

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,

25 *Plaintiff,*

26 *v.*

27 UBIQUITI NETWORKS, INC.,

28 *Defendant.*

Case No. 8:21-cv-01065

**COMPLAINT FOR PATENT  
 INFRINGEMENT**

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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 speed, 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. Ubiquiti Networks, Inc. ("Ubiquiti" or "Defendant") is a corporation  
14 organized and existing under the laws of Delaware with its principal place of  
15 business at 2580 Orchard Parkway, San Jose, CA 95131. Ubiquiti has a registered  
16 agent for service of process at C T Corporation System, 818 W 7th St. Ste. 930, Los  
17 Angeles, CA 90017.

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

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

25 ///

26 **III. BACKGROUND OF THE TECHNOLOGY**

27 11. This complaint arises from Defendant's unlawful infringement of the  
28 following United States patents owned by Vivato, each of which generally relate to

1 wireless communications technology: United States Patent Nos. 7,729,728 (the  
2 “‘728 Patent”) and 10,594,376 (the “‘376 Patent”) (collectively, the “Asserted  
3 Patents”).

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

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

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

27 15. In 1905, Braun invented the first phased array antenna. This phased array  
28 antenna featured three antennas carefully positioned relative to one another with a

1 specific phase relationship so that the radio waves output from each antenna could  
2 add together to increase radiation in a desired direction. This design allowed Braun’s  
3 phased array antenna to transmit a directed signal.

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

13 17. At the beginning of the twenty-first century, the vast majority of wireless  
14 networks still did not yet take advantage of directed wireless communications.  
15 Instead, “omnidirectional” access points were ubiquitous. Omnidirectional access  
16 points transmit radio waves uniformly around the access point in every direction and  
17 do not steer the signal in particular directions. Omnidirectional antennas access  
18 points do typically achieve 360 degrees of coverage around the access point, but  
19 with a reduced coverage distance. Omnidirectional access points also lack  
20 sophisticated approaches to overcome certain types of interference in the  
21 environment. As only one example, the presence of solid obstructions, such as a  
22 concrete wall, ceiling, or pillar, can limit signal penetration. As another example,  
23 interference arises when radio waves are reflected, refracted, or diffracted based on  
24 obstacles present between the transmitter and receiver. The multiple paths that radio  
25 waves can travel between the transmitter and receiver often result in signal  
26 interference that decreases performance, and omnidirectional access points lack  
27 advanced solutions to overcome these “multipath” effects.  
28

1 18. Moving from omnidirectional networks to modern networks has required  
2 an additional series of advancements that harness the capabilities of directed wireless  
3 technology. These advancements range from conceiving various ways to steer and  
4 modify radiation patterns, to enhancing the transmission signal power in a desired  
5 direction, to suppressing radiation in undesired directions, to minimizing signal  
6 “noise,” and then applying these new approaches into communications networks  
7 with multiple, heterogenous transmitters and receivers.

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

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

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

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

27 22. Defendant has directly infringed and continues to directly infringe  
28 numerous claims of the ’728 Patent, including at least claim 4, by manufacturing,

1 using, selling, offering to sell, and/or importing into the United States Wi-Fi 6 access  
 2 points and routers supporting MU-MIMO, including without limitation access points  
 3 and routers utilizing the IEEE 802.11ax or “Wi-Fi 6” standard (e.g., Defendant’s U6  
 4 Long Range Access Point, U6 Lite Access Point, and AmpliFi Alien system  
 5 (collectively, the “’728 Accused Products”). Defendant is liable for infringement of  
 6 the ’728 Patent pursuant to 35 U.S.C. § 271(a).

7 23. The ’728 Accused Products satisfy all claim limitations of Claims 3, 4,  
 8 5, and 12 of the ’728 Patent. The following paragraphs compare limitations of Claim  
 9 4 to an exemplary ’728 Accused Product, the U6 Long Range wireless access point.

10 24. Each of the ’728 Accused Products comprises a wireless communication  
 11 system and performs a method for use in a wireless communication system. For  
 12 example, the U6 Long Range Access Point is a wireless access point for use in a Wi-  
 13 Fi network. *See, e.g.,* UniFi 6 Long-Range Access Point Data Sheet,<sup>1</sup> indicating the  
 14 U6-LR includes a “Dual-Core Cortex A53 at 1.35 GHz” processor, “2.4 GHz 4 x 4”  
 15 and “5 GHz 4x4” MIMO, with “4 dBi” of “Antenna Gain” on the “2.4 GHz” radio  
 16 and “5.5 dBi” of “Antenna Gain” on the “5 GHz” radio, supporting “802.11a/b/g  
 17 Wi-Fi4/Wi-Fi 5/Wi-Fi 6” standards and “802.11ax (Wi-Fi 6)” data rates. *See also*  
 18 UniFi 6 Long-Range Access Point Webpage<sup>2</sup> stating, the “U6-LR is a high-  
 19 performance Access Point leveraging advanced WiFi 6 technology to provide  
 20 powerful wireless coverage to enterprise environments. It delivers an aggregate  
 21 radio rate of up to 3.0 Gbps with 5 GHz (4x4 MU-MIMO and OFDMA) and 2.4  
 22 GHz 4x4 MIMO radios.” “Features” include “1.3 GHz dual-core processor (now  
 23 upgraded to support full-duplex 1 Gbps TCP/IP performance)... Four-stream high-  
 24 efficiency Wi-Fi 6 technology... 5 GHz band 4x4 MU-MIMO and OFDMA with  
 25 radio rate of 2.4 Gbps... 2.4 GHz band 4x4 MIMO with radio rate of 600 Mbps.”).

26  
 27 <sup>1</sup> UniFi 6 Long-Range Access Point Data Sheet available at Defendant’s website: [http://dl-  
 origin.ubnt.com/ds/u6-lr\\_ds.pdf](http://dl-origin.ubnt.com/ds/u6-lr_ds.pdf) (last visited Jun 8, 2021).

28 <sup>2</sup> UniFi 6 Long-Range Access Point Webpage available at Defendant’s website:  
<https://store.ui.com/products/unifi-6-long-range-access-point> (last visited Jun 8, 2021).

1 Further, the UniFi 6 Long Range Access Point is capable of “Simultaneously  
 2 connect[ing] to more devices” and can “Create and support over 300 distinct client  
 3 connections:”



14 Ubiquiti’s Wi-Fi Webpage<sup>3</sup> further indicates that the UniFi 6 Long Range includes  
 15 “Wi-Fi 6,” “4x4 OFDMA” MIMO, and “MU-MIMO.”

16 25. Each of the ’728 Accused Products comprises a phased array antenna  
 17 configured to selectively allow a receiving device to operatively associate with a  
 18 beam downlink transmittable to the receiving device via a phased array antenna of  
 19 an access point. For example, as with each Accused Product, the U6 Long Range  
 20 Access Point selectively allows a receiving device (*e.g.*, station, abbreviated “STA”) to  
 21 operatively associate (*e.g.*, connect) with a beam downlink transmittable to the  
 22 receiving device (*e.g.*, SU-MIMO, DL MU-MIMO or UL MU-MIMO  
 23 beamforming) via a phased array antenna of an access point (*e.g.*, the antenna array  
 24 and supporting mechanisms of the U6 Long Range Access Point). *See, e.g.*, UniFi 6  
 25 Long-Range Access Point Data Sheet, indicating the U6-LR includes a “Dual-Core  
 26 Cortex A53 at 1.35 GHz” processor, “2.4 GHz 4 x 4” and “5 GHz 4x4” MIMO, with

27

28 <sup>3</sup> UniFi Wi-Fi Webpage available at Defendant’s website: <https://www.ui.com/wi-fi/> (last visited Jun 8, 2021).



1 “4 dBi” of “Antenna Gain” on the “2.4 GHz” radio and “5.5 dBi” of “Antenna Gain”  
2 on the “5 GHz” radio, supporting “802.11a/b/g Wi-Fi 4/Wi-Fi 5/Wi-Fi 6” standards  
3 and “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi 6 Long-Range Access Point  
4 Webpage stating, the “U6-LR is a high-performance Access Point leveraging  
5 advanced WiFi 6 technology to provide powerful wireless coverage to enterprise  
6 environments. It delivers an aggregate radio rate of up to 3.0 Gbps with 5 GHz (4x4  
7 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.” “Features” include “1.3  
8 GHz dual-core processor (now upgraded to support full-duplex 1 Gbps TCP/IP  
9 performance)... Four-stream high-efficiency Wi-Fi 6 technology... 5 GHz band 4x4  
10 MU-MIMO and OFDMA with radio rate of 2.4 Gbps... 2.4 GHz band 4x4 MIMO  
11 with radio rate of 600 Mbps.”). Further, the UniFi 6 Long Range Access Point is  
12 capable of “Simultaneously connect[ing] to more devices” and can “Create and  
13 support over 300 distinct client connections.” Ubiquiti’s Wi-Fi Webpage further  
14 indicates that the UniFi 6 Long Range includes “Wi-Fi 6,” “4x4 OFDMA” MIMO,  
15 and “MU-MIMO.” *See, e.g.,* IEEE 802.11ax Standard, at Sections 9.3.1.22, 26.5,  
16 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,  
17 27.3.10.9, 27.3.15, including Tables 27-19, 27-20, 27-21, 27-24, 27-25, 27-26, 27-  
18 27, 27-28, 27-29, Annex G at G.5, Annex Z. *See, e.g.,* IEEE 802.11ax Standard,  
19 Section 27.3.1.1 (“The transmission within an RU in a PPDU may be single stream  
20 to one user, spatially multiplexed to one user (SU-MIMO), or spatially multiplexed  
21 to multiple users (MU-MIMO).”); Section 27.3.2.5 (“The number of users in the  
22 MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-  
23 MIMO Users field in HE-SIG-A. The allocated spatial streams for each user and the  
24 total number of spatial streams are indicated in the Spatial Configuration field of  
25 User field in HE-SIG-B containing the STA-ID of the designated MU-MIMO STA  
26 as defined in Table 27-29 (Spatial Configuration subfield encoding)...[i]f there is  
27 only one User field (see Table 27-27 (User field format for a non-MU-MIMO  
28 allocation)) for an RU in the HE-SIG-B content channel, then the number of spatial

1 streams for the user in the RU is indicated by the NSTS field in the User field. If  
2 there is more than one User field (see Table 27-28 (User field for an MU-MIMO  
3 allocation)) for an RU in the HE-SIG-B content channel, then the number of  
4 allocated spatial streams for each user in the RU is indicated by the Spatial  
5 Configuration field of the User field in HE-SIG-B.”); Section 27.3.2.6 (“UL MU  
6 transmissions are preceded by a Trigger frame or frame carrying a TRS Control  
7 subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield  
8 indicates the parameters, such as the duration of the HE TB PPDU, RU allocation,  
9 target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control)  
10 and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit  
11 an HE TB PPDU”); Section 27.3.10.8 (HE-SIG-B) (“The HE-SIG-B field provides  
12 the OFDMA and DL MU-MIMO resource allocation information to allow the STAs  
13 to look up the corresponding resources to be used in the data portion of the frame.”);  
14 Section 27.3.15 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used  
15 by a STA with multiple antennas (the beamformer) to steer signals using knowledge  
16 of the channel to improve throughput. With SU-MIMO beamforming all space-time  
17 streams in the transmitted signal are intended for reception at a single STA in an RU.  
18 With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are  
19 intended for reception at different STAs in an RU of size greater than or equal to  
20 106-tones”); Section 27.3.10.8.5 (HE-SIG-B per user content) (“The User Specific  
21 field consists of multiple User fields. The User fields follow the Common field of  
22 HE-SIG-B. The RU Allocation field in the Common field and the position of the  
23 User field in the User Specific field together identify the RU used to transmit a  
24 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

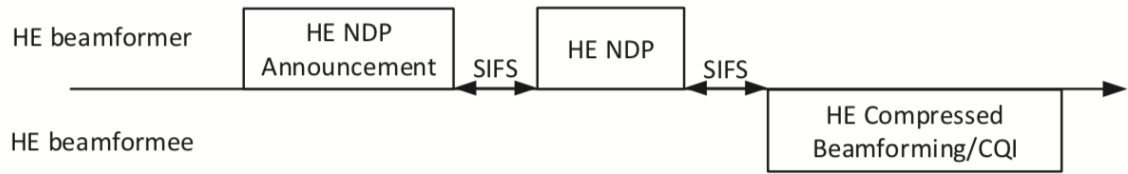
**Table 27-28—User field for an MU-MIMO allocation**

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.			

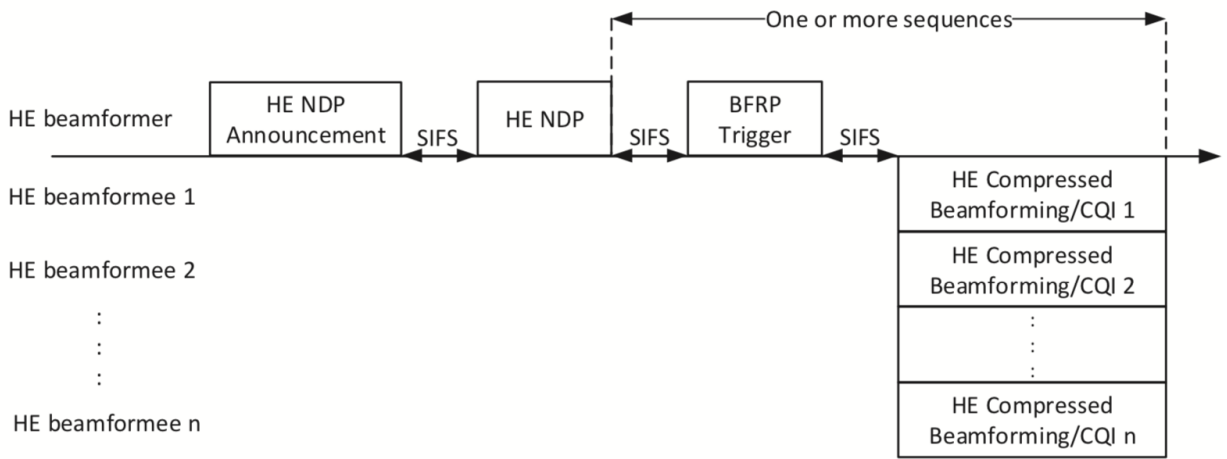
Section 9.3.1.22 (Trigger frame format) (“A Trigger frame allocates resources for and solicits one or more HE TB PPDU transmissions. The Trigger frame also carries other information required by the responding STA to send an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the 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 '728 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 U6 Long Range Access Point is  
4 configured to receive an uplink transmission (*e.g.*, receiving an uplink transmission  
5 in response to a trigger frame soliciting an uplink transmission, including, *e.g.*, HE  
6 TB PPDU, *e.g.*, HE TB feedback NDP, further including, *e.g.*, receiving an uplink  
7 transmission that includes information regarding an estimate of the channel state in,  
8 *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE  
9 Compressed Beamforming/CQI frames) from the receiving device (*e.g.*, a STA, or  
10 HE beamformee) through the phased array antenna. *See, e.g.*, 802.11ax Standard,  
11 Sections 9.3.1.19, 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,  
12 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, 27.3.10.10. *See,*  
13 *e.g.*, Section 26.7 (HE sounding protocol) (“Transmit beamforming and DL MU-  
14 MIMO require knowledge of the channel state to compute a steering matrix that is  
15 applied to the transmit signal to optimize reception at one or more receivers. HE  
16 STAs use the HE sounding protocol to determine the channel state information. The  
17 HE sounding protocol provides explicit feedback mechanisms, defined as HE non-  
18 trigger-based (non-TB) sounding and HE trigger-based (TB) sounding, where the  
19 HE beamformee measures the channel using a training signal (*i.e.*, an HE sounding  
20 NDP) transmitted by the HE beamformer and sends back a transformed estimate of  
21 the channel state. The HE beamformer uses this estimate to derive the steering  
22 matrix. The HE beamformee returns an estimate of the channel state in an HE

1 compressed beamforming/CQI report carried in one or more HE Compressed  
 2 Beamforming/CQI frames.”); Section 26.7.3, Figures 26-6 and 26-7:



3  
4  
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7 **Figure 26-6—An example of the sounding protocol with a single HE beamformee**



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9  
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16 **Figure 26-7—An example of the sounding protocol with more than one HE beamformee**

17  
18 ; Section 26.7.3 (“An HE beamformee that receives an HE NDP Announcement  
 19 frame from an HE beamformer with which it is associated and that contains the HE  
 20 beamformee’s MAC address in the RA field and also receives an HE sounding NDP  
 21 a SIFS after the HE NDP Announcement frame shall transmit its HE compressed  
 22 beamforming/CQI report a SIFS after the HE sounding NDP. The TXVECTOR  
 23 parameter CH\_BANDWIDTH for the PPDU containing the HE compressed  
 24 beamforming/CQI report shall be set to indicate a bandwidth not wider than that  
 25 indicated by the RXVECTOR parameter CH\_BANDWIDTH of the HE sounding  
 26 NDP. An HE beamformee that receives an HE NDP Announcement frame as part of  
 27 an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or  
 28 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<sub>r,total</sub> 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<sub>r,u</sub> 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 ’728 Accused Products is configured to determine from the  
14 uplink transmission if the receiving device should operatively associate with a  
15 different beam downlink transmittable via the phased array antenna. For example,  
16 the U6 Long Range Access Point is configured to determine from information  
17 contained in the uplink transmission (*e.g.*, an uplink transmission received in  
18 response to a trigger frame soliciting an uplink transmission, including, *e.g.*, HE TB  
19 PPDU, *e.g.*, HE TB feedback NDP, further including, *e.g.*, an uplink transmission  
20 that includes information regarding an estimate of the channel state in, *e.g.*, an HE  
21 compressed beamforming/CQI report carried in one or more HE Compressed  
22 Beamforming/CQI frames) if the receiving device (*e.g.*, STA, or HE beamformee)  
23 that sent the uplink transmission should operatively associate with a different beam  
24 downlink transmittable via the phased array antenna. *See, e.g.*, UniFi 6 Long-Range  
25 Access Point Data Sheet, indicating the U6-LR includes a “Dual-Core Cortex A53  
26 at 1.35 GHz” processor, “2.4 GHz 4 x 4” and “5 GHz 4x4” MIMO, with “4 dBi” of  
27 “Antenna Gain” on the “2.4 GHz” radio and “5.5 dBi” of “Antenna Gain” on the “5  
28 GHz” radio, supporting “802.11a/b/g Wi-Fi 4/Wi-Fi 5/Wi-Fi 6” standards and

1 “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi 6 Long-Range Access Point  
 2 Webpage stating, the “U6-LR is a high-performance Access Point leveraging  
 3 advanced WiFi 6 technology to provide powerful wireless coverage to enterprise  
 4 environments. It delivers an aggregate radio rate of up to 3.0 Gbps with 5 GHz (4x4  
 5 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.” “Features” include “1.3  
 6 GHz dual-core processor (now upgraded to support full-duplex 1 Gbps TCP/IP  
 7 performance)... Four-stream high-efficiency Wi-Fi 6 technology... 5 GHz band 4x4  
 8 MU-MIMO and OFDMA with radio rate of 2.4 Gbps... 2.4 GHz band 4x4 MIMO  
 9 with radio rate of 600 Mbps.”). Further, the UniFi 6 Long Range Access Point is  
 10 capable of “Simultaneously connect[ing] to more devices” and can “Create and  
 11 support over 300 distinct client connections.” Ubiquiti’s Wi-Fi Webpage further  
 12 indicates that the UniFi 6 Long Range includes “Wi-Fi 6,” “4x4 OFDMA” MIMO,  
 13 and “MU-MIMO.” *See, e.g.*, IEEE 802.11ax Standard, at Sections 9.3.1.22, 9.4.1.64,  
 14 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,  
 15 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,  
 16 27.3.10.9, 27.3.10.10, 27.3.15 – 27.3.15.3. *See, e.g.*, IEEE 802.11ax Standard at  
 17 Section 26.7.1 (“Transmit beamforming and DL MU-MIMO require knowledge of  
 18 the channel state to compute a steering matrix that is applied to the transmit signal  
 19 to optimize reception at one or more receivers. HE STAs use the HE sounding  
 20 protocol to determine the channel state information. The HE sounding protocol  
 21 provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB)  
 22 sounding and HE trigger-based (TB) sounding, where the HE beamformee measures  
 23 the channel using a training signal (i.e., an HE sounding NDP) transmitted by the  
 24 HE beamformer and sends back a transformed estimate of the channel state. The HE  
 25 beamformer uses this estimate to derive the steering matrix.”); Section 27.3.15.1  
 26 (SU-MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix  
 27  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the  
 28 beamforming feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r}$



1 -1. The feedback report format is described in 9.4.1.65 (HE Compressed  
2 Beamforming Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report  
3 field). The steering matrix that is computed (or updated) using new beamforming  
4 feedback from some or all of participating beamformees might replace the existing  
5 steering matrix  $Q_k$  for the next DL MU-MIMO data transmission. For SU-MIMO  
6 beamforming, the steering matrix  $Q_k$  can be determined from the beamforming  
7 feedback matrix  $V_k$  that is sent back to the beamformer by the beamformee using  
8 the compressed beamforming feedback matrix format as defined in 19.3.12.3.6  
9 (Compressed beamforming feedback matrix). The feedback report format is  
10 described in 9.4.1.65 (HE Compressed Beamforming Report field.”); Section  
11 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE Compressed  
12 Beamforming Report field carries the average SNR of each space-time stream and  
13 compressed beamforming feedback matrices  $V$  for use by a transmit beamformer to  
14 determine steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback  
15 beamforming) and 19.3.12.3 (Explicit feedback beamforming”); Section 9.1.4.66  
16 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive  
17 Beamforming Report field carries explicit feedback in the form of delta SNRs. The  
18 information in the HE Compressed Beamforming Report field and the HE MU  
19 Exclusive Beamforming Report field can be used by the transmit MU beamformer  
20 to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”);  
21 Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-  
22 RU average SNRs of each space-time stream, where each per-RU average SNR is  
23 the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback  
24 is being requested.”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field provides a  
25 means for the receiver to estimate the MIMO channel between the set of  
26 constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs)  
27 and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter  
28 provides training for NSTS space-time streams (spatial mapper inputs) used for the

1 transmission of the PSDU. In an HE MU PPDU, the transmitter provides training  
 2 for NSTS<sub>r,total</sub> space-time streams used for the transmission of the PSDU(s) in the  
 3 r-th RU. In an HE TB PPDU, the transmitter of user u in the r-th RU provides training  
 4 for NSTS<sub>r,u</sub> space-time streams used for the transmission of the PSDU. For each  
 5 tone in the r-th RU, the MIMO channel that can be estimated is an  $N_{RX} \times$   
 6  $N_{STS,r,total}$  matrix. An HE transmission has a preamble that contains HE-LTF  
 7 symbols, where the data tones of each HE-LTF symbol are multiplied by entries  
 8 belonging to a matrix PHE-LTF, to enable channel estimation at the receiver.... In  
 9 an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the combination of HE-  
 10 LTF type and GI duration is indicated in HE-SIG-A field. In an HE TB PPDU, the  
 11 combination of HE-LTF type and GI duration is indicated in the Trigger frame that  
 12 triggers transmission of the PPDU. If an HE PPDU is an HE sounding NDP, the  
 13 combinations of HE-LTF types and GI durations are listed in 27.3.18 (Transmit  
 14 specification). If an HE PPDU is an HE TB feedback NDP, the combination of HE-  
 15 LTF types and GI durations are listed in 27.3.4 (HE PPDU formats.”).

16 28. Each of the '728 Accused Products is configured to allow the receiving  
 17 device to operatively associate with the different beam downlink if determining that  
 18 the receiving device should operatively associate with the different beam downlink.  
 19 For example, as with each Accused Product, the U6 Long Range Access Point is  
 20 configured to allow the receiving device (e.g., STA or HE beamformee) to  
 21 operatively associate with a different beam downlink if determining that the  
 22 receiving device should operatively associate with the different beam downlink. *See,*  
 23 *e.g.,* IEEE 802.11ax Standard, at Sections 9.3.1.22, 9.4.1.64, 9.4.1.65, 9.4.1.66,  
 24 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, 26.7.4, 26.7.5,  
 25 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, 27.3.10.10,  
 26 27.3.15 – 27.3.15.3. *See, e.g.,* IEEE 802.11ax Standard, Section 27.3.15.1 (SU-  
 27 MIMO and DL-MIMO beamforming) (“The DL MU-MIMO steering matrix  $Q_k =$   
 28  $[Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming

1 feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The  
 2 feedback report format is described in 9.4.1.65 (HE Compressed Beamforming  
 3 Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The  
 4 steering matrix that is computed (or updated) using new beamforming feedback from  
 5 some or all of participating beamformees might replace the existing steering matrix  
 6  $Q_k$  for the next DL MU-MIMO data transmission. For SU-MIMO beamforming, the  
 7 steering matrix  $Q_k$  can be determined from the beamforming feedback matrix  $V_k$  that  
 8 is sent back to the beamformer by the beamformee using the compressed  
 9 beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed  
 10 beamforming feedback matrix). The feedback report format is described in 9.4.1.65  
 11 (HE Compressed Beamforming Report field.”); Section 27.3.15.2 (“After receiving  
 12 the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using  
 13 Equation (19-79). For SU-MIMO beamforming, the beamformer uses  $V_{k,0}$  matrix to  
 14 determine the steering matrix  $Q_k$ . For DL MU-MIMO beamforming, the beamformer  
 15 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  
 16  $\Delta SNR_{k,u}$  ( $0 \leq u \leq N_{user,r}-1$ ) in order to suppress crosstalk between participating  
 17 beamformees. The method used by the beamformer to calculate the steering matrix  
 18  $Q_k$  is implementation specific.”); Section 27.3.2.5 (Resource indication and User  
 19 identification in an HE MU PPDU) (“The number of users in the MU-MIMO group  
 20 is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-  
 21 SIG-A. The allocated spatial streams for each user and the total number of spatial  
 22 streams are indicated in the Spatial Configuration field of User field in HE-SIG-B  
 23 containing the STA-ID of the designated MU-MIMO STA as defined in Table 27-  
 24 29 (Spatial Configuration subfield encoding)...[i]f there is only one User field (see  
 25 Table 27-27 (User field format for a non-MU-MIMO allocation)) for an RU in the  
 26 HE-SIG-B content channel, then the number of spatial streams for the user in the  
 27 RU is indicated by the  $N_{STS}$  field in the User field. If there is more than one User  
 28 field (see Table 27-28 (User field for an MU-MIMO allocation)) for an RU in the

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

15 ///

16 29. Each of the '728 Accused Products is configured to actively probe the  
 17 receiving device by generating a signal to initiate that the phased array antenna  
 18 transmits at least one downlink transmittable message over the different beam  
 19 downlink, and gathering signal parameter information from uplink transmittable  
 20 messages received from the receiving device through the phased array antenna. For  
 21 example, as with each Accused Product, the U6 Long Range Access Point actively  
 22 probes the receiving device by generating a signal causing the phased array antenna  
 23 to transmit at least one downlink transmittable message over the different beam  
 24 downlink (*e.g.*, one or more messages sent to elicit a responsive uplink transmission  
 25 from the receiving STA, including, *e.g.*, HE PDU that carries a trigger frame, *e.g.*,  
 26 messages soliciting feedback or including parameters for feedback from HE  
 27 beamformee(s) such as, *e.g.*, messages pursuant to HE non-TB or HE TB sounding,  
 28 such as, *e.g.*, NDP Announcement, HE sounding NDP frame, Trigger frame), and

1 gathering signal parameter information (*e.g.*, information in an HE compressed  
2 beamforming/CQI report, RSSI, SNR, delta SNR measurements for spatial  
3 stream(s), or information gathered from training fields in uplink PPDU) from uplink  
4 transmittable messages received from the receiving device (*e.g.*, STA or HE  
5 beamformee) through the phased array antenna (*e.g.*, uplink transmittable messages  
6 received from the STA such as in response to a trigger frame soliciting an uplink  
7 transmission, including, *e.g.*, HE TB PPDU, further including, *e.g.*, an uplink  
8 transmission that includes information regarding an estimate of the channel state in,  
9 *e.g.*, an HE compressed beamforming/CQI report carried in one or more HE  
10 Compressed Beamforming/CQI frames). *See, e.g.*, IEEE 802.11ax Standard,  
11 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,  
12 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, -  
13 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,  
14 27.3.16, 27.3.17. *See, e.g.*, IEEE 802.11ax Standard, Section 26.7 (“Transmit  
15 beamforming and DL MU-MIMO require knowledge of the channel state to  
16 compute a steering matrix that is applied to the transmit signal to optimize reception  
17 at one or more receivers. HE STAs use the HE sounding protocol to determine the  
18 channel state information. The HE sounding protocol provides explicit feedback  
19 mechanisms, defined as HE non-trigger-based (non-TB) sounding and HE trigger-  
20 based (TB) sounding, where the HE beamformee measures the channel using a  
21 training signal (*i.e.*, an HE sounding NDP) transmitted by the HE beamformer and  
22 sends back a transformed estimate of the channel state. The HE beamformer uses  
23 this estimate to derive the steering matrix.”); Section 27.3.2.5 (“HE-LTF symbols in  
24 the DL HE MU PDU are used to measure the channel for the space-time streams  
25 intended for the STA and can also be used to measure the channel for the interfering  
26 space-time streams.”); Section 27.3.4 (HE PDU formats) (“Four HE PDU formats  
27 are defined: HE SU PDU, HE MU PDU, HE ER SU PDU, and HE TB PDU.  
28 The HE sounding NDP is a variant of the HE SU PDU and defined in 27.3.16 (HE

1 sounding NDP). The HE TB feedback NDP is a variant of the HE TB PPDU and  
2 defined in 27.3.17 (HE TB feedback NDP)”; Section 27.3.10.10 (HE-LTF) (“The  
3 HT-LTF field provides a means for the receiver to estimate the MIMO channel  
4 between the set of constellation mapper outputs (or, if STBC is applied, the STBC  
5 encoder outputs) and the receive chains.”); Section 26.5.3.3.3 (TXVECTOR  
6 parameters for HE TB PPDU response to Trigger frame); Section 27.3.2.6 (“UL MU  
7 transmissions are preceded by a Trigger frame or frame carrying a TRS Control  
8 subfield from the AP. The Trigger frame or frame carrying the TRS Control subfield  
9 indicates the parameters, such as the duration of the HE TB PPDU, RU allocation,  
10 target RSSI and MCS (see 9.3.1.22 (Trigger frame format), 9.2.4.6a.1 (TRS Control)  
11 and 26.5.3.3 (Non-AP STA behavior for UL MU operation)), required to transmit  
12 an HE TB PPDU.”); Section 9.3.1.22 (Trigger frame format) (“A Trigger frame  
13 allocates resources for and solicits one or more HE TB PPDU transmissions. The  
14 Trigger frame also carries other information required by the responding STA to send  
15 an HE TB PPDU... The SS Allocation subfield of the User Info field indicates the  
16 spatial streams of the solicited HE TB PPDU and the format is defined in Figure 9-  
17 64e (SS Allocation subfield format).”) Section 27.2.2 (TXVECTOR and  
18 RXVECTOR parameters) (EXPANSION\_MAT, CHAN\_MAT, DELTA\_SNR,  
19 SNR, CQI, STBC, GI\_TYPE, RSSI, RSSI\_LEGACY, NUM\_STS,  
20 RU\_ALLOCATION, BEAMFORMED, HE\_LTF\_TYPE, HE\_LTF\_MODE,  
21 NUM\_HE\_LTF, STARTING\_STS\_NUM, PREAMBLE\_TYPE,  
22 TRIGGER\_METHOD, BEAM\_CHANGE, BSS\_COLOR, UPLINK\_FLAG,  
23 STA\_ID\_LIST, NDP\_REPORT, FEEDBACK\_STATUS,  
24 RU\_TONE\_SET\_INDEX); Section 26.5.3.2.4 (Allowed settings of the Trigger  
25 frame fields and TRS Control subfield) (“An AP shall transmit an HE PPDU that  
26 carries a Trigger frame or frame that includes a TRS Control subfield with the  
27 TXVECTOR parameter BEAM\_CHANGE set to 1.”). Section 26.5.3.3 (Non-AP  
28 STA behavior for UL MU operation) (“UL MU operation allows an AP to solicit

1 simultaneous immediate response frames from one or more non-AP STAs. A non-  
 2 AP STA shall follow the rules in this subclause for the transmission of response  
 3 frames in an HE TB PPDU unless the Trigger frame is an MU-RTS Trigger frame,  
 4 in which case the response is a CTS frame sent in a non-HT PPDU (see 26.2.6 (MU-  
 5 RTS Trigger/CTS frame exchange procedure)).”); Section 26.11 (Setting  
 6 TXVECTOR parameters for an HE PPDU); Section 26.11.3 (BEAM\_CHANGE)  
 7 (“An HE STA uses the TXVECTOR parameter BEAM\_CHANGE to indicate a  
 8 change in the spatial mapping of the pre-HE-STF portion of the PPDU and the first  
 9 symbol of HE-LTF (see Table 27-1 (TXVECTOR and RXVECTOR parameter)).  
 10 An HE STA that transmits an HE SU PPDU or an HE ER SU PPDU shall set the  
 11 TXVECTOR parameter BEAM\_CHANGE to 1 if one or more of the following  
 12 conditions are met: - The number of spatial streams is greater than 2; - The PPDU is  
 13 the first PPDU in a TXOP; - The PPDU carries a Trigger frame.”).

14 30. The ’728 Accused Products determine a current position of the receiving  
 15 device relative to the phased array antenna from the uplink transmission received  
 16 from the receiving device through the phased array antenna. For example, as with  
 17 each Accused Product, the U6 Long Range Access Point determines a current  
 18 position of the receiving device (*e.g.*, STA or HE beamformee) relative to the phased  
 19 array antenna from the uplink transmission received from the receiving device  
 20 through the phased array antenna (*e.g.*, uplink transmission received from the STA  
 21 such as in response to a trigger frame soliciting an uplink transmission, including,  
 22 *e.g.*, HE TB PDUs, further including, *e.g.*, an uplink transmission that includes  
 23 information regarding an estimate of the channel state in, *e.g.*, an HE compressed  
 24 beamforming/CQI report carried in one or more HE Compressed Beamforming/CQI  
 25 frames). *See, e.g.*, UniFi 6 Long-Range Access Point Data Sheet, indicating the U6-  
 26 LR includes a “Dual-Core Cortex A53 at 1.35 GHz” processor, “2.4 GHz 4 x 4” and  
 27 “5 GHz 4x4” MIMO, with “4 dBi” of “Antenna Gain” on the “2.4 GHz” radio and  
 28 “5.5 dBi” of “Antenna Gain” on the “5 GHz” radio, supporting “802.11a/b/g Wi-

1 Fi4/Wi-Fi 5/Wi-Fi 6” standards and “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi  
2 6 Long-Range Access Point Webpage stating, the “U6-LR is a high-performance  
3 Access Point leveraging advanced WiFi 6 technology to provide powerful wireless  
4 coverage to enterprise environments. It delivers an aggregate radio rate of up to 3.0  
5 Gbps with 5 GHz (4x4 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.”  
6 “Features” include “1.3 GHz dual-core processor (now upgraded to support full-  
7 duplex 1 Gbps TCP/IP performance)... Four-stream high-efficiency Wi-Fi 6  
8 technology... 5 GHz band 4x4 MU-MIMO and OFDMA with radio rate of 2.4  
9 Gbps... 2.4 GHz band 4x4 MIMO with radio rate of 600 Mbps.”). Further, the UniFi  
10 6 Long Range Access Point is capable of “Simultaneously connect[ing] to more  
11 devices” and can “Create and support over 300 distinct client connections.”  
12 Ubiquiti’s Wi-Fi Webpage further indicates that the UniFi 6 Long Range includes  
13 “Wi-Fi 6,” “4x4 OFDMA” MIMO, and “MU-MIMO.” *See, e.g.*, IEEE 802.11ax  
14 Standard, 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,  
15 27.3.1, 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,  
16 27.3.3.2.2, - 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,  
17 27.3.15, 27.3.16, 27.3.17, Table 27-1. *See, e.g.*, IEEE 802.11ax Standard, at Section  
18 27.3.1.1 (“The transmission within an RU in a PPDU may be single stream to one  
19 user, spatially multiplexed to one user (SU-MIMO), or spatially multiplexed to  
20 multiple users (MU-MIMO).”); Section 27.3.10.10 (HE-LTF) (“The HT-LTF field  
21 provides a means for the receiver to estimate the MIMO channel between the set of  
22 constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs)  
23 and the receive chains.”); Section 27.3.15 (SU-MIMO and DL-MIMO  
24 beamforming); Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming  
25 are techniques used by a STA with multiple antennas (the beamformer) to steer  
26 signals using knowledge of the channel to improve throughput. With SU-MIMO  
27 beamforming all space-time streams in the transmitted signal are intended for  
28 reception at a single STA in an RU. With DL MU-MIMO beamforming, disjoint



1 subsets of the space-time streams are intended for reception at different STAs in an  
 2 RU of size greater than or equal to 106-tones.”); Section 27.3.15.2 (“After receiving  
 3 the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using  
 4 Equation (19-79). For SU-MIMO beamforming, the beamformer uses  $V_{k,0}$  matrix to  
 5 determine the steering matrix  $Q_k$ . For DL MU-MIMO beamforming, the beamformer  
 6 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  
 7  $\Delta SNR_{k,u}$  ( $0 \leq u \leq N_{user,r}-1$ ) in order to suppress crosstalk between participating  
 8 beamformees. The method used by the beamformer to calculate the steering matrix  
 9  $Q_k$  is implementation specific.”).

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

15 32. By at least the filing and service of the original Complaint for patent  
 16 infringement in this United States District Court for the Central District of California  
 17 on April 19, 2017, and July 14, 2017, respectively, Defendant had knowledge of the  
 18 '728 Patent, and that its actions resulted in a direct infringement of the '728 Patent.  
 19 Defendant also knew or was willfully blind that its actions would induce direct  
 20 infringement by others and intended that its actions would induce direct  
 21 infringement by others.

22 33. Despite this knowledge of the '728 Patent, Defendant actively induced,  
 23 and continues to induce, such infringement by, among other things, providing user  
 24 manuals and other instruction material for its '728 Accused Products that induce its  
 25 customers to use the '728 Accused Products in their normal and customary way to  
 26 infringe the '728 Patent. For example, Defendant’s website provided, and continues  
 27 to provide, instructions for using the '728 Accused Products on wireless  
 28 communication systems, and to utilize their 802.11ax beamforming and MU-MIMO

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

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

18 35. Defendant also contributorily infringes by making, using, selling, offering  
19 to sell, and/or importing the '728 Accused Products, knowing they constitute a  
20 material part of the invention, are especially made or adapted for use in infringing,  
21 and that they are not staple articles of commerce capable of substantial non-  
22 infringing use.

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

26 37. The '728 Patent is valid and enforceable.  
27  
28

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1 38. Vivato has complied with 35 U.S.C. § 287 and it does not bar recovery of  
2 pre-suit damages at least because Vivato is only asserting method claims from the  
3 '728 Patent.

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

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

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

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

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

24 43. Defendant has directly infringed and continues to directly infringe  
25 numerous claims of the '376 Patent, including at least claim 1, by manufacturing,  
26 using, selling, offering to sell, and/or importing into the United States Wi-Fi 6 access  
27 points and routers supporting MU-MIMO, including without limitation access points  
28 and routers utilizing the IEEE 802.11ax / "Wi-Fi 6" standard, and/or the IEEE

1 802.11ac standard because WiFi 6 is backward compatible (*e.g.*, U6 Long Range,  
2 U6 Lite, AmpliFi Alien, the HD, nanoHD, InWallHD, WiFi BaseStation XG,  
3 FlexHD, BeaconHD, Dream Machine, Access Point XG, Access Point SHD, Access  
4 Point Long Range, Access Point Mesh Pro, AmpliFi Instant, AmpliFi HD, and  
5 AmpliFi HD Gamer’s Edition) (collectively, the “’376 Accused Products”).  
6 Defendant is liable for infringement of the ’376 Patent pursuant to 35 U.S.C. §  
7 271(a).

8 44. The ’376 Accused Products satisfy all claim limitations of numerous  
9 claims of the ’376 Patent, including Claim 1. The following paragraphs compare  
10 limitations of Claim 1 to an exemplary ’376 Accused Product, the U6 Long Range  
11 wireless access point.

12 45. Each of the ’376 Accused Products comprises a data-communications  
13 networking apparatus. For example, the U6 Long Range Access Point is a data-  
14 communications networking apparatus. *See, e.g.*, UniFi 6 Long-Range Access Point  
15 Data Sheet, indicating the U6-LR includes a “Dual-Core Cortex A53 at 1.35 GHz”  
16 processor, “2.4 GHz 4 x 4” and “5 GHz 4x4” MIMO, with “4 dBi” of “Antenna  
17 Gain” on the “2.4 GHz” radio and “5.5 dBi” of “Antenna Gain” on the “5 GHz”  
18 radio, supporting “802.11a/b/g Wi-Fi 4/Wi-Fi 5/Wi-Fi 6” standards and “802.11ac  
19 (Wi-Fi 5)” and “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi 6 Long-Range  
20 Access Point Webpage stating, the “U6-LR is a high-performance Access Point  
21 leveraging advanced WiFi 6 technology to provide powerful wireless coverage to  
22 enterprise environments. It delivers an aggregate radio rate of up to 3.0 Gbps with 5  
23 GHz (4x4 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.” “Features”  
24 include “1.3 GHz dual-core processor (now upgraded to support full-duplex 1 Gbps  
25 TCP/IP performance)... Four-stream high-efficiency Wi-Fi 6 technology... 5 GHz  
26 band 4x4 MU-MIMO and OFDMA with radio rate of 2.4 Gbps... 2.4 GHz band 4x4  
27 MIMO with radio rate of 600 Mbps.”). Further, the UniFi 6 Long Range Access  
28 Point is capable of “Simultaneously connect[ing] to more devices” and can “Create

1 and support over 300 distinct client connections.” Ubiquiti’s Wi-Fi Webpage further  
2 indicates that the UniFi 6 Long Range includes “Wi-Fi 6,” “4x4 OFDMA” MIMO,  
3 “Wave 2,” and “MU-MIMO.”

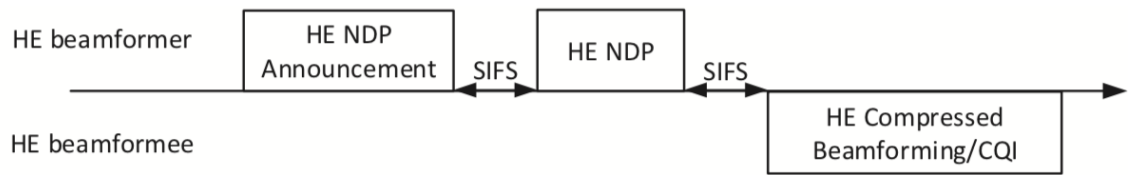
4 46. Each of the ’376 Accused Products comprises a processor configured to  
5 generate a probing signal for transmission to at least a first client device and a second  
6 client device. For example, as with each ’376 Accused Product, the U6 Long Range  
7 Access Point has at least one processor (*e.g.*, one or more central processing units  
8 (CPUs), Wi-Fi processors, a baseband processor in the Wi-Fi 6 radio, as examples)  
9 for generating signals for transmission. *See, e.g.*, UniFi 6 Long-Range Access Point  
10 Data Sheet, indicating the U6-LR includes a “Dual-Core Cortex A53 at 1.35 GHz”  
11 processor, “2.4 GHz 4 x 4” and “5 GHz 4x4” MIMO, with “4 dBi” of “Antenna  
12 Gain” on the “2.4 GHz” radio and “5.5 dBi” of “Antenna Gain” on the “5 GHz”  
13 radio, supporting “802.11a/b/g Wi-Fi 4/Wi-Fi 5/Wi-Fi 6” standards and “802.11ac  
14 (Wi-Fi 5)” and “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi 6 Long-Range  
15 Access Point Webpage stating, the “U6-LR is a high-performance Access Point  
16 leveraging advanced WiFi 6 technology to provide powerful wireless coverage to  
17 enterprise environments. It delivers an aggregate radio rate of up to 3.0 Gbps with 5  
18 GHz (4x4 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.” “Features”  
19 include “1.3 GHz dual-core processor (now upgraded to support full-duplex 1 Gbps  
20 TCP/IP performance)... Four-stream high-efficiency Wi-Fi 6 technology... 5 GHz  
21 band 4x4 MU-MIMO and OFDMA with radio rate of 2.4 Gbps... 2.4 GHz band 4x4  
22 MIMO with radio rate of 600 Mbps.”). Further, the UniFi 6 Long Range Access  
23 Point is capable of “Simultaneously connect[ing] to more devices” and can “Create  
24 and support over 300 distinct client connections.” Ubiquiti’s Wi-Fi Webpage further  
25 indicates that the UniFi 6 Long Range includes “Wi-Fi 6,” “4x4 OFDMA” MIMO,  
26 “Wave 2,” and “MU-MIMO.” For a further example, as with each ’376 Accused  
27 Product, the U6 Long Range Access Point generates a probing signal for  
28 transmission (*e.g.*, a probing signal transmission that triggers or elicits a responsive

1 transmission from each of a first client device and a second client device, such as  
2 NDP Announcement, HE sounding NDP, Beamforming Report trigger frames  
3 pursuant to High Efficiency (HE) channel sounding, including preamble training  
4 fields allowing an estimate of the channel for MU-MIMO) to at least a first client  
5 device and a second client device (*e.g.*, a first non-AP STA / HE beamformee and a  
6 second non-AP STA / HE beamformee). *See, e.g.*, 802.11ax Standard, Sections  
7 9.3.1.19, 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,  
8 26.7, 26.7.1, 26.7.2, 26.7.3, 26.7.4, 26.7.5, 27.1.1. *See, e.g.*, Section 26.7 (HE  
9 sounding protocol) (“Transmit beamforming and DL MU-MIMO require knowledge  
10 of the channel state to compute a steering matrix that is applied to the transmit signal  
11 to optimize reception at one or more receivers. HE STAs use the HE sounding  
12 protocol to determine the channel state information. The HE sounding protocol  
13 provides explicit feedback mechanisms, defined as HE non-trigger-based (non-TB)  
14 sounding and HE trigger-based (TB) sounding, where the HE beamformee measures  
15 the channel using a training signal (*i.e.*, an HE sounding NDP) transmitted by the  
16 HE beamformer and sends back a transformed estimate of the channel state. The HE  
17 beamformer uses this estimate to derive the steering matrix. The HE beamformee  
18 returns an estimate of the channel state in an HE compressed beamforming/CQI  
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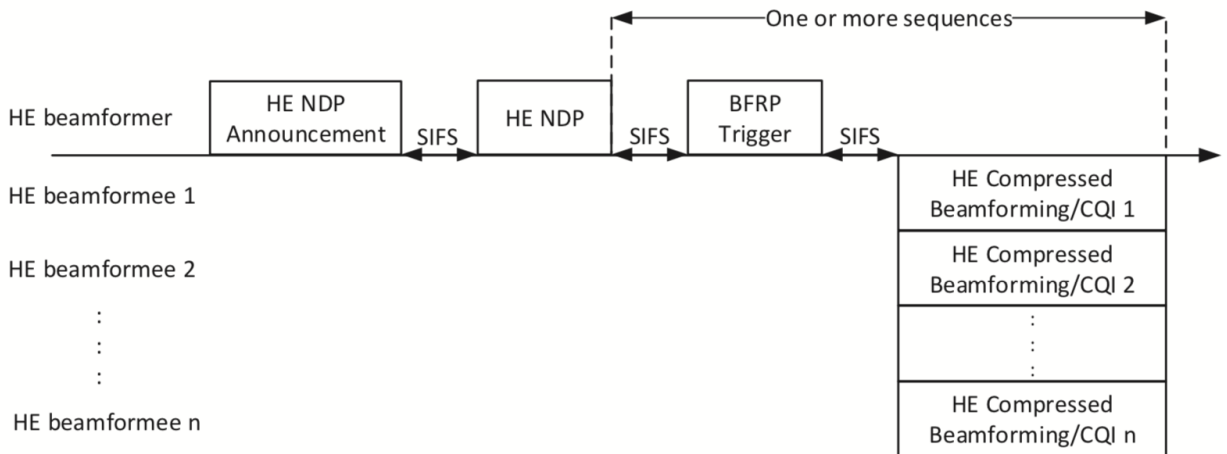
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1 report carried in one or more HE Compressed Beamforming/CQI frames.”); Section  
 2 26.7.3, Figures 26-6 and 26-7.

3 ; Section 26.7.3 (“An HE beamformee that receives an HE NDP Announcement  
 4 frame from an HE beamformer with which it is associated and that contains the HE  
 5 beamformee’s MAC address in the RA field and also receives an HE sounding NDP  
 6 a SIFS after the HE NDP Announcement frame shall transmit its HE compressed  
 7 beamforming/CQI report a SIFS after the HE sounding NDP. The TXVECTOR  
 8 parameter CH\_BANDWIDTH for the PPDU containing the HE compressed  
 9 beamforming/CQI report shall be set to indicate a bandwidth not wider than that  
 10 indicated by the RXVECTOR parameter CH\_BANDWIDTH of the HE sounding  
 11 NDP. An HE beamformee that receives an HE NDP Announcement frame as part of  
 12 an HE TB sounding sequence with a STA Info field addressed to it soliciting SU or  
 13 MU feedback shall generate an HE compressed beamforming/CQI report using the  
 14 feedback type,  $N_g$  and codebook size indicated in the STA Info field. If the HE  
 15 beamformee then receives a BFRP Trigger frame with a User Info field addressed



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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 to it, the HE beamformee transmits an HE TB PPDU containing the HE compressed  
 2 beamforming/CQI report following the rules defined in 26.5.3.3 (Non-AP STA  
 3 behavior for UL MU operation.”); Section 26.5.3 (UL MU operation) (“UL MU  
 4 operation allows an AP to solicit simultaneous immediate response frames from one  
 5 or more non-AP HE STAs”); Section 27.3.10.10 (HE-LTF) (“The HE-LTF field  
 6 provides a means for the receiver to estimate the MIMO channel between the set of  
 7 constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs)  
 8 and the receive chains. In an HE SU PPDU and HE ER SU PPDU, the transmitter  
 9 provides training for  $N_{STS}$  space-time streams (spatial mapper inputs) used for the  
 10 transmission of the PSDU. In an HE MU PPDU, the transmitter provides training  
 11 for  $N_{STS,r,total}$  space-time streams used for the transmission of the PSDU(s) in the  $r$ -th  
 12 RU. In an HE TB PPDU, the transmitter of user  $u$  in the  $r$ -th RU provides training  
 13 for  $N_{STS,r,u}$  space-time streams used for the transmission of the PSDU. For each tone  
 14 in the  $r$ -th RU, the MIMO channel that can be estimated is an  $N_{RX} \times N_{STS,r,total}$  matrix.  
 15 An HE transmission has a preamble that contains HE-LTF symbols, where the data  
 16 tones of each HE-LTF symbol are multiplied by entries belonging to a matrix  $P_{HE-}$   
 17  $LTF$ , to enable channel estimation at the receiver.... In an HE SU PPDU, HE MU  
 18 PPDU and HE ER SU PPDU, the combination of HE-LTF type and GI duration is  
 19 indicated in HE-SIG-A field. In an HE TB PPDU, the combination of HE-LTF type  
 20 and GI duration is indicated in the Trigger frame that triggers transmission of the  
 21 PPDU. If an HE PPDU is an HE sounding NDP, the combinations of HE-LTF types  
 22 and GI durations are listed in 27.3.18 (Transmit specification). If an HE PPDU is an  
 23 HE TB feedback NDP, the combination of HE-LTF types and GI durations are listed  
 24 in 27.3.4 (HE PPDU formats.”); Section 27.3.15.1 (SU-MIMO and DL-MIMO  
 25 beamforming) (“The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$   
 26 can be detected by the beamformer using the beamforming feedback for subcarrier  
 27  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The feedback report format is  
 28 described in 9.4.1.65 (HE Compressed Beamforming Report field) and 9.4.1.66 (HE



1 MU Exclusive Beamforming Report field). The steering matrix that is computed (or  
2 updated) using new beamforming feedback from some or all of participating  
3 beamformees might replace the existing steering matrix  $Q_k$  for the next DL MU-  
4 MIMO data transmission. For SU-MIMO beamforming, the steering matrix  $Q_k$  can  
5 be determined from the beamforming feedback matrix  $V_k$  that is sent back to the  
6 beamformer by the beamformee using the compressed beamforming feedback  
7 matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback  
8 matrix). The feedback report format is described in 9.4.1.65 (HE Compressed  
9 Beamforming Report field.”). Section 9.4.1.65 (HE Compressed Beamforming  
10 Report field) (“The HE Compressed Beamforming Report field carries the average  
11 SNR of each space-time stream and compressed beamforming feedback matrices  $V$   
12 for use by a transmit beamformer to determine steering matrices  $Q$ , as described in  
13 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback  
14 beamforming”); Section 9.1.4.66 (HE MU Exclusive Beamforming Report field)  
15 (“The HE MU Exclusive Beamforming Report field carries explicit feedback in the  
16 form of delta SNRs. The information in the HE Compressed Beamforming Report  
17 field and the HE MU Exclusive Beamforming Report field can be used by the  
18 transmit MU beamformer to determine the steering matrices  $Q$ , as described in  
19 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI  
20 Report field carries the per-RU average SNRs of each space-time stream, where each  
21 per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone  
22 RU for which the feedback is being requested.”). For a further example, as with each  
23 ’376 Accused Product, the U6 Long Range Access Point generates a probing signal  
24 for transmission (*e.g.*, a probing signal transmission that triggers or elicits a  
25 responsive transmission from each of a first client device and a second client device,  
26 such as NDP Announcement pursuant to Very High Throughput (VHT) channel  
27 sounding, including preamble training fields allowing an estimate of the channel for  
28 MU-MIMO) to at least a first client device and a second client device (*e.g.*, a first

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

3 ///

4 47. Each of the '376 Accused Products comprises a processor configured to

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

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

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

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 U6 Long Range Access Point has at least one processor  
 24 and Wi-Fi 6 radio functionality (e.g., the CPU(s) and/or Wi-Fi processors and/or  
 25 baseband processor(s) in the Wi-Fi 6 radio) configured to generate a first data stream  
 26 for transmission to the first client device (“non-AP STA” or “non-Access Point  
 27 Station”) and a second data stream for transmission to a second client device (non-  
 28 AP STA) pursuant to MU-MIMO transmissions. *See, e.g.,* UniFi 6 Long-Range  
 Access Point Data Sheet, indicating the U6-LR includes a “Dual-Core Cortex A53  
 at 1.35 GHz” processor, “2.4 GHz 4 x 4” and “5 GHz 4x4” MIMO, with “4 dBi” of  
 “Antenna Gain” on the “2.4 GHz” radio and “5.5 dBi” of “Antenna Gain” on the “5  
 GHz” radio, supporting “802.11a/b/g Wi-Fi4/Wi-Fi 5/Wi-Fi 6” standards and  
 “802.11ac (Wi-Fi 5)” and “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi 6 Long-  
 Range Access Point Webpage stating, the “U6-LR is a high-performance Access

1 Point leveraging advanced WiFi 6 technology to provide powerful wireless coverage  
2 to enterprise environments. It delivers an aggregate radio rate of up to 3.0 Gbps with  
3 5 GHz (4x4 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.” “Features”  
4 include “1.3 GHz dual-core processor (now upgraded to support full-duplex 1 Gbps  
5 TCP/IP performance)... Four-stream high-efficiency Wi-Fi 6 technology... 5 GHz  
6 band 4x4 MU-MIMO and OFDMA with radio rate of 2.4 Gbps... 2.4 GHz band 4x4  
7 MIMO with radio rate of 600 Mbps.”). Further, the UniFi 6 Long Range Access  
8 Point is capable of “Simultaneously connect[ing] to more devices” and can “Create  
9 and support over 300 distinct client connections.” Ubiquiti’s Wi-Fi Webpage further  
10 indicates that the UniFi 6 Long Range includes “Wi-Fi 6,” “4x4 OFDMA” MIMO,  
11 “Wave 2,” and “MU-MIMO.” *See, e.g.*, IEEE 802.11ax Standard, at Sections 26.5,  
12 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, 27.3.6.11.4,  
13 27.3.10.7, 27.3.10.8, 27.3.10.9, 27.3.15, including Tables 27-19, 27-20, 27-21, 27-  
14 24, 27-25, 27-26, 27-27, 27-28, 27-29, Figures 27-19, 27-20, and other transmitter  
15 block diagrams for MU-MIMO transmission. *See, e.g.*, Section 27.1.1 (“The HE  
16 PHY extends the maximum number of users supported for DL MU-MIMO  
17 transmissions up to 8 users per resource unit (RU) and provides support for DL and  
18 UL orthogonal frequency division multiple access (OFDMA) as well as for UL MU-  
19 MIMO. Both DL and UL MU-MIMO transmissions are supported on portions of the  
20 PPDU bandwidth (on resource units greater than or equal to 106 tones). In an MU-  
21 MIMO resource unit, there is support for up to 8 users with up to 4 space-time  
22 streams per user with the total not exceeding 8 space-time streams”); Section  
23 27.3.1.1 (“DL MU transmission allows an AP to simultaneously transmit  
24 information to more than one non-AP STA. For a DL MU transmission, the AP uses  
25 the HE MU PPDU format and employs either DL OFDMA, DL MU-MIMO, or a  
26 mixture of both.”); Section 27.3.10.8.1 (“The HE-SIG-B field provides the OFDMA  
27 and DL MU-MIMO resource allocation information to allow the STAs to look up  
28 the corresponding resources to be used in the data portion of the frame.”); Section

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1 27.3.2.5 (“If there is more than one User field (see Table 27-28 (User field for an  
2 MU-MIMO allocation)) for an RU in the HE-SIG-B content channel, then the  
3 number of allocated spatial streams for each user in the RU is indicated by the Spatial  
4 Configuration field of the User field in HE-SIG-B...In each HE-SIG-B content  
5 channel, the User fields are first ordered in the order of RUs (from lower frequency  
6 to higher frequency) as described by the RU Allocation field if the HE-SIG-B  
7 contains the Common field. If an RU has multiple User fields in an HE-SIG-B  
8 content channel, the User fields of the RU are ordered in the order of spatial stream  
9 index, from lower to higher spatial stream, as indicated in the Spatial Configuration  
10 field. The STA-ID field in each User field indicates the intended recipient user of  
11 the corresponding spatial streams and the RU.”); *See, e.g.*, IEEE 802.11ax Standard,  
12 Section 27.3.5 (Transmitter block diagram), at, *e.g.*, Figure 27-19:

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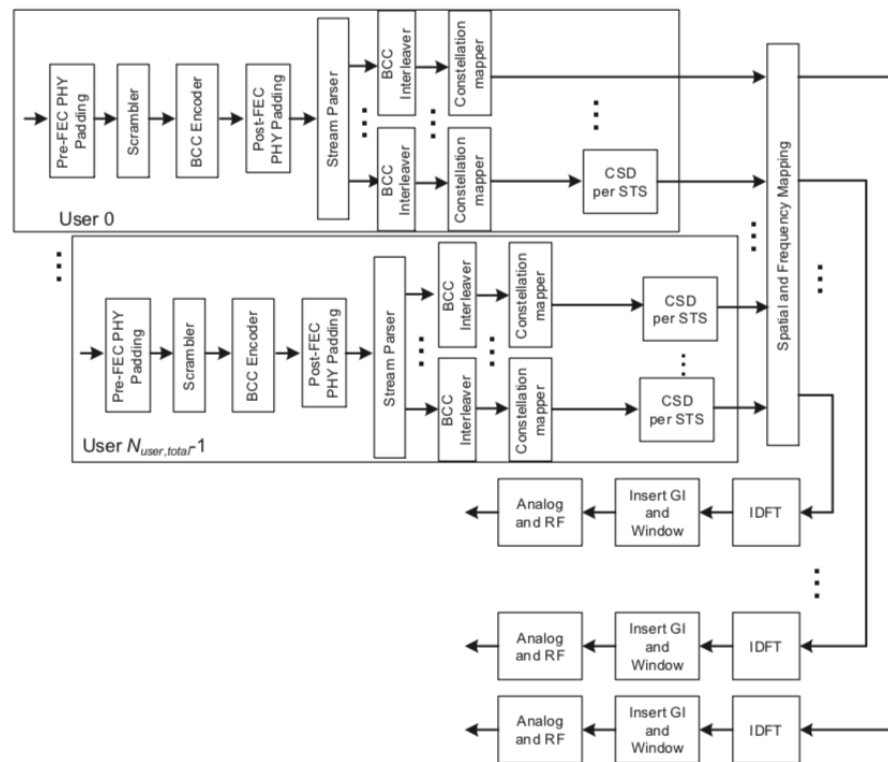


Figure 27-19—Transmitter block diagram for the Data field of an HE DL MU-MIMO transmission in a 106-, 242-, 484- or 996-tone RU with BCC encoding

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:

- 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.
- IDFT: Compute the inverse discrete Fourier transform.
- 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).
- 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 U6 Long Range Access Point has at least one processor and Wi-Fi radio functionality (e.g., the CPU and/or baseband processor(s) in the Wi-Fi radio) configured to generate a first data stream

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

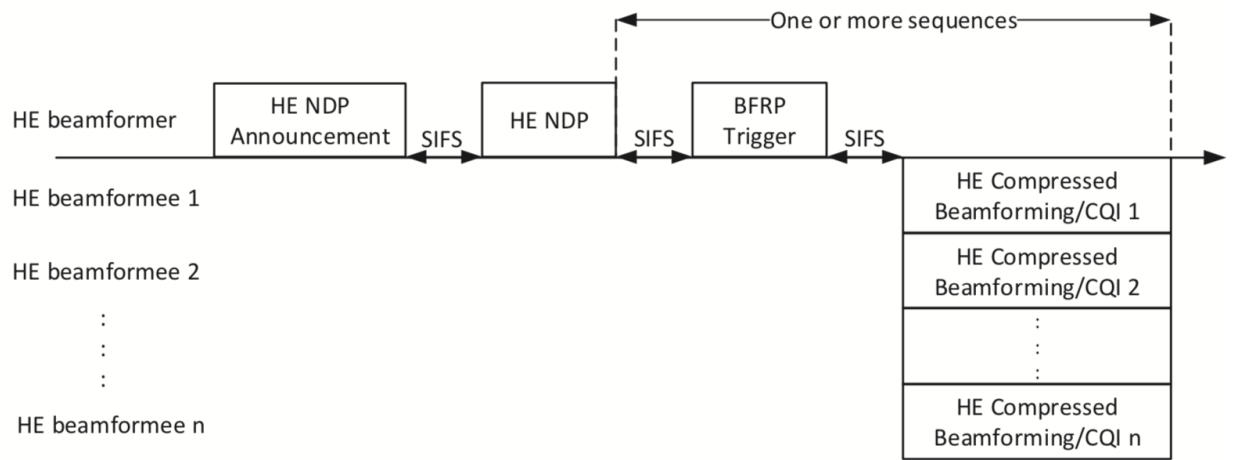
18 48. Each of the ’376 Accused Products comprises a transceiver operatively  
19 coupled to the processor and configured to: transmit the probing signal to at least the  
20 first client device and the second client device via a smart antenna; wherein the smart  
21 antenna is operatively coupled to the transceiver and comprises a first antenna  
22 element and a second antenna element. For example, as with each ’376 Accused  
23 Product, the U6 Long Range Access Point has a Wi-Fi 6 radio with a transceiver  
24 operatively coupled to the processor (*e.g.*, the Wi-Fi 6 radio generates signals for  
25 transmission and processes received signals with, *e.g.*, the CPU, Wi-Fi processors,  
26 and/or baseband processor in the Wi-Fi 6 radio, and the radio comprises a transceiver  
27 that transmits and receives signals via a smart antenna); and, as with each ’376  
28 Accused Product, the U6 Long Range Access Point has a Wi-Fi 6 radio transceiver

1 operatively coupled to the processor and to a smart antenna, wherein the smart  
2 antenna is operatively coupled to the Wi-Fi 6 radio and comprises a first antenna  
3 element and a second antenna element. *See, e.g.*, UniFi 6 Long-Range Access Point  
4 Data Sheet, indicating the U6-LR includes a “Dual-Core Cortex A53 at 1.35 GHz”  
5 processor, “2.4 GHz 4 x 4” and “5 GHz 4x4” MIMO, with “4 dBi” of “Antenna  
6 Gain” on the “2.4 GHz” radio and “5.5 dBi” of “Antenna Gain” on the “5 GHz”  
7 radio, supporting “802.11a/b/g Wi-Fi4/Wi-Fi 5/Wi-Fi 6” standards and “802.11ac  
8 (Wi-Fi 5)” and “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi 6 Long-Range  
9 Access Point Webpage stating, the “U6-LR is a high-performance Access Point  
10 leveraging advanced WiFi 6 technology to provide powerful wireless coverage to  
11 enterprise environments. It delivers an aggregate radio rate of up to 3.0 Gbps with 5  
12 GHz (4x4 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.” “Features”  
13 include “1.3 GHz dual-core processor (now upgraded to support full-duplex 1 Gbps  
14 TCP/IP performance)... Four-stream high-efficiency Wi-Fi 6 technology... 5 GHz  
15 band 4x4 MU-MIMO and OFDMA with radio rate of 2.4 Gbps... 2.4 GHz band 4x4  
16 MIMO with radio rate of 600 Mbps.”). Further, the UniFi 6 Long Range Access  
17 Point is capable of “Simultaneously connect[ing] to more devices” and can “Create  
18 and support over 300 distinct client connections.” Ubiquiti’s Wi-Fi Webpage further  
19 indicates that the UniFi 6 Long Range includes “Wi-Fi 6,” “4x4 OFDMA” MIMO,  
20 “Wave 2,” and “MU-MIMO.” For a further example, as with each ’376 Accused  
21 Product, the U6 Long Range Access Point transmits the probing signal (*e.g.*, a  
22 probing signal transmission that triggers or elicits a responsive transmission from  
23 each of a first client device and a second client device, such as NDP Announcement,  
24 HE sounding NDP, Beamforming Report trigger frames pursuant to High Efficiency  
25 (HE) channel sounding, including preamble training fields allowing an estimate of  
26 the channel for MU-MIMO) to at least the first client device and the second client  
27 device (*e.g.*, the first non-AP STA and the second non-AP STA) via the smart  
28 antenna. *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3,



1 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,  
2 26.7.4, 26.7.5, 27.1.1. *See, e.g.*, Section 26.7.5 (HE sounding NDP transmission)  
3 (setting forth TXVECTOR parameters for HE sounding NDP); Section 27.3.10.10  
4 (HE-LTF) (“The HE-LTF field provides a means for the receiver to estimate the  
5 MIMO channel between the set of constellation mapper outputs (or, if STBC is  
6 applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU and  
7 HE ER SU PPDU, the transmitter provides training for  $N_{STS}$  space-time streams  
8 (spatial mapper inputs) used for the transmission of the PSDU. In an HE MU PPDU,  
9 the transmitter provides training for  $N_{STS,r,total}$  space-time streams used for the  
10 transmission of the PSDU(s) in the  $r$ -th RU. In an HE TB PPDU, the transmitter of  
11 user  $u$  in the  $r$ -th RU provides training for  $N_{STS,r,u}$  space-time streams used for the  
12 transmission of the PSDU. For each tone in the  $r$ -th RU, the MIMO channel that can  
13 be estimated is an  $N_{RX} \times N_{STS,r,total}$  matrix. An HE transmission has a preamble that  
14 contains HE-LTF symbols, where the data tones of each HE-LTF symbol are  
15 multiplied by entries belonging to a matrix  $P_{HE-LTF}$ , to enable channel estimation at  
16 the receiver.... In an HE SU PPDU, HE MU PPDU and HE ER SU PPDU, the  
17 combination of HE-LTF type and GI duration is indicated in HE-SIG-A field. In an  
18 HE TB PPDU, the combination of HE-LTF type and GI duration is indicated in the  
19 Trigger frame that triggers transmission of the PPDU. If an HE PPDU is an HE  
20 sounding NDP, the combinations of HE-LTF types and GI durations are listed in  
21 27.3.18 (Transmit specification). If an HE PPDU is an HE TB feedback NDP, the  
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1 combination of HE-LTF types and GI durations are listed in 27.3.4 (HE PPDU  
 2 formats.’’). See, e.g., Section 26.7.3, Figure 26-7



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

12 ; Section 9.4.1.65 (HE Compressed Beamforming Report field) (“The HE  
 13 Compressed Beamforming Report field carries the average SNR of each space-time  
 14 stream and compressed beamforming feedback matrices  $V$  for use by a transmit  
 15 beamformer to determine steering matrices  $Q$ , as described in 10.32.3 (Explicit  
 16 feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming)’’); Section  
 17 9.1.4.66 (HE MU Exclusive Beamforming Report field) (“The HE MU Exclusive  
 18 Beamforming Report field carries explicit feedback in the form of delta SNRs. The  
 19 information in the HE Compressed Beamforming Report field and the HE MU  
 20 Exclusive Beamforming Report field can be used by the transmit MU beamformer  
 21 to determine the steering matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)’’);  
 22 Section 9.4.1.67 (HE CQI Report Field) (“The HE CQI Report field carries the per-  
 23 RU average SNRs of each space-time stream, where each per-RU average SNR is  
 24 the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback  
 25 is being requested.’’). See, e.g., 802.11ac Standard Clause 9.31.5.2 (“A VHT  
 26 beamformer shall initiate a sounding feedback sequence by transmitting a VHT NDP  
 27 Announcement frame followed by a VHT NDP after a SIFS. The VHT beamformer  
 28 shall include in the VHT NDP Announcement frame one STA Info field for each

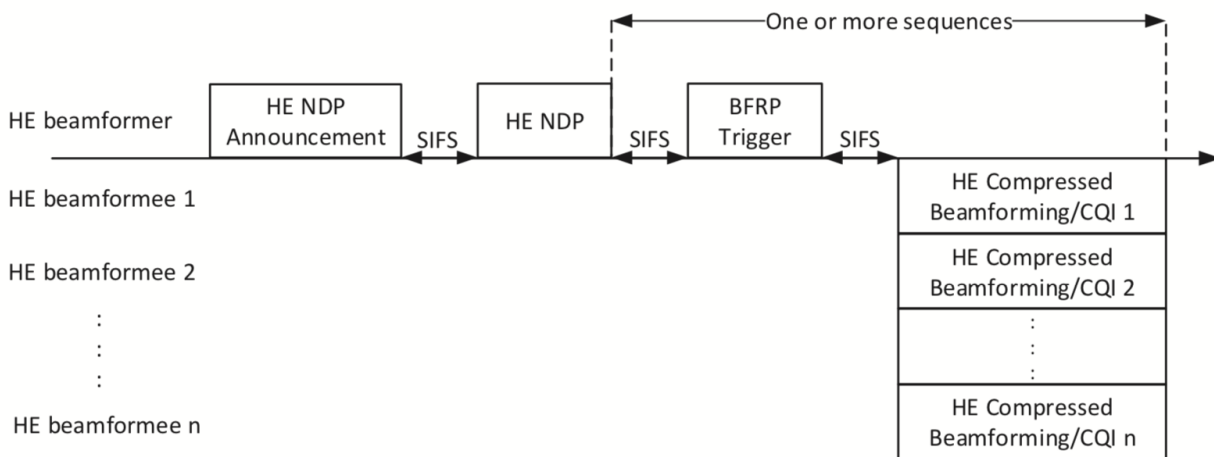
1 VHT beamformee that is expected to prepare VHT Compressed Beamforming  
2 feedback and shall identify the VHT beamformee by including the VHT  
3 beamformee's AID in the AID subfield of the STA Info field. The VHT NDP  
4 Announcement frame shall include at least one STA Info field.”); *id.* (“A non-AP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

16 49. Each of the '376 Accused Products comprises a data-communications  
17 networking apparatus wherein one or more of the processor, the transceiver, or the  
18 smart antenna is further configured to: receive a first feedback information from the  
19 first client device in response to the transmission of the probing signal; receive a  
20 second feedback information from the second client device in response to  
21 transmission of the probing signal. For example, as with each '376 Accused Product,  
22 the U6 Long Range Access Point comprises one or more of the processor, the  
23 transceiver, or the smart antenna further configured to receive channel state  
24 information and estimates of the channel state and MU MIMO-related feedback  
25 information from each of the first non-AP STA and the second non-AP STA  
26 pursuant to HE MU-MIMO sounding procedures. This feedback information,  
27 carried in one or more HE Compressed Beamforming/CQI frames, is in response to  
28 the transmission of the probing signal (*e.g.*, a probing signal transmission that

1 triggers or elicits a responsive transmission from each of a first client device and a  
 2 second client device, such as NDP Announcement, HE sounding NDP,  
 3 Beamforming Report trigger frames pursuant to High Efficiency (HE) channel  
 4 sounding, including preamble training fields allowing an estimate of the channel for  
 5 MU-MIMO). *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.3.1.22, 9.3.1.22.3,  
 6 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,  
 7 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  
 8 Compressed Beamforming Report field) (“The HE Compressed Beamforming  
 9 Report field carries the average SNR of each space-time stream and compressed  
 10 beamforming feedback matrices  $V$  for use by a transmit beamformer to determine  
 11 steering matrices  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and  
 12 19.3.12.3 (Explicit feedback beamforming)”); Section 9.1.4.66 (HE MU Exclusive  
 13 Beamforming Report field) (“The HE MU Exclusive Beamforming Report field  
 14 carries explicit feedback in the form of delta SNRs. The information in the HE  
 15 Compressed Beamforming Report field and the HE MU Exclusive Beamforming  
 16 Report field can be used by the transmit MU beamformer to determine the steering  
 17 matrices  $Q$ , as described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI  
 18 Report Field) (“The HE CQI Report field carries the per-RU average SNRs of each  
 19 space-time stream, where each per-RU average SNR is the arithmetic mean of the  
 20 SNR in decibels over a 26-tone RU for which the feedback is being requested.”);  
 21 Section 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques  
 22 used by a STA with multiple antennas (the beamformer) to steer signals using  
 23 knowledge of the channel to improve throughput. With SU-MIMO beamforming all  
 24 space-time streams in the transmitted signal are intended for reception at a single  
 25 STA in an RU. With DL MU-MIMO beamforming, disjoint subsets of the space-  
 26 time streams are intended for reception at different STAs in an RU of size greater  
 27 than or equal to 106-tones...The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0},$   
 28  $Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be detected by the beamformer using the beamforming

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1 feedback for subcarrier  $k$  from beamformee  $u$ , where  $u = 0, 1, \dots, N_{user,r} - 1$ . The  
 2 feedback report format is described in 9.4.1.65 (HE Compressed Beamforming  
 3 Report field) and 9.4.1.66 (HE MU Exclusive Beamforming Report field). The  
 4 steering matrix that is computed (or updated) using new beamforming feedback from  
 5 some or all of participating beamformees might replace the existing steering matrix  
 6  $Q_k$  for the next DL MU-MIMO data transmission.”); Section 27.3.15.2 (“Upon  
 7 receipt of an HE sounding NDP, the beamformee computes a set of matrices for  
 8 feedback to the beamformer as described in 21.3.11.2 (Beamforming Feedback  
 9 Matrix V). The eligible beamformees shall remove the space-time stream CSD in  
 10 Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU) from the  
 11 measured channel before computing a set of matrices for feedback to the  
 12 beamformer.”); *See, e.g.*, Section 26.7.3, Figure 26-7:



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

22  
 23 For a further example, as with each '376 Accused Product, the U6 Long Range  
 24 Access Point comprises one or more of the processor, the transceiver, or the smart  
 25 antenna further configured to receive channel state information and estimates of the  
 26 channel state and MU MIMO-related feedback information from each of the first  
 27 non-AP STA and the second non-AP STA pursuant to MU-MIMO sounding  
 28 procedures. This feedback information, carried in one or more compressed

1 beamforming frames, is in response to the transmission of the probing signal (*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 pursuant to Very High Throughput (VHT) channel sounding, including preamble  
5 training fields allowing an estimate of the channel for MU-MIMO). *See, e.g.*,  
6 802.11ac Standard Clause 9.31.5.2 (“A VHT beamformer shall initiate a sounding  
7 feedback sequence by transmitting a VHT NDP Announcement frame followed by  
8 a VHT NDP after a SIFS. The VHT beamformer shall include in the VHT NDP  
9 Announcement frame one STA Info field for each VHT beamformee that is expected  
10 to prepare VHT Compressed Beamforming feedback and shall identify the VHT  
11 beamformee by including the VHT beamformee’s AID in the AID subfield of the  
12 STA Info field. The VHT NDP Announcement frame shall include at least one STA  
13 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:

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

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

8 After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation  
 9 (20-79). For SU-MIMO beamforming, the beamformer can use this  $V_{k,0}$  matrix to determine the steering  
 10 matrix  $Q_k$ . For DL-MU-MIMO beamforming, the beamformer may calculate a steering matrix  
 11  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  using  $V_{k,u}$  and  $SNR_{k,u}$  ( $0 \leq u \leq N_{user} - 1$ ) in order to suppress crosstalk  
 12 between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$   
 13 is implementation specific.

12 ///

13 50. Each of the '376 Accused Products comprises a data-communications  
 14 networking apparatus wherein one or more of the processor, the transceiver, or the  
 15 smart antenna is further configured to: determine where to place transmission peaks  
 16 and transmission nulls within one or more spatially distributed patterns of  
 17 electromagnetic signals based in part on the first and the second feedback  
 18 information. For example, as with each '376 Accused Product, the U6 Long Range  
 19 Access Point comprises one or more of the processor, the transceiver, or the smart  
 20 antenna further configured to determine where to place transmission peaks and  
 21 transmission nulls within one or more spatially distributed patterns of  
 22 electromagnetic signals based in part on the first and the second feedback  
 23 information, including, *e.g.*, where it determines where to place transmission peaks  
 24 and transmission nulls through a beamforming steering matrix pursuant to  
 25 beamforming and MU-MIMO spatial multiplexing, which beamforming steering  
 26 matrix is determined based on the received CSI (channel state information) and  
 27 MIMO-related feedback from the first client device (first non-AP STA) and the  
 28 second client device (second non-AP STA) pursuant to HE MU-MIMO sounding.

1 [DATA SHEET]. *See, e.g.*, 802.11ax Standard, Sections 9.3.1.19, 9.4.1.64, 9.4.1.65,  
 2 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,  
 3 27.3.15.1, 27.3.15.2, 27.3.15.3. *See, e.g.*, Section 9.4.1.65 (HE Compressed  
 4 Beamforming Report field) (“The HE Compressed Beamforming Report field  
 5 carries the average SNR of each space-time stream and compressed beamforming  
 6 feedback matrices  $V$  for use by a transmit beamformer to determine steering matrices  
 7  $Q$ , as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit  
 8 feedback beamforming”); Section 9.1.4.66 (HE MU Exclusive Beamforming  
 9 Report field) (“The HE MU Exclusive Beamforming Report field carries explicit  
 10 feedback in the form of delta SNRs. The information in the HE Compressed  
 11 Beamforming Report field and the HE MU Exclusive Beamforming Report field can  
 12 be used by the transmit MU beamformer to determine the steering matrices  $Q$ , as  
 13 described in 27.3.3.1 (DL MU-MIMO)”); Section 9.4.1.67 (HE CQI Report Field)  
 14 (“The HE CQI Report field carries the per-RU average SNRs of each space-time  
 15 stream, where each per-RU average SNR is the arithmetic mean of the SNR in  
 16 decibels over a 26-tone RU for which the feedback is being requested.”); Section  
 17 27.3.15.1 (“SU-MIMO and DL-MU-MIMO beamforming are techniques used by a  
 18 STA with multiple antennas (the beamformer) to steer signals using knowledge of  
 19 the channel to improve throughput. With SU-MIMO beamforming all space-time  
 20 streams in the transmitted signal are intended for reception at a single STA in an RU.  
 21 With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are  
 22 intended for reception at different STAs in an RU of size greater than or equal to  
 23 106-tones...The DL MU-MIMO steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  can be  
 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 (“Upon receipt of an HE sounding  
 3 NDP, the beamformee computes a set of matrices for feedback to the beamformer  
 4 as described in 21.3.11.2 (Beamforming Feedback Matrix  $V$ ). The eligible  
 5 beamformees shall remove the space-time stream CSD in Table 21-11 (Cyclic shift  
 6 values for the VHT modulated fields of a PPDU) from the measured channel before  
 7 computing a set of matrices for feedback to the beamformer. The beamforming  
 8 feedback matrix  $V_{k,u}$  found by the beamformee  $u$  for subcarrier  $k$  in RU  $r$  shall be  
 9 compressed in the form of angles using the method described in 19.3.12.3.6  
 10 (Compressed beamforming feedback matrix). The angles  $\phi(k,u)$  and  $\psi(k,u)$ , are  
 11 quantized according to Table 9-68 (Quantization of angles)... The beamformee  
 12 shall generate the beamforming feedback matrices with the number of rows ( $Nr$ )  
 13 equal to the  $N_{STS}$  of the HE sounding NDP. After receiving the angle information,  
 14  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation (19-79). For SU-  
 15 MIMO beamforming, the beamformer uses  $V_{k,0}$  matrix to determine the steering  
 16 matrix  $Q_k$ . For DL MU-MIMO beamforming, the beamformer may calculate a  
 17 steering matrix  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user,r}-1}]$  using  $V_{k,u}$  and Delta  $\Delta SNR_{k,u}$  ( $0$   
 18  $\leq u \leq N_{user,r}-1$ ) in order to suppress crosstalk between participating beamformees. The  
 19 method used by the beamformer to calculate the steering matrix  $Q_k$  is  
 20 implementation specific.”). *See, e.g.*, 802.11ac Standard Clause 9.31.5.1 (“Transmit  
 21 beamforming and DL-MU-MIMO require knowledge of the channel state to  
 22 compute a steering matrix that is applied to the transmitted signal to optimize  
 23 reception at one or more receivers. The STA transmitting using the steering matrix  
 24 is called the VHT beamformer and a STA for which reception is optimized is called  
 25 a VHT beamformee. An explicit feedback mechanism is used where the VHT  
 26 beamformee directly measures the channel from the training symbols transmitted by  
 27 the VHT beamformer and sends back a transformed estimate of the channel state to  
 28 the VHT beamformer. The VHT beamformer then uses this estimate, perhaps

1 combining estimates from multiple VHT beamformees, to derive the steering  
 2 matrix.”); *id.* Clauses 22.3.4.6(d), 22.3.4.7(e), 22.3.4.8(l), 22.3.4.9.1(m),  
 3 22.3.4.9.2(m), 22.3.4.10.4(a) (“Spatial mapping: Apply the Q matrix as described in  
 4 22.3.10.11.1.”); *id.* Clause 22.3.10.11.1; IEEE 802.11-2012 Standard Clause  
 5 20.3.12.3.6; 802.11ac Standard Clauses 8.4.1.24, 9.31.5.1, 9.31.5.2; *id.* Clause  
 6 22.3.11.1:

7 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  
 8 beamformer using the beamforming feedback matrices for subcarrier  $k$  from beamformee  $u$ ,  $V_{k,u}$ , and SNR  
 9 information for subcarrier  $k$  from beamformee  $u$ ,  $SNR_{k,u}$ , where  $u = 0, 1, \dots, N_{user} - 1$ . The steering matrix  
 10 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).

11 , Clause 22.3.11.2:

12 Upon receipt of a VHT NDP sounding PPDU, the beamformee shall remove the space-time stream CSD in  
 13 Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer.  
 14 The beamforming feedback matrix,  $V_{k,u}$ , found by the beamformee  $u$  for subcarrier  $k$  shall be compressed in  
 15 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  
 16 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.

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

18 After receiving the angle information,  $\phi(k,u)$  and  $\psi(k,u)$ , the beamformer reconstructs  $V_{k,u}$  using Equation  
 19 (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  
 20  $Q_k = [Q_{k,0}, Q_{k,1}, \dots, Q_{k,N_{user}-1}]$  using  $V_{k,u}$  and  $SNR_{k,u}$  ( $0 \leq u \leq N_{user} - 1$ ) in order to suppress crosstalk  
 21 between participating beamformees. The method used by the beamformer to calculate the steering matrix  $Q_k$   
 is implementation specific.

22 ///

23 51.Each of the '376 Accused Products comprises a data-communications  
 24 networking apparatus wherein one or more of the processor, the transceiver, or the  
 25 smart antenna is further configured to: transmit the first data stream to the first client  
 26 device via the one or more spatially distributed patterns of electromagnetic signals;  
 27 and transmit the second data stream to the second client device via the one or more  
 28 spatially distributed patterns of electromagnetic signals; wherein transmission of the

1 first data stream and transmission of at least part of the second data stream occur at  
2 the same time; and wherein the one or more spatially distributed patterns of  
3 electromagnetic signals are configured to exhibit a first transmission peak at a  
4 location of the first client device and a second transmission peak at a location of the  
5 second client device. For example, as with each '376 Accused Product, the U6 Long  
6 Range Access Point comprises one or more of the processor, the transceiver, or the  
7 smart antenna further configured to transmit the first data stream to the first client  
8 device (*e.g.*, the first non-AP STA) via the one or more spatially distributed patterns  
9 of electromagnetic signals (*e.g.*, transmission of data to the first non-AP STA  
10 pursuant to HE MU-MIMO beamforming where a beamforming steering matrix is  
11 applied); and transmit the second data stream to the second client device (*e.g.*, the  
12 second non-AP STA) via the one or more spatially distributed patterns of  
13 electromagnetic signals (*e.g.*, transmission of data to the second non-AP STA  
14 pursuant to HE MU-MIMO beamforming where a beamforming steering matrix is  
15 applied); wherein transmission of the first data stream and transmission of at least  
16 part of the second data stream occur at the same time (*e.g.*, simultaneous HE DL  
17 MU-MIMO transmissions); and wherein the one or more spatially distributed  
18 patterns of electromagnetic signals are configured to exhibit a first transmission peak  
19 at a location of the first client device and a second transmission peak at a location of  
20 the second client device (*e.g.*, through HE MU-MIMO beamforming, radio energy  
21 is directed at each of the first client device and the second client device to form a  
22 transmission peak at the location of each device, and including, *e.g.*, where the  
23 beamforming steering matrix is applied, a first space-time stream (“STS”) intended  
24 for reception at the first client device and a second STS intended for reception at the  
25 second client device is representative of a first transmission peak being placed at the  
26 location of the first client device and a second transmission peak being placed at the  
27 location of second client device). *See, e.g.*, UniFi 6 Long-Range Access Point Data  
28 Sheet, indicating the U6-LR includes a “Dual-Core Cortex A53 at 1.35 GHz”

1 processor, “2.4 GHz 4 x 4” and “5 GHz 4x4” MIMO, with “4 dBi” of “Antenna  
 2 Gain” on the “2.4 GHz” radio and “5.5 dBi” of “Antenna Gain” on the “5 GHz”  
 3 radio, supporting “802.11a/b/g Wi-Fi 4/Wi-Fi 5/Wi-Fi 6” standards and “802.11ac  
 4 (Wi-Fi 5)” and “802.11ax (Wi-Fi 6)” data rates. *See also* UniFi 6 Long-Range  
 5 Access Point Webpage stating, the “U6-LR is a high-performance Access Point  
 6 leveraging advanced WiFi 6 technology to provide powerful wireless coverage to  
 7 enterprise environments. It delivers an aggregate radio rate of up to 3.0 Gbps with 5  
 8 GHz (4x4 MU-MIMO and OFDMA) and 2.4 GHz 4x4 MIMO radios.” “Features”  
 9 include “1.3 GHz dual-core processor (now upgraded to support full-duplex 1 Gbps  
 10 TCP/IP performance)... Four-stream high-efficiency Wi-Fi 6 technology... 5 GHz  
 11 band 4x4 MU-MIMO and OFDMA with radio rate of 2.4 Gbps... 2.4 GHz band 4x4  
 12 MIMO with radio rate of 600 Mbps.”). Further, the UniFi 6 Long Range Access  
 13 Point is capable of “Simultaneously connect[ing] to more devices” and can “Create  
 14 and support over 300 distinct client connections.” Ubiquiti’s Wi-Fi Webpage further  
 15 indicates that the UniFi 6 Long Range includes “Wi-Fi 6,” “4x4 OFDMA” MIMO,  
 16 “Wave 2,” and “MU-MIMO.” *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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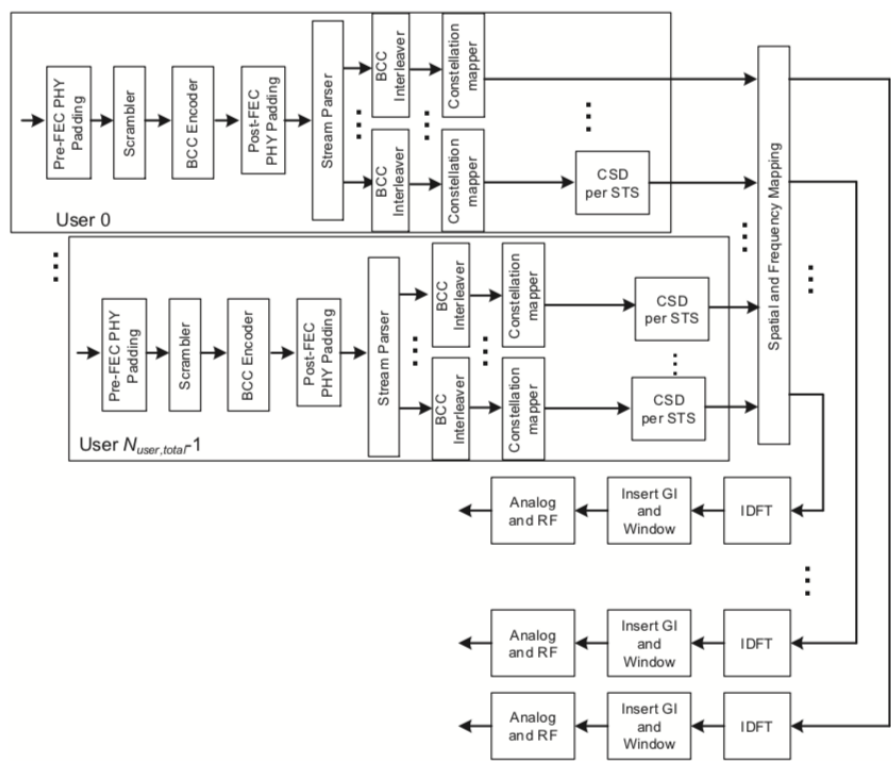


Figure 27-19—Transmitter block diagram for the Data field of an HE DL MU-MIMO transmission in a 106-, 242-, 484- or 996-tone RU with BCC encoding

; 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  
 Table 22-11 from the measured channel before computing a set of matrices for feedback to the beamformer.  
 21 The beamforming feedback matrix,  $V_{k,u}$ , found by the beamformee  $u$  for subcarrier  $k$  shall be compressed in  
 the form of angles using the method described in 20.3.12.3.6. The angles,  $\phi(k,u)$  and  $\psi(k,u)$ , are quantized  
 22 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  
 23 beamforming feedback format defined.

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

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

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2 52. 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 '376 Accused Products. More specifically, Defendant has been and is  
7 now actively inducing direct infringement by other persons (*e.g.*, Defendant's  
8 customers who use, sell or offer for sale the '376 Accused Products).

9 53. 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 '376 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 54. Defendant also contributorily infringes by making, using, selling, offering  
28 to sell, and/or importing the '376 Accused Products, knowing they constitute a



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

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

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

10 57.Vivato's '376 Patent is valid and enforceable.

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

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

21 **VI. WILLFUL INFRINGEMENT**

22 60.Defendant had knowledge of Vivato's '728 Patent by at least the date of  
23 the filing and service of the Complaints for Patent Infringement on April 19, 2017,  
24 and July 14, 2017, in the United States District Court for the Central District of  
25 California.

26 61.Despite Defendant's knowledge of Vivato's '728 Patent and its patent  
27 portfolio, Defendant infringed and continues to infringe the '728 Patent with full and  
28 complete knowledge of the patents' applicability to Defendant's MU-MIMO Wi-Fi

1 6 access point and router products without taking a license and without a good faith  
2 belief that the '728 Patent are invalid and not infringed. Defendant's infringement  
3 occurred, and continues to occur, with knowledge of infringement and objective  
4 recklessness, and/or with willful blindness to its infringement.

5 62. Defendant sold, and continues to sell, its '728 Accused Products (*e.g.*, Wi-  
6 Fi 6 / IEEE 802.11ax Access Points such as the U6 Long Range Access Point) to  
7 customers despite its knowledge of Vivato's Asserted Patents, such as on  
8 store.ui.com. Defendant also manufactured and imported into the United States, and  
9 continues to do so, the '728 Accused Products for sale and distribution to its  
10 customers, despite its knowledge of Vivato's Asserted Patents, including without  
11 limitation the '728 Patent.

12 63. Defendant's infringement of Vivato's '728 Patent is egregious because  
13 despite its knowledge of the '728 Patent, Defendant deliberately and flagrantly  
14 copied the invention claimed in the '728 Patent and implemented that patented  
15 invention in its '728 Accused Products. Further, despite Defendant's knowledge of  
16 the '728 Patent, Defendant sold, offered for sale, manufactured, and imported, the  
17 '728 Accused Products—and continues to do so—without investigating the scope of  
18 the '728 Patent and without forming a good-faith belief that its '728 Accused  
19 Products do not infringe or that the '728 Patent is invalid. Defendant has not taken  
20 any steps to remedy its infringement of the '728 Patent (*e.g.*, by removing the '728  
21 Accused Products from its sales channels). Instead, Defendant continues to sell its  
22 '728 Accused Products to customers, such as its continued sale of its U6 Long Range  
23 Access Point, for example. Defendant's behavior is egregious because it engaged,  
24 and continues to engage, in misconduct beyond that of typical infringement. For  
25 example, in a typical infringement, an infringer would investigate the scope of the  
26 asserted patents and develop a good-faith belief that it does not infringe the asserted  
27 patents or that the asserted patents are invalid before selling (and continuing to sell)

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1 its accused products. An infringer would also remove its accused products from its  
2 sales channels and discontinue further sales.

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

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7 **PRAYER FOR RELIEF**

8 WHEREFORE, Vivato prays for the following relief:

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

11 (b) An award of damages to Vivato arising out of Defendant’s infringement  
12 of U.S. Patent Nos. 7,729,728 and 10,594,376, together with prejudgment and post-  
13 judgment interest, in an amount according to proof;

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

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

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

21 **DEMAND FOR JURY TRIAL**

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

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RUSS, AUGUST & KABAT

DATED: June 16, 2021

Respectfully submitted,

**RUSS AUGUST & KABAT**

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