

RUSS, AUGUST & KABAT

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

23 XR COMMUNICATIONS, LLC, dba
 24 VIVATO TECHNOLOGIES,

Case No. 8:21-cv-01064

Plaintiff,

**COMPLAINT FOR PATENT
 INFRINGEMENT**

v.

NETGEAR INC.,

Defendant.

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1 **I. JURISDICTION AND VENUE**

2 1. This is an action for patent infringement. This Court has subject matter
3 jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a) because this action arises
4 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 (“Vivato”
7 or “Plaintiff”) is a limited liability company organized and existing under the laws
8 of Delaware with its principal place of business at 2809 Ocean Front Walk, Venice,
9 California 90291. Vivato is the sole owner by assignment of all right, title, and
10 interest in each Asserted Patent.

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

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

25 5. Among many fundamental breakthroughs achieved by Vivato are
26 inventions that allow for intelligent and adaptive beamforming based on up-to-date
27 information about the wireless medium. Through these and many other inventions,
28 Vivato’s engineers pioneered a wireless technology that provides for simultaneous

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1 transmission and reception, a significant leap forward over conventional wireless
2 technology.

3 6. Over the years, Vivato has developed proven technology, with over 400
4 deployments globally, including private, public and government, and it has become
5 a recognized provider of extended range Wi-Fi network infrastructure solutions.
6 Vivato's wireless base stations integrate beamforming phased array antenna design
7 with packet steering technology to deliver high-bandwidth extended range
8 connections to serve multiple users and multiple devices

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

13 8. Netgear, Inc. (“Netgear” or “Defendant”) is a corporation organized and
14 existing under the laws of Delaware with its principal place of business at 350 E.
15 Plumeria Drive, San Jose, CA 95134. Netgear has a registered agent for service of
16 process at C T Corporation System, 818 W 7th St Ste. 930, Los Angeles, CA 90017.

17 9. This Court has personal jurisdiction over Netgear because it has its
18 principal place of business in California.

19 10. Venue is proper in this federal district pursuant to 28 U.S.C. §§ 1391(b)-
20 (d) and 1400(b) in that Netgear is subject to jurisdiction in this District, has done
21 business in this District, has regular and established places of business in this
22 District, has committed acts of infringement in this District, and continues to commit
23 acts of infringement in this District, entitling Plaintiff to relief.

24 ///

25 **III. BACKGROUND OF THE TECHNOLOGY**

26 11. This complaint arises from Defendants’ unlawful infringement of the
27 following United States patents owned by Vivato, each of which generally relate to
28 wireless communications technology: United States Patent Nos. 7,729,728 (the

1 “‘728 Patent”), 10,594,376 (the “‘376 Patent”), and 8,289,939 (collectively, the
2 “Asserted Patents”).

3 12. Countless electronic devices today connect to the Internet wirelessly.
4 Beyond just connecting our devices together, wireless networks have become an
5 inseparable part of our lives in our homes, our offices, and our neighborhood coffee
6 shops. In even our most crowded spaces, today’s wireless technology allows all of
7 us to communicate with each other, on our own devices, at virtually the same time.
8 Our connected world would be unrecognizable without the ubiquity of sophisticated
9 wireless networking technology.

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

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

26 15. In 1905, Braun invented the first phased array antenna. This phased array
27 antenna featured three antennas carefully positioned relative to one another with a
28 specific phase relationship so that the radio waves output from each antenna could

1 add together to increase radiation in a desired direction. This design allowed Braun's
2 phased array antenna to transmit a directed signal.

3 16. Building on the fundamental breakthrough that radio transmissions can be
4 directed according to a specific radiation pattern through the use of a phased array
5 antenna, directed wireless communication technology has developed many
6 applications over the years. Braun's invention of the phased array antenna led to the
7 development of radar, smart antennas, and, eventually, to a technology known as
8 "MIMO," or "multiple-input, multiple-output," which would ultimately allow a
9 single radio channel to receive and transmit multiple data signals simultaneously.
10 Along the way, engineers have worked tirelessly to overcome limitations and
11 roadblocks directed wireless communication technology.

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

27 18. Moving from omnidirectional networks to modern networks has required
28 an additional series of advancements that harness the capabilities of directed wireless

1 technology. These advancements range from conceiving various ways to steer and
2 modify radiation patterns, to enhancing the transmission signal power in a desired
3 direction, to suppressing radiation in undesired directions, to minimizing signal
4 “noise,” and then applying these new approaches into communications networks
5 with multiple, heterogenous transmitters and receivers.

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

15 **IV. COUNT ONE: INFRINGEMENT OF UNITED STATES**
16 **PATENT NO. 7,729,728**

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

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

25 22. Defendant has directly infringed and continues to directly infringe
26 numerous claims of the ’728 Patent, including at least claim 4, by manufacturing,
27 using, selling, offering to sell, and/or importing into the United States Wi-Fi 6 access
28 points and routers supporting MU-MIMO, including without limitation access points

1 and routers utilizing the IEEE 802.11ax or “Wi-Fi 6” standard (e.g., Nighthawk
 2 Dual-Band WiFi 6 Routers with MU-MIMO including RAX200, RAX120, RAX80,
 3 RAX78, RAX75, RAX50, RAX48, RAX50S, RAX45, RAX43, RAX42, RAX40,
 4 RAX38, RAX35, RAX20, RAX15, RAX10, LAX20, RAXE500, RAXE450,
 5 R6700AX, Archer Series including AX73, AX11000, AX1800 4-Stream, AX1500,
 6 Orbi Wi-Fi 6 Series including RBK853, RBK852, RBK842, RBS850, RBR850,
 7 RBK854, RBK752, RBK753, RBK753S, RBK754, CBK752, RBX750, Nighthawk
 8 Dual-Band WiFi 6 Mesh including MK62, MK63S, MK64, MK83, MS60, MS80,
 9 Gaming Series including Nighthawk 6-Stream WiFi 6 Gaming Router XR1000, and
 10 business solutions including Orbi Pro WiFi 6 Series including SXX80, SXX30B3,
 11 SXR80, SXX80B3, SXX30, SXR30, SXS30, SXS80, SXX80B4 as well as AX3600
 12 Dual band PoE Multi-Gig WiFi 6 Access Point WAX620, AX1800 Dual Band PoE
 13 Multi-Gig Insight Managed WiFi 6 Access Point WAX610 / WAX610PA, AX1800
 14 Dual Band PoE multi-Gig Insight Managed WiFi 6 Outdoor Access Point
 15 WAX610Y, Essentials WiFi 6 AX1800 Dual Band Access Point WAX204,
 16 Essentials WiFi 6 AX1800 WAX214 / WAX214PA, WAX218 / WAX218PA,
 17 WAX610Y / WAX610PA)) (collectively the “’728 Accused Products”). Defendant
 18 is liable for infringement of the ’728 Patent pursuant to 35 U.S.C. § 271(a).

19 23. The Accused Products satisfy all claim limitations of Claims 3, 4, 5,
 20 and 12 of the ’728 Patent. The following paragraphs compare limitations of Claim 4
 21 to an exemplary ’728 Accused Product, the NETGEAR AX12 12-Stream AX6000
 22 Wi-Fi Router RAX120 wireless access point.

23 24. Each of the Accused Products comprises a wireless communication
 24 system and performs a method for use in a wireless communication system. For
 25 example, the NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 is a
 26 wireless access point for use in a Wi-Fi network. *See, e.g.*, NETGEAR Nighthawk
 27 RAX120 Data Sheet (“Nighthawk AX12 WiFi 6 Router is powered by the industry’s
 28 latest WiFi 6 (802.11ax) standard with 4 times increased data capacity in a dense

1 environment to handle up to 30 devices in your growing home network. Blazing-fast
2 combined WiFi speeds up to 6Gbps and AX optimized 64-bit 2.2GHz quad-core
3 processor powers smart home automation, ultra-smooth 4K UHD streaming, online
4 gaming, and more.”; “WiFi 6 gives you improved network capacity for more WiFi
5 devices. Have more fun with the uninterrupted 4K/8K streaming, gaming, and the
6 smart home experience. With MU-MIMO, WiFi 6 supports up to eight simultaneous
7 streams for the number of users that can be served double at the same time as
8 compared to an AC router.”; “12-Stream WiFi 6”; “8 High-performance Antennas.
9 Enjoy up to 1.5X more usable WiFi coverage for things like Ultra-HD video &
10 gaming.”; “Quad-core 2.2GHz Processor. Engineered to deliver a new era of WiFi
11 performance”; “8x8 MU-MIMO enables up to four (4) 2x2 devices to stream content
12 at the same time”; “High-performance antennas—Eight (8) antennas extend wireless
13 range coverage indoors and out”; “Using multi-user MIMO technology, routers can
14 stream data to multiple devices simultaneously. That means faster downloads and
15 smoother streaming for your devices. WiFi 6 extends MU-MIMO to 8-stream
16 support so it can support double the number of simultaneous transmission as
17 compared to 4x4 MU-MIMO AC WiFi routers”; “This powerful processor is
18 optimized for AX making intelligent spontaneous decisions to schedule data traffic
19 to maximize WiFi bandwidth utilization.”).

20 25. Each of the Accused Products comprises a phased array antenna
21 configured to selectively allow a receiving device to operatively associate with a
22 beam downlink transmittable to the receiving device via a phased array antenna of
23 an access point. For example, as with each Accused Product, the NETGEAR AX12
24 12-Stream AX6000 Wi-Fi Router RAX120 selectively allows a receiving device
25 (*e.g.*, station, abbreviated “STA”) to operatively associate (*e.g.*, connect) with a
26 beam downlink transmittable to the receiving device (*e.g.*, SU-MIMO, DL MU-
27 MIMO or UL MU-MIMO beamforming) via a phased array antenna of an access
28 point (*e.g.*, the antenna array and supporting mechanisms of the NETGEAR AX12

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1 12-Stream AX6000 Wi-Fi Router RAX120). *See, e.g.*, NETGEAR Nighthawk
2 RAX120 Data Sheet (“Nighthawk AX12 WiFi 6 Router is powered by the industry’s
3 latest WiFi 6 (802.11ax) standard with 4 times increased data capacity in a dense
4 environment to handle up to 30 devices in your growing home network. Blazing-fast
5 combined WiFi speeds up to 6Gbps and AX optimized 64-bit 2.2GHz quad-core
6 processor powers smart home automation, ultra-smooth 4K UHD streaming, online
7 gaming, and more.”; “WiFi 6 gives you improved network capacity for more WiFi
8 devices. Have more fun with the uninterrupted 4K/8K streaming, gaming, and the
9 smart home experience. With MU-MIMO, WiFi 6 supports up to eight simultaneous
10 streams for the number of users that can be served double at the same time as
11 compared to an AC router.”; “12-Stream WiFi 6”; “8 High-performance Antennas.
12 Enjoy up to 1.5X more usable WiFi coverage for things like Ultra-HD video &
13 gaming.”; “Quad-core 2.2GHz Processor. Engineered to deliver a new era of WiFi
14 performance”; “8x8 MU-MIMO enables up to four (4) 2x2 devices to stream content
15 at the same time”; “High-performance antennas—Eight (8) antennas extend wireless
16 range coverage indoors and out”; “Using multi-user MIMO technology, routers can
17 stream data to multiple devices simultaneously. That means faster downloads and
18 smoother streaming for your devices. WiFi 6 extends MU-MIMO to 8-stream
19 support so it can support double the number of simultaneous transmission as
20 compared to 4x4 MU-MIMO AC WiFi routers”; “This powerful processor is
21 optimized for AX making intelligent spontaneous decisions to schedule data traffic
22 to maximize WiFi bandwidth utilization.”);

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Enjoy simultaneous streaming with MU-MIMO

Data sent to one device at a time



Traditional WiFi

Data sent to multiple devices simultaneously



MU-MIMO WiFi

. See, e.g., IEEE 802.11ax Standard, at Sections 9.3.1.22, 26.5, 26.5.1, 26.5.2, 26.5.3, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.10.7, 27.3.10.8, 27.3.10.9, 27.3.15, including Tables 27-19, 27-20, 27-21, 27-24, 27-25, 27-26, 27-27, 27-28, 27-29, Annex G at G.5, Annex Z. See, e.g., IEEE 802.11ax Standard, Section 27.3.1.1 (“The transmission within an RU in a PPDU may be single stream to one user, spatially multiplexed to one user (SU-MIMO), or spatially multiplexed to multiple users (MU-MIMO).”); Section 27.3.2.5 (“The number of users in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A. The allocated spatial streams for each user and the total number of spatial streams are indicated in the Spatial Configuration field of User field in HE-SIG-B containing the STA-ID of the designated MU-MIMO STA as defined in Table 27-29 (Spatial Configuration subfield encoding)...[i]f there is only one User field (see Table 27-27 (User field format for a non-MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of spatial streams for the user in the RU is indicated by the NSTS field in the User field. If there is more than one User field (see Table 27-28 (User field for an MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the number of allocated spatial streams for each user in the RU is indicated by the Spatial Configuration field of the User field in HE-SIG-B.”); Section 27.3.2.6 (“UL MU transmissions are preceded by a Trigger frame

1 or frame carrying a TRS Control subfield from the AP. The Trigger frame or frame
2 carrying the TRS Control subfield indicates the parameters, such as the duration of
3 the HE TB PPDU, RU allocation, target RSSI and MCS (see 9.3.1.22 (Trigger frame
4 format), 9.2.4.6a.1 (TRS Control) and 26.5.3.3 (Non-AP STA behavior for UL MU
5 operation)), required to transmit an HE TB PPDU”); Section 27.3.10.8 (HE-SIG-B)
6 (“The HE-SIG-B field provides the OFDMA and DL MU-MIMO resource
7 allocation information to allow the STAs to look up the corresponding resources to
8 be used in the data portion of the frame.”); Section 27.3.15 (“SU-MIMO and DL-
9 MU-MIMO beamforming are techniques used by a STA with multiple antennas (the
10 beamformer) to steer signals using knowledge of the channel to improve throughput.
11 With SU-MIMO beamforming all space-time streams in the transmitted signal are
12 intended for reception at a single STA in an RU. With DL MU-MIMO beamforming,
13 disjoint subsets of the space-time streams are intended for reception at different
14 STAs in an RU of size greater than or equal to 106-tones”); Section 27.3.10.8.5 (HE-
15 SIG-B per user content) (“The User Specific field consists of multiple User fields.
16 The User fields follow the Common field of HE-SIG-B. The RU Allocation field in
17 the Common field and the position of the User field in the User Specific field
18 together identify the RU used to transmit a STA’s data...

Table 27-27—User field format for a non-MU-MIMO allocation

Bit	Subfield	Number of bits	Description
B0–B10	STA-ID	11	Set to a value of the element indicated from TXVECTOR parameter STA_ID_LIST (see 26.11.1 (STA_ID_LIST)).
B11–B13	NSTS	3	Number of space-time streams. Set to the number of space-time streams minus 1.
B14	Beamformed	1	Use of transmit beamforming. Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.
B15–B18	MCS	4	Modulation and coding scheme Set to n for MCS n , where $n = 0, 1, 2, \dots, 11$ Values 12 to 15 are reserved

Table 27-28—User field for an MU-MIMO allocation

Bit	Subfield	Number of bits	Description
B0–B10	STA-ID	11	Set to a value of element indicated from TXVECTOR parameter STA_ID_LIST (see 26.11.1 (STA_ID_LIST)).
B11–B14	Spatial Configuration	4	Indicates the number of spatial streams for a STA in an MU-MIMO allocation (see Table 27-29 (Spatial Configuration subfield encoding)).
B15–B18	MCS	4	Modulation and coding scheme. Set to n for MCS n , where $n = 0, 1, 2, \dots, 11$ Values 12 to 15 are reserved
B19	Reserved	1	Reserved and set to 0
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—If the STA-ID subfield is set to 2046, then the other subfields can be set to arbitrary values.			

Section 9.3.1.22 (Trigger frame format) (“A Trigger frame allocates resources for and solicits one or more HE TB PPDU transmissions. The Trigger frame also carries other information required by the responding STA to send an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the spatial streams of the solicited HE TB PPDU and the format is defined in Figure 9-64e (SS Allocation subfield format).

1 26. Each of the Accused Products is configured to receive an uplink
2 transmission from the receiving device through the phased array antenna. For
3 example, as with each Accused Product, the NETGEAR AX12 12-Stream AX6000
4 Wi-Fi Router RAX120 is configured to receive an uplink transmission (*e.g.*,
5 receiving an uplink transmission in response to a trigger frame soliciting an uplink
6 transmission, including, *e.g.*, HE TB PPDU, *e.g.*, HE TB feedback NDP, further
7 including, *e.g.*, receiving an uplink transmission that includes information regarding
8 an estimate of the channel state in, *e.g.*, an HE compressed beamforming/CQI report
9 carried in one or more HE Compressed Beamforming/CQI frames) from the
10 receiving device (*e.g.*, a STA, or HE beamformee) through the phased array antenna.
11 See, *e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3, 9.4.1.64,
12 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4,
13 26.7.5, 27.1.1, 27.3.10.10. See, *e.g.*, Section 26.7 (HE sounding protocol) (“Transmit
14 beamforming and DL MU-MIMO require knowledge of the channel state to
15 compute a steering matrix that is applied to the transmit signal to optimize reception
16 at one or more receivers. HE STAs use the HE sounding protocol to determine the
17 channel state information. The HE sounding protocol provides explicit feedback
18 mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-
19 based (TB) sounding, where the HE beamformee measures the channel using a
20 training signal (*i.e.*, an HE sounding NDP) transmitted by the HE beamformer and
21 sends back a transformed estimate of the channel state. The HE beamformer uses
22 this estimate to derive the steering matrix. The HE beamformee returns an estimate
23 of the channel state in an HE compressed beamforming/CQI report carried in one or
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more HE Compressed Beamforming/CQI frames.”); Section 26.7.3, Figures 26-6 and 26-7:

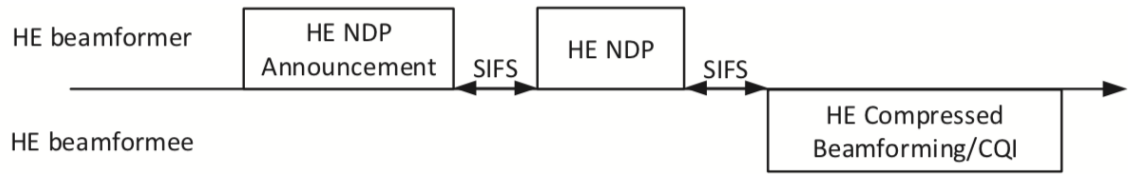


Figure 26-6—An example of the sounding protocol with a single HE beamformee

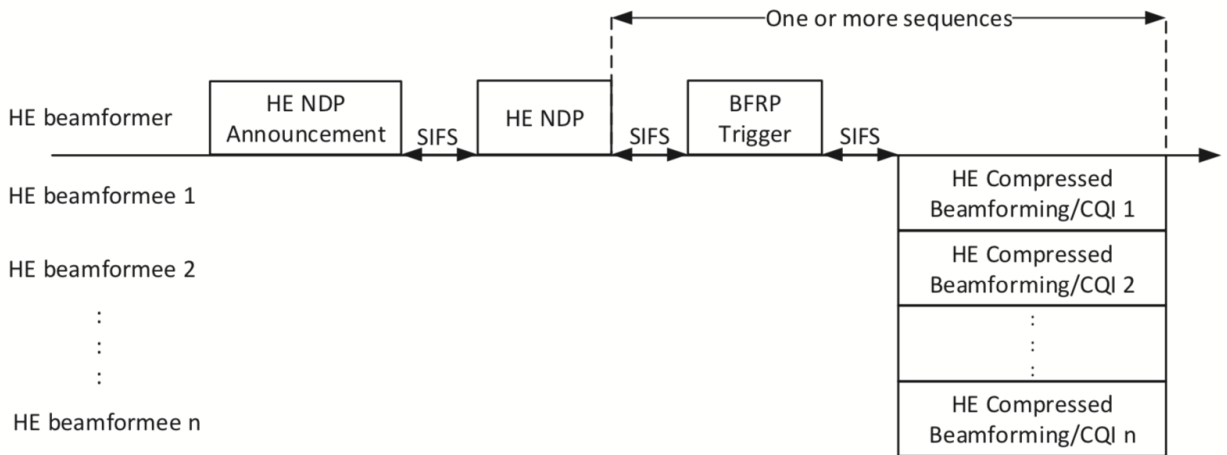


Figure 26-7—An example of the sounding protocol with more than one HE beamformee

; Section 26.7.3 (“An HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee’s MAC address in the RA field and also receives an HE sounding NDP a SIFS after the HE NDP Announcement frame shall transmit its HE compressed beamforming/CQI report a SIFS after the HE sounding NDP. The TXVECTOR parameter CH_BANDWIDTH for the PPDU containing the HE compressed beamforming/CQI report shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH_BANDWIDTH of the HE sounding NDP. An HE beamformee that receives an HE NDP Announcement frame as part of an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or MU feedback shall generate an HE compressed beamforming/CQI report using the

1 feedback type, Ng and codebook size indicated in the STA Info field. If the HE
 2 beamformee then receives a BFRP Trigger frame with a User Info field addressed
 3 to it, the HE beamformee transmits an HE TB PPDU containing the HE compressed
 4 beamforming/CQI report following the rules defined in 26.5.3.3 (Non-AP STA
 5 behavior for UL MU operation.”); Section 26.5.3 (UL MU operation) (“UL MU
 6 operation allows an AP to solicit simultaneous immediate response frames from one
 7 or more non-AP HE STAs”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field
 8 provides a means for the receiver to estimate the MIMO channel between the set of
 9 constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs)
 10 and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter
 11 provides training for NSTS space-time streams (spatial mapper inputs) used for the
 12 transmission of the PSDU. In an HE MU PPDU, the transmitter provides training
 13 for NSTS_{r,total} space-time streams used for the transmission of the PSDU(s) in the
 14 r-th RU. In an HE TB PPDU, the transmitter of user u in the r-th RU provides training
 15 for NSTS_{r,u} space-time streams used for the transmission of the PSDU. For each
 16 tone in the r-th RU, the MIMO channel that can be estimated is an $N_{RX} \times$
 17 $N_{STS,r,total}$ matrix. An HE transmission has a preamble that contains HE-LTF
 18 symbols, where the data tones of each HE-LTF symbol are multiplied by entries
 19 belonging to a matrix PHE-LTF, to enable channel estimation at the receiver.... In
 20 an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-
 21 LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the
 22 combination of HE-LTF type and GI duration is indicated in the Trigger frame that
 23 triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the
 24 combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit
 25 specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-
 26 LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”); Section
 27 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering
 28 matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ can be detected by the beamformer using

1 the beamforming feedback for subcarrier k from beamformee u , where $u =$
2 $0, 1, \dots, N_{\text{user}, r} - 1$. The feedback report format is described in 9.4.1.65 (HE
3 Compressed Beamforming Report field) and 9.4.1.66 (HE MU Exclusive
4 Beamforming Report field). The steering matrix that is computed (or updated) using
5 new beamforming feedback from some or all of participating beamformees might
6 replace the existing steering matrix Q_k for the next DL MU-MIMO data
7 transmission. For SU-MIMO beamforming, the steering matrix Q_k can be
8 determined from the beamforming feedback matrix V_k that is sent back to the
9 beamformer by the beamformee using the compressed beamforming feedback
10 matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback
11 matrix). The feedback report format is described in 9.4.1.65 (HE Compressed
12 Beamforming Report field.”)

13 27. Each of the Accused Products is configured to determine from the uplink
14 transmission if the receiving device should operatively associate with a different
15 beam downlink transmittable via the phased array antenna. For example, the
16 NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 is configured to
17 determine from information contained in the uplink transmission (*e.g.*, an uplink
18 transmission received in response to a trigger frame soliciting an uplink
19 transmission, including, *e.g.*, HE TB PPDU, *e.g.*, HE TB feedback NDP, further
20 including, *e.g.*, an uplink transmission that includes information regarding an
21 estimate of the channel state in, *e.g.*, an HE compressed beamforming/CQI report
22 carried in one or more HE Compressed Beamforming/CQI frames) if the receiving
23 device (*e.g.*, STA, or HE beamformee) that sent the uplink transmission should
24 operatively associate with a different beam downlink transmittable via the phased
25 array antenna. *See, e.g.*, NETGEAR Nighthawk RAX120 Data Sheet (“Nighthawk
26 AX12 WiFi 6 Router is powered by the industry’s latest WiFi 6 (802.11ax) standard
27 with 4 times increased data capacity in a dense environment to handle up to 30
28 devices in your growing home network. Blazing-fast combined WiFi speeds up to

1 6Gbps and AX optimized 64-bit 2.2GHz quad-core processor powers smart home
2 automation, ultra-smooth 4K UHD streaming, online gaming, and more.”; “WiFi 6
3 gives you improved network capacity for more WiFi devices. Have more fun with
4 the uninterrupted 4K/8K streaming, gaming, and the smart home experience. With
5 MU-MIMO, WiFi 6 supports up to eight simultaneous streams for the number of
6 users that can be served double at the same time as compared to an AC router.”; “12-
7 Stream WiFi 6”; “8 High-performance Antennas. Enjoy up to 1.5X more usable
8 WiFi coverage for things like Ultra-HD video & gaming.”; “Quad-core 2.2GHz
9 Processor. Engineered to deliver a new era of WiFi performance”; “8x8 MU-MIMO
10 enables up to four (4) 2x2 devices to stream content at the same time”; “High-
11 performance antennas—Eight (8) antennas extend wireless range coverage indoors
12 and out”; “Using multi-user MIMO technology, routers can stream data to multiple
13 devices simultaneously. That means faster downloads and smoother streaming for
14 your devices. WiFi 6 extends MU-MIMO to 8-stream support so it can support
15 double the number of simultaneous transmission as compared to 4x4 MU-MIMO
16 AC WiFi routers”; “This powerful processor is optimized for AX making intelligent
17 spontaneous decisions to schedule data traffic to maximize WiFi bandwidth
18 utilization.”). *See, e.g.*, IEEE 802.11ax Standard, at Sections 9.3.1.22, 9.4.1.64,
19 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.5, 26.5.1, 26.5.2, 26.5.3, 26.7, 26.7.1, 26.7.3, 26.7.3,
20 26.7.4, 26.7.5, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.10.7, 27.3.10.8,
21 27.3.10.9, 27.3.10.10, 27.3.15 – 27.3.15.3. *See, e.g.*, IEEE 802.11ax Standard at
22 Section 26.7.1 (“Transmit beamforming and DL MU-MIMO require knowledge of
23 the channel state to compute a steering matrix that is applied to the transmit signal
24 to optimize reception at one or more receivers. HE STAs use the HE sounding
25 protocol to determine the channel state information. The HE sounding protocol
26 provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB)
27 sounding and HE trigger-based (TB) sounding, where the HE beamformee measures
28 the channel using a training signal (i.e., an HE sounding NDP) transmitted by the

1 HE beamformer and sends back a transformed estimate of the channel state. The HE
2 beamformer uses this estimate to derive the steering matrix.”); Section 27.3.15.1
3 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix
4 $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ can be detected by the beamformer using the
5 beamforming feedback for subcarrier k from beamformee u , where $u = 0, 1, \dots, N_{user,r}$
6 -1 . The feedback report format is described in 9.4.1.65 (HE Compressed
7 Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report
8 field). The steering matrix that is computed (or updated) using new beamforming
9 feedback from some or all of participating beamformees might replace the existing
10 steering matrix Q_k for the next DL MU-MIMO data transmission. For SU-MIMO
11 beamforming, the steering matrix Q_k can be determined from the beamforming
12 feedback matrix V_k that is sent back to the beamformer by the beamformee using
13 the compressed beamforming feedback matrix format as defined in 19.3.12.3.6
14 (Compressed beamforming feedback matrix). The feedback report format is
15 described in 9.4.1.65 (HE Compressed Beamforming Report field.”); Section
16 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed
17 Beamforming Report field carries the average SNR of each space-time stream and
18 compressed beamforming feedback matrices V for use by a transmit beamformer to
19 determine steering matrices Q , as described in 10.32.3 (Explicit feedback
20 beamforming) and 19.3.12.3 (Explicit feedback beamforming”); Section 9.1.4.66
21 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive
22 Beamforming Report field carries explicit feedback in the form of delta SNRs. The
23 information in the HE Compressed Beamforming Report field and the HE MU
24 Exclusive Beamforming Report field can be used by the transmit MU beamformer
25 to determine the steering matrices Q , as described in 27.3.3.1 (DL MU-MIMO”);
26 Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-
27 RU average SNRs of each space-time stream, where each per-RU average SNR is
28 the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback

1 is being requested.”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a
 2 means for the receiver to estimate the MIMO channel between the set of
 3 constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs)
 4 and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter
 5 provides training for NSTS space-time streams (spatial mapper inputs) used for the
 6 transmission of the PSDU. In an HE MU PPDU, the transmitter provides training
 7 for NSTS_{r,total} space-time streams used for the transmission of the PSDU(s) in the
 8 r-th RU. In an HE TB PPDU, the transmitter of user u in the r-th RU provides training
 9 for NSTS_{r,u} space-time streams used for the transmission of the PSDU. For each
 10 tone in the r-th RU, the MIMO channel that can be estimated is an $N_{RX} \times$
 11 NSTS_{r,total} matrix. An HE transmission has a preamble that contains HE-LTF
 12 symbols, where the data tones of each HE-LTF symbol are multiplied by entries
 13 belonging to a matrix PHE-LTF, to enable channel estimation at the receiver.... In
 14 an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-
 15 LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the
 16 combination of HE-LTF type and GI duration is indicated in the Trigger frame that
 17 triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the
 18 combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit
 19 specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-
 20 LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”).

21 28. Each of the Accused Products is configured to allow the receiving device
 22 to operatively associate with the different beam downlink if determining that the
 23 receiving device should operatively associate with the different beam downlink. For
 24 example, as with each Accused Product, the NETGEAR AX12 12-Stream AX6000
 25 Wi-Fi Router RAX120 is configured to allow the receiving device (e.g., STA or HE
 26 beamformee) to operatively associate with a different beam downlink if determining
 27 that the receiving device should operatively associate with the different beam
 28 downlink. *See, e.g.,* IEEE 802.11ax Standard, at Sections 9.3.1.22, 9.4.1.64,

1 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.5, 26.5.1, 26.5.2, 26.5.3, 26.7, 26.7.1, 26.7.3, 26.7.3,
2 26.7.4, 26.7.5, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.10.7, 27.3.10.8,
3 27.3.10.9, 27.3.10.10, 27.3.15 – 27.3.15.3. *See, e.g.*, IEEE 802.11ax Standard,
4 Section 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO
5 steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ can be detected by the beamformer using
6 the beamforming feedback for subcarrier k from beamformee u , where $u =$
7 $0, 1, \dots, N_{user,r} - 1$. The feedback report format is described in 9.4.1.65 (HE Compressed
8 Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report
9 field). The steering matrix that is computed (or updated) using new beamforming
10 feedback from some or all of participating beamformees might replace the existing
11 steering matrix Q_k for the next DL MU-MIMO data transmission. For SU-MIMO
12 beamforming, the steering matrix Q_k can be determined from the beamforming
13 feedback matrix V_k that is sent back to the beamformer by the beamformee using the
14 compressed beamforming feedback matrix format as defined in 19.3.12.3.6
15 (Compressed beamforming feedback matrix). The feedback report format is
16 described in 9.4.1.65 (HE Compressed Beamforming Report field.”); Section
17 27.3.15.2 (“After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer
18 reconstructs $V_{k,u}$ using Equation (19-79). For SU-MIMO beamforming, the
19 beamformer uses $V_{k,0}$ matrix to determine the steering matrix Q_k . For DL MU-MIMO
20 beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots,$
21 $Q_{k,N_{user,r}-1}]$ using $V_{k,u}$ and Delta $\Delta SNR_{k,u}$ ($0 \leq u \leq N_{user,r} - 1$) in order to suppress crosstalk
22 between participating beamformees. The method used by the beamformer to
23 calculate the steering matrix Q_k is implementation specific.”); Section 27.3.2.5
24 (Resource indication and User identification in an HE MU PPDU) (“The number of
25 users in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols
26 Or MU-MIMO Users field in HE-SIG-A. The allocated spatial streams for each user
27 and the total number of spatial streams are indicated in the Spatial Configuration
28 field of User field in HE-SIG-B containing the STA-ID of the designated MU-

1 MIMO STA as defined in Table 27-29 (Spatial Configuration subfield
2 encoding)...[i]f there is only one User field (see Table 27-27 (User field format for
3 a non-MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the
4 number of spatial streams for the user in the RU is indicated by the N_{STS} field in the
5 User field. If there is more than one User field (see Table 27-28 (User field for an
6 MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the
7 number of allocated spatial streams for each user in the RU is indicated by the Spatial
8 Configuration field of the User field in HE-SIG-B.”); Section 27.3.2.6 (“UL MU
9 transmissions are preceded by a Trigger frame or frame carrying a TRS Control
10 subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield
11 indicates the parameters, such as the duration of the HE TB PPDU, RU allocation,
12 target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control)
13 and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit
14 an HE TB PPDU.”); Section 9.3.1.22 (Trigger frame format) (“A Trigger frame
15 allocates resources for and solicits one or more HE TB PPDU transmissions. The
16 Trigger frame also carries other information required by the responding STA to send
17 an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the
18 spatial streams of the solicited HE TB PPDU and the format is defined in Figure 9-
19 64e (SS Allocation subfield format).”); Section 26.5.3.3.3 (TXVECTOR parameters
20 for HE TB PPDU response to Trigger frame).

21 ///

22 29. Each of the Accused Products is configured to actively probe the receiving
23 device by generating a signal to initiate that the phased array antenna transmits at
24 least one downlink transmittable message over the different beam downlink, and
25 gathering signal parameter information from uplink transmittable messages received
26 from the receiving device through the phased array antenna. For example, as with
27 each Accused Product, the NETGEAR AX12 12-Stream AX6000 Wi-Fi Router
28 RAX120 actively probes the receiving device by generating a signal causing the

1 phased array antenna to transmit at least one downlink transmittable message over
2 the different beam downlink (*e.g.*, one or more messages sent to elicit a responsive
3 uplink transmission from the receiving STA, including, *e.g.*, HE PPDU that carries
4 a trigger frame, *e.g.*, messages soliciting feedback or including parameters for
5 feedback from HE beamformee(s) such as, *e.g.*, messages pursuant to HE non-TB
6 or HE TB sounding, such as, *e.g.*, NDP Announcement, HE sounding NDP frame,
7 Trigger frame), and gathering signal parameter information (*e.g.*, information in an
8 HE compressed beamforming/CQI report, RSSI, SNR, delta SNR measurements for
9 spatial stream(s), or information gathered from training fields in uplink PPDUs)
10 from uplink transmittable messages received from the receiving device (*e.g.*, STA
11 or HE beamformee) through the phased array antenna (*e.g.*, uplink transmittable
12 messages received from the STA such as in response to a trigger frame soliciting an
13 uplink transmission, including, *e.g.*, HE TB PPDUs, further including, *e.g.*, an uplink
14 transmission that includes information regarding an estimate of the channel state in,
15 *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE
16 Compressed Beamforming/CQI frames). See, *e.g.*, IEEE 802.11ax Standard,
17 Sections 9.6.31.2, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.7.1 – 26.7.5, 27.3.1,
18 27.3.1.1, 27.3.2.5, 27.3.2.6, 27.3.3, 27.3.3.1, 27.3.3.1.1, 27.3.3.1.2, 27.3.3.2.2, -
19 27.3.3.2.4, 27.3.4, 9.3.1.22, 26.5.3, 27.3.10.8, 27.3.10.8.5, 27.3.10.10, 27.3.15,
20 27.3.16, 27.3.17. See, *e.g.*, IEEE 802.11ax Standard, Section 26.7 (“Transmit
21 beamforming and DL MU-MIMO require knowledge of the channel state to
22 compute a steering matrix that is applied to the transmit signal to optimize reception
23 at one or more receivers. HE STAs use the HE sounding protocol to determine the
24 channel state information. The HE sounding protocol provides explicit feedback
25 mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-
26 based (TB) sounding, where the HE beamformee measures the channel using a
27 training signal (*i.e.*, an HE sounding NDP) transmitted by the HE beamformer and
28 sends back a transformed estimate of the channel state. The HE beamformer uses

1 this estimate to derive the steering matrix.”); Section 27.3.2.5 (“HE-LTF symbols in
2 the DL HE MU PPDU are used to measure the channel for the space-time streams
3 intended for the STA and can also be used to measure the channel for the interfering
4 space-time streams.”); Section 27.3.4 (HE PPDU formats) (“Four HE PPDU formats
5 are defined: HE SU PPDU, HE MU PPDU, HE ER SU PPDU, and HE TB PPDU.
6 The HE sounding NDP is a variant of the HE SU PPDU and defined in 27.3.16 (HE
7 sounding NDP). The HE TB feedback NDP is a variant of the HE TB PPDU and
8 defined in 27.3.17 (HE TB feedback NDP)”); Section 27.3.10.10 (HE-LTF) (“The
9 HT-LTF field provides a means for the receiver to estimate the MIMO channel
10 between the set of constellation mapper outputs (or, if STBC is applied, the STBC
11 encoder outputs) and the receive chains.”); Section 26.5.3.3.3 (TXVECTOR
12 parameters for HE TB PPDU response to Trigger frame); Section 27.3.2.6 (“UL MU
13 transmissions are preceded by a Trigger frame or frame carrying a TRS Control
14 subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield
15 indicates the parameters, such as the duration of the HE TB PPDU, RU allocation,
16 target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control)
17 and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit
18 an HE TB PPDU.”); Section 9.3.1.22 (Trigger frame format) (“A Trigger frame
19 allocates resources for and solicits one or more HE TB PPDU transmissions. The
20 Trigger frame also carries other information required by the responding STA to send
21 an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the
22 spatial streams of the solicited HE TB PPDU and the format is defined in Figure 9-
23 64e (SS Allocation subfield format).”) Section 27.2.2 (TXVECTOR and
24 RXVECTOR parameters) (EXPANSION_MAT, CHAN_MAT, DELTA_SNR,
25 SNR, CQI, STBC, GI_TYPE, RSSI, RSSI_LEGACY, NUM_STS,
26 RU_ALLOCATION, BEAMFORMED, HE_LTF_TYPE, HE_LTF_MODE,
27 NUM_HE_LTF, STARTING_STS_NUM, PREAMBLE_TYPE,
28 TRIGGER_METHOD, BEAM_CHANGE, BSS_COLOR, UPLINK_FLAG,

1 STA_ID_LIST, NDP_REPORT, FEEDBACK_STATUS,
 2 RU_TONE_SET_INDEX); Section 26.5.3.2.4 (Allowed settings of the Trigger
 3 frame fields and TRS Control subfield) (“An AP shall transmit an HE PPDU that
 4 carries a Trigger frame or frame that includes a TRS Control subfield with the
 5 TXVECTOR parameter BEAM_CHANGE set to 1.”). Section 26.5.3.3 (Non-AP
 6 STA behavior for UL MU operation) (“UL MU operation allows an AP to solicit
 7 simultaneous immediate response frames from one or more non-AP STAs. A non-
 8 AP STA shall follow the rules in this subclause for the transmission of response
 9 frames in an HE TB PPDU unless the Trigger frame is an MU-RTS Trigger frame,
 10 in which case the response is a CTS frame sent in a non-HT PPDU (see 26.2.6 (MU-
 11 RTS Trigger/CTS frame exchange procedure)).”); Section 26.11 (Setting
 12 TXVECTOR parameters for an HE PPDU); Section 26.11.3 (BEAM_CHANGE)
 13 (“An HE STA uses the TXVECTOR parameter BEAM_CHANGE to indicate a
 14 change in the spatial mapping of the pre-HE-STF portion of the PPDU and the first
 15 symbol of HE-LTF (see Table 27-1 (TXVECTOR and RXVECTOR parameter)).
 16 An HE STA that transmits an HE SU PPDU or an HE ER SU PPDU shall set the
 17 TXVECTOR parameter BEAM_CHANGE to 1 if one or more of the following
 18 conditions are met: - The number of spatial streams is greater than 2; - The PPDU
 19 is the first PPDU in a TXOP; - The PPDU carries a Trigger frame.”).

20 30. The Accused Products determine a current position of the receiving device
 21 relative to the phased array antenna from the uplink transmission received from the
 22 receiving device through the phased array antenna. For example, as with each
 23 Accused Product, the NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120
 24 determines a current position of the receiving device (*e.g.*, STA or HE beamformee)
 25 relative to the phased array antenna from the uplink transmission received from the
 26 receiving device through the phased array antenna (*e.g.*, uplink transmission
 27 received from the STA such as in response to a trigger frame soliciting an uplink
 28 transmission, including, *e.g.*, HE TB PPDUs, further including, *e.g.*, an uplink

1 transmission that includes information regarding an estimate of the channel state in,
 2 *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE
 3 Compressed Beamforming/CQI frames). *See, e.g.*, NETGEAR Nighthawk RAX120
 4 Data Sheet (“Nighthawk AX12 WiFi 6 Router is powered by the industry’s latest
 5 WiFi 6 (802.11ax) standard with 4 times increased data capacity in a dense
 6 environment to handle up to 30 devices in your growing home network. Blazing-fast
 7 combined WiFi speeds up to 6Gbps and AX optimized 64-bit 2.2GHz quad-core
 8 processor powers smart home automation, ultra-smooth 4K UHD streaming, online
 9 gaming, and more.”; “WiFi 6 gives you improved network capacity for more WiFi
 10 devices. Have more fun with the uninterrupted 4K/8K streaming, gaming, and the
 11 smart home experience. With MU-MIMO, WiFi 6 supports up to eight simultaneous
 12 streams for the number of users that can be served double at the same time as
 13 compared to an AC router.”; “12-Stream WiFi 6”; “8 High-performance Antennas.
 14 Enjoy up to 1.5X more usable WiFi coverage for things like Ultra-HD video &
 15 gaming.”; “Quad-core 2.2GHz Processor. Engineered to deliver a new era of WiFi
 16 performance”; “8x8 MU-MIMO enables up to four (4) 2x2 devices to stream content
 17 at the same time”; “High-performance antennas—Eight (8) antennas extend wireless
 18 range coverage indoors and out”; “Using multi-user MIMO technology, routers can
 19 stream data to multiple devices simultaneously. That means faster downloads and
 20 smoother streaming for your devices. WiFi 6 extends MU-MIMO to 8-stream
 21 support so it can support double the number of simultaneous transmission as
 22 compared to 4x4 MU-MIMO AC WiFi routers”; “This powerful processor is
 23 optimized for AX making intelligent spontaneous decisions to schedule data traffic
 24 to maximize WiFi bandwidth utilization.”). *See, e.g.*, IEEE 802.11ax Standard,
 25 Sections 9.6.31.2, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 26.7.1 – 26.7.5, 27.3.1,
 26 27.3.1.1, 27.3.2.5, 27.3.2.6, 27.3.3, 27.3.3.1, 27.3.3.1.1, 27.3.3.1.2, 27.3.3.2.2, -
 27 27.3.3.2.4, 27.3.4, 9.3.1.22, 26.5.3, 27.3.10.8, 27.3.10.8.5, 27.3.10.10, 27.3.15,
 28 27.3.16, 27.3.17, Table 27-1. *See, e.g.*, IEEE 802.11ax Standard, at Section 27.3.1.1

1 (“The transmission within an RU in a PDU may be single stream to one user,
 2 spatially multiplexed to one user (SU-MIMO), or spatially multiplexed to multiple
 3 users (MU-MIMO).”); Section 27.3.10.10 (HE-LTF) (“The HT-LTF field provides
 4 a means for the receiver to estimate the MIMO channel between the set of
 5 constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs)
 6 and the receive chains.”); Section 27.3.15 (SU-MIMO and DL-MIMO
 7 beamforming); Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming
 8 are techniques used by a STA with multiple antennas (the beamformer) to steer
 9 signals using knowledge of the channel to improve throughput. With SU-MIMO
 10 beamforming all space-time streams in the transmitted signal are intended for
 11 reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint
 12 subsets of the space-time streams are intended for reception at different STAs in an
 13 RU of size greater than or equal to 106-tones.”); Section 27.3.15.2 (“After receiving
 14 the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using
 15 Equation (19-79). For SU-MIMO beamforming, the beamformer uses $V_{k,0}$ matrix to
 16 determine the steering matrix Q_k . For DL MU-MIMO beamforming, the beamformer
 17 may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ using $V_{k,u}$ and Delta
 18 $\Delta SNR_{k,u}$ ($0 \leq u \leq N_{user,r}-1$) in order to suppress crosstalk between participating
 19 beamformees. The method used by the beamformer to calculate the steering matrix
 20 Q_k is implementation specific.”).

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

26 32. By at least the filing and service of the original Complaint for patent
 27 infringement in this United States District Court for the Central District of California
 28 on April 19, 2017, and July 14, 2017, respectively, Defendant had knowledge of the

1 '728 Patent, and that its actions resulted in a direct infringement of the '728 Patent.
2 Defendant also knew or was willfully blind that its actions would induce direct
3 infringement by others and intended that its actions would induce direct
4 infringement by others.

5 33.Despite this knowledge of the '728 Patent, Defendant actively induced,
6 and continues to induce, such infringement by, among other things, providing user
7 manuals and other instruction material for its Accused Products that induce its
8 customers to use the Accused Products in their normal and customary way to
9 infringe the '728 Patent. For example, Defendant's website provided, and continues
10 to provide, instructions for using the Accused Products on wireless communication
11 systems, and to utilize their 802.11ax beamforming and MU-MIMO functionalities.
12 Defendant sold, and continues to sell, the Accused Products to customers despite its
13 knowledge of the '728 Patent. Defendant manufactured and imported into the United
14 States, and continues to do so, the Accused Products for sale and distribution to its
15 customers, despite its knowledge of the '728 Patent. Through its continued
16 manufacture, importation, and sales of its Accused Products, Defendant specifically
17 intended for its customers to infringe claims of the '728 Patent. Further, Defendant
18 was aware that these normal and customary activities would infringe the '728 Patent.
19 Defendant performed, and continues to perform, acts that constitute induced
20 infringement, and that would induce actual infringement, with knowledge of the
21 '728 Patent and with the knowledge or willful blindness that the induced acts would
22 constitute direct infringement.

23 34.Accordingly, a reasonable inference is that Defendant specifically intended
24 for others, such as its customers, to directly infringe one or more claims of the '728
25 Patent in the United States because Defendant had knowledge of the '728 Patent and
26 actively induced others (e.g., its customers) to directly infringe the '728 Patent by
27 using, selling, or offering to sell the Accused Products and the 802.11ax MU-MIMO
28 functionality within the Accused Products.

RUSS, AUGUST & KABAT

1 35. Defendant also contributorily infringes by making, using, selling, offering
2 to sell, and/or importing the Accused Products, knowing they constitute a material
3 part of the invention, are especially made or adapted for use in infringing, and that
4 they are not staple articles of commerce capable of substantial non-infringing use.

5 36. Defendant also infringes claims 3, 5, and 12, of the '728 Patent, directly
6 and through inducing infringement, for similar reasons as explained above with
7 respect to Claim 4.

8 37. The '728 Patent is valid and enforceable.

9 38. Vivato has complied with 35 U.S.C. § 287 and it does not bar recovery of
10 pre-suit damages at least because Vivato only asserts method claims of the '728
11 Patent.

12 39. As a result of Defendant's infringement of the '728 Patent, Defendant's
13 infringement of the '728 Patent has damaged Vivato, and Defendant is liable to
14 Vivato in an amount to be determined at trial that compensates Vivato for the
15 infringement, which by law can be no less than a reasonable royalty, together with
16 interest and costs as fixed by the Court.

17 40. As a result of Defendant's infringement of the '728 Patent, Vivato has
18 suffered irreparable harm and will continue to suffer loss and injury. Defendant's
19 infringing activities have injured and will continue to injure Vivato, unless and until
20 this Court enters an injunction prohibiting further infringement of the '728 Patent,
21 and, specifically, enjoining further manufacture, use, sale, importation, and/or offers
22 for sale that come within the scope of the patent claims.

23 **V. COUNT TWO: INFRINGEMENT OF UNITED STATES**
24 **PATENT NO. 10,594,376**

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

27 42. On March 17, 2020, United States Patent No. 10,594,376 ("the '376
28 Patent") was duly and legally issued for inventions entitled "Directed Wireless

1 Communication.” Vivato owns the ’376 Patent and holds the right to sue and recover
 2 damages for infringement thereof. A copy of the ’376 Patent is attached hereto as
 3 Exhibit B.

4 43. Defendant has directly infringed and continues to directly infringe
 5 numerous claims of the ’376 Patent, including at least claim 1, by manufacturing,
 6 using, selling, offering to sell, and/or importing into the United States Wi-Fi 6 access
 7 points and routers supporting MU-MIMO, including without limitation access points
 8 and routers utilizing the IEEE 802.11ax or “Wi-Fi 6” standard (e.g., home solutions
 9 including Nighthawk Series such as Nighthawk Dual-Band WiFi 6 Routers with
 10 MU-MIMO including RAX200, RAX120, RAX80, RAX78, RAX75, RAX50,
 11 RAX48, RAX50S, RAX45, RAX43, RAX42, RAX40, RAX38, RAX35, RAX20,
 12 RAX15, RAX10, LAX20, RAXE500, RAXE450, R6700AX, Archer Series
 13 including AX73, AX11000, AX1800 4-Stream, AX1500, Orbi Wi-Fi 6 Series
 14 including RBK853, RBK852, RBK842, RBS850, RBR850, RBK854, RBK752,
 15 RBK753, RBK753S, RBK754, CBK752, RBX750, Nighthawk Dual-Band WiFi 6
 16 Mesh including MK62, MK63S, MK64, MK83, MS60, MS80, Gaming Series
 17 including Nighthawk 6-Stream WiFi 6 Gaming Router XR1000, and business
 18 solutions including Orbi Pro WiFi 6 Series including SXX80, SXX30B3, SXR80,
 19 SXX80B3, SXX30, SXR30, SXS30, SXS80, SXX80B4 as well as AX3600 Dual
 20 band PoE Multi-Gig WiFi 6 Access Point WAX620, AX1800 Dual Band PoE Multi-
 21 Gig Insight Managed WiFi 6 Access Point WAX610 / WAX610PA, AX1800 Dual
 22 Band PoE multi-Gig Insight Managed WiFi 6 Outdoor Access Point WAX610Y,
 23 Essentials WiFi 6 AX1800 Dual Band Access Point WAX204, Essentials WiFi 6
 24 AX1800 WAX214 / WAX214PA, WAX218 / WAX218PA, WAX610Y /
 25 WAX610PA) as well as access points and routers supporting MU-MIMO that utilize
 26 the IEEE 802.11ac standard (e.g., the Orbi Series, including Orbi Pro WiFi 5 SRK60,
 27 SRK60B03, SRC60, SRR60, SRS60, SRK60B04, AD7200-Nighthawk AD7200-
 28 Nighthawk X10 Smart WiFi Router Model R9000, AC5300-Nighthawk X8 Tri-

1 Band WiFi Router Model R8500, AC2600-Nighthawk X4S Smart WiFi Gaming
 2 Router Model R7800, AC2350-Nighthawk X4 AC2350 Dual Band WiFi Router
 3 Model R7500, AC2300-Nighthawk Smart WiFi Router with MU-MIMO Model
 4 R7000P, AC5000-Nighthawk X8 Smart WiFi Router Model R8300, AC1900-WiFi
 5 Range Extender - Essentials Edition Model EX6400, AC2200-Nighthawk X4 WiFi
 6 Range Extender Model EX7300, AC1200-Dual Band WiFi Range Extender Model
 7 EX6200, AC1200-WiFi Range Extender Model EX6150, AC WiFi Business Access
 8 Point Model WAC510, ProSAFE 4 x 4 Wave 2 Wireless-AC Model WAC740,
 9 AC4000-Nighthawk X6S Tri-Band WiFi Router With MU-MIMO Model R8000P,
 10 AD7000-Nighthawk X10 Smart WiFi Router Model R8900, AC3000-Nighthawk
 11 X6S Smart WiFi Router with MU-MIMO Model R7900P, and AC1900-Nighthawk
 12 Smart WiFi Router with MU-MIMO Model R6900P, AC1750 Gaming Router
 13 XR300, AC2600 Gaming Router XR500, AC2600 Gaming Router XRM570,
 14 AC4000 WiFi Router R8000P, AC3200 WiFi Router R8000, AC1900 WiFi Router
 15 R8000, R6700, R6400, R6350, R6330, R6850, R7850,) (collectively, the “’376
 16 Accused Products”). Defendant is liable for infringement of the ’376 Patent pursuant
 17 to 35 U.S.C. § 271(a).

18 44.The ’376 Accused Products satisfy all claim limitations of numerous
 19 claims of the ’376 Patent, including Claim 1. The following paragraphs compare
 20 limitations of Claim 1 to an exemplary ’376 Accused Product, the NETGEAR
 21 Nighthawk AX12 12-Stream AX6000 Wi-Fi Router RAX120 wireless access point.
 22 *See, e.g.,* NETGEAR Nighthawk RAX120 Data Sheet.¹

23 45.Each of the ’376 Accused Products comprises a data-communications
 24 networking apparatus. For example, the NETGEAR AX12 12-Stream AX6000 Wi-
 25 Fi Router RAX120 is a data-communications networking apparatus. .
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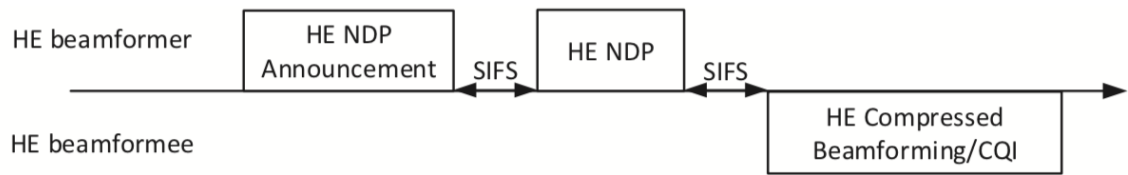
28 ¹ *See* NETGEAR Nighthawk AX12 12-Stream AX6000 Wi-Fi Router RAX120 Data Sheet,
 available at https://www.netgear.com/media/RAX120_DS_tcm148-120134.pdf

1 Each of the '376 Accused Products comprises a processor configured to generate a
2 probing signal for transmission to at least a first client device and a second client
3 device. For example, as with each '376 Accused Product, the NETGEAR AX12 12-
4 Stream AX6000 Wi-Fi Router RAX120 has at least one processor (*e.g.*, one or more
5 central processing units (CPUs), Wi-Fi processors, a baseband processor in the Wi-
6 Fi 6 radio, as examples) for generating signals for transmission. *See, e.g.*,
7 NETGEAR Nighthawk RAX120 Data Sheet (“Nighthawk AX12 WiFi 6 Router is
8 powered by the industry’s latest WiFi 6 (802.11ax) standard with 4 times increased
9 data capacity in a dense environment to handle up to 30 devices in your growing
10 home network. Blazing-fast combined WiFi speeds up to 6Gbps and AX optimized
11 64-bit 2.2GHz quad-core processor powers smart home automation, ultra-smooth
12 4K UHD streaming, online gaming, and more.”; “WiFi 6 gives you improved
13 network capacity for more WiFi devices. Have more fun with the uninterrupted
14 4K/8K streaming, gaming, and the smart home experience. With MU-MIMO, WiFi
15 6 supports up to eight simultaneous streams for the number of users that can be
16 served double at the same time as compared to an AC router.”; “12-Stream WiFi 6”;
17 “8 High-performance Antennas. Enjoy up to 1.5X more usable WiFi coverage for
18 things like Ultra-HD video & gaming.”; “Quad-core 2.2GHz Processor. Engineered
19 to deliver a new era of WiFi performance”; “8x8 MU-MIMO enables up to four (4)
20 2x2 devices to stream content at the same time”; “High-performance antennas—
21 Eight (8) antennas extend wireless range coverage indoors and out”; “Using multi-
22 user MIMO technology, routers can stream data to multiple devices simultaneously.
23 That means faster downloads and smoother streaming for your devices. WiFi 6
24 extends MU-MIMO to 8-stream support so it can support double the number of
25 simultaneous transmission as compared to 4x4 MU-MIMO AC WiFi routers”; “This
26 powerful processor is optimized for AX making intelligent spontaneous decisions to
27 schedule data traffic to maximize WiFi bandwidth utilization.”). For a further
28 example, as with each '376 Accused Product, the NETGEAR AX12 12-Stream

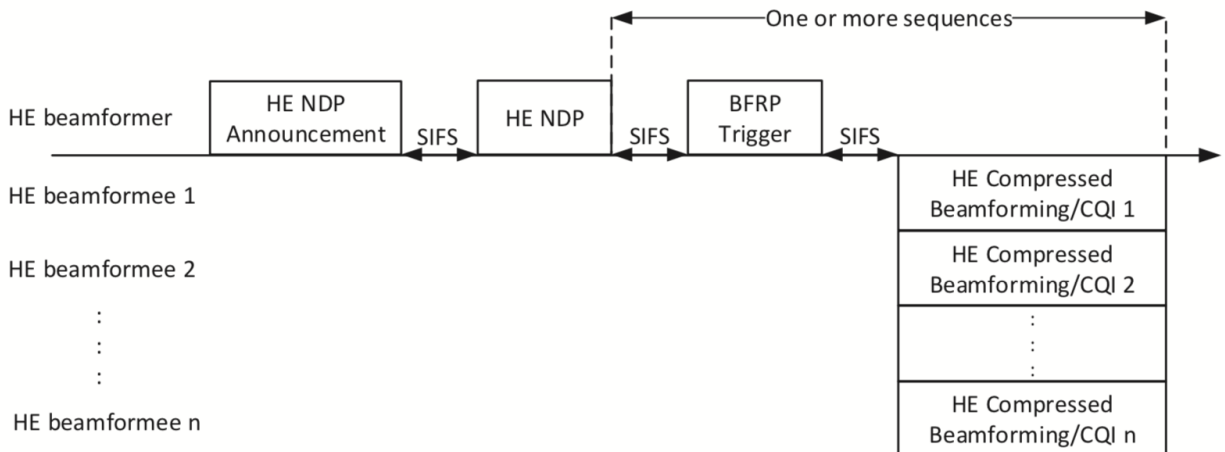
1 AX6000 Wi-Fi Router RAX120 generates a probing signal for transmission (*e.g.*, a
2 probing signal transmission that triggers or elicits a responsive transmission from
3 each of a first client device and a second client device, such as NDP Announcement,
4 HE sounding NDP, Beamforming Report trigger frames pursuant to High Efficiency
5 (HE) channel sounding, including preamble training fields allowing an estimate of
6 the channel for MU-MIMO) to at least a first client device and a second client device
7 (*e.g.*, a first non-AP STA / HE beamformee and a second non-AP STA / HE
8 beamformee). *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3,
9 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3,
10 26.7.4, 26.7.5, 27.1.1. *See, e.g.*, Section 26.7 (HE sounding protocol) (“Transmit
11 beamforming and DL MU-MIMO require knowledge of the channel state to
12 compute a steering matrix that is applied to the transmit signal to optimize reception
13 at one or more receivers. HE STAs use the HE sounding protocol to determine the
14 channel state information. The HE sounding protocol provides explicit feedback
15 mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-
16 based (TB) sounding, where the HE beamformee measures the channel using a
17 training signal (*i.e.*, an HE sounding NDP) transmitted by the HE beamformer and
18 sends back a transformed estimate of the channel state. The HE beamformer uses
19 this estimate to derive the steering matrix. The HE beamformee returns an estimate
20 of the channel state in an HE compressed beamforming/CQI report carried in one or
21 more HE Compressed Beamforming/CQI frames.”); Section 26.7.3, Figures 26-6
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1 and 26-7; Section 26.7.3 (“An HE beamformee that receives an HE NDP
 2 Announcement frame from an HE beamformer with which it is associated and that
 3 contains the HE beamformee’s MAC address in the RA field and also receives an
 4 HE sounding NDP a SIFS after the HE NDP Announcement frame shall transmit its
 5 HE compressed beamforming/CQI report a SIFS after the HE sounding NDP. The
 6 TXVECTOR parameter CH_BANDWIDTH for the PPDU containing the HE
 7 compressed beamforming/CQI report shall be set to indicate a bandwidth not wider
 8 than that indicated by the RXVECTOR parameter CH_BANDWIDTH of the HE
 9 sounding NDP. An HE beamformee that receives an HE NDP Announcement frame
 10 as part of an HE TB sounding sequence with a STA Info field addressed to it
 11 soliciting SU or MU feedback shall generate an HE compressed beamforming/CQI
 12 report using the feedback type, N_g and codebook size indicated in the STA Info field.
 13 If the HE beamformee then receives a BFRP Trigger frame with a User Info field
 14 addressed to it, the HE beamformee transmits an HE TB PPDU containing the HE
 15 compressed beamforming/CQI report following the rules defined in 26.5.3.3 (Non-



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20 **Figure 26-6—An example of the sounding protocol with a single HE beamformee**



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28 **Figure 26-7—An example of the sounding protocol with more than one HE beamformee**

1 AP STA behavior for UL MU operation.”); Section 26.5.3 (UL MU operation)
 2 (“UL MU operation allows an AP to solicit simultaneous immediate response frames
 3 from one or more non-AP HE STAs”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF
 4 field provides a means for the receiver to estimate the MIMO channel between the
 5 set of constellation mapper outputs (or, if STBC is applied, the STBC encoder
 6 outputs) and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the
 7 transmitter provides training for N_{STS} space-time streams (spatial mapper inputs)
 8 used for the transmission of the PSDU. In an HE MU PPDU, the transmitter provides
 9 training for $N_{STS,r,total}$ space-time streams used for the transmission of the PSDU(s)
 10 in the r -th RU. In an HE TB PPDU, the transmitter of user u in the r -th RU provides
 11 training for $N_{STS,r,u}$ space-time streams used for the transmission of the PSDU. For
 12 each tone in the r -th RU, the MIMO channel that can be estimated is an $N_{RX} \times$
 13 $N_{STS,r,total}$ matrix. An HE transmission has a preamble that contains HE-LTF symbols,
 14 where the data tones of each HE-LTF symbol are multiplied by entries belonging to
 15 a matrix P_{HE-LTF} , to enable channel estimation at the receiver.... In an HE SU PPDU,
 16 HE MU PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI
 17 duration is indicated in HE-SIG-A field. In an HE TB PPDU, the combination of
 18 HE-LTF type and GI duration is indicated in the Trigger frame that triggers
 19 transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the
 20 combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit
 21 specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-
 22 LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”); Section
 23 27.3.15.1 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering
 24 matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ can be detected by the beamformer using the
 25 beamforming feedback for subcarrier k from beamformee u , where $u = 0, 1, \dots, N_{user,r}$
 26 -1 . The feedback report format is described in 9.4.1.65 (HE Compressed
 27 Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report
 28 field). The steering matrix that is computed (or updated) using new beamforming

1 feedback from some or all of participating beamformees might replace the existing
2 steering matrix Q_k for the next DL MU-MIMO data transmission. For SU-MIMO
3 beamforming, the steering matrix Q_k can be determined from the beamforming
4 feedback matrix V_k that is sent back to the beamformer by the beamformee using the
5 compressed beamforming feedback matrix format as defined in 19.3.12.3.6
6 (Compressed beamforming feedback matrix). The feedback report format is
7 described in 9.4.1.65 (HE Compressed Beamforming Report field.”). Section
8 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed
9 Beamforming Report field carries the average SNR of each space-time stream and
10 compressed beamforming feedback matrices V for use by a transmit beamformer to
11 determine steering matrices Q , as described in 10.32.3 (Explicit feedback
12 beamforming) and 19.3.12.3 (Explicit feedback beamforming”); Section 9.1.4.66
13 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive
14 Beamforming Report field carries explicit feedback in the form of delta SNRs. The
15 information in the HE Compressed Beamforming Report field and the HE MU
16 Exclusive Beamforming Report field can be used by the transmit MU beamformer
17 to determine the steering matrices Q , as described in 27.3.3.1 (DL MU-MIMO)”);
18 Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-
19 RU average SNRs of each space-time stream, where each per-RU average SNR is
20 the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback
21 is being requested.”). For a further example, as with each ’376 Accused Product,
22 the NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 generates a
23 probing signal for transmission (*e.g.*, a probing signal transmission that triggers or
24 elicits a responsive transmission from each of a first client device and a second client
25 device, such as NDP Announcement pursuant to Very High Throughput (VHT)
26 channel sounding, including preamble training fields allowing an estimate of the
27 channel for MU-MIMO) to at least a first client device and a second client device
28 (*e.g.*, a first non-AP STA / VHT beamformee and a second non-AP STA / VHT

1 beamformee). See, e.g., 802.11ac Standard Clause 9.31.5.2 (“A VHT beamformer
2 shall initiate a sounding feedback sequence by transmitting a VHT NDP
3 Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer
4 shall include in the VHT NDP Announcement frame one STA Info field for each
5 VHT beamformee that is expected to prepare VHT Compressed Beamforming
6 feedback and shall identify the VHT beamformee by including the VHT
7 beamformee’s AID in the AID subfield of the STA Info field. The VHT NDP
8 Announcement frame shall include at least one STA Info field.”); id. (“A non-AP
9 VHT beamformee that receives a VHT NDP Announcement frame... shall transmit
10 its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming
11 Report Poll with RA matching its MAC address and a non-bandwidth signaling TA
12 obtained from the TA field matching the MAC address of the VHT beamformer.”);
13 id. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed
14 Beamforming frame); id. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) (“Each
15 SNR value per tone in stream i (before being averaged) corresponds to the SNR
16 associated with the column i of the beamforming feedback matrix V determined at
17 the beamformee”); id. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive

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1 Beamforming Report information); id. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id.
2 Clause 22.3.8.3.5; id. Clause 22.3.11.2:

3 Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in
4 Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer.
5 The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k shall be compressed in
6 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
7 according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the
8 indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-
9 MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22
10 beamforming feedback format defined.

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

13 After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation
14 (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering
15 matrix Q_k . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix
16 $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \leq u \leq N_{user} - 1$) in order to suppress crosstalk
17 between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k
18 is implementation specific.

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20 46. Each of the '376 Accused Products comprises a processor configured to
21 generate a first data stream for transmission to the first client device and generate a
22 second data stream for transmission to the second client device. For example, as with
23 each Accused Product, the NETGEAR AX12 12-Stream AX6000 Wi-Fi Router
24 RAX120 has at least one processor and Wi-Fi 6 radio functionality (e.g., the CPU(s)
25 and/or Wi-Fi processors and/or baseband processor(s) in the Wi-Fi 6 radio)
26 configured to generate a first data stream for transmission to the first client device
27 ("non-AP STA" or "non-Access Point Station") and a second data stream for
28 transmission to a second client device (non-AP STA) pursuant to MU-MIMO
transmissions. See, e.g., NETGEAR Nighthawk RAX120 Data Sheet ("Nighthawk
AX12 WiFi 6 Router is powered by the industry's latest WiFi 6 (802.11ax) standard
with 4 times increased data capacity in a dense environment to handle up to 30
devices in your growing home network. Blazing-fast combined WiFi speeds up to
6Gbps and AX optimized 64-bit 2.2GHz quad-core processor powers smart home
automation, ultra-smooth 4K UHD streaming, online gaming, and more."; "WiFi 6

1 gives you improved network capacity for more WiFi devices. Have more fun with
2 the uninterrupted 4K/8K streaming, gaming, and the smart home experience. With
3 MU-MIMO, WiFi 6 supports up to eight simultaneous streams for the number of
4 users that can be served double at the same time as compared to an AC router.”; “12-
5 Stream WiFi 6”; “8 High-performance Antennas. Enjoy up to 1.5X more usable
6 WiFi coverage for things like Ultra-HD video & gaming.”; “Quad-core 2.2GHz
7 Processor. Engineered to deliver a new era of WiFi performance”; “8x8 MU-MIMO
8 enables up to four (4) 2x2 devices to stream content at the same time”; “High-
9 performance antennas—Eight (8) antennas extend wireless range coverage indoors
10 and out”; “Using multi-user MIMO technology, routers can stream data to multiple
11 devices simultaneously. That means faster downloads and smoother streaming for
12 your devices. WiFi 6 extends MU-MIMO to 8-stream support so it can support
13 double the number of simultaneous transmission as compared to 4x4 MU-MIMO
14 AC WiFi routers”; “This powerful processor is optimized for AX making intelligent
15 spontaneous decisions to schedule data traffic to maximize WiFi bandwidth
16 utilization.”). *See, e.g.*, IEEE 802.11ax Standard, at Sections 26.5, 26.5.1, 26.5.2,
17 26.5.3, 27.1.1, 27.3.1, 27.3.2.5, 27.3.2.6, 27.3.5, 27.3.6.11.4, 27.3.10.7, 27.3.10.8,
18 27.3.10.9, 27.3.15, including Tables 27-19, 27-20, 27-21, 27-24, 27-25, 27-26, 27-
19 27, 27-28, 27-29, Figures 27-19, 27-20, and other transmitter block diagrams for
20 MU-MIMO transmission. *See, e.g.*, Section 27.1.1 (“The HE PHY extends the
21 maximum number of users supported for DL MU-MIMO transmissions up to 8 users
22 per resource unit (RU) and provides support for DL and UL orthogonal frequency
23 division multiple access (OFDMA) as well as for UL MU-MIMO. Both DL and UL
24 MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on
25 resource units greater than or equal to 106 tones). In an MU-MIMO resource unit,
26 there is support for up to 8 users with up to 4 space-time streams per user with the
27 total not exceeding 8 space-time streams”); Section 27.3.1.1 (“DL MU transmission
28 allows an AP to simultaneously transmit information to more than one non-AP STA.

1 For a DL MU transmission, the AP uses the HE MU PPDU format and employs
2 either DL OFDMA, DL MU-MIMO, or a mixture of both.”); Section 27.3.10.8.1
3 (“The HE-SIG-B field provides the OFDMA and DL MU-MIMO resource
4 allocation information to allow the STAs to look up the corresponding resources to
5 be used in the data portion of the frame.”); Section 27.3.2.5 (“If there is more than
6 one User field (see Table 27-28 (User field for an MU-MIMO allocation)) for an RU
7 in the HE-SIG-B content channel, then the number of allocated spatial streams for
8 each user in the RU is indicated by the Spatial Configuration field of the User field
9 in HE-SIG-B...In each HE-SIG-B content channel, the User fields are first ordered
10 in the order of RUs (from lower frequency to higher frequency) as described by the
11 RU Allocation field if the HE-SIG-B contains the Common field. If an RU has
12 multiple User fields in an HE-SIG-B content channel, the User fields of the RU are
13 ordered in the order of spatial stream index, from lower to higher spatial stream, as
14 indicated in the Spatial Configuration field. The STA-ID field in each User field
15 indicates the intended recipient user of the corresponding spatial streams and the
16 RU.”); *See, e.g.*, IEEE 802.11ax Standard, Section 27.3.5 (Transmitter block
17 diagram), at, *e.g.*, Figure 27-19:

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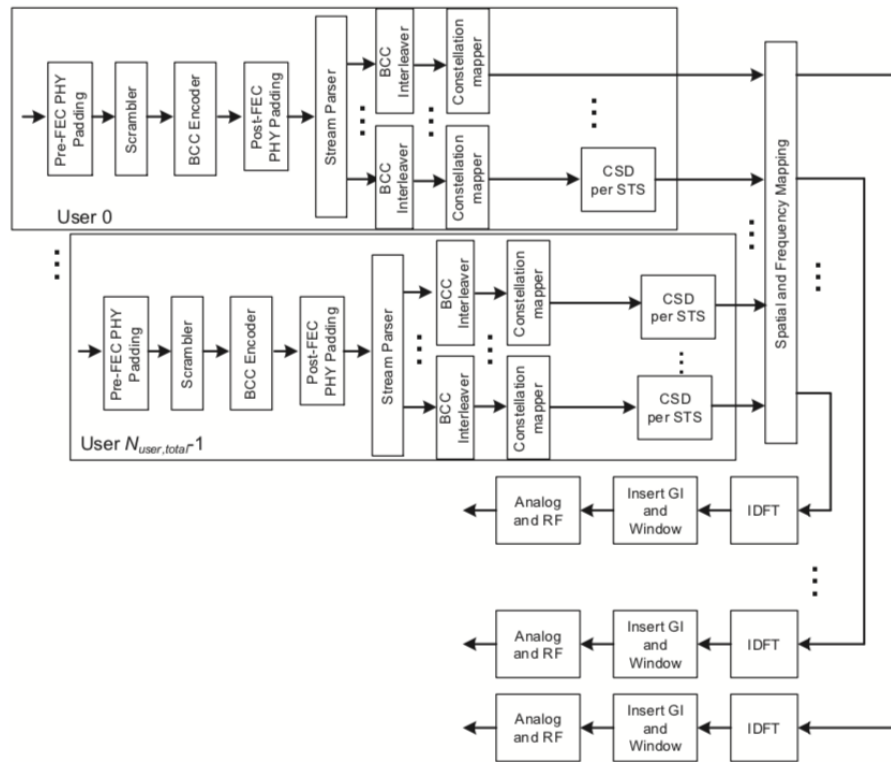


Figure 27-19—Transmitter block diagram for the Data field of an HE DL MU-MIMO transmission in a 106-, 242-, 484- or 996-tone RU with BCC encoding

See, e.g., Section 27.3.6.11.4 – 27.3.7:

27.3.6.11.4 Combining to form an HE MU PPDU

The per user data is combined as follows:

- a) Spatial mapping: The Q matrix is applied as described in 27.3.11.14 (OFDM modulation). The combining of all user data of an RU is done in this block.
- b) IDFT: Compute the inverse discrete Fourier transform.
- c) Insert GI and apply windowing: Prepend a GI determined by the TXVECTOR parameter GI_TYPE and apply windowing as described in 27.3.9 (Mathematical description of signals).
- d) Analog and RF: Upconvert the resulting complex baseband waveform with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 27.3.9 (Mathematical description of signals) and 27.3.10 (HE preamble) for details.

27.3.7 HE modulation and coding schemes (HE-MCSs)

The HE-MCS is a compact representation of the modulation and coding used in the Data field of the PPDU. For an HE SU PPDU and an HE ER SU PPDU it is carried in the HE-SIG-A field. For an HE MU PPDU it is carried per user in the User Specific field of the HE-SIG-B field. For an HE TB PPDU, it is carried in the User Info field of the Trigger frame soliciting the HE TB PPDU.

For a further example, as with each Accused Product, the NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 has at least one processor and Wi-Fi radio functionality (e.g., the CPU and/or baseband processor(s) in the Wi-Fi radio)

1 configured to generate a first data stream for transmission to the first client device
 2 (“non-AP STA” or “non-Access Point Station”) and a second data stream for
 3 transmission to a second client device (non-AP STA) pursuant to MU-MIMO
 4 transmissions. *See, e.g.*, 802.11ac Standard Clause 9.31.5.1 (“Transmit
 5 beamforming and DL-MU-MIMO require knowledge of the channel state to
 6 compute a steering matrix that is applied to the transmitted signal to optimize
 7 reception at one or more receivers. The STA transmitting using the steering matrix
 8 is called the VHT beamformer and a STA for which reception is optimized is called
 9 a VHT beamformee. An explicit feedback mechanism is used where the VHT
 10 beamformee directly measures the channel from the training symbols transmitted by
 11 the VHT beamformer and sends back a transformed estimate of the channel state to
 12 the VHT beamformer. The VHT beamformer then uses this estimate, perhaps
 13 combining estimates from multiple VHT beamformees, to derive the steering
 14 matrix.”); *id.* Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m),
 15 22.3.4.9.2(m), 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in
 16 22.3.10.11.1.”); *id.* Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause
 17 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; *id.* Clause
 18 22.3.11.1, 22.3.11.2. *See, e.g.*, NETGEAR Nighthawk RAX120 Data Sheet:

Enjoy simultaneous streaming with MU-MIMO

Data sent to one device at a time



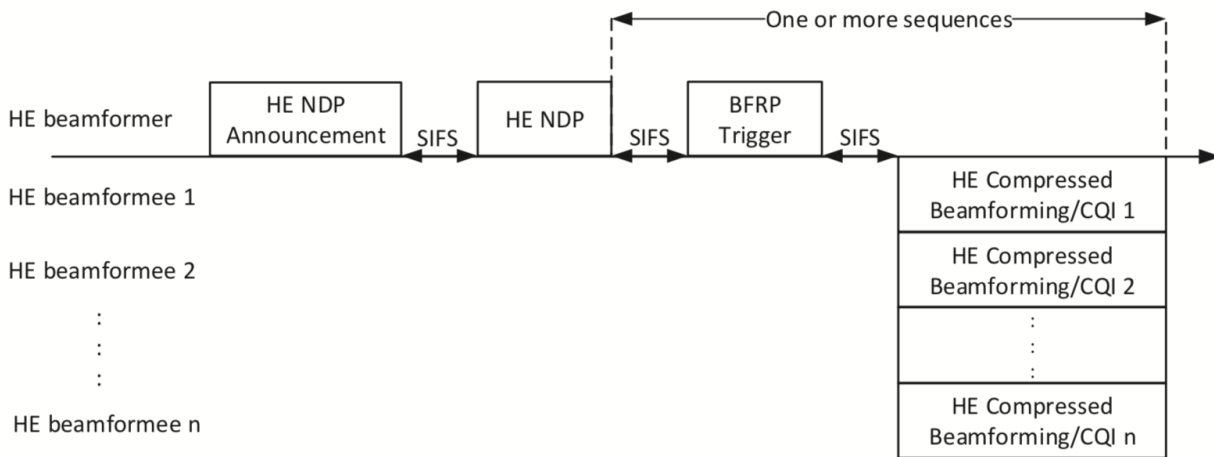
Data sent to multiple devices simultaneously



1 Each of the '376 Accused Products comprises a transceiver operatively coupled to
2 the processor and configured to: transmit the probing signal to at least the first client
3 device and the second client device via a smart antenna; wherein the smart antenna
4 is operatively coupled to the transceiver and comprises a first antenna element and
5 a second antenna element. For example, as with each '376 Accused Product, the
6 NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 has a Wi-Fi 6 radio
7 with a transceiver operatively coupled to the processor (*e.g.*, the Wi-Fi 6 radio
8 generates signals for transmission and processes received signals with, *e.g.*, the CPU,
9 Wi-Fi processors, and/or baseband processor in the Wi-Fi 6 radio, and the radio
10 comprises a transceiver that transmits and receives signals via a smart antenna); and,
11 as with each '376 Accused Product, the NETGEAR AX12 12-Stream AX6000 Wi-
12 Fi Router RAX120 has a Wi-Fi 6 radio transceiver operatively coupled to the
13 processor and to a smart antenna, wherein the smart antenna is operatively coupled
14 to the Wi-Fi 6 radio and comprises a first antenna element and a second antenna
15 element. *See, e.g.*, NETGEAR Nighthawk RAX120 Data Sheet (“Nighthawk AX12
16 WiFi 6 Router is powered by the industry’s latest WiFi 6 (802.11ax) standard with
17 4 times increased data capacity in a dense environment to handle up to 30 devices in
18 your growing home network. Blazing-fast combined WiFi speeds up to 6Gbps and
19 AX optimized 64-bit 2.2GHz quad-core processor powers smart home automation,
20 ultra-smooth 4K UHD streaming, online gaming, and more.”; “WiFi 6 gives you
21 improved network capacity for more WiFi devices. Have more fun with the
22 uninterrupted 4K/8K streaming, gaming, and the smart home experience. With MU-
23 MIMO, WiFi 6 supports up to eight simultaneous streams for the number of users
24 that can be served double at the same time as compared to an AC router.”; “12-
25 Stream WiFi 6”; “8 High-performance Antennas. Enjoy up to 1.5X more usable
26 WiFi coverage for things like Ultra-HD video & gaming.”; “Quad-core 2.2GHz
27 Processor. Engineered to deliver a new era of WiFi performance”; “8x8 MU-MIMO
28 enables up to four (4) 2x2 devices to stream content at the same time”; “High-

1 performance antennas—Eight (8) antennas extend wireless range coverage indoors
 2 and out”; “Using multi-user MIMO technology, routers can stream data to multiple
 3 devices simultaneously. That means faster downloads and smoother streaming for
 4 your devices. WiFi 6 extends MU-MIMO to 8-stream support so it can support
 5 double the number of simultaneous transmission as compared to 4x4 MU-MIMO
 6 AC WiFi routers”; “This powerful processor is optimized for AX making intelligent
 7 spontaneous decisions to schedule data traffic to maximize WiFi bandwidth
 8 utilization.”). For a further example, as with each ’376 Accused Product, the
 9 NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 transmits the probing
 10 signal (*e.g.*, a probing signal transmission that triggers or elicits a responsive
 11 transmission from each of a first client device and a second client device, such as
 12 NDP Announcement, HE sounding NDP, Beamforming Report trigger frames
 13 pursuant to High Efficiency (HE) channel sounding, including preamble training
 14 fields allowing an estimate of the channel for MU-MIMO) to at least the first client
 15 device and the second client device (*e.g.*, the first non-AP STA and the second non-
 16 AP STA) via the smart antenna. *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19,
 17 9.3.1.22, 9.3.1.22.3, 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7,
 18 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1. *See, e.g.*, Section 26.7.5 (HE sounding
 19 NDP transmission) (setting forth TXVECTOR parameters for HE sounding NDP);
 20 Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a means for the receiver
 21 to estimate the MIMO channel between the set of constellation mapper outputs (or,
 22 if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU
 23 PPDU and HE ER SU PPDU, the transmitter provides training for N_{STS} space-time
 24 streams (spatial mapper inputs) used for the transmission of the PSDU. In an HE
 25 MU PPDU, the transmitter provides training for $N_{STS,r,total}$ space-time streams used
 26 for the transmission of the PSDU(s) in the r -th RU. In an HE TB PPDU, the
 27 transmitter of user u in the r -th RU provides training for $N_{STS,r,u}$ space-time streams
 28 used for the transmission of the PSDU. For each tone in the r -th RU, the MIMO

1 channel that can be estimated is an $N_{RX} \times N_{STS,r,total}$ matrix. An HE transmission has
 2 a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF
 3 symbol are multiplied by entries belonging to a matrix P_{HE-LTF} , to enable channel
 4 estimation at the receiver.... In an HE SU PPDU, HE MU PPDU and HE ER SU
 5 PPDU, the combination of HE-LTF type and GI duration is indicated in HE-SIG-A
 6 field. In an HE TB PPDU, the combination of HE-LTF type and GI duration is



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 15 **Figure 26-7—An example of the sounding protocol with more than one HE beamformee**
 16 indicated in the Trigger frame that triggers transmission of the PPDU. If an HE
 17 PPDU is an HE sounding NDP, the combinations of HE-LTF types and GI durations
 18 are listed in 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback
 19 NDP, the combination of HE-LTF types and GI durations are listed in 27.3.4 (HE
 20 PPDU formats.”). See, e.g., Section 26.7.3, Figure 26-7; Section 9.4.1.65 (HE
 21 Compressed Beamforming Report field) (“The HE Compressed Beamforming
 22 Report field carries the average SNR of each space-time stream and compressed
 23 beamforming feedback matrices V for use by a transmit beamformer to determine
 24 steering matrices Q , as described in 10.32.3 (Explicit feedback beamforming) and
 25 19.3.12.3 (Explicit feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive
 26 Beamforming Report field) (“The HE MU Exclusive Beamforming Report field
 27 carries explicit feedback in the form of delta SNRs. The information in the HE
 28 Compressed Beamforming Report field and the HE MU Exclusive Beamforming

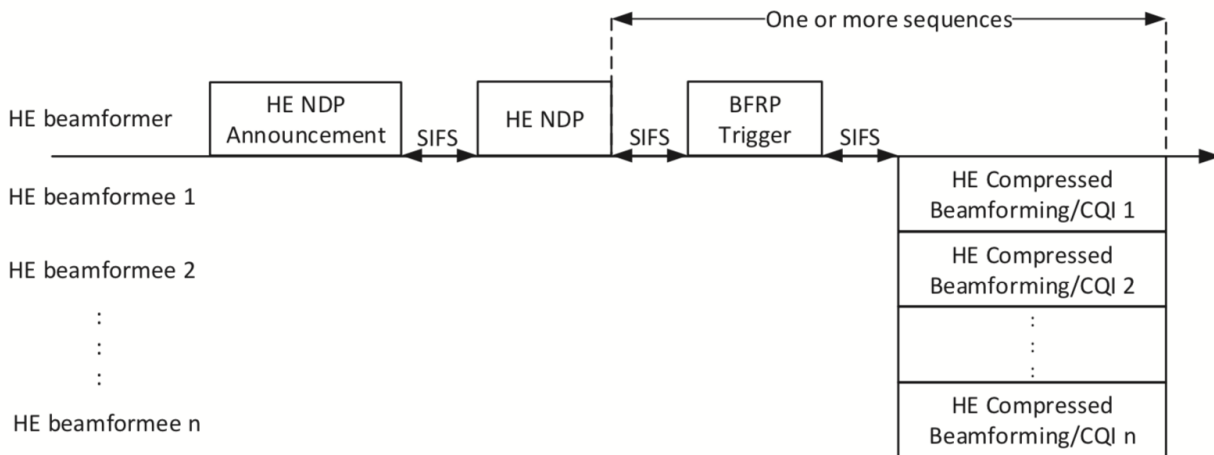
1 Report field can be used by the transmit MU beamformer to determine the steering
2 matrices Q , as described in 27.3.3.1 (DL MU-MIMO)"); Section 9.4.1.67 (HE CQI
3 Report Field) ("The HE CQI Report field carries the per-RU average SNRs of each
4 space-time stream, where each per-RU average SNR is the arithmetic mean of the
5 SNR in decibels over a 26-tone RU for which the feedback is being requested.").
6 *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 ("A VHT beamformer shall initiate a
7 sounding feedback sequence by transmitting a VHT NDP Announcement frame
8 followed by a VHT NDP after a SIFS. The VHT beamformer shall include in the
9 VHT NDP Announcement frame one STA Info field for each VHT beamformee that
10 is expected to prepare VHT Compressed Beamforming feedback and shall identify
11 the VHT beamformee by including the VHT beamformee's AID in the AID subfield
12 of the STA Info field. The VHT NDP Announcement frame shall include at least
13 one STA Info field."); *id.* ("A non-AP VHT beamformee that receives a VHT NDP
14 Announcement frame... shall transmit its VHT Compressed Beamforming feedback
15 a SIFS after receiving a Beamforming Report Poll with RA matching its MAC
16 address and a non-bandwidth signaling TA obtained from the TA field matching the
17 MAC address of the VHT beamformer."); *id.* Clause 8.5.23.2 (defining format and
18 subfields within the VHT Compressed Beamforming frame); *id.* Clause 8.4.1.48
19 (including Tables 8-53(d)-(h)) ("Each SNR value per tone in stream i (before being
20 averaged) corresponds to the SNR associated with the column i of the beamforming
21 feedback matrix V determined at the beamformee"); *id.* Clause 8.4.1.49 (including
22 Table 8-53i – MU Exclusive Beamforming Report information); *id.* Clauses
23 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.

24 47. Each of the '376 Accused Products comprises a data-communications
25 networking apparatus wherein one or more of the processor, the transceiver, or the
26 smart antenna is further configured to: receive a first feedback information from the
27 first client device in response to the transmission of the probing signal; receive a
28 second feedback information from the second client device in response to

1 transmission of the probing signal. For example, as with each '376 Accused Product,
2 the NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 comprises one or
3 more of the processor, the transceiver, or the smart antenna further configured to
4 receive channel state information and estimates of the channel state and MU MIMO-
5 related feedback information from each of the first non-AP STA and the second non-
6 AP STA pursuant to HE MU-MIMO sounding procedures. This feedback
7 information, carried in one or more HE Compressed Beamforming/CQI frames, is
8 in response to the transmission of the probing signal (*e.g.*, a probing signal
9 transmission that triggers or elicits a responsive transmission from each of a first
10 client device and a second client device, such as NDP Announcement, HE sounding
11 NDP, Beamforming Report trigger frames pursuant to High Efficiency (HE) channel
12 sounding, including preamble training fields allowing an estimate of the channel for
13 MU-MIMO). *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3,
14 9.4.1.64, 9.4.1.65, 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3,
15 26.7.4, 26.7.5, 27.1.1, 27.3.15.1 – 27.3.15.3. *See, e.g.*, Section 9.4.1.65 (HE
16 Compressed Beamforming Report field) (“The HE Compressed Beamforming
17 Report field carries the average SNR of each space-time stream and compressed
18 beamforming feedback matrices V for use by a transmit beamformer to determine
19 steering matrices Q , as described in 10.32.3 (Explicit feedback beamforming) and
20 19.3.12.3 (Explicit feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive
21 Beamforming Report field) (“The HE MU Exclusive Beamforming Report field
22 carries explicit feedback in the form of delta SNRs. The information in the HE
23 Compressed Beamforming Report field and the HE MU Exclusive Beamforming
24 Report field can be used by the transmit MU beamformer to determine the steering
25 matrices Q , as described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI
26 Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each
27 space-time stream, where each per-RU average SNR is the arithmetic mean of the
28 SNR in decibels over a 26-tone RU for which the feedback is being requested.”);

1 Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques
2 used by a STA with multiple antennas (the beamformer) to steer signals using
3 knowledge of the channel to improve throughput. With SU-MIMO beamforming all
4 space-time streams in the transmitted signal are intended for reception at a single
5 STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-
6 time streams are intended for reception at different STAs in an RU of size greater
7 than or equal to 106-tones...The DL MU-MIMO steering matrix $Q_k = [Q_{k,0},$
8 $Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ can be detected by the beamformer using the beamforming
9 feedback for subcarrier k from beamformee u , where $u = 0, 1, \dots, N_{user,r} - 1$. The
10 feedback report format is described in 9.4.1.65 (HE Compressed Beamforming
11 Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The
12 steering matrix that is computed (or updated) using new beamforming feedback from
13 some or all of participating beamformees might replace the existing steering matrix
14 Q_k for the next DL MU-MIMO data transmission.”); Section 27.3.15.2 (“Upon
15 receipt of an HE sounding NDP, the beamformee computes a set of matrices for
16 feedback to the beamformer as described in 21.3.11.2 (Beamforming Feedback
17 Matrix V). The eligible beamformees shall remove the space-time stream CSD in
18 Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU) from the
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1 measured channel before computing a set of matrices for feedback to the
 2 beamformer.”); *See, e.g.*, Section 26.7.3, Figure 26-7:



11 **Figure 26-7—An example of the sounding protocol with more than one HE beamformee**

13 For a further example, as with each '376 Accused Product, the NETGEAR AX12
 14 12-Stream AX6000 Wi-Fi Router RAX120 comprises one or more of the processor,
 15 the transceiver, or the smart antenna further configured to receive channel state
 16 information and estimates of the channel state and MU MIMO-related feedback
 17 information from each of the first non-AP STA and the second non-AP STA
 18 pursuant to MU-MIMO sounding procedures. This feedback information, carried in
 19 one or more compressed beamforming frames, is in response to the transmission of
 20 the probing signal (*e.g.*, a probing signal transmission that triggers or elicits a
 21 responsive transmission from each of a first client device and a second client device,
 22 such as NDP Announcement pursuant to Very High Throughput (VHT) channel
 23 sounding, including preamble training fields allowing an estimate of the channel for
 24 MU-MIMO). *See, e.g.*, 802.11ac Standard Clause 9.31.5.2 (“A VHT beamformer
 25 shall initiate a sounding feedback sequence by transmitting a VHT NDP
 26 Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer
 27 shall include in the VHT NDP Announcement frame one STA Info field for each
 28 VHT beamformee that is expected to prepare VHT Compressed Beamforming

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1 feedback and shall identify the VHT beamformee by including the VHT
2 beamformee’s AID in the AID subfield of the STA Info field. The VHT NDP
3 Announcement frame shall include at least one STA Info field.”); id. (“A non-AP
4 VHT beamformee that receives a VHT NDP Announcement frame... shall transmit
5 its VHT Compressed Beamforming feedback a SIFS after receiving a Beamforming
6 Report Poll with RA matching its MAC address and a non-bandwidth signaling TA
7 obtained from the TA field matching the MAC address of the VHT beamformer.”);
8 id. Clause 8.5.23.2 (defining format and subfields within the VHT Compressed
9 Beamforming frame); id. Clause 8.4.1.48 (including Tables 8-53(d)-(h)) (“Each
10 SNR value per tone in stream i (before being averaged) corresponds to the SNR
11 associated with the column i of the beamforming feedback matrix V determined at
12 the beamformee”); id. Clause 8.4.1.49 (including Table 8-53i – MU Exclusive
13 Beamforming Report information); id. Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id.
14 Clause 22.3.8.3.5; id. Clause 22.3.11.2:

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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, $\phi(k,u)$ and $\psi(k,u)$, are quantized
 5 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.

6 The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to
 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
 10 between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k
 is implementation specific.

11 ///

12 48. Each of the '376 Accused Products comprises a data-communications
 13 networking apparatus wherein one or more of the processor, the transceiver, or the
 14 smart antenna is further configured to: determine where to place transmission peaks
 15 and transmission nulls within one or more spatially distributed patterns of
 16 electromagnetic signals based in part on the first and the second feedback
 17 information. For example, as with each '376 Accused Product, the NETGEAR
 18 AX12 12-Stream AX6000 Wi-Fi Router RAX120 comprises one or more of the
 19 processor, the transceiver, or the smart antenna further configured to determine
 20 where to place transmission peaks and transmission nulls within one or more
 21 spatially distributed patterns of electromagnetic signals based in part on the first and
 22 the second feedback information, including, *e.g.*, where it determines where to place
 23 transmission peaks and transmission nulls through a beamforming steering matrix
 24 pursuant to beamforming and MU-MIMO spatial multiplexing, which beamforming
 25 steering matrix is determined based on the received CSI (channel state information)
 26 and MIMO-related feedback from the first client device (first non-AP STA) and the
 27 second client device (second non-AP STA) pursuant to HE MU-MIMO sounding.
 28 *See, e.g.*, NETGEAR Nighthawk RAX120 Data Sheet ("Nighthawk AX12 WiFi 6

1 Router is powered by the industry’s latest WiFi 6 (802.11ax) standard with 4 times
2 increased data capacity in a dense environment to handle up to 30 devices in your
3 growing home network. Blazing-fast combined WiFi speeds up to 6Gbps and AX
4 optimized 64-bit 2.2GHz quad-core processor powers smart home automation, ultra-
5 smooth 4K UHD streaming, online gaming, and more.”; “WiFi 6 gives you
6 improved network capacity for more WiFi devices. Have more fun with the
7 uninterrupted 4K/8K streaming, gaming, and the smart home experience. With MU-
8 MIMO, WiFi 6 supports up to eight simultaneous streams for the number of users
9 that can be served double at the same time as compared to an AC router.”; “12-
10 Stream WiFi 6”; “8 High-performance Antennas. Enjoy up to 1.5X more usable
11 WiFi coverage for things like Ultra-HD video & gaming.”; “Quad-core 2.2GHz
12 Processor. Engineered to deliver a new era of WiFi performance”; “8x8 MU-MIMO
13 enables up to four (4) 2x2 devices to stream content at the same time”; “High-
14 performance antennas—Eight (8) antennas extend wireless range coverage indoors
15 and out”; “Using multi-user MIMO technology, routers can stream data to multiple
16 devices simultaneously. That means faster downloads and smoother streaming for
17 your devices. WiFi 6 extends MU-MIMO to 8-stream support so it can support
18 double the number of simultaneous transmission as compared to 4x4 MU-MIMO
19 AC WiFi routers”; “This powerful processor is optimized for AX making intelligent
20 spontaneous decisions to schedule data traffic to maximize WiFi bandwidth
21 utilization.”). *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.4.1.64, 9.4.1.65,
22 9.4.1.66, 9.4.1.67, 9.6.31.2, 10.37, 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1,
23 27.3.15.1, 27.3.15.2, 27.3.15.3. *See, e.g.*, Section 9.4.1.65 (HE Compressed
24 Beamforming Report field) (“The HE Compressed Beamforming Report field
25 carries the average SNR of each space-time stream and compressed beamforming
26 feedback matrices V for use by a transmit beamformer to determine steering matrices
27 Q , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit
28 feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive Beamforming

1 Report field) (“The HE MU Exclusive Beamforming Report field carries explicit
 2 feedback in the form of delta SNRs. The information in the HE Compressed
 3 Beamforming Report field and the HE MU Exclusive Beamforming Report field can
 4 be used by the transmit MU beamformer to determine the steering matrices Q , as
 5 described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI Report Field)
 6 (“The HE CQI Report field carries the per-RU average SNRs of each space-time
 7 stream, where each per-RU average SNR is the arithmetic mean of the SNR in
 8 decibels over a 26-tone RU for which the feedback is being requested.”); Section
 9 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a
 10 STA with multiple antennas (the beamformer) to steer signals using knowledge of
 11 the channel to improve throughput. With SU-MIMO beamforming all space-time
 12 streams in the transmitted signal are intended for reception at a single STA in an RU.
 13 With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are
 14 intended for reception at different STAs in an RU of size greater than or equal to
 15 106-tones...The DL MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ can be
 16 detected by the beamformer using the beamforming feedback for subcarrier k from
 17 beamformee u , where $u = 0, 1, \dots, N_{user,r} - 1$. The feedback report format is described in
 18 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU
 19 Exclusive Beamforming Report field). The steering matrix that is computed (or
 20 updated) using new beamforming feedback from some or all of participating
 21 beamformees might replace the existing steering matrix Q_k for the next DL MU-
 22 MIMO data transmission.”); Section 27.3.15.2 (“Upon receipt of an HE sounding
 23 NDP, the beamformee computes a set of matrices for feedback to the beamformer
 24 as described in 21.3.11.2 (Beamforming Feedback Matrix V). The eligible
 25 beamformees shall remove the space-time stream CSD in Table 21-11 (Cyclic shift
 26 values for the VHT modulated fields of a PPDU) from the measured channel before
 27 computing a set of matrices for feedback to the beamformer. The beamforming
 28 feedback matrix $V_{k,u}$ found by the beamformee u for subcarrier k in RU r shall be

1 compressed in the form of angles using the method described in 19.3.12.3.6
2 (Compressed beamforming feedback matrix). The angles $\phi(k,u)$ and $\psi(k,u)$, are
3 quantized according to Table 9-68 (Quantization of angles)... The beamformee
4 shall generate the beamforming feedback matrices with the number of rows (Nr)
5 equal to the N_{STS} of the HE sounding NDP. After receiving the angle information,
6 $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (19-79). For SU-
7 MIMO beamforming, the beamformer uses $V_{k,0}$ matrix to determine the steering
8 matrix Q_k . For DL MU-MIMO beamforming, the beamformer may calculate a
9 steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ using $V_{k,u}$ and Delta $\Delta SNR_{k,u}$ (0
10 $\leq u \leq N_{user,r}-1$) in order to suppress crosstalk between participating beamformees. The
11 method used by the beamformer to calculate the steering matrix Q_k is
12 implementation specific.”). See, e.g., 802.11ac Standard Clause 9.31.5.1 (“Transmit
13 beamforming and DL-MU-MIMO require knowledge of the channel state to
14 compute a steering matrix that is applied to the transmitted signal to optimize
15 reception at one or more receivers. The STA transmitting using the steering matrix
16 is called the VHT beamformer and a STA for which reception is optimized is called
17 a VHT beamformee. An explicit feedback mechanism is used where the VHT
18 beamformee directly measures the channel from the training symbols transmitted by
19 the VHT beamformer and sends back a transformed estimate of the channel state to
20 the VHT beamformer. The VHT beamformer then uses this estimate, perhaps
21 combining estimates from multiple VHT beamformees, to derive the steering
22 matrix.”); id. Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m),
23 22.3.4.9.2(m), 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in
24 22.3.10.11.1.”); id. Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause
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1 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; id. Clause
2 22.3.11.1:

3 , Clause 22.3.11.2:

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5 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
6 beamformer using the beamforming feedback matrices for subcarrier k from beamformee u , $V_{k,u}$, and SNR
7 information for subcarrier k from beamformee u , $SNR_{k,u}$, where $u = 0, 1, \dots, N_{user} - 1$. The steering matrix
8 that is computed (or updated) using new beamforming feedback matrices and new SNR information from
9 some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL-MU-
10 MIMO data transmission. The beamformee group for the MU transmission is signaled using the Group ID
11 field in VHT-SIG-A (see 22.3.8.3.3 and 22.3.11.4).

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
15 according to Table 8-53e. The number of bits for quantization is chosen by the beamformee, based on the
16 indication from the beamformer as to whether the feedback is requested for SU-MIMO beamforming or DL-
17 MU-MIMO beamforming. The compressed beamforming feedback using 20.3.12.3.6 is the only Clause 22
18 beamforming feedback format defined.

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

21 After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation
22 (20-79). For SU-MIMO beamforming, the beamformer can use this $V_{k,0}$ matrix to determine the steering
23 matrix Q_k . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix
24 $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \leq u \leq N_{user} - 1$) in order to suppress crosstalk
25 between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k
26 is implementation specific.

27 49. Each of the '376 Accused Products comprises a data-communications
28 networking apparatus wherein one or more of the processor, the transceiver, or the
smart antenna is further configured to: transmit the first data stream to the first client
device via the one or more spatially distributed patterns of electromagnetic signals;
and transmit the second data stream to the second client device via the one or more
spatially distributed patterns of electromagnetic signals; wherein transmission of the
first data stream and transmission of at least part of the second data stream occur at
the same time; and wherein the one or more spatially distributed patterns of
electromagnetic signals are configured to exhibit a first transmission peak at a
location of the first client device and a second transmission peak at a location of the
second client device. For example, as with each '376 Accused Product, the

1 NETGEAR AX12 12-Stream AX6000 Wi-Fi Router RAX120 comprises one or
2 more of the processor, the transceiver, or the smart antenna further configured to
3 transmit the first data stream to the first client device (*e.g.*, the first non-AP STA)
4 via the one or more spatially distributed patterns of electromagnetic signals (*e.g.*,
5 transmission of data to the first non-AP STA pursuant to HE MU-MIMO
6 beamforming where a beamforming steering matrix is applied); and transmit the
7 second data stream to the second client device (*e.g.*, the second non-AP STA) via
8 the one or more spatially distributed patterns of electromagnetic signals (*e.g.*,
9 transmission of data to the second non-AP STA pursuant to HE MU-MIMO
10 beamforming where a beamforming steering matrix is applied); wherein
11 transmission of the first data stream and transmission of at least part of the second
12 data stream occur at the same time (*e.g.*, simultaneous HE DL MU-MIMO
13 transmissions); and wherein the one or more spatially distributed patterns of
14 electromagnetic signals are configured to exhibit a first transmission peak at a
15 location of the first client device and a second transmission peak at a location of the
16 second client device (*e.g.*, through HE MU-MIMO beamforming, radio energy is
17 directed at each of the first client device and the second client device to form a
18 transmission peak at the location of each device, and including, *e.g.*, where the
19 beamforming steering matrix is applied, a first space-time stream (“STS”) intended
20 for reception at the first client device and a second STS intended for reception at the
21 second client device is representative of a first transmission peak being placed at the
22 location of the first client device and a second transmission peak being placed at the
23 location of second client device). *See, e.g.*, NETGEAR Nighthawk RAX120 Data
24 Sheet (“Nighthawk AX12 WiFi 6 Router is powered by the industry’s latest WiFi 6
25 (802.11ax) standard with 4 times increased data capacity in a dense environment to
26 handle up to 30 devices in your growing home network. Blazing-fast combined WiFi
27 speeds up to 6Gbps and AX optimized 64-bit 2.2GHz quad-core processor powers
28 smart home automation, ultra-smooth 4K UHD streaming, online gaming, and

1 more.”; “WiFi 6 gives you improved network capacity for more WiFi devices. Have
 2 more fun with the uninterrupted 4K/8K streaming, gaming, and the smart home
 3 experience. With MU-MIMO, WiFi 6 supports up to eight simultaneous streams for
 4 the number of users that can be served double at the same time as compared to an
 5 AC router.”; “12-Stream WiFi 6”; “8 High-performance Antennas. Enjoy up to 1.5X
 6 more usable WiFi coverage for things like Ultra-HD video & gaming.”; “Quad-core
 7 2.2GHz Processor. Engineered to deliver a new era of WiFi performance”; “8x8
 8 MU-MIMO enables up to four (4) 2x2 devices to stream content at the same time”;
 9 “High-performance antennas—Eight (8) antennas extend wireless range coverage
 10 indoors and out”; “Using multi-user MIMO technology, routers can stream data to
 11 multiple devices simultaneously. That means faster downloads and smoother
 12 streaming for your devices. WiFi 6 extends MU-MIMO to 8-stream support so it can
 13 support double the number of simultaneous transmission as compared to 4x4 MU-
 14 MIMO AC WiFi routers”; “This powerful processor is optimized for AX making
 15 intelligent spontaneous decisions to schedule data traffic to maximize WiFi
 16 bandwidth utilization.”). *See, e.g.,* IEEE 802.11ax Standard, Section 27.3.15.1
 17 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with
 18 multiple antennas (the beamformer) to steer signals using knowledge of the channel
 19 to improve throughput. With SU-MIMO beamforming all space-time streams in the
 20 transmitted signal are intended for reception at a single STA in an RU. With DL
 21 MU-MIMO beamforming, disjoint subsets of the space-time streams are intended
 22 for reception at different STAs in an RU of size greater than or equal to 106-
 23 tones...The DL MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ can be
 24 detected by the beamformer using the beamforming feedback for subcarrier k from
 25 beamformee u , where $u = 0, 1, \dots, N_{user,r} - 1$. The feedback report format is described in
 26 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE MU
 27 Exclusive Beamforming Report field). The steering matrix that is computed (or
 28 updated) using new beamforming feedback from some or all of participating

1 beamformees might replace the existing steering matrix Q_k for the next DL MU-
2 MIMO data transmission.”); Section 27.3.15.2 (“The beamformee shall generate the
3 beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of
4 the HE sounding NDP. After receiving the angle information, $\phi(k,u)$ and $\psi(k,u)$, the
5 beamformer reconstructs $V_{k,u}$ using Equation (19-79). For SU-MIMO beamforming,
6 the beamformer uses $V_{k,0}$ matrix to determine the steering matrix Q_k . For DL MU-
7 MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0},$
8 $Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$ using $V_{k,u}$ and Delta $\Delta SNR_{k,u}$ ($0 \leq u \leq N_{user,r}-1$) in order to suppress
9 crosstalk between participating beamformees. The method used by the beamformer
10 to calculate the steering matrix Q_k is implementation specific.”); Section 27.1.1
11 (“The HE PHY extends the maximum number of users supported for DL MU-MIMO
12 transmissions up to 8 users per resource unit (RU) and provides support for DL and
13 UL orthogonal frequency division multiple access (OFDMA) as well as for UL MU-
14 MIMO. Both DL and UL MU-MIMO transmissions are supported on portions of the
15 PPDU bandwidth (on resource units greater than or equal to 106 tones). In an MU-
16 MIMO resource unit, there is support for up to 8 users with up to 4 space-time
17 streams per user with the total not exceeding 8 space-time streams”); Section
18 27.3.1.1 (“DL MU transmission allows an AP to simultaneously transmit
19 information to more than one non-AP STA. For a DL MU transmission, the AP uses
20 the HE MU PPDU format and employs either DL OFDMA, DL MU-MIMO, or a
21 mixture of both.”); Section 27.3.10.8.1 (“The HE-SIG-B field provides the OFDMA
22 and DL MU-MIMO resource allocation information to allow the STAs to look up
23 the corresponding resources to be used in the data portion of the frame.”); *See, e.g.,*
24 IEEE 802.11ax Standard, Section 27.3.5 (Transmitter block diagram), at, *e.g.,* Figure
25 27-19:

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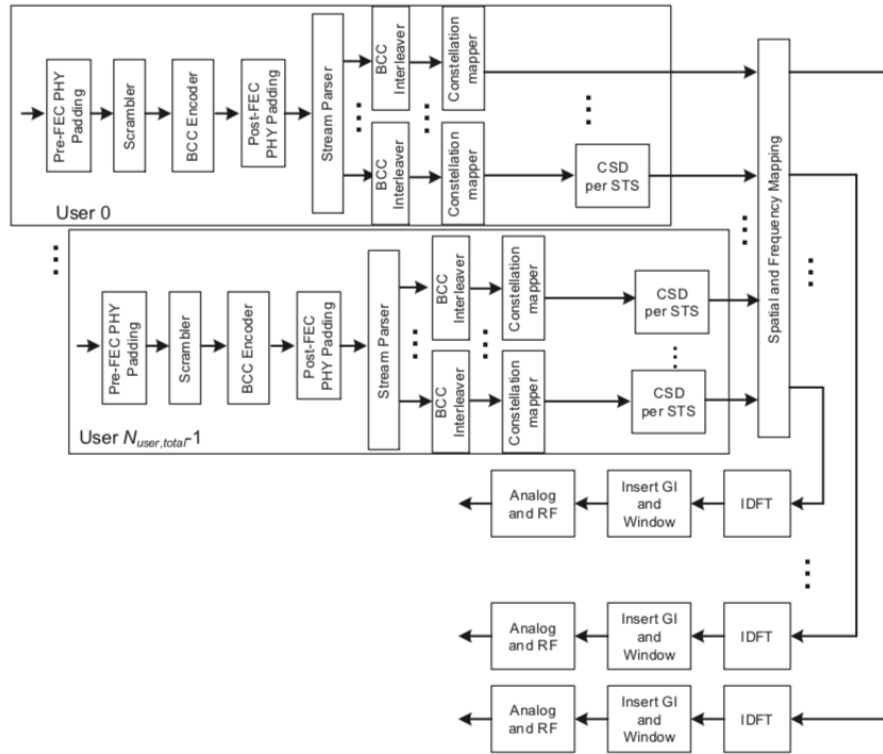


Figure 27-19—Transmitter block diagram for the Data field of an HE DL MU-MIMO transmission in a 106-, 242-, 484- or 996-tone RU with BCC encoding

; Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed Beamforming Report field carries the average SNR of each space-time stream and compressed beamforming feedback matrices V for use by a transmit beamformer to determine steering matrices Q , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices Q , as described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback

1 is being requested.”). *See, e.g.*, 802.11ac Standard Clause 9.31.5.1 (“Transmit
 2 beamforming and DL-MU-MIMO require knowledge of the channel state to
 3 compute a steering matrix that is applied to the transmitted signal to optimize
 4 reception at one or more receivers. The STA transmitting using the steering matrix
 5 is called the VHT beamformer and a STA for which reception is optimized is called
 6 a VHT beamformee. An explicit feedback mechanism is used where the VHT
 7 beamformee directly measures the channel from the training symbols transmitted by
 8 the VHT beamformer and sends back a transformed estimate of the channel state to
 9 the VHT beamformer. The VHT beamformer then uses this estimate, perhaps
 10 combining estimates from multiple VHT beamformees, to derive the steering
 11 matrix.”); *id.* Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m),
 12 22.3.4.9.2(m), 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in
 13 22.3.10.11.1.”); *id.* Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause
 14 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; *id.* Clause
 15 22.3.11.1, 22.3.11.2:

16 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
 17 beamformer using the beamforming feedback matrices for subcarrier k from beamformee u , $V_{k,u}$, and SNR
 18 information for subcarrier k from beamformee u , $SNR_{k,u}$, where $u = 0, 1, \dots, N_{user} - 1$. The steering matrix
 19 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).

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
 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 ///

2 50. Defendant also has been and is now knowingly and intentionally inducing
3 infringement of at least claim 1 of the '376 Patent in violation of 35 U.S.C. § 271(b),
4 in this district and elsewhere in the United States. Through the filing and service of
5 this Complaint, Defendant has had knowledge of the '376 Patent and the infringing
6 nature of the Accused Products. More specifically, Defendant has been and is now
7 actively inducing direct infringement by other persons (e.g., Defendant's customers
8 who use, sell or offer for sale the Accused Products).

9 51. Despite this knowledge of the '376 Patent, Defendant continues to actively
10 encourage and instruct its customers and end users (for example, through user
11 manuals and online instruction materials on its website) to use the '376 Accused
12 Products in ways that directly infringe the '376 Patent. For example, Defendant's
13 website provided, and continues to provide, instructions for using the Accused
14 Products on wireless communications systems, and to utilize their 802.11ax
15 beamforming and MU-MIMO functionalities. Defendant does so knowing and
16 intending that its customers and end users will commit these infringing acts.
17 Defendant also continues to make, use, offer for sale, sell, and/or import the '376
18 Accused Products, despite its knowledge of the '376 Patent, thereby specifically
19 intending for and inducing its customers to infringe the '376 Patent through the
20 customers' normal and customary use of the '376 Accused Products. Defendant also
21 knew or was willfully blind that its actions would induce direct infringement by
22 others and intended that its actions would induce direct infringement by others.
23 Accordingly, a reasonable inference is that Defendant specifically intended for
24 others, such as its customers, to directly infringe one or more claims of Vivato's
25 '376 Patent in the United States because Defendant had knowledge of the '376 Patent
26 and actively induced others (e.g., its customers) to directly infringe the '376 Patent.

27 52. Defendant also contributorily infringes by making, using, selling, offering
28 to sell, and/or importing the Accused Products, knowing they constitute a material

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1 part of the invention, are especially made or adapted for use in infringing, and that
2 they are not staple articles of commerce capable of substantial non-infringing use.

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

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

9 55. Vivato's '376 Patent is valid and enforceable.

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

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

20 **VI. COUNT THREE: INFRINGEMENT OF UNITED STATES**
21 **PATENT NO. 9,289,939**

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

24 59. On October 16, 2012, United States Patent No. 8,289,939 duly and legally
25 issued for inventions entitled "Signal Communication Coordination." Vivato owns
26 the '939 Patent and holds the right to sue and recover damages for infringement
27 thereof. A copy of the '939 Patent is attached hereto as Exhibit C.
28

1 60. Defendants have directly infringed and continue to directly infringe
 2 numerous claims of the '939 Patent, including at least claim 1, by manufacturing,
 3 using, selling, offering to sell, and/or importing into the United States certain Wi-Fi
 4 access points, routers, and controllers supporting “Smart WiFi” or “Auto-Radio
 5 Resource Management” in Insight or “automatic channel allocation” or comparable
 6 automatic channel allocation features to reduce interference (*e.g.*, WAC500 Series
 7 (And Above) Access Points, Orbi Pro Router and Satellites, Orbi Pro WiFi 6
 8 including including RBK853, RBK852, RBK842, RBS850, RBR850, RBK854,
 9 RBK752, RBK753, RBK753S, RBK754, CBK752, RBX750, the WAX600 Series
 10 Access Points including WAX610, WAX610Y, High Capacity Wireless Controllers
 11 including WC9500, WC7600, WB7630, WC7500, and Access Points such as
 12 WAC720, WAC730) (collectively, '939 Accused Products). Defendant is liable for
 13 infringement of the '939 Patent pursuant to 35 U.S.C. § 271(a).

14 61. The '939 Accused Products satisfy all claim limitations of numerous
 15 claims of the '939 Patent, including Claim 1. The following paragraphs compare
 16 limitations of Claim 1 to exemplary '939 Accused Products, the NETGEAR
 17 WAC540 and NETGEAR WC9500. The NETGEAR WAC540 supports “Smart
 18 WiFi,” “Auto-Radio Resource Management,” or “WiFi Auto Radio Management.”
 19 *See, e.g.*, NETGEAR Insight 5.11 Offers and Features.² *See e.g.*, How do I use Smart
 20 WiFi or Auto-Radio Resource Management (RRM) in Insight?³ The NETGEAR
 21 WC9500 supports automatic RF management and automatic channel allocation. *See,*
 22 *e.g.*, NETGEAR ProSafe High Capacity Wireless Controller WC9500 Data Sheet.⁴

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 25 ² NETGEAR Insight 5.11 Offers and Features, available at
<https://www.netgear.com/Insight/pdf/Insight-V5-11-Flyer.pdf/>.

26 ³ How do I use Smart WiFi or Auto-Radio Resource Management (RRM) in Insight?,
 NETGEAR Support, available at [https://kb.netgear.com/000053883/How-do-I-use-Smart-WiFi-](https://kb.netgear.com/000053883/How-do-I-use-Smart-WiFi-or-Auto-Radio-Resource-Management-RRM-in-Insight)
 27 [or-Auto-Radio-Resource-Management-RRM-in-Insight](https://kb.netgear.com/000053883/How-do-I-use-Smart-WiFi-or-Auto-Radio-Resource-Management-RRM-in-Insight)

28 ⁴ NETGEAR ProSafe High Capacity Wireless Controller WC9500 Data Sheet available at
[https://www.downloads.netgear.com/files/GDC/datasheet/en/WC9500.pdf?_ga=2.215401758.84](https://www.downloads.netgear.com/files/GDC/datasheet/en/WC9500.pdf?_ga=2.215401758.846076231.1622666769-1688466665.1622666769)
[6076231.1622666769-1688466665.1622666769](https://www.downloads.netgear.com/files/GDC/datasheet/en/WC9500.pdf?_ga=2.215401758.846076231.1622666769-1688466665.1622666769)

1 62. Each Accused Product is an apparatus comprising a wireless input/output
2 (I/O) unit that is configured to establish a plurality of access points. For example,
3 the NETGEAR WAC540 or WC9500 is an apparatus comprising a wireless
4 input/output (I/O) unit that is configured to establish a plurality of access points. *See,*
5 *e.g.*, NETGEAR Insight 5.11 Offers and Features (“Access Point Management
6 Features: Setup SSIDs, security and guest Captive Portals. Manage WiFi Channels
7 and seamless Fast Roaming”; “WiFi Auto Radio Management”; “Instant WiFi with
8 Auto RRM (available with WAC540”). *See, e.g.*, How do I use Smart WiFi or Auto-
9 Radio Resource Management (RRM) in Insight? (“Auto Radio Resource
10 Management (RRM) uses WiFi radio statistics from each access point in a network
11 location to calculate the best channel and best transmit power for the access point.
12 Auto RRM is sometimes called Smart WiFi. If your WiFi environment changes
13 significantly, consider telling Insight to recalculate the best channel and transmit
14 power settings for your access points. The Optimize Now button triggers a new
15 computation of the automatic channel and transmit power for all of the access points
16 in a network location according to the current Auto RRM settings. By default, Auto
17 RRM is turned on for every network location. You can turn Auto RRM on and off
18 for each network location independently. You can also turn auto channel selection
19 and auto transmit power selection on and off for each WiFi radio at the network
20 location level.”). *See, e.g.*, NETGEAR ProSafe High Capacity Wireless Controller
21 WC9500 Data Sheet (“The NETGEAR WC9500 High Capacity Controller supports
22 up to 200 APs and is upgradable in 10, 50, 100, or 200 APs via software licenses.
23 Stackable up to three controllers, a WC9500 High Capacity Controller stack can
24 support up to 600 access points with a single interface. The WC9500 offers
25 redundancy for always-on reliability.”; “RF Management and Hole Detection.
26 Automatic control of AP transmit power and channel allocation ensures coverage by
27 minimizing interferences. Automatic WLAN healing after loss of AP or due to RF
28 interferences adapts the power and channel of the other APs around the area.

1 Scheduled automatic channel allocation authorizes an enterprise-class reliable
2 wireless experience”; “The WC9500 uses a heartbeat mechanism between the
3 controller and the AP. It is monitored based on several factors, such as RF
4 interference, clients, error levels, etc. Each AP is constantly monitored (number of
5 clients, traffic load, RF interference, packet error levels and retransmission
6 statistics). Statistics provide reliable metrics per AP, per client, per floor and for the
7 entire wireless network.”).

8 63. Each Accused Product is an apparatus comprising a signal
9 transmission/reception coordination logic that is capable of ascertaining, by
10 monitoring the plurality of access points for received signals, that a first access point
11 of the plurality of access points is receiving a first signal and that is adapted to
12 restrain at least two other access points of the plurality of access points from
13 transmitting signal responsive to the ascertaining that the first access point is
14 receiving the first signal. For example, as with each Accused Product, the
15 NETGEAR WAC540 or WC9500 is an apparatus comprising a signal
16 transmission/reception coordination logic that is capable of ascertaining, by
17 monitoring the plurality of access points for received signals, that a first access point
18 of the plurality of access points is receiving a first signal and that is adapted to
19 restrain at least two other access points of the plurality of access points from
20 transmitting signal responsive to the ascertaining that the first access point is
21 receiving the first signal. *See, e.g.*, NETGEAR Insight 5.11 Offers and Features
22 (“Access Point Management Features: Setup SSIDs, security and guest Captive
23 Portals. Manage WiFi Channels and seamless Fast Roaming”; “WiFi Auto Radio
24 Management”; “Instant WiFi with Auto RRM (available with WAC540”). *See, e.g.*,
25 How do I use Smart WiFi or Auto-Radio Resource Management (RRM) in Insight?
26 (“Auto Radio Resource Management (RRM) uses WiFi radio statistics from each
27 access point in a network location to calculate the best channel and best transmit
28 power for the access point. Auto RRM is sometimes called Smart WiFi. If your WiFi

1 environment changes significantly, consider telling Insight to recalculate the best
2 channel and transmit power settings for your access points. The Optimize Now
3 button triggers a new computation of the automatic channel and transmit power for
4 all of the access points in a network location according to the current Auto RRM
5 settings. By default, Auto RRM is turned on for every network location. You can
6 turn Auto RRM on and off for each network location independently. You can also
7 turn auto channel selection and auto transmit power selection on and off for each
8 WiFi radio at the network location level.”). *See, e.g.*, NETGEAR ProSafe High
9 Capacity Wireless Controller WC9500 Data Sheet (“The NETGEAR WC9500 High
10 Capacity Controller supports up to 200 APs and is upgradable in 10, 50, 100, or 200
11 APs via software licenses. Stackable up to three controllers, a WC9500 High
12 Capacity Controller stack can support up to 600 access points with a single interface.
13 The WC9500 offers redundancy for always-on reliability.”; “RF Management and
14 Hole Detection. Automatic control of AP transmit power and channel allocation
15 ensures coverage by minimizing interferences. Automatic WLAN healing after loss
16 of AP or due to RF interferences adapts the power and channel of the other APs
17 around the area. Scheduled automatic channel allocation authorizes an enterprise-
18 class reliable wireless experience”; “The WC9500 uses a heartbeat mechanism
19 between the controller and the AP. It is monitored based on several factors, such as
20 RF interference, clients, error levels, etc. Each AP is constantly monitored (number
21 of clients, traffic load, RF interference, packet error levels and retransmission
22 statistics). Statistics provide reliable metrics per AP, per client, per floor and for the
23 entire wireless network.”)

24 64. Each Accused Product is an apparatus comprising a signal
25 transmission/reception coordination logic that is capable of ascertaining, by
26 monitoring the plurality of access points for received signals, that a first access point
27 of the plurality of access points is receiving a first signal and that is adapted to
28 restrain at least two other access points of the plurality of access points from

1 transmitting signal responsive to the ascertaining that the first access point is
2 receiving the first signal, wherein the signal transmission/reception coordination
3 logic restrains at least one other access point of the plurality of access points from
4 transmitting the other signal on a first channel responsive to the ascertaining that the
5 access point of the plurality of access points is receiving the signal on a second
6 different channel. For example, as with each Accused Product, the NETGEAR
7 WAC540 or WC9500 is an apparatus comprising a signal transmission/reception
8 coordination logic that is capable of ascertaining, by monitoring the plurality of
9 access points for received signals, that a first access point of the plurality of access
10 points is receiving a first signal and that is adapted to restrain at least two other
11 access points of the plurality of access points from transmitting signal responsive to
12 the ascertaining that the first access point is receiving the first signal, wherein the
13 signal transmission/reception coordination logic restrains at least one other access
14 point of the plurality of access points from transmitting the other signal on a first
15 channel responsive to the ascertaining that the access point of the plurality of access
16 points is receiving the signal on a second different channel. *See, e.g.*, NETGEAR
17 Insight 5.11 Offers and Features (“Access Point Management Features: Setup
18 SSIDs, security and guest Captive Portals. Manage WiFi Channels and seamless Fast
19 Roaming”; “WiFi Auto Radio Management”; “Instant WiFi with Auto RRM
20 (available with WAC540”). *See, e.g.*, How do I use Smart WiFi or Auto-Radio
21 Resource Management (RRM) in Insight? (“Auto Radio Resource Management
22 (RRM) uses WiFi radio statistics from each access point in a network location to
23 calculate the best channel and best transmit power for the access point. Auto RRM
24 is sometimes called Smart WiFi. If your WiFi environment changes significantly,
25 consider telling Insight to recalculate the best channel and transmit power settings
26 for your access points. The Optimize Now button triggers a new computation of the
27 automatic channel and transmit power for all of the access points in a network
28 location according to the current Auto RRM settings. By default, Auto RRM is

1 turned on for every network location. You can turn Auto RRM on and off for each
2 network location independently. You can also turn auto channel selection and auto
3 transmit power selection on and off for each WiFi radio at the network location
4 level.”). *See, e.g.*, NETGEAR ProSafe High Capacity Wireless Controller WC9500
5 Data Sheet (“The NETGEAR WC9500 High Capacity Controller supports up to 200
6 APs and is upgradable in 10, 50, 100, or 200 APs via software licenses. Stackable
7 up to three controllers, a WC9500 High Capacity Controller stack can support up to
8 600 access points with a single interface. The WC9500 offers redundancy for
9 always-on reliability.”; “RF Management and Hole Detection. Automatic control of
10 AP transmit power and channel allocation ensures coverage by minimizing
11 interferences. Automatic WLAN healing after loss of AP or due to RF interferences
12 adapts the power and channel of the other APs around the area. Scheduled automatic
13 channel allocation authorizes an enterprise-class reliable wireless experience”; “The
14 WC9500 uses a heartbeat mechanism between the controller and the AP. It is
15 monitored based on several factors, such as RF interference, clients, error levels, etc.
16 Each AP is constantly monitored (number of clients, traffic load, RF interference,
17 packet error levels and retransmission statistics). Statistics provide reliable metrics
18 per AP, per client, per floor and for the entire wireless network.”).

19 65. Defendant also has been and is now knowingly and intentionally inducing
20 infringement of at least claim 1 of the ’939 Patent in violation of 35 U.S.C. § 271(b).
21 Through at least the filing and service of this Complaint, Defendant has had
22 knowledge of the ’939 Patent and the infringing nature of the ’939 Accused
23 Products.

24 66. Despite this knowledge of the ’939 Patent, Defendants continue to actively
25 encourage and instruct its customers and end users (for example, through user
26 manuals and online instruction materials on its website) to use the ’939 Accused
27 Products in ways that directly infringe the ’939 Patent. For example, Defendants’
28 websites provided, and continues to provide, instructions for using the Accused

1 Products on wireless communications systems, to utilize their 802.11ax
2 beamforming and/or MU-MIMO functionalities and to utilize their Smart WiFi,
3 Auto-Radio Resource Management, automatic channel allocation and adaptive radio
4 functionalities. Defendants do so knowing and intending that its customers and end
5 users will commit these infringing acts. Defendant also continue to make, use, offer
6 for sale, sell, and/or import the Accused Products, despite its knowledge of the '939
7 Patent, thereby specifically intending for and inducing its customers to infringe the
8 '939 Patent through the customers' normal and customary use of the '939 Accused
9 Products. Defendants also knew or were willfully blind that its actions would induce
10 direct infringement by others and intended that its actions would induce direct
11 infringement by others. Accordingly, a reasonable inference is that Defendant
12 specifically intended for others, such as its customers, to directly infringe one or
13 more claims of Vivato's '939 Patent in the United States because Defendants had
14 knowledge of the '939 Patent and actively induced others (*e.g.*, its customers) to
15 directly infringe the '939 Patent.

16 67. Defendants also contributorily infringe by making, using, selling, offering
17 to sell, and/or importing the "939 Accused Products, knowing they constitute a
18 material part of the invention, are especially made or adapted for use in infringing,
19 and that they are not staple articles of commerce capable of substantial non-
20 infringing use.

21 68. By making, using, offering for sale, selling and/or importing into the
22 United States the '939 Accused Products, Defendants have injured Vivato and is
23 liable for infringement of the '939 Patent pursuant to 35 U.S.C. § 271.

24 69. Defendant also infringes numerous additional claims of the '939 Patent,
25 including Claims 2 – 35, directly and through inducing infringement, for similar
26 reasons as explained above with respect to Claim 1.

27 70. Vivato's '939 Patent is valid and enforceable.
28

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1 71. Vivato has complied with 35 U.S.C. § 287 and it does not bar recovery of
2 pre-suit damages at least because there are no unmarked patented articles subject to
3 a duty to mark.

4 72. As a result of Defendant's infringement of the '939 Patent, Defendant has
5 damaged Vivato, and Vivato is entitled to monetary damages in an amount to be
6 determined at trial that is adequate to compensate for Defendant's infringement, but
7 in no event less than a reasonable royalty for the use made of the invention by
8 Defendant, together with interest and costs as fixed by the Court.

9 73. Defendant's infringing activities have injured and will continue to injure
10 Vivato, unless and until this Court enters an injunction prohibiting further
11 infringement of the '939 Patent, and, specifically, enjoining further manufacture,
12 use, sale, importation, and/or offers for sale that come within the scope of the patent
13 claims.

14 **VII. WILLFUL INFRINGEMENT**

15 74. Defendant had knowledge of Vivato's '728 Patent by at least the date of
16 the filing and service of the Complaints for Patent Infringement on April 19, 2017,
17 and July 14, 2017 in the United States District Court for the Central District of
18 California.

19 75. Despite Defendant's knowledge of Vivato's '728 Patent and its patent
20 portfolio, Defendant infringed and continues to infringe the '728 Patent with full and
21 complete knowledge of the patents' applicability to Defendant's MU-MIMO Wi-Fi
22 6 access point and router products without taking a license and without a good faith
23 belief that the '728 Patent are invalid and not infringed. Defendant's infringement
24 occurred, and continues to occur, with knowledge of infringement and/or with
25 willful blindness to its infringement.

26 76. Defendant sold, and continues to sell, its '728 Accused Products (*e.g.*, Wi-
27 Fi 6 / IEEE 802.11ax Access Points) to customers despite its knowledge of Vivato's
28 Asserted Patents, such as on netgear.com. Defendant also manufactured and

1 imported into the United States, and continues to do so, the Accused Products for
 2 sale and distribution to its customers, despite its knowledge of Vivato's Asserted
 3 Patents, including without limitation the '728 Patent.

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

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

24 ///

25 PRAYER FOR RELIEF

26 WHEREFORE, Vivato prays for the following relief:

27 (a) A judgment in favor of Vivato that Defendant has infringed and is
 28 infringing U.S. Patent Nos. 7,729,728, 10,594,376, and 8,289,939;

1 (b) An award of damages to Vivato arising out of Defendant’s infringement
2 of U.S. Patent Nos. 7,729,728, 10,594,376, and 8,289,939, together with
3 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: June 16, 2021

Respectfully submitted,

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17
18
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