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

1 knowledge of the '728 Patent's applicability to Defendant's MU-MIMO WiFi
2 access point and router products without taking a license and without a good faith
3 belief that the '728 Patent is invalid and not infringed. Defendant's infringement of
4 the '728 Patent occurred, and continues to occur, with knowledge of infringement
5 and objective recklessness. Defendant's infringement was, and continues to be,
6 willful, deliberate, and flagrant. Upon information and belief, Defendant's
7 employees, contractors, agents, and attorneys responsible for the procurement and
8 management of Defendant's '449 Application informed Defendant's employees,
9 contractors, and agents responsible for the research, development, and
10 manufacturing of its Accused Products about the '728 Patent and its relevance to
11 the research, development, and manufacturing of the Accused Products. Further,
12 upon information and belief, Defendant's employees, contractors, agents, and
13 attorneys responsible for the procurement and management of Defendant's '449
14 Application collaborated with Defendant's employees, contractors, and agents
15 responsible for the research, development, and manufacturing of its Accused
16 Products and as a result, Defendant deliberately and flagrantly copied and
17 incorporated into its Accused Products the invention claimed in the '728 Patent.
18 Upon information and belief, it is Defendant's regular practice for its employees,
19 contractors, and agents responsible for the research, development, and
20 manufacturing of its products to collaborate with Defendant's employees,
21 contractors, agents, and attorneys responsible for the procurement and management
22 of Defendant's patent portfolio during the development process of Defendant's
23 products.

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

1 of the '728 Patent.

2 67. Defendant's infringement of the '728 Patent is egregious because
3 despite its knowledge of the '728 Patent, Defendant deliberately and flagrantly
4 copied the invention claimed in the '728 Patent and implemented that patented
5 invention in its Accused Products. Further, despite Defendant's knowledge of the
6 '728 Patent, Defendant sold, offered for sale, manufactured, and imported, the
7 Accused Products—and continues to do so—without investigating the scope of the
8 '728 Patent and without forming a good-faith belief that its Accused Products do
9 not infringe or that the '728 Patent is invalid. Defendant has not taken any steps to
10 remedy its infringement of the '728 Patent (e.g., by removing the Accused
11 Products from its sales channels). Instead, Defendant continues to sell its Accused
12 Products to customers, such as its continued sale of its RT-AC88U Wireless-
13 AC3100 Dual Band Gigabit Router on Amazon.com. Defendant's behavior is
14 egregious because it engaged, and continues to engage, in misconduct beyond that
15 of typical infringement. For example, in a typical infringement, an infringer would
16 investigate the scope of the asserted patents and develop a good-faith belief that it
17 does not infringe the asserted patents or that the asserted patents are invalid before
18 selling (and continuing to sell) its accused products. An infringer would also
19 remove its accused products from its sales channels and discontinue further sales.

20 68. Thus, Defendant's infringement of the '728 Patent is willful,
21 deliberate, and flagrant, entitling Vivato to increased damages under 35 U.S.C.
22 § 284 and to attorneys' fees and costs incurred in prosecuting this action under 35
23 U.S.C. § 285.

24 **PRAYER FOR RELIEF**

25 WHEREFORE, Vivato prays for the following relief:

26 (a) A judgment in favor of Vivato that Defendant has infringed and is
27 infringing U.S. Patent Nos. 7,062,296, 7,729,728, and 6,611,231;
28

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

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

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

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

11 **DEMAND FOR JURY TRIAL**

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

14
15 DATED: July 27, 2017

Respectfully submitted,

16 **RUSS AUGUST & KABAT**

17
18
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RUSS, AUGUST & KABAT