

U.S. Patent No. 9,848,442 (“the ’442 Patent”); (5) U.S. Patent No. 9,912,513 (“the ’513 Patent”); (6) U.S. Patent No. 9,917,679 (“the ’679 Patent”); (7) U.S. Patent No. 10,020,919 (“the ’919 Patent”); (8) U.S. Patent No. 10,153,886 (“the ’886 Patent”); and (9) U.S. Patent No. 10,756,851 (“the ’851 Patent”), (collectively, “the Asserted Patents”).

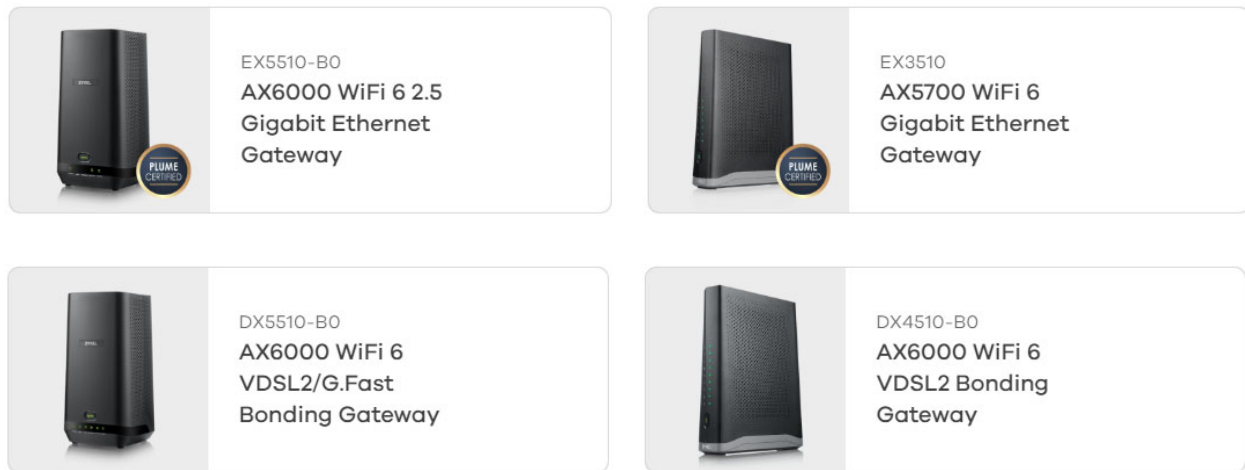
The Accused Instrumentalities are Zyxel’s Wi-Fi 6 devices that comply with the 802.11ax-2021 Wi-Fi 6 Standard, including its Wi-Fi 6 access points and Wi-Fi 6 stations. The following is a non-exhaustive listing of Zyxel’s Accused Instrumentalities based on publicly-available information, but this listing will necessarily be incomplete as Zyxel continues to introduce new Wi-Fi 6 devices:

Accused Products
Armor G5 AX6000 12-Stream Multi-Gigabit WiFi 6 Router
AX7501 Dual Band Wireless AX6000 10G Fiber IAD with SFP+
C3510XZ WiFi 6 Gigabit Ethernet Gateway
C4000BZ Dual-Band Wireless AX VDSL2 Gigabit Bonding Gateway
C4000LZ Dual-Band Wireless AX VDSL2Gigabit Gateway
DX3300 Dual Band Wireless AX1800 VDSL2/Ethernet/IAD/Gateway
DX3301 Dual Band Wireless AX1800 VDSL2/Ethernet/IAD/Gateway
DX4510 AX6000 WiFi 6 VDSL2 Bonding Gateway
DX5410 Dual-Band Wireless AX6000 VDSL2/Ethernet IAD
DX5510 AX6000 WiFi 6 VDSL2/G.Fast Bonding Gateway
EX3300 Dual Band Wireless AX1800 VDSL2/Ethernet/IAD/Gateway
EX3301 Dual Band Wireless AX1800 VDSL2/Ethernet/IAD/Gateway
EX3320 Mesh Wireless Gateway
EX3510 AX5700 WiFi 6 Gigabit Ethernet Gateway
EX5401 Dual-Band Wireless AX6000 VDSL2/Ethernet IAD
EX5510 AX6000 WiFi 6 Gigabit Ethernet Gateway
HGW-500IX4X8-Q Amplificador Smart WiFi 6

Multy AX1800 WiFi 6 Whole Home WiFi System
NR2101 5G NR Mobile WiFi
NR5101 5G NR Indoor Router
NR5103 5G Indoor Router
NR5103E 5G Indoor Router
NWA50AX WiFi 6 Dual-Radio PoE Access Point
NWA55AXE WiFi 6 Dual-Radio Outdoor PoE Access Point
NWA90AX WiFi 6 Dual-Radio PoE Access Point
NWA110AX WiFi 6 Dual-Radio PoE Access Point
NWA210AX WiFi 6 Dual-Radio PoE Access Point
NWA220AX-6E WiFi 6E Dual-Radio Access Point
WAX510D WiFi 6 Dual-Radio Unified Pro Access Point
WAX610D WiFi 6 Dual-Radio Unified Pro Access Point
WAX620D-6E AXE5400 WiFi 6E Dual-Radio Access Point
WAX630S WiFi 6 Dual-Radio Unified Pro Access Point
WAX640S-6E AXE7800 Tri-Band WiFi 6E Access Point
WAX650S WiFi 6 Dual-Radio Unified Pro Access Point
WSM20 AX18080 Dual-Band WiFi 6 System
WX3100 Dual-Band Wireless AX1800 Gigabit Extender
WX3300 Dual-Band Wireless AX Gigabit Access Point/Extender
WX3310 Dual-Band Wireless AX Gigabit Access Point/Extender
WX3401 Dual-Band Wireless AX5400 Gigabit Extender

<https://selector.zyxel.com/type/3;> <https://selector.zyxel.com/type/5;> <https://service-provider.zyxel.com/na/en/wifi-6-solutions#featured-products;> <https://service-provider.zyxel.com/global/en/products/wifi-system;> https://www.wi-fi.org/product-finder-results?sort_by=default&sort_order=desc&capabilities=189&companies=268; ATLAS-ZYXEL-00000024-314.

Examples of Zyxel's Wi-Fi 6 products are shown below from Zyxel's website:

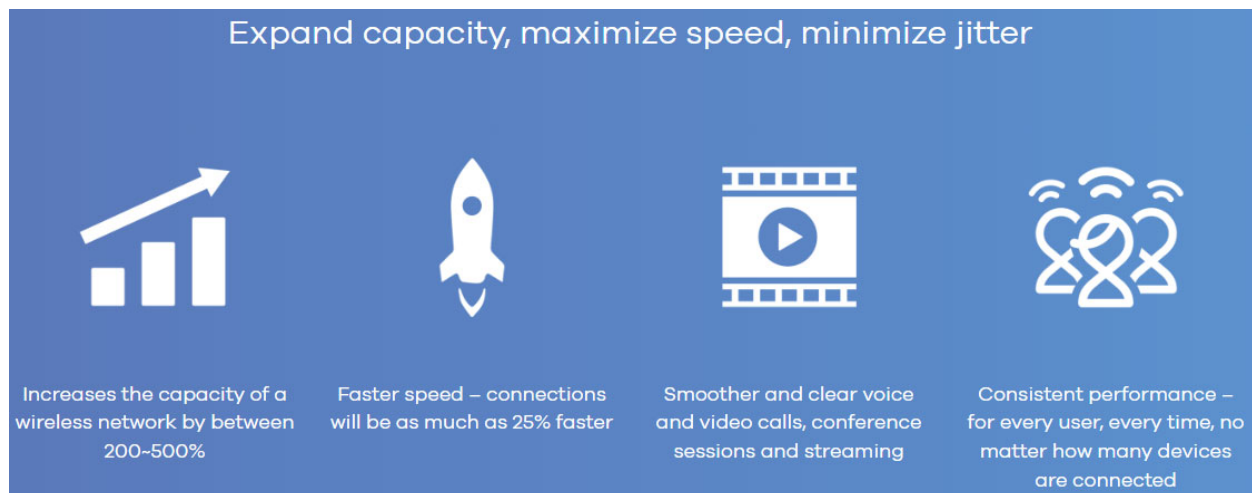


<https://service-provider.zyxel.com/na/en/wifi-6-solutions#featured-products>.

Zyxel both directly and indirectly infringes each of the Asserted Patents. Zyxel directly infringes the method claims of the Asserted Patents by using the Accused Instrumentalities in the United States without a license. Those uses meet every limitation of each method claim, either literally or under the doctrine of equivalents. Zyxel directly infringes the apparatus claims of the Asserted Patents by making, using, selling, offering to sell, and/or importing the Accused Instrumentalities in the United States without a license. Those instrumentalities meet every limitation of each apparatus claim, either literally or under the doctrine of equivalents.

Zyxel also indirectly infringes the method claims of the Asserted Patents by inducing third parties—including Zyxel's customers and end-users of Zyxel's products—to use the Zyxel Accused Instrumentalities in the United States in an infringing manner, as directed and instructed by Zyxel. Zyxel also indirectly infringes the apparatus claims of the Asserted Patents by inducing others to make, use, sell, offer to sell, and/or import the Accused Instrumentalities in the United States in an infringing manner, as directed and instructed by Zyxel.

For example, Zyxel affirmatively touts Wi-Fi 6 technology and its advantages to its prospective customers who purchase Wi-Fi products. For example, Zyxel tells its customers that “WiFi 6 – or 802.11ax – is the latest and the best wireless networking standard” and it allows their customers’ “devices to respond in higher density environments.” <https://www.zyxel.com/us/en/solutions/WiFi6-AP-Solution-20211125-829884.shtml>. According to Zyxel, “With WiFi 6 there is no contention, no waiting, no degradation in performance.” *Id.* Zyxel claims this improvement “make WiFi 6 a great technology for any organization that ... has many users and devices connected simultaneously.” *Id.* As Zyxel notes, “[w]herever there are going to be large numbers of people ... connecting to the wireless network on a daily basis . . . significant efficiency and performance gains will be delivered by WiFi 6.” *Id.* Zyxel includes this graphic on its website highlighting the benefits of Wi-Fi 6:



Id. Zyxel even produced a seven-page whitepaper on Wi-Fi 6 that touts Wi-Fi 6’s “significant benefits over 802.11ac in terms of speed and even more significantly, the density of users it can support.” <https://www.zyxel.com/library/assets/tech-library/whitepaper/wifi6.pdf>.

Zyxel’s user manuals and technical support also instruct customers and end users how to configure the Accused Instrumentalities to form and/or connect to Wi Fi 6 networks; once

complete, they will automatically implement the WiFi 6 standard to infringe based on the hardware and software provided by Zyxel. Further evidence that Zyxel induces its customers to infringe, including via promoting its products' Wi-Fi 6 functionality on its website and via obtaining Wi-Fi 6 certification, can be found in this production: ATLAS-ZYXEL-00000024-314.

The infringement claim charts set forth representative examples of how Zyxel infringes each limitation of each claim. Atlas also describes Zyxel's infringement in its Complaint (Dkt. No. 1), which is incorporated by reference in its entirety.

Pursuant to the Court's Standing Order Governing Proceedings – Patent Cases, these infringement contentions are preliminary. *See* §II (General Deadlines) & §XI (App'x A) at row 2 and fn 8. The deadline to serve final infringement contentions is eight weeks after the *Markman* hearing. *See* §XI (App'x A) at row 19.

These disclosures, including Exhibits A to I, are based on the present state of Atlas's knowledge, without the benefit of any discovery. Atlas's investigation is ongoing, and no *Markman* order has been entered in this action. Atlas reserves all rights to supplement, amend, and/or otherwise modify its infringement contentions.

The parties have not exchanged claim terms or proposed claim constructions, Zyxel has not served its preliminary invalidity contentions and accompanying production, and the *Markman* hearing date is yet to be determined. Atlas is not required to disclose claim construction positions at this time, and does not. These disclosures, inclusive of Exhibits A to I, should not be construed as setting forth Atlas's claim construction positions. To the extent Zyxel asserts that a particular Atlas claim construction position is implied by these disclosures, including Exhibits A to I, Atlas denies and objects to any such assertion. Atlas reserves all rights to modify its claim construction positions.

II. Disclosure of the Priority Date

These initial disclosures are based on the present state of Atlas's knowledge. Atlas's investigation is ongoing, and Atlas reserves all rights to modify the positions taken in these initial disclosures.

A. U.S. Patent No. 9,531,520 ("the '520 Patent")

The '520 Patent was filed on March 23, 2016 as Application No. 15/078,920 and claims the benefit of U.S. Provisional Application No. 62/140,349, filed on March 30, 2015, and U.S. Provisional Application No. 62/137,138, filed on March 23, 2015. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '520 Patent is March 20, 2015.

B. U.S. Patent No. 9,763,259 ("the '259 Patent")

The '259 Patent was filed on September 22, 2015 as Application No. 14/862,078 and claims the benefit of Korean Patent Application No. 10-2015-0116576, filed on August 19, 2015, and U.S. Provisional Application No. 62/054,270, filed on September 23, 2014. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '259 Patent is September 15, 2014.

C. U.S. Patent No. 9,825,738 ("the '738 Patent")

The '738 Patent was filed on April 3, 2015 as Application No. 14/678,724 and claims the benefit of U.S. Provisional Application No. 61/981,427, filed on April 18, 2014, and U.S. Provisional Application No. 61/975,622, filed on April 4, 2014. Based on information currently

available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '738 Patent is April 4, 2015.

D. U.S. Patent No. 9,848,442 (“the ‘442 Patent”)

The '442 Patent was filed on November 10, 2015 as Application No. 14/937,284 and claims the benefit of U.S. Provisional Application No. 62/077,771, filed on November 10, 2014. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '442 Patent is November 6, 2014.

E. U.S. Patent No. 9,912,513 (“the ‘513 Patent”)

The '513 Patent was filed on July 6, 2016 as Application No. 15/203,717 as a continuation of Application No. 14/868,303, filed on September 28, 2015 (which resulted in U.S. Patent No. 9,413,581), and further claims the benefit of U.S. Provisional Application No. 62/061,503, filed on October 8, 2014. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '513 Patent is late September 2014.

F. U.S. Patent No. 9,917,679 (“the ‘679 Patent”)

The '679 Patent was filed on November 3, 2015 as Application No. 14/931,753 and claims the benefit of U.S. Provisional Application No. 62/080,026, filed on November 14, 2014, and U.S. Provisional Application No. 62/074,514, filed on November 3, 2014. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '679 Patent is November 3, 2014.

G. U.S. Patent No. 10,020,919 (“the ‘919 Patent”)

The '919 Patent was filed on April 25, 2017 as Application No. 15/497,094 as a continuation of Application No. 15/291,947, filed on October 12, 2016 (which resulted in U.S. Patent No. 9,667,394), and further claims the benefit of U.S. Provisional Application No.

62/333,192, filed on May 7, 2016, U.S. Provisional Application No. 62/333,077, filed on May 6, 2016, U.S. Provisional Application No. 62/331,380, filed on May 3, 2016, and U.S. Provisional Application No. 62/240,419, filed on October 12, 2015. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '919 Patent is October 9, 2015.

H. U.S. Patent No. 10,153,886 (“the ’886 Patent”)

The '886 Patent was filed on November 15, 2016 as Application No. 15/352,435 as a continuation of Application No. 15/078,920, filed on March 23, 2016 (which resulted in U.S. Patent No. 9,531,520), and further claims the benefit of U.S. Provisional Application No. 62/140,349, filed on March 30, 2015, and U.S. Provisional Application No. 62/137,138, filed on March 23, 2015. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '886 Patent is March 20, 2015.

I. U.S. Patent No. 10,756,851 (“the ’851 Patent”)

The '851 Patent was filed on November 28, 2018 as Application No. 16/203,501 as a continuation of Application No. 15/151,433, filed on May 10, 2016 (which resulted in U.S. Patent No. 10,181,930), and further claims the benefit of U.S. Provisional Application No. 62/193,305, filed on July 16, 2015, U.S. Provisional Application No. 62/191,623, filed on July 13, 2015, U.S. Provisional Application No. 62/160,527, filed on May 12, 2015, and U.S. Provisional Application No. 62/159,346, filed on May 10, 2015. Based on information currently available to Atlas, the earliest priority date (*i.e.*, the earliest date of invention) for the '851 Patent is May 10, 2015.

III. Disclosure of Accompanying Production

These disclosures include an accompanying document production that includes documents evidencing conception and reduction to practice for each claimed invention and copies of the

prosecution histories for each patent-in-suit. The accompanying production is subject to and without waiving the objections and reservations set forth herein. The Bates number ranges for the documents evidencing conception and reduction to practice are: ATLAS-00004101-00004261 ('520); ATLAS-00008764-00008980 ('259); ATLAS-00013749-00013899 ('738); ATLAS-00014103-00014188 ('442); ATLAS-00014361-00014729 ('513); ATLAS-00018813-00019944 ('679); ATLAS-00019278-00019944 ('919); ATLAS-00020155-00021067 ('886); and ATLAS-00020585-00021067 ('851). The Bates number ranges for the copies of the file histories for each patent in suit are: ATLAS-00000034-00004100 ('520); ATLAS-00004659-00008763 ('259); ATLAS-00009023-00013748 ('738); ATLAS-00014214-00014360 ('442); ATLAS-00014214-00014360 ('513); ATLAS-00014777-00018812 ('679); ATLAS-00018996-00019277 ('919); ATLAS-00019977-00020154 ('886); and ATLAS-00020389-00020584 ('851).

In producing the accompanying documents, Atlas does not admit or concede the relevancy, materiality, authenticity, or admissibility as evidence of any of these documents. All objections to the use, at trial or otherwise, of any document produced are hereby expressly reserved, and Atlas objects to the production of any documents protected by the attorney-client privilege, the work-product doctrine, or any other immunities from discovery.

Atlas makes these disclosures without the benefit of discovery. Further, Atlas's investigation is ongoing. Atlas produces these documents without prejudice to its right to produce additional documents after considering documents obtained and reviewed throughout discovery and further investigation.

Dated: August 4, 2022

Respectfully submitted,

/s/ Eric J. Enger

Max L. Tribble, Jr.

Texas State Bar No. 20213950

Joseph S. Grinstein

Texas State Bar No. 24002188

Alejandra C. Salinas

Texas State Bar No. 24102452

SUSMAN GODFREY, LLP

1000 Louisiana Street, Suite 5100

Houston, Texas 77002

Telephone: (713) 651-9366

Facsimile: (713) 654-6666

mtribble@susmangodfrey.com

jgrinstein@susmangodfrey.com

asalinas@susmangodfrey.com

Kalpana Srinivasan

California State Bar No. 237460

Oleg Elkhunovich

California State Bar No. 269238

SUSMAN GODFREY, LLP

1900 Avenue of the Stars, 14th Floor

Los Angeles, CA 90067

Telephone: (310) 789-3100

Facsimile: (310) 789-3150

ksrinivasan@susmangodfrey.com

oelkhunovich@susmangodfrey.com

Michael F. Heim

Texas State Bar No. 09380923

Eric J. Enger

Texas State Bar No. 24045833

Blaine A. Larson

Texas State Bar No. 24083360

Alden G. Harris

Texas State Bar No. 24083138

William B. Collier, Jr.

Texas State Bar No. 24097519

HEIM, PAYNE & CHORUSH, LLP

1111 Bagby, Suite 2100

Houston, Texas 77002

Telephone: (713) 221-2000

Facsimile: (713) 221-2021

mheim@hpcllp.com
eenger@hpcllp.com
blarson@hpcllp.com
aharris@hpcllp.com
wcollier@hpcllp.com

T. John Ward, Jr.
Texas Bar No. 00794818
Email: jw@wsfirm.com
Andrea L. Fair
Texas Bar No. 24078488
Email: andrea@wsfirm.com
WARD, SMITH & HILL, PLLC
1507 Bill Owens Parkway
Longview, Texas 75604

S. Calvin Capshaw
Texas State Bar No. 03783900
Elizabeth L. DeRieux
Texas State Bar No. 05770585
CAPSHAW DeRIEUX, LLP
114 E. Commerce Ave.
Gladewater, TX 75647
Telephone: (903) 845-5770
Email: ccapshaw@capshawlaw.com

*ATTORNEYS FOR ATLAS GLOBAL
TECHNOLOGIES LLC*

CERTIFICATE OF SERVICE

I certify that all counsel of record are being served via electronic mail with a copy of this document and its attached exhibits on August 4, 2022.

/s/Eric J. Enger

Eric J. Enger

EXHIBIT A – Infringement Chart for U.S. Patent No. 9,531,520

The Accused Instrumentalities are Zyxel’s Wi-Fi 6 High Efficiency Access Points and Station Devices. Each of the Accused Instrumentalities contains hardware, software, and/or other components that implement, practice, and/or comply with IEEE Std 802.11-2020 as amended by IEEE Std 802.11ax-2021 (the “Wi-Fi 6 Standard” or “802.11ax”). A listing of Zyxel’s Wi-Fi 6 High Efficiency Access Points and High Efficiency Station Devices (based on publicly-available information) is included in the Zyxel infringement contention cover pleading.¹

Based on the information presently available to it, Atlas contends that Zyxel directly and indirectly infringes claims 1-6, 8-16, and 18-20 of United States Patent No. 9,531,520 (“the ’520 Patent”). Claims 1-6 primarily relate to Wi-Fi 6 Access Points, while claims 8-16 and 18-20 primarily relate to Wi-Fi 6 Stations.

Zyxel directly infringes method claims 1-6, 8-16, and 18-20 by using the Accused Instrumentalities in the United States without a license. Zyxel also indirectly infringes method claims 1-6, 8-16, and 18-20 by inducing third parties—including Zyxel’s customers and end-users of Zyxel’s products—to use the Zyxel Accused Instrumentalities in the United States in an infringing manner, as directed and instructed by Zyxel. Publicly-available evidence of the above can be found in the Zyxel infringement contention cover pleading, as well as in the chart below.

¹ Upon information and belief, some of Zyxel’s accused instrumentalities operate as both a Wi-Fi 6 Access Point and a Wi-Fi 6 Station. For example, Zyxel’s Wi-Fi Mesh Extenders operate as a STA when communicating with the primary AP host, but operate as an AP when communicating with other STA devices. See <https://service-provider.zyxel.com/na/en/mpro-mesh-solutions>; <https://service-provider.zyxel.com/global/en/products/network-extenders/wireless-extenders/wx3401-b0>; <https://computer.howstuffworks.com/how-wireless-mesh-networks-work.htm>; <https://www.pcmag.com/how-to/wi-fi-range-extender-vs-mesh-network-whats-the-difference>; <https://www.wi-fi.org/discover-wi-fi/wi-fi-easymesh>; https://www.wi-fi.org/downloads-registered-guest/Wi-Fi_EasyMesh_Specification_v4_0.pdf/35509.

CLAIM 1	Elements in Accused Instrumentality
1[A]. A method, implemented by a network device in a wireless network, for coordinating an uplink multi-user response transmission to a downlink multi-user transmission, the method comprising:	A Wi-Fi 6 High Efficiency (HE) AP Device is a network device in a wireless network that coordinates an uplink multi-user response transmission to a downlink multi-user transmission, as shown by the following excerpts from the IEEE 802.11-2020 Specification and the IEEE 802.11ax-2021 amendment thereto (collectively, “802.11ax-2021”)²: • “The purpose of this standard is to provide wireless connectivity for fixed, portable, and moving stations within a local area. This standard also offers regulatory bodies a means of standardizing access to one or more frequency bands for the purpose of local area communication.” 802.11ax-2021 at §1.2 Purpose • “In IEEE Std 802.11, the addressable unit is a station (STA). Physical and operational characteristics are defined by modifiers that are placed in front of the term STA.” 802.11ax-2021 at §4.2.2 Wireless station (STA) • “access point (AP): An entity that contains one station (STA) and provides access to the distribution system services, via the wireless medium (WM) for associated STAs. An AP comprises a STA and a distribution system access function (DSAF).” 802.11ax-2021 at §3.1 Definitions • “An access point (AP) is any entity that has STA functionality and a distribution system access function (DSAF), which enables access to the DS, via the WM for associated STAs.” 802.11-2020 at §4.3.5.1 Overview • “The IEEE 802.11 HE STA operates in frequency bands between 1 GHz and 7.125 GHz.... The main PHY features in an HE STA that are not present in VHT STA or HT STA are the following: - Mandatory support for DL and UL OFDMA - Mandatory support for DL MU-MIMO by an HE AP that supports 4 or more spatial streams when MU-MIMO is done on the entire PPDU bandwidth - Mandatory support for DL MU-MIMO reception for a non-AP HE STA

² All emphasis, including italicizing, underlining, highlighting and annotations, is added unless otherwise noted.

	- Mandatory support for the HE sounding protocol to support beamforming for a non-AP STA beamformee and optional otherwise - Optional support for HE-MCSs 10 and 11 - <u>Optional support for UL MU-MIMO</u> - Optional support for preamble puncturing The <u>main MAC features in an HE STA</u> that are not present in VHT STA or HT STA are the following: - In an AP, mandatory support for the role of operating mode indication (OMI) responder and optional support for the role of OMI initiator - In an AP, mandatory support for individual wake time (TWT) operation - In a non-AP STA, mandatory support for two NAV operation - In a non-AP STA, mandatory support for multiple BSSID operation - In an AP, optional support for two NAV operation - In a non-AP STA, optional support for the roles of OMI initiator and responder - In a non-AP STA, optional support for individual TWT operation - Optional support for dynamic fragmentation levels 1, 2 and 3 - Optional support for broadcast TWT - Optional support for UL OFDMA-based random access (UORA) - Optional support for spatial reuse operation - Optional support for multi-TID A-MPDU operation - Optional support for ER BSS - Optional support for the NDP feedback report.” 802.11ax-2021 at §4.3.15a High Efficiency (HE) STA In 802.11ax, the AP coordinates an uplink multi-user response transmission to a downlink multi-user transmission using triggering frames, which solicit an uplink multi-user response frame from wireless Stations. Triggering frames are defined as either a Trigger frame or a frame containing a TRS Control subfield: • <u>“triggering frame: A trigger frame or a frame carrying a TRS Control subfield.”</u> 802.11ax-2021 at §3.2 Definitions Specific to IEEE 802.11.
--	--

- “**The format of the HE MU PPDU is defined as in Figure 27-9.** This format is used for transmission to **one or more users** if the PPDU is not a response of a Trigger frame. In the HE MU PPDU, the HE-SIG-A field is not repeated. The HE-SIG-B field is present in this format.

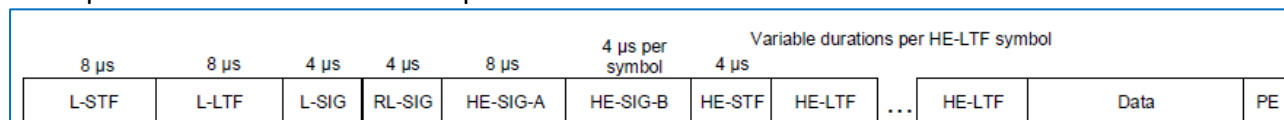


Figure 27-9—HE MU PPDU format

802.11ax-2021 at §27.3.4 HE PPDU Formats

- “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.” 802.11ax-2021 at §9.3.1.22 Trigger frame format

The format for the Trigger frame is defined in Figure 9-64a.

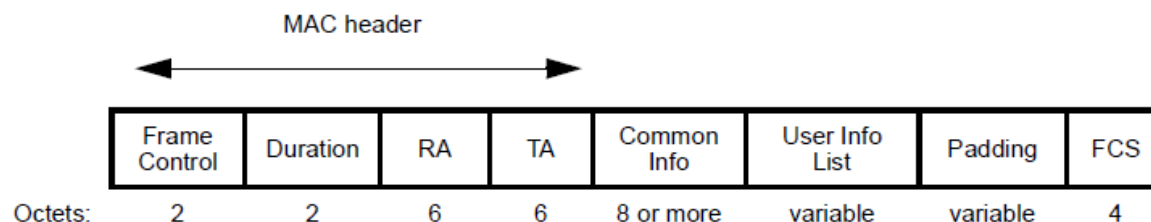


Figure 9-64a—Trigger frame format

- 802.11ax-2021 at §9.3.1.22 Trigger frame format

An AP transmits MAC frames as part of a downlink transmission using frame formats described in 802.11ax-2021. Each MAC frame contains a header, a body, and a frame check sequence. MAC frame formats are described in §9 of the Wi-Fi 6 Standard:

- “9. Frame formats
 - 9.1 General requirements

The format of the MAC frames is specified in this clause. A STA shall be able to properly construct a subset of the frames specified in this clause for transmission and to decode a (potentially different) subset of the frames specified in this clause upon validation following reception. The particular subset of these frames that a STA constructs and decodes is determined by the functions supported by that particular STA. A STA shall be able to validate every received frame using the frame check sequence (FCS) and to interpret certain fields from the MAC headers of all frames. A STA shall transmit frames using only the frame formats described in Clause 9.
 - 9.2 MAC frame formats
 - 9.2.1 Basic components

Each frame consists of the following basic components:

 - a) **A MAC header, which comprises** frame control, duration, address, optional sequence control information, optional QoS Control information (QoS Data frames only), and **optional HT Control fields** (+HTC frames only);
 - b) A variable length *frame body*, which contains information specific to the frame *type* and *subtype*;
 - c) An *FCS*, which contains a 32-bit CRC based on ITU-T Recommendation V.42 [B55] (see 9.2.4.8).”

802.11ax-2021 at §9 Frame Formats
- The contents of the MAC header are shown in Figure 9-2 of the Wi-Fi 6 Standard. Note that the header may include an “HT Control” field:
- “9.2.3 General frame format

The MAC frame format comprises a set of fields that occur in a fixed order in all frames. Figure 9-2 depicts the general MAC frame format for protocol version 0 (PV0) MPDUs, and Figure 9-978 (in 9.8.2) depicts the general MAC frame format for protocol version 1 (PV1) frames. The first 2 bits of the first subfield (Protocol Version) of the Frame Control field and the last field (FCS) in Figure 9-2 are present in all PV0 MPDUs and PV1 MPDUs, including reserved types and subtypes.

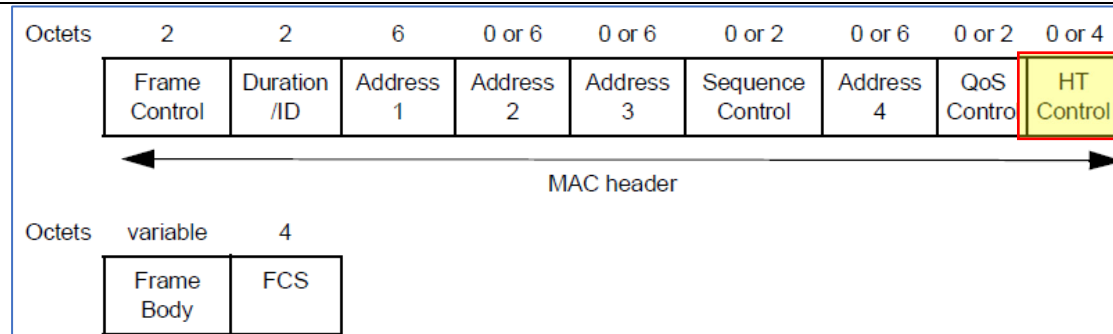


Figure 9-2—MAC frame format

802.11ax-2021 at §9.2.3 General Frame Format

The HT Control field of the MAC header is described in §9.2.4.6 of the Wi-Fi 6 Standard:

- **“The HT Control field** is always present in a Control Wrapper frame and is present in QoS Data, QoS Null, and Management frames as determined by the +HTC subfield of the Frame Control field as defined in 9.2.4.1.10.

NOTE 1—The only control frame subtype for which HT Control field is present is the Control Wrapper frame. A Control frame that is described as +HTC (e.g., an RTS+HTC, CTS+HTC, BlockAck+HTC or BlockAckReq+HTC frame) implies the use of the Control Wrapper frame to carry that Control frame.” 802.11ax-2021 at §9.2.4.6.1 HT Control Field, General.

The HT Control field (originally introduced for HT frames) has been extended to accommodate VHT and HE frames. The variant in use is indicated by bits B0 and B1, the Variant field bits, as shown in Table 9-13b of IEEE 802.11ax-2021. For an HE frame, bits B0-B1 are set to 11 to indicate the HE Variant of the field:

Table 9-13b—HT Control field format

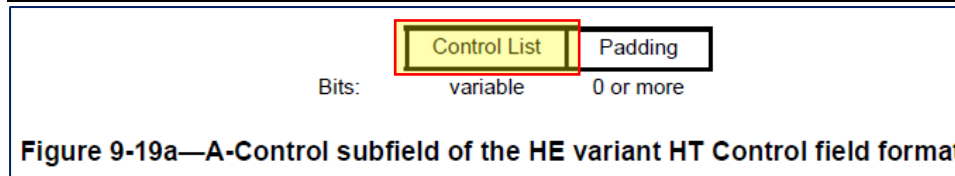
<u>Variant</u>	<u>B0</u>	<u>B1</u>	<u>B2–B29</u>	<u>B30</u>	<u>B31</u>
<u>HT</u>	<u>0</u>		<u>HT Control Middle</u>	<u>AC Constraint</u>	<u>RDG/More PPDU</u>
<u>VHT</u>	<u>1</u>	<u>0</u>	<u>VHT Control Middle</u>	<u>AC Constraint</u>	<u>RDG/More PPDU</u>
<u>HE</u>	<u>1</u>	<u>1</u>	<u>A-Control</u>		

- “ 802.11ax-2021 at §9.2.4.6.1 HT Control Field, General.

For 802.11ax HE frames, the HE Variant of the HT Control field contains an A-Control subfield in bits B2-B31, as described in §9.2.4.6.3a:

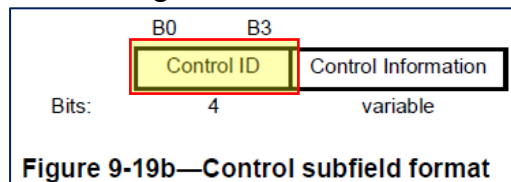
- “9.2.4.6.3a HE variant

The format of the A-Control subfield of the HE variant HT Control field is shown in Figure 9-19a.



The A-Control subfield is 30 bits in length.

The Control List subfield contains one or more Control subfields. The format of each Control subfield is shown in Figure 9-19b.



802.11ax-2021 at §9.2.4.6.3a HE Variant

The Control ID subfield indicates the type of information carried in the Control Information subfield. The length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-22a (Control ID subfield values). See 802.11ax-2021 at § 9.2.4.6.3a HE variant.

As shown in Table 9-22a, the Control ID value 0 indicates the content of the Control Information subfield is Triggered response scheduling (TRS):

Table 9-22a—Control ID subfield values

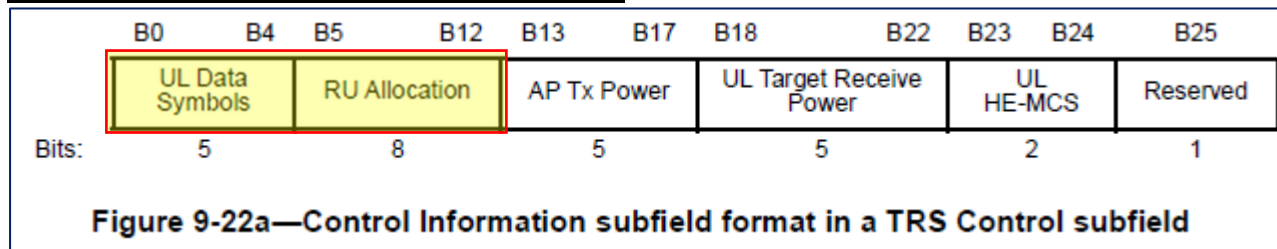
Control ID value	Meaning	Length of the Control Information subfield (bits)	Content of the Control Information subfield
0	Triggered response scheduling (TRS)	26	See 9.2.4.6a.1.
1	Operating mode (OM)	12	See 9.2.4.6a.2.
2	HE link adaptation (HLA)	26	See 9.2.4.6a.3.
3	Buffer status report (BSR)	26	See 9.2.4.6a.4.
4	UL power headroom (UPH)	8	See 9.2.4.6a.5.
5	Bandwidth query report (BQR)	10	See 9.2.4.6a.6.
6	Command and status (CAS)	8	See 9.2.4.6a.7.
7–14	Reserved		
15	Ones need expansion surely (ONES)	26	Set to all 1s.

802.11ax-2021 at §9.2.4.6.3a HE Variant

Triggering frames with a TRS control subfield carry scheduling information for a Station to use for generating a response, as shown in § 9.2.4.6a.1 of the Wi-Fi 6 Standard:

- “9.2.4.6a.1 TRS Control

The Control Information subfield in a TRS Control subfield contains triggered response scheduling (TRS) information for soliciting an HE TB PPDU that follows an HE MU PPDU, HE SU PPDU or HE ER SU PPDU carrying the Control subfield (see 26.5.2.2 [Rules for soliciting UL MU frames]). See 26.5.2.4 [A-MPDU contents in an HE TB PPDU] for details on allowed content in an A-MPDU carried in an HE TB PPDU. The format of the subfield is shown in Figure 9-22a:



802.11ax-2021 at § 9.2.4.6a.1 TRS Control

- “**The UL Data Symbols subfield indicates the number of OFDM symbols in the Data field of the HE TB PPDU response** and is set to the number of OFDM symbols minus 1.

The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE TB PPDU response and the encoding is defined in 9.3.1.22.1 (General).

The AP Tx Power subfield indicates the AP’s combined transmit power at the transmit antenna connector of all the antennas used to transmit the triggering PPDU in units of dBm / 20 MHz. The transmit power in dBm/20 MHz, P_{TX} , is calculated as $P_{TX} = -20 + 2 \times F_{Val}$, where F_{Val} is the value of the AP Tx Power subfield, except for the value 31, which is reserved.

The UL Target Receive Power subfield indicates the expected receive signal power, measured at the AP’s antenna connector and averaged over the antennas, for the HE portion of the HE TB PPDU transmitted on the assigned RU as defined in Table 9-24a (UL Target Receive Power subfield in TRS Control field).

The UL HE-MCS subfield indicates the HE-MCS, in the range HE-MCS 0 to 3, to be used by the receiving STA for the HE TB PPDU is set to the HE-MCS index (see 27.5 (Parameters for HE-MCSs)).” 802.11ax-2021 at § 9.2.4.6a.1 TRS Control

Similarly, a Trigger frame contains a Common Info field and a User Info List field with User Info fields:

The Common Info field is defined in Figure 9-64b.

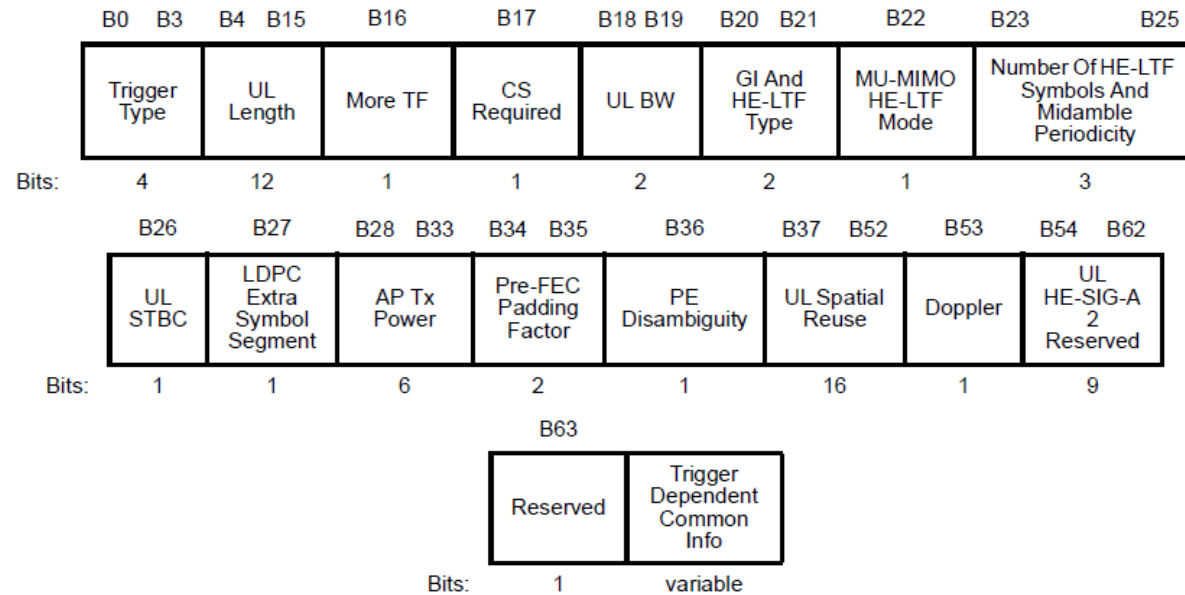


Figure 9-64b—Common Info field format

The User Info field is defined in Figure 9-64d for all Trigger frame variants, except the NFRP Trigger frame, which is defined in 9.3.1.22.9.

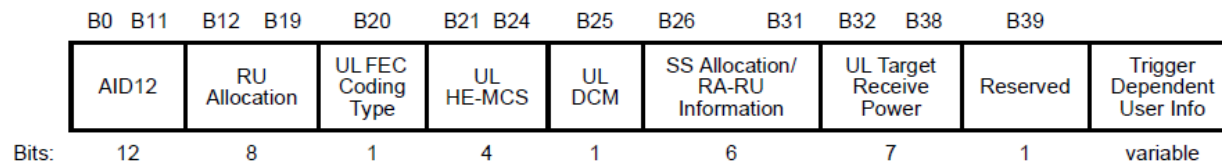


Figure 9-64d—User Info field format

802.11ax-2021 at §9.3.1.22 Trigger frame format

The Common Info field and the User Info List field carry scheduling information for a Station to use for generating a response, for example:

- “The RU Allocation subfield along with the UL BW subfield in the Common Info field identifies the size and the location of the RU. If the UL BW subfield indicates 20 MHz, 40 MHz, or 80 MHz PPDU, then B0 of the RU Allocation subfield is set to 0. If the UL BW subfield indicates 80+80 MHz or 160 MHz, then B0 of the RU Allocation subfield is set to 0 to indicate that the RU allocation applies to the primary 80 MHz channel and set to 1 to indicate that the RU allocation applies to the secondary 80 MHz channel. The mapping of B7–B1 of the RU Allocation subfield for a Trigger frame that is not an MU-RTS Trigger frame is defined in Table 9-29i. See 9.3.1.22.5 for the encoding of the RU Allocation subfield in an MU-RTS Trigger frame.” 802.11ax-2021 at §9.3.1.22 Trigger frame format
- “The UL FEC Coding Type subfield of the User Info field indicates the code type of the solicited HE TB PPDU. The UL FEC Coding Type subfield is set to 0 to indicate BCC and set to 1 to indicate LDPC.” 802.11ax-2021 at §9.3.1.22 Trigger frame format

An HE TB PPDU is generated by an HE STA in response to a triggering frame from an AP:

- “The format of the **HE TB PPDU** is defined as in Figure 27-11. **This format is used for a transmission that is a response to a triggering frame from an AP.** The format of the HE TB PPDU is the same as the HE SU PPDU, except that the duration of the HE-STF field in the HE TB PPDU is twice the duration of the HE-STF field in the HE SU PPDU.

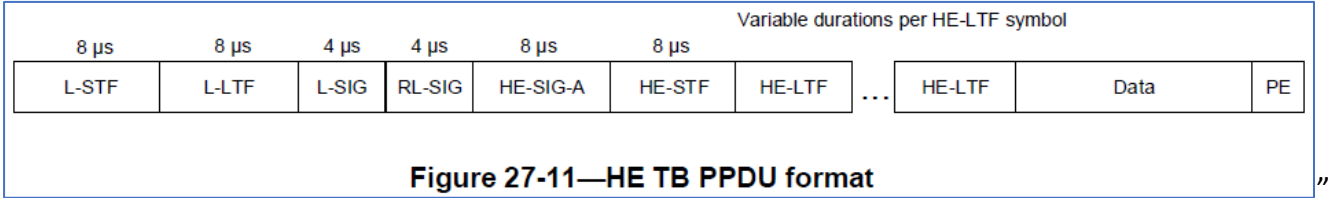


Figure 27-11—HE TB PPDU format

802.11ax-2021 at §27.3.4 HE PPDU Formats

	• “27.1.4 PPDU formats <u>The structure of the PPDU transmitted by an HE STA is determined by the TXVECTOR parameters as defined in Table 27-1.</u> <u>The FORMAT parameter determines the overall structure of the PPDU and can take on one of the following values:</u> * * * * * — <u>HE TB PPDU format (HE TB)</u> that carries a single PSDU and <u>is sent in response to a PPDU that carries a triggering frame</u>. The preamble format prior to the HE-STF field is identical to the HE SU PPDU.” 802.11ax-2021 §27.1.4 PPDU Formats. Wi-Fi Mesh Extenders operate as Wi-Fi 6 High Efficiency Access Point Devices when using Fronthaul AP functionality to communicate with a STA device (including non-AP STA devices and devices that use Backhaul STA functionality) in a mesh network. Wi-Fi EasyMesh Specification v4.0 at 16-17, 21, Figs. 1, 2, 3.
1[B] generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-	A Wi-Fi 6 High Efficiency AP Device generates a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), as shown by the following excerpts from the 802.11ax-2021 Standard: An HE MU PPDU and/or a Trigger frame is a downlink frame addressed to a plurality of stations including a plurality of resource units (RUs) which are allocated to the plurality of STAs respectively: • “DL MU transmission allows an <u>AP to simultaneously transmit information to more than one non-AP STA</u>. For a DL MU transmission, the AP uses the HE MU PPDU format and employs either <u>DL OFDMA</u>, DL MU-MIMO, or <u>a mixture of both</u>.” 802.11ax-2021 at §27.3.1.1 MU Transmission • “The HE PHY supports OFDMA transmissions, both in the DL and the UL where <u>different users can occupy different RUs in a PPDU</u> (see 27.3.10 (Mathematical description of signals)). The transmission within an RU in a PPDU may be a single stream to one user (SISO), multiple streams spatially multiplexed to one user (SU-MIMO), or multiple streams spatially multiplexed to multiple users (MU-MIMO).” 802.11ax-2021 at §27.3.1.1 MU Transmission

user frame
comprises:

- **"The RUs defined for DL and UL transmission are as follows:** 26-tone RU, 52-tone RU, 106-tone RU, 242 tone RU, 484-tone RU, 996-tone RU and 2×996-tone RU. ... The maximum number of RUs in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz HE PPDU formats are defined in Table 27-6 (Maximum number of RUs for each channel width). ... An HE MU PPDU using OFDMA transmission can carry a mixture of 26-, 52-, 106-, 242-, 484-, and 996-tone RUs.

Table 27-6—Maximum number of RUs for each channel width

RU type	CBW20	CBW40	CBW80	CBW80+80 and CBW160
26-tone RU	9	18	37	74
52-tone RU	4	8	16	32
106-tone RU	2	4	8	16
242-tone RU	1	2	4	8
484-tone RU	N/A	1	2	4
996-tone RU	N/A	N/A	1	2
2×996 tone RU	N/A	N/A	N/A	1

802.11ax-2021 at §27.3.2.2 Resource unit, guard and DC subcarriers

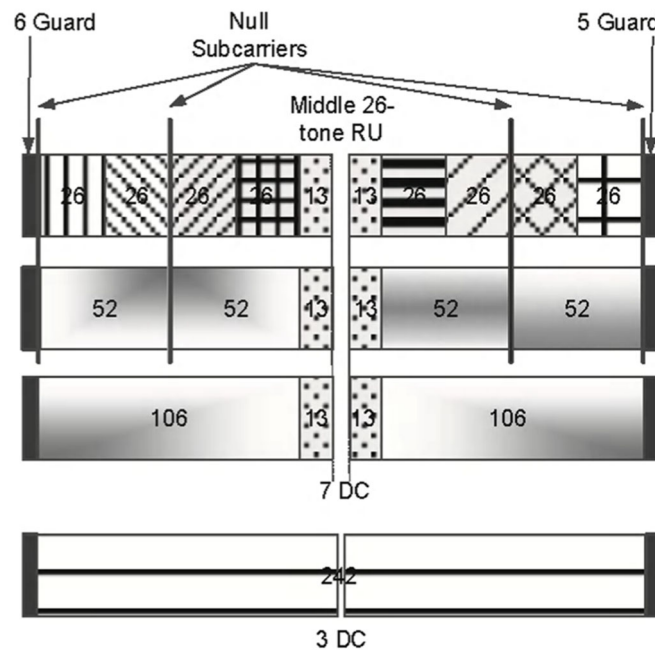


Figure 27-5—RU locations in a 20 MHz HE PPDU

802.11ax-2021 at §27.3.2.2 Resource unit, guard and DC subcarriers

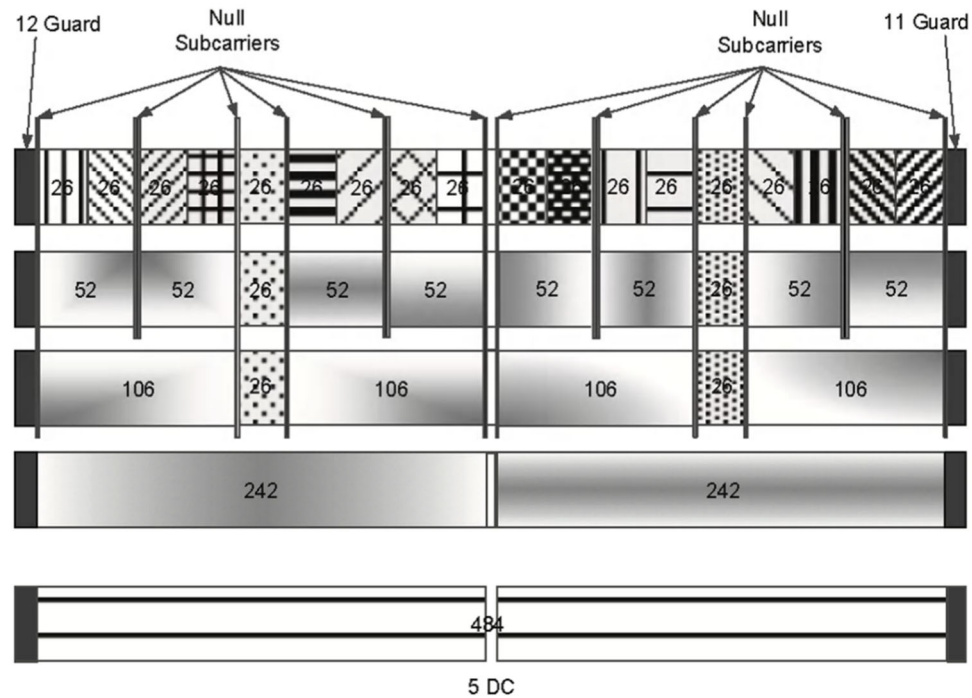


Figure 27-6—RU locations in a 40 MHz HE PPDU

802.11ax-2021 at §27.3.2.2 Resource unit, guard and DC subcarriers

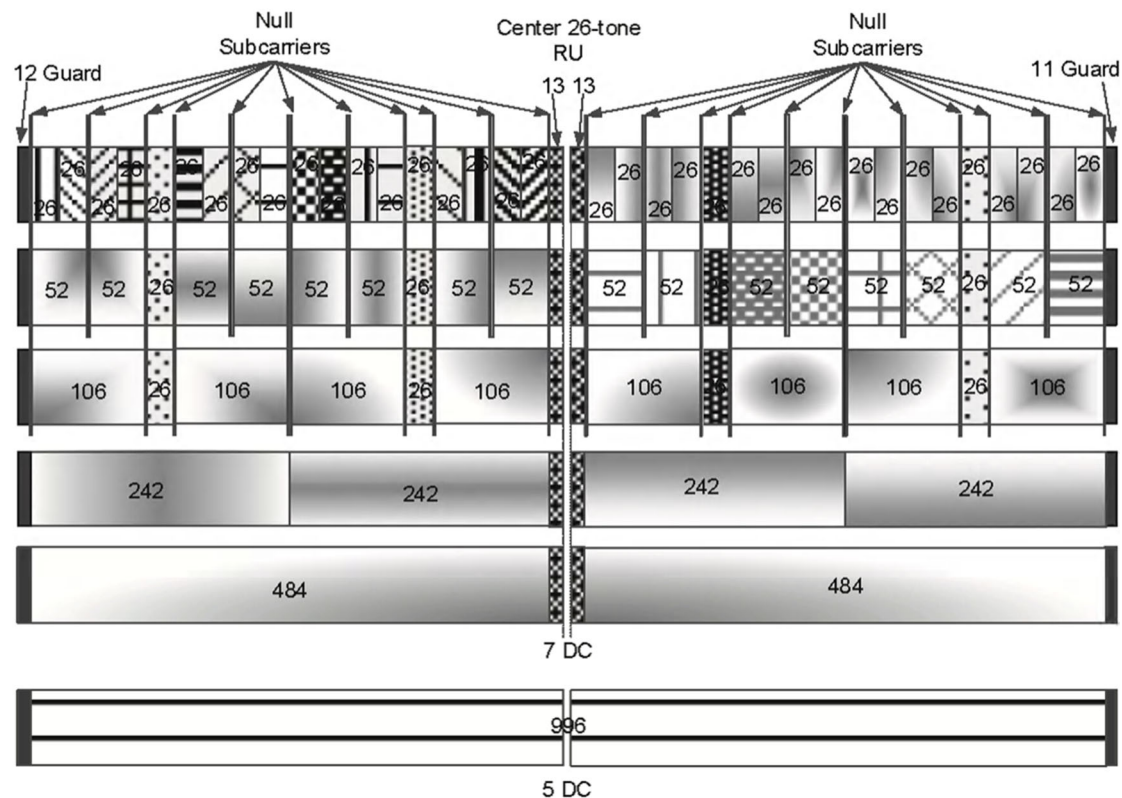


Figure 27-7—RU locations in an 80 MHz HE PPDU

- 802.11ax-2021 at §27.3.2.2 Resource unit, guard and DC subcarriers
- “The mapping from the 8-bit RU Allocation subfield to the RU assignment and the number of User fields per RU contributed to the User Specific field in the same HE-SIG-B content channel as the RU Allocation subfield are defined in Table 27-26.” 802.11ax-2021 at §27.3.11.8.3 Common field
- See also Table 27-26 (showing mapping from RU Allocation subfield to RU assignment). 802.11ax-2021 at §27.3.11.8.3 Common field

- “An **AP includes in the TXVECTOR for an HE MU PPDU at least one parameter STA_ID for each RU in the HE MU PPDU** as defined in 26.11.1. The AP shall not include in the TXVECTOR more than one parameter STA_ID with the same value, unless the value is 2046 (indicating an unallocated RU).” 802.11ax-2021 at §26.5.1.2 RU addressing in an HE MU PPDU
- “Each parameter **STA_ID in the TXVECTOR identifies the STA or group of STAs that is the recipient of an RU in the HE MU PPDU** transmitted with the TXVECTOR parameter UPLINK_FLAG set to 0. For an individually addressed RU the parameter STA_ID is set to the 11 LSBs of the AID of the STA receiving the PSDU contained in that RU.” 802.11ax-2021 at §26.11.1 STA_ID
- “**The format of the HE MU PPDU is defined as in Figure 27-9.** This format is used for transmission to **one or more users** if the PPDU is not a response of a Trigger frame. In the HE MU PPDU, the HE-SIG-A field is not repeated. The HE-SIG-B field is present in this format.

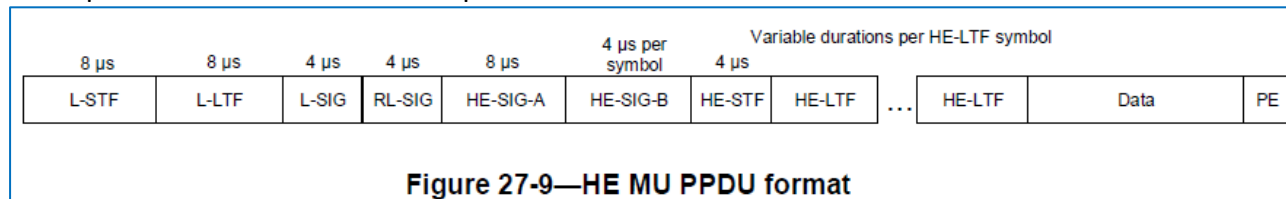


Figure 27-9—HE MU PPDU format

802.11ax-2021 at §27.3.4 HE PPDU Formats

The HE-SIG-B field contains information that allows each STA to determine its RU allocation:

- “**The HE-SIG-B field provides the necessary signaling, including the OFDMA and DL MU-MIMO resource allocation information, to allow the STAs to look up the corresponding resources to be used in the HE modulated fields of the PPDU.** The integer fields of the HE-SIG-B field are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.” 802.11ax-2021 § 27.3.11.8.1 HE-SIG-B Field, General

As shown in Figure 9-2, the MAC frame contains a destination address (referred to as “Address 1”) that identifies the intended receiver(s) of the frame:

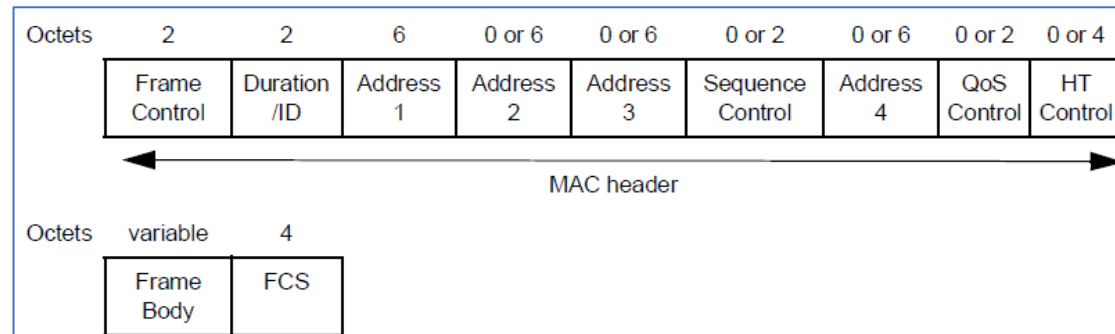


Figure 9-2—MAC frame format

802.11ax-2021 at §9.2.3 General Frame Format

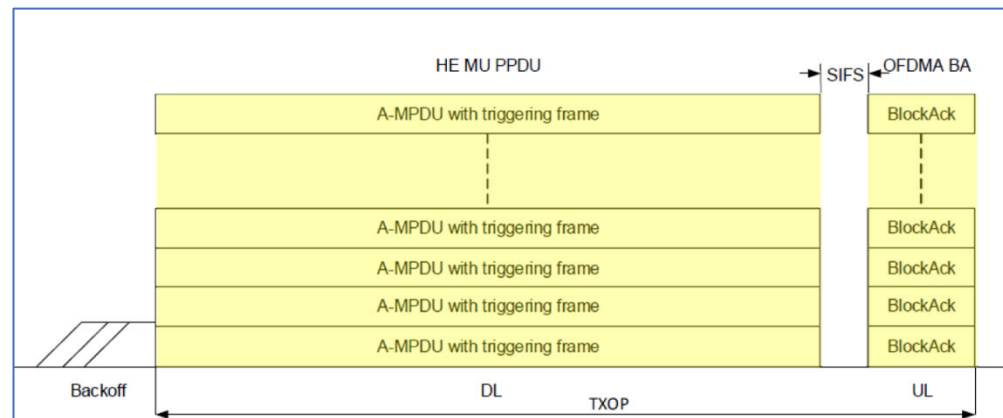


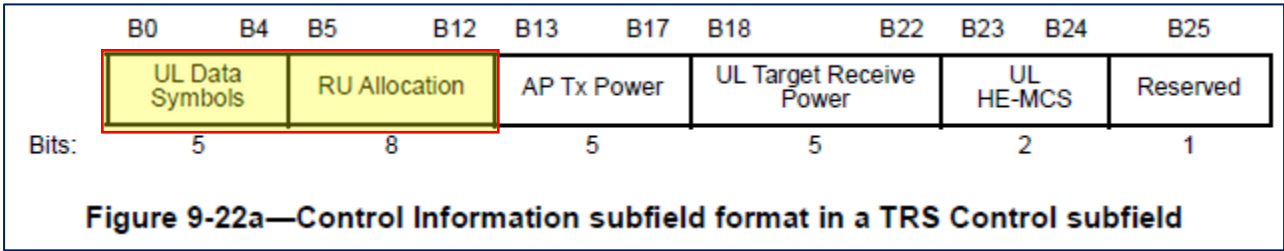
Figure 10-14a—Example of HE MU PPDU transmission with immediate UL OFDMA acknowledgment

802.11ax-2021 at §10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU format

	Figure 10-14a shows the downlink multi-user frame (referred to as an “HE MU PPDU”) that an AP generates and transmits to a plurality of STA devices, as well as the multi-user acknowledgment transmission (referred to as “OFDMA BA”) that the AP receives from the STA devices. • “All of the MPDUs within an A-MPDU are addressed to the same RA. All of the MPDUs within an A-MPDU have the same TA. All QoS Data frames within an A-MPDU that have a TID for which an HT-immediate block ack agreement exists have the same value for the Ack Policy Indicator subfield of the QoS Control field.” 802.11ax-2021 at §9.7.3 A-MPDU contents • See <i>also</i> Table 27-1—TXVECTOR and RXVECTOR parameters “STA_ID ... Indicates the list of STA-IDs for an HE MU PPDU”). 802.11ax-2021 at §27.2.2 TXVECTOR and RXVECTOR parameters
1[C] assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and	A Wi-Fi 6 High Efficiency AP Device assigns each RU of the plurality of RUs to a respective station in the plurality of stations, as shown by the following excerpts from the 802.11ax-2021 Standard: Each RU of the plurality of RUs in the downlink multi-user frame is addressed to a respective station in the plurality of stations. • <u>“The HE-SIG-B field provides the necessary signaling, including the OFDMA and DL MU-MIMO resource allocation information, to allow the STAs to look up the corresponding resources to be used in the HE modulated fields of the PPDU.</u> The integer fields of the HE-SIG-B field are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.” 802.11ax-2021 § 27.3.11.8.1 HE-SIG-B Field, General • See <i>also</i> evidence and analysis at Claim 1[A] and 1[B], above. As shown above at Claim 1[A], the MAC frame contains an HT Control field, the possible contents of which are shown in Table 9-13b. If bits B0 and B1 of the HT Control field are “11,” that indicates the HT Control field has been extended to accommodate the 802.11ax standard using the HE variant, and the A-Control subfield will be present. The A-Control subfield has a Control List subfield shown in Figure 9-19a, which in turn has Control ID and Control Information subfields shown in Figure 9-19b. The Control ID subfield may have a value of “0,” which (as shown in Table 9-22a) indicates that the Control Information subfield provides Triggered Response

Scheduling. And when Triggered Response Scheduling is used, the Control Information subfield has UL Data Symbols and RU Allocation subfields (as shown in Figure 9-22a), which are acknowledgment information that indicates properties for the uplink acknowledgment responsive transmission (e.g., the number of OFDM data symbols and resource unit allocation for that uplink acknowledgment responsive transmission).

- “**The Control Information subfield in a TRS Control subfield contains triggered response scheduling (TRS) information for soliciting an HE TB PPDU** that follows an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU carrying the Control subfield (see 26.5.2.2). See 26.5.2.4 for details on allowed content in an A-MPDU carried in an HE TB PPDU. **The format of the subfield is shown in Figure 9-22a.**



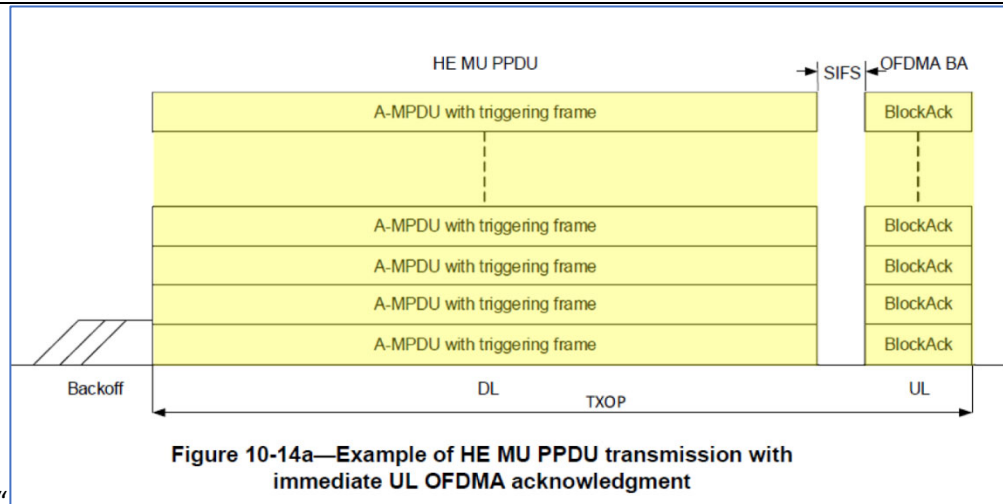
The UL Data Symbols subfield indicates the number of OFDM symbols in the Data field of the HE TB PPDU response and is set to the number of OFDM symbols minus 1.

The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE TB PPDU response and the encoding is defined in 9.3.1.22.1 (General).” 802.11ax-2021 at § 9.2.4.6a.1 TRS Control

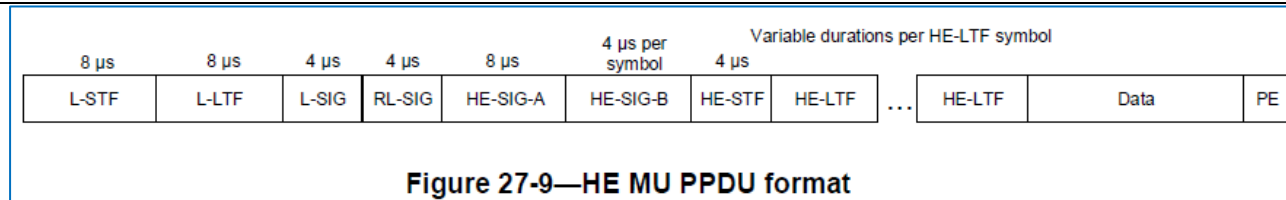
1[D] including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs,

A Wi-Fi 6 High Efficiency AP Device includes a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs, as shown by the following excerpts from the 802.11ax-2021 Standard:

Each RU in the downlink multi-user frame includes a respective A-MPDU:



- “
- 802.11ax-2021 at § 10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU Format.
- “An **AP includes in the TXVECTOR for an HE MU PPDU at least one parameter STA ID for each RU in the HE MU PPDU** as defined in 26.11.1. The AP shall not include in the TXVECTOR more than one parameter STA_ID with the same value, unless the value is 2046 (indicating an unallocated RU).” 802.11ax-2021 at §26.5.1.2 RU addressing in an HE MU PPDU
- “Each parameter **STA ID in the TXVECTOR identifies the STA or group of STAs that is the recipient of an RU in the HE MU PPDU** transmitted with the TXVECTOR parameter UPLINK_FLAG set to 0. For an individually addressed RU the parameter STA_ID is set to the 11 LSBs of the AID of the STA receiving the PSDU contained in that RU.” 802.11ax-2021 at §26.11.1 STA_ID
- “**The format of the HE MU PPDU is defined as in Figure 27-9.** This format is used for transmission to **one or more users** if the PPDU is not a response of a Trigger frame. In the HE MU PPDU, the HE-SIG-A field is not repeated. The HE-SIG-B field is present in this format.



802.11ax-2021 at §27.3.4 HE PPDU Formats

- **“The HE-SIG-B field provides the necessary signaling, including the OFDMA and DL MU-MIMO resource allocation information, to allow the STAs to look up the corresponding resources to be used in the HE modulated fields of the PPDU.** The integer fields of the HE-SIG-B field are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.” 802.11ax-2021 § 27.3.11.8.1 HE-SIG-B Field, General
- “All of the MPDUs within an A-MPDU are addressed to the same RA. All of the MPDUs within an A-MPDU have the same TA. All QoS Data frames within an A-MPDU that have a TID for which an HT-immediate block ack agreement exists have the same value for the Ack Policy Indicator subfield of the QoS Control field.” 802.11ax-2021 at §9.7.3 A-MPDU contents
- *See also* evidence and analysis at Claim 1[A] and 1[B], above.

1[E] wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement

A Wi-Fi 6 High Efficiency AP Device includes an MPDU in one or more of the RUs in the plurality of RUs which includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame, as shown by the following excerpts from the 802.11ax-2021 Standard:

As shown above at Claim 1[A] and 1[C], the MPDU includes a HT Control field of the MAC header, the possible contents of which are shown in Table 9-13b. If bits B0 and B1 of the HT Control field are “11,” that indicates the HT Control field has been extended to accommodate the 802.11ax standard using the HE variant, and the A-Control subfield will be present. The A-Control subfield has a Control List subfield shown in Figure 9-19a, which in turn has Control ID and Control Information subfields shown in Figure 9-19b. The Control ID subfield

transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame;	may have a value of “0,” which (as shown in Table 9-22a) indicates that the Control Information subfield provides Triggered Response Scheduling. And when Triggered Response Scheduling is used, the Control Information subfield has UL Data Symbols and RU Allocation subfields (as shown in Figure 9-22a), which include acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame (e.g., the number of OFDM data symbols and resource unit allocation for that uplink acknowledgment responsive transmission).
1[F] transmitting the downlink multi-user frame to the plurality of stations over a wireless channel; and	A Wi-Fi 6 High Efficiency AP Device transmits the downlink multi-user frame to the plurality of stations over a wireless channel, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[B], above.</i> <i>See also 802.11ax-2021 at § 27.3.5 Transmitter block diagram (describing procedure for transmitting the downlink multi-user frame to the plurality of stations over a wireless channel).</i>
1[G] receiving the uplink multi-user response transmission, the uplink multi-user response transmission including multi-user acknowledgement transmissions respectively and simultaneously transmitted by	A Wi-Fi 6 High Efficiency AP Device receives the uplink multi-user response transmission, the uplink multi-user response transmission including multi-user acknowledgement transmissions respectively and simultaneously transmitted by two or more stations in the plurality of stations, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A] and 1[B], above.</i> The triggering frame is used to solicit an HE TB PPDU (an uplink multi-user response transmission including multi-user acknowledgement transmissions respectively and simultaneously transmitted by two or more stations in the plurality of stations), which follows the PPDU containing the triggering frame: • “9.2.4.6a.1 TRS Control <u>The Control Information subfield in a TRS Control subfield contains triggered response scheduling (TRS) information for soliciting an HE TB PPDU</u> that follows an HE MU PPDU, HE SU PPDU or HE ER SU PPDU

two or more stations in the plurality of stations,	carrying the Control subfield (see 26.5.2.2 [Rules for soliciting UL MU frames]). See 26.5.2.4 [A-MPDU contents in an HE TB PPDU] for details on allowed content in an A-MPDU carried in an HE TB PPDU. The format of the subfield is shown in Figure 9-22a. 802.11ax-2021 at §9.2.4.6a.1 TRS Control Scheduling information for the TRS field is described above. As explained in §26.5.2.3.4 (TXVECTOR parameters for HE TB PPDU response to TRS Control subfield) of the Wi-Fi 6 Standard, the STA transmitting an HE TB PPDU in response to a frame containing a TRS Control subfield uses the following TXVECTOR parameters: • “6.5.2.3.4 TXVECTOR parameters for HE TB PPDU response to TRS Control subfield <u>A non-AP STA transmitting an HE TB PPDU in response to a frame containing a TRS Control subfield shall set the TXVECTOR parameters as follows:</u> — The FORMAT parameter is set to HE_TB. — The TRIGGER_METHOD parameter is set to TRS. — <u>The L_LENGTH parameter is computed as described in Equation (27-11) using the TXTIME value. The TXTIME is defined by Equation (27-136) where NSYM is set to FVAL + 1, where FVAL is the value of the UL Data Symbols subfield of the TRS Control subfield.</u> — <u>The RU_ALLOCATION and MCS parameters are set to the values of the RU Allocation and UL HE-MCS subfields of the TRS Control subfield, respectively.</u> — The CH_BANDWIDTH parameter is set to the value of the RXVECTOR parameter CH_BANDWIDTH of the soliciting DL HE PPDU (see Table 27-1). — The BSS_COLOR and DCM parameters are set to the values of the RXVECTOR parameters BSS_COLOR and DCM of the soliciting DL HE PPDU, respectively. — The DOPPLER parameter is set to 0, and the MIDAMBLE_PERIODICITY parameter is absent. — The NUM_HE_LTF parameter is set to 1. — The STARTING_STS_NUM parameter is set to 0. — The STBC parameter is set to 0, and the NUM_STS parameter is set to 1 (the HE_LTF_MODE parameter is not present). — The FEC_CODING parameter is set to BCC_CODING if the RU Allocation subfield indicates an RU that is smaller than a 484-tone RU; otherwise, it is set to LDPC_CODING.
---	---

	— The LDPC_EXTRA_SYMBOL parameter is set to 0 if the RU Allocation subfield indicates less than a 484-tone RU; otherwise, it is set to 1. — The SPATIAL_REUSE parameter is set to PSR_AND_NON_SRG_OBSS_PD_PROHIBITED. — The DEFAULT_PE_DURATION parameter is set to the default PE duration value for UL MU response scheduling, which is indicated by the AP in the Default PE Duration subfield of the HE Operation element it transmits. — The TXOP_DURATION parameter is set as defined in 26.11.5. — The HE_SIG_A2_RESERVED parameter is set to 511 (all 1s). — If the RXVECTOR parameters HE_LTF_TYPE and GI_TYPE of HE MU PPDU carrying the frame with the TRS Control subfield are either 4xHE-LTF and 3u2s_GI, respectively, or 2xHE-LTF and 1u6s_GI, respectively, then the HE_LTF_TYPE and GI_TYPE parameters are set to 4xHE-LTF and 3u2s_GI, respectively. Otherwise, the HE_LTF_TYPE and GI_TYPE parameters are set to 2xHE-LTF and 1u6s_GI, respectively. — The TXPWR_LEVEL_INDEX parameter is set to a value based on the computed transmission power (see 27.3.15.2) for an HE TB PPDU and the value of the AP Tx Power subfield of the TRS Control subfield and the UL Target Receive Power subfield of the TRS Control subfield.” 802.11ax-2021 at §26.5.2.3.4 TXVECTOR Parameters for HE TB PPDU Response to TRS Control Subfield HE TB PPDU are transmitted on the uplink in response to triggering frames: • “27.3.2.6 Resource allocation for an HE TB PPDU <u>UL MU transmissions are preceded by a triggering frame from the AP. The triggering frame</u> indicates the parameters, such as the duration of the HE TB PPDU, RU allocation, target RSSI, and HE-MCS (see 9.3.1.22, 9.2.4.6a.1, and 26.5.2.3), <u>required to transmit an HE TB PPDU.</u>” 802.11ax-2021 at §27.3.2.6 Resource Allocation for an HE TB PPDU HE TB PPDU are used in UL transmission in response to triggering frames. By way of example, the text below shows an encoding for UL transmission of an HE TB PPDU: • “<u>Figure 27-17 shows the transmitter blocks for the UL transmission</u> or DL non-MU-MIMO transmission of a Data field with BCC encoding <u>on a 26-, 52-, 106-, or 242-tone RU</u> for a single frequency segment if the number of spatial streams is less than or equal to 4. <u>Figure 27-17 applies to the Data field of an HE MU</u>
--	--

PPDU that is transmitted on an RU allocated to a single user, the Data field of an HE SU PPDU, **and the Data field of an HE TB PPDU** (regardless of whether it is spatially multiplexed with other users).

The DCM tone mapper, which is part of the constellation mapper, is applied only if DCM is indicated for the RU. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks and the blocks to the right of, and including, the spatial mapping block is also used to generate the HE-LTF fields. This is illustrated in Figure 27-32 (in 27.3.11.10). A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks and the blocks to the right of, and including, the spatial and frequency mapping block of Figure 27-17 is also used to generate the HE-STF field. **This figure also applies to the Data field with BCC encoding in an HE TB PPDU.**

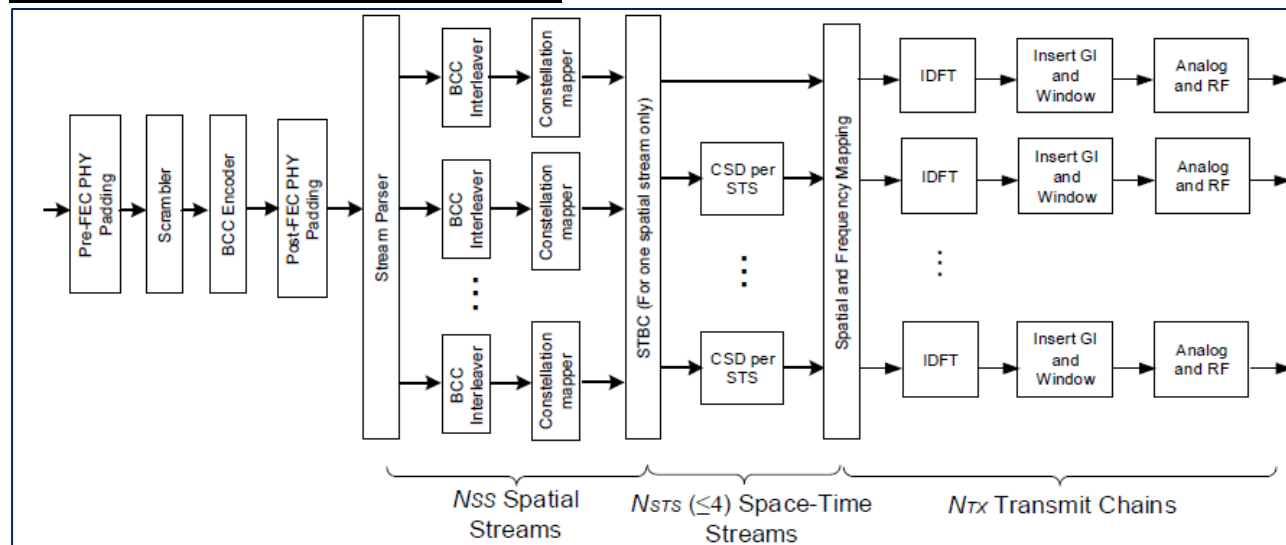
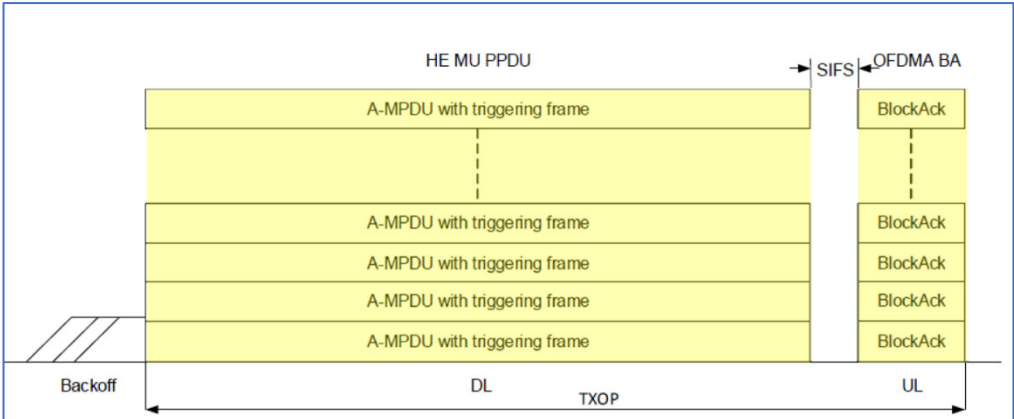


Figure 27-17—Transmitter block diagram for UL transmission or DL non-MU-MIMO transmission of a Data field with BCC encoding on a 26-, 52-, 106-, or 242-tone RU

802.11ax-2021 at §27.3.5 Transmitter Block Diagram

- See also 802.11ax-2021 at § 10.3.2.13.2 showing acknowledgements generated by trigger frames at Figure 10-41a and HE TB PPDU's generated in response to a trigger frame at Figure 10-14b.

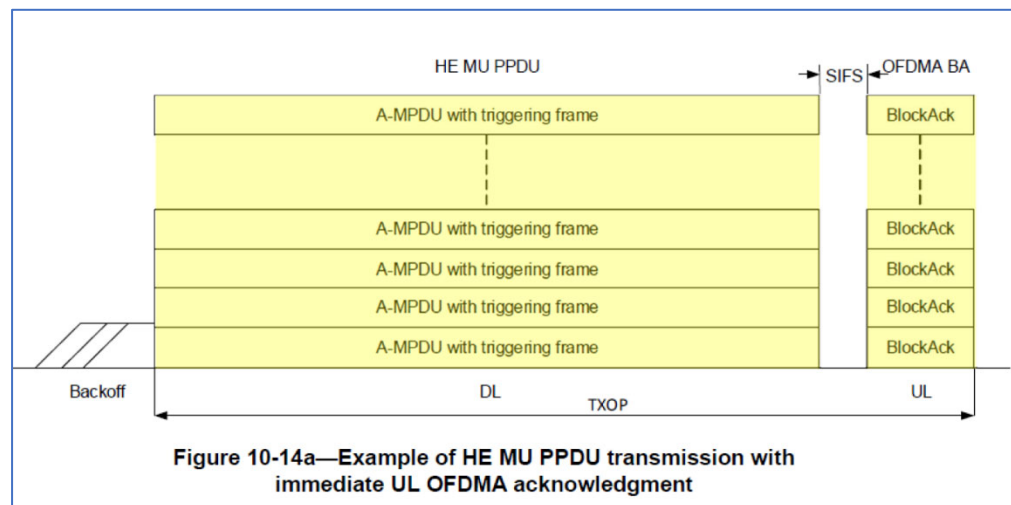
	The acknowledgement transmissions are simultaneous:  Figure 10-14a—Example of HE MU PPDU transmission with immediate UL OFDMA acknowledgment “ 802.11ax-2021 at § 10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU Format. “A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame with HETP Ack ack policy, of an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame, or of a Management frame that solicits acknowledgment, shall send the immediate response according to the scheduling information that is carried either in the Trigger frame(s) or TRS Control subfield.” 802.11ax-2021 at § 10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU Format. “<u>The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE TB PPDU response</u> and the encoding is defined in 9.3.1.22.1 (General).” 802.11ax-2021 at § 9.2.4.6a.1 TRS Control
1[H] wherein the plurality of RUs respectively correspond to a plurality of simultaneous	The plurality of RUs respectively correspond to a plurality of simultaneous uplink transmissions, and each of the plurality of simultaneous uplink transmissions uses a sub-channel, spatial stream, or sub-channel and spatial stream combination that is not used by any other of the plurality of simultaneous uplink transmissions, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A], 1[B], 1[C], and 1[G] above.</i>

uplink transmissions, and each of the plurality of simultaneous uplink transmissions uses a sub-channel, spatial stream, or sub-channel and spatial stream combination that is not used by any other of the plurality of simultaneous uplink transmissions.

As shown above at 1[C], each RU contains scheduling information corresponding to a respective uplink transmission.

Further, each uplink transmission is simultaneous and each uses at least a different sub-channel as set by the RU allocation subfield:

- “An example of UL OFDMA acknowledgment to an HE MU PPDU is shown in Figure 10-14a.

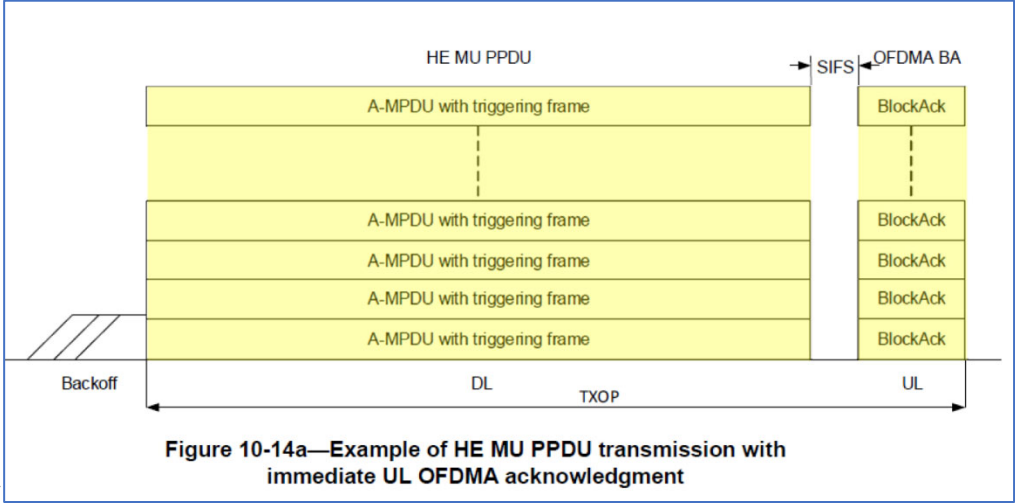


802.11ax-2021 at §10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU format

- “A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame with HETP Ack ack policy, of an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame, or of a Management frame that solicits acknowledgment, **shall send the immediate response according to the scheduling information that is carried either in the Trigger frame(s) or TRS Control subfield.**” 802.11ax-2021 at § 10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU Format.
- “**The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE TB PPDU response** and the encoding is defined in 9.3.1.22.1 (General).” 802.11ax-2021 at § 9.2.4.6a.1 TRS Control

CLAIM 2		ELEMENTS IN ACCUSED INSTRUMENTALITY	
2[A]. The method of claim 1, wherein generating the downlink multi-user frame further comprises:		A Wi-Fi 6 High Efficiency AP Device performs the method of claim 1. <i>See evidence and analysis at Claim 1, above.</i>	
2[B] including the acknowledgement information, for indicating properties of the multi-user acknowledgement transmission transmitted by each respective station in the plurality of stations to acknowledge the downlink multi-user frame, in a header of the one or more MPDUs.		A Wi-Fi 6 High Efficiency AP Device includes the acknowledgement information, for indicating properties of the multi-user acknowledgement transmission transmitted by each respective station in the plurality of stations to acknowledge the downlink multi-user frame, in a header of the one or more MPDUs, as shown by the following excerpts from the 802.11ax-2021 Standard: As shown at Claim 1[A], the acknowledgement information (including the Control Information subfield and its UL Data Symbols and RU Allocation subfields) are located in the MAC header of an MPDU of the downlink multi-user frame. <i>See also</i> §9.2.4.6 of the Wi-Fi 6 Standard	
CLAIM 3		ELEMENTS IN ACCUSED INSTRUMENTALITY	
3[A]. The method of claim 2, wherein the header is a MAC header of the one or more MPDUs.		A Wi-Fi 6 High Efficiency AP Device performs the method of claim 2, wherein the header is a MAC header of the one or more MPDUs, as shown by the following excerpts from the 802.11ax-2021 Standard: As shown at Claim 1[A], the acknowledgement information (including the Control Information subfield and its UL Data Symbols and RU Allocation subfields) are located in the MAC header of an MPDU of the downlink multi-user frame. <i>See also</i> §9.2.4.6 of the Wi-Fi 6 Standard	

CLAIM 4	ELEMENTS IN ACCUSED INSTRUMENTALITY
4[A]. The method of claim 1, wherein one of the one or more MPDUs in each of the RUs of the plurality of RUs is a unicast trigger frame that contains the acknowledgement information for the respective station in the plurality of stations.	A Wi-Fi 6 High Efficiency AP Device performs the method of claim 1, wherein one of the one or more MPDUs in each of the RUs of the plurality of RUs is a unicast trigger frame that contains the acknowledgement information for the respective station in the plurality of stations, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1, above.</i> The MPDU is unicast because it is not broadcast (<i>i.e.</i> the MPDU is addressed to a particular receiver address): • “All of the MPDUs within an A-MPDU are addressed to the same RA.” 802.11ax-2021 at §9.7.3 A-MPDU contents The MPDU is a trigger frame. <i>See evidence and analysis at Claim 1[A], above.</i>
CLAIM 5	ELEMENTS IN ACCUSED INSTRUMENTALITY
5[A]. The method of claim 4, wherein the trigger frame instigates each respective station in the plurality of stations to transmit the multi-user acknowledgement transmission after an interframe spacing period following receipt of the downlink multi-user frame.	A Wi-Fi 6 High Efficiency AP Device performs the method of claim 4, wherein the trigger frame instigates each respective station in the plurality of stations to transmit the multi-user acknowledgement transmission after an interframe spacing period following receipt of the downlink multi-user frame, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 4, above.</i>

	The trigger frame solicits a multi-user acknowledgement transmission after an interframe spacing period (a SIFS) following receipt of the downlink multi-user frame:  Figure 10-14a—Example of HE MU PPDU transmission with immediate UL OFDMA acknowledgment • “ 802.11ax-2021 at § 10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU Format. ”
CLAIM 6	ELEMENTS IN ACCUSED INSTRUMENTALITY
6[A]. The method of claim 1, further comprising:	A Wi-Fi 6 High Efficiency AP Device performs the method of claim 1, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1, above.</i>
6[B] generating, by the network device, a multi-user block acknowledgement request frame to solicit acknowledgements from two or more	A Wi-Fi 6 High Efficiency AP Device generates a multi-user block acknowledgement request frame to solicit acknowledgements from two or more stations of the plurality of stations, as shown by the following excerpts from the 802.11ax-2021 Standard: As shown above at Claim 1, the downlink multi-user frame (a triggering frame) solicits one or more uplink multi-user acknowledgement transmission(s).

stations of the plurality of stations; and	Infringement of this claim occurs when the AP sends a second triggering frame to solicit acknowledgement transmissions from two or more STAs after it sends the first triggering frame. This can happen, for example, because the AP does not receive two or more of the acknowledgement transmissions it solicited with the first triggering frame (<i>e.g.</i> the AP solicited acknowledgement from six STAs but only received acknowledgement from four STAs). In such a situation, the AP can send a second triggering frame (the “multi-user block acknowledgement request frame”) to solicit acknowledgements from two or more stations of the plurality of stations (<i>e.g.</i> the two STAs that did not acknowledge the first triggering frame).
6[C] transmitting the multi-user block acknowledgment request frame following transmission of the downlink multi-user frame.	A Wi-Fi 6 High Efficiency AP Device transmits the multi-user block acknowledgment request frame following transmission of the downlink multi-user frame, as shown by the following excerpts from the 802.11ax-2021 Standard: The acknowledgment request frame (the second triggering frame) is sent following transmission of the downlink multi-user frame (the first triggering frame). <i>See</i> evidence and analysis at Claim 6[B].
CLAIM 8 ELEMENTS IN ACCUSED INSTRUMENTALITY	
8[A]. A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:	A Wi-Fi 6 High Efficiency (HE) Station Device is a wireless device that transmits an uplink acknowledgment, as shown by the following excerpts from the 802.11ax-2021 Standard: • “The purpose of this standard is to provide wireless connectivity for fixed, portable, and moving stations within a local area. This standard also offers regulatory bodies a means of standardizing access to one or more frequency bands for the purpose of local area communication.” 802.11ax-2021 at §1.2 Purpose • “In IEEE Std 802.11, the addressable unit is a station (STA). Physical and operational characteristics are defined by modifiers that are placed in front of the term STA.” 802.11ax-2021 at §4.2.2 Wireless station (STA) • “The IEEE 802.11 HE STA operates in frequency bands between 1 GHz and 7.125 GHz.... The main PHY features in an HE STA that are not present in VHT STA or HT STA are the following:

- **Mandatory support for DL and UL OFDMA**
 - **Mandatory support for DL MU-MIMO** by an HE AP that supports 4 or more spatial streams when MU-MIMO is done on the entire PPDU bandwidth
 - Mandatory support for DL MU-MIMO reception for a non-AP HE STA
 - Mandatory support for the HE sounding protocol to support beamforming for a non-AP STA beamformee and optional otherwise
 - Optional support for HE-MCSs 10 and 11
 - **Optional support for UL MU-MIMO**
 - Optional support for preamble puncturing
- The **main MAC features in an HE STA** that are not present in VHT STA or HT STA are the following:
- In an AP, mandatory support for the role of operating mode indication (OMI) responder and optional support for the role of OMI initiator
 - In an AP, mandatory support for individual wake time (TWT) operation
 - In a non-AP STA, mandatory support for two NAV operation
 - In a non-AP STA, mandatory support for multiple BSSID operation
 - In an AP, optional support for two NAV operation
 - In a non-AP STA, optional support for the roles of OMI initiator and responder
 - In a non-AP STA, optional support for individual TWT operation
 - Optional support for dynamic fragmentation levels 1, 2 and 3
 - Optional support for broadcast TWT
 - Optional support for UL OFDMA-based random access (UORA)
 - Optional support for spatial reuse operation
 - Optional support for multi-TID A-MPDU operation
 - Optional support for ER BSS
 - Optional support for the NDP feedback report.”
- 802.11ax-2021 at §4.3.15a High Efficiency (HE) STA

An HE TB PPDU is generated by an HE STA in response to a triggering frame from an AP:

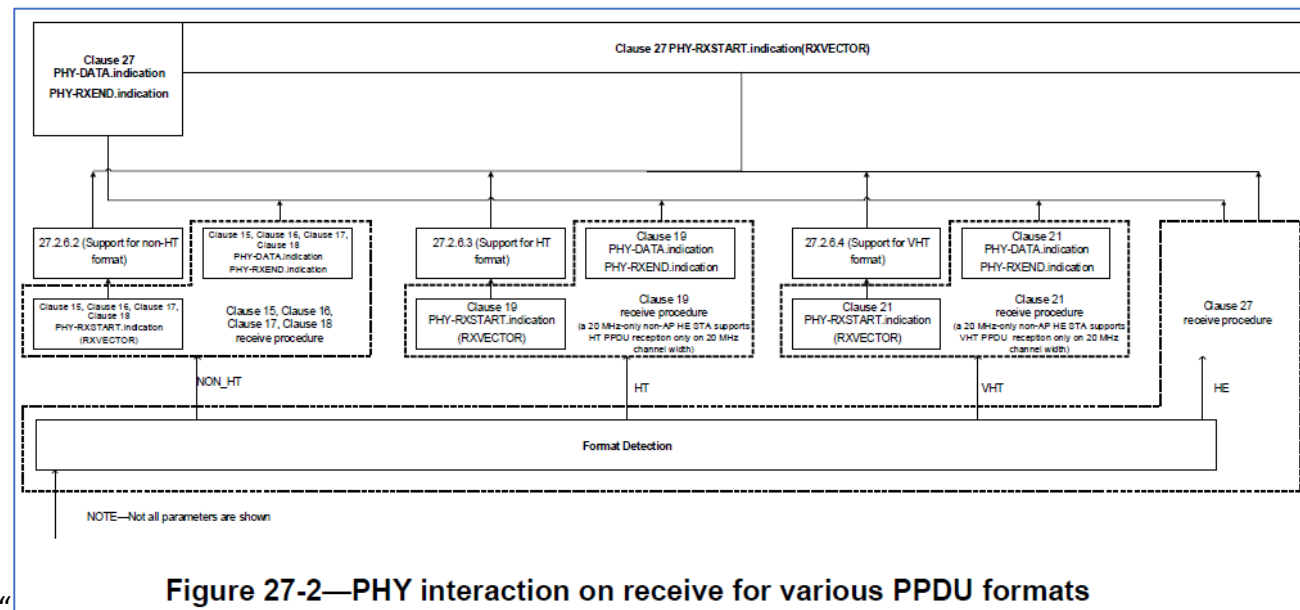
- “The format of the **HE TB PPDU** is defined as in Figure 27-11. **This format is used for a transmission that is a response to a triggering frame from an AP.** The format of the HE TB PPDU is the same as the HE SU

	PPDU, except that the duration of the HE-STF field in the HE TB PPDU is twice the duration of the HE-STF field in the HE SU PPDU. 802.11ax-2021 at §27.3.4 HE PPDU Formats “27.1.4 PPDU formats <u>The structure of the PPDU transmitted by an HE STA is determined by the TXVECTOR parameters as defined in Table 27-1.</u> <u>The FORMAT parameter determines the overall structure of the PPDU and can take on one of the following values:</u> * * * * * — <u>HE TB PPDU format (HE TB)</u> that carries a single PSDU and <u>is sent in response to a PPDU that carries a triggering frame.</u> The preamble format prior to the HE-STF field is identical to the HE SU PPDU.” 802.11ax-2021 at §27.1.4 PPDU Formats.
8[B] receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, and received from an access point in the wireless network;	A Wi-Fi 6 High Efficiency Station Device receives a downlink multi-user frame addressed to a plurality of stations, including the first station, and received from an access point in the wireless network, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A] and 1[B], above.</i> A Wi-Fi 6 downlink frame is processed according to the 802.11ax Standard. The PHY layer Scope describes the HE PHY services: “27.1.2 Scope <u>The services provided to the MAC by the HE PHY consist of the following protocol functions:</u>

	a) A function that maps the PSDU received from the MAC into a PPDU for transmission to one or more receiving STAs. b) A function that defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs. Depending on the PPDU format, these STAs support a mixture of HE: Clause 21, Clause 19, Clause 18, Clause 17, Clause 16, and Clause 15 PHYs. A 20 MHz-only non-AP HE STA supports a mixture of HE, Clause 19 and Clause 17 PHYs, and also supports transmission and reception of VHT PPDU of 20 MHz PDU bandwidth.” 802.11ax-2021 at §27.1.2 HE PHY Specification, Scope. • “27.1.3 HE PHY functions 27.1.3.1 General The HE PHY contains two functional entities: the PHY function and the physical layer management function (i.e., the PLME). These functions are described in detail in 27.3 and 27.4, respectively. <u>The HE PHY service is provided to the MAC through the PHY service primitives defined in Clause 8.</u> The HE PHY service interface is described in 27.2.” 802.11ax-2021 at §27.1.3 HE PHY Functions, General Upon reception of a PHY layer frame, the STA decodes the frame, extracting the MAC layer frame as well as parameters used to transmit the frame: • “27.2 HE PHY service interface 27.2.1 Introduction <u>The PHY provides an interface to the MAC</u> through an extension of the generic PHY service interface defined in 8.3.4. The interface includes TXVECTOR, RXVECTOR, PHYCONFIG_VECTOR, and TRIG_VECTOR. The MAC uses the TXVECTOR to supply the PHY with per-PPDU transmit parameters. The PHY uses the RXVECTOR to inform the MAC of the received PPDU parameters. The MAC uses the PHYCONFIG_VECTOR to configure the PHY for operation that is independent of frame transmission or reception. The MAC uses the TRIG_VECTOR to configure the PHY to receive HE TB PPDU over each assigned RU.” 802.11ax-2021 at §27.2.1 HE PHY Service Interface, Introduction. • “The HE PHY TXVECTOR and RXVECTOR contain additional parameters related to the HE PHY modes of operation as described in 27.2. In certain modes of operation, the DATARATE parameter is replaced by
--	--

MCS, CH_BANDWIDTH, RU_ALLOCATION, NUM_STS, STBC, GI_TYPE, and DCM values. The mapping from these values to data rate is defined in 27.5, where HE-MCS is MCS and NSS is NUM_STS / (STBC + 1). The HE PHY TRIGVECTOR contains parameters for UL MU operation (see Table 27-2).” 802.11ax-2021 at §8.3.4.4 Vector Descriptions.

The PHY layer receive process is as shown in the following figure:



802.11ax-2021 at §27.2.6.1 Support for non-HT, HT and VHT Formats, General.

Clause 27.3 describes the procedures for processing a received frame:

- “27.3 HE PHY

- 27.3.1 Introduction

Subclause 27.3 provides the procedure by which PSDUs are converted to and from transmissions on the wireless medium. During transmission, a PSDU (in the SU case) or one or more PSDUs (in the MU case) are processed (i.e., scrambled and coded) and appended to the PHY preamble to create the PPDU. At the

“27.3.22 HE receive procedure

The diagram illustrates the PHY receive procedure for an HE SU PPDU, showing the interaction between the MAC and PHY layers. The PHY layer (bottom) processes the received signal, which includes L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A1, HE-SIG-A2, HE training symbols, Data (variable number of OFDM symbols), Packet extension (if present), and Signal extension (if present). The MAC layer (top) manages the CS/CCA state and RX state. Key events include PHY-CCA indication (busy primary), PHY-RXSTART indication (RXVECTOR), PHY-DATA indication, PHY-DATA indication, PHY-DATA indication, PHY-RXEND indication (N-Error, RXVECTOR), and PHY-CCA indication (IDLE). The diagram also shows the decoding delay, the A-MPDU, and the Pre-FEC padding (if present), tail bits (if present), and post-FEC padding. The PHY layer measures RSSI and RCP1, and the MAC layer measures RSSI and RCP1. The diagram is divided into CS/CCA state and RX state sections.

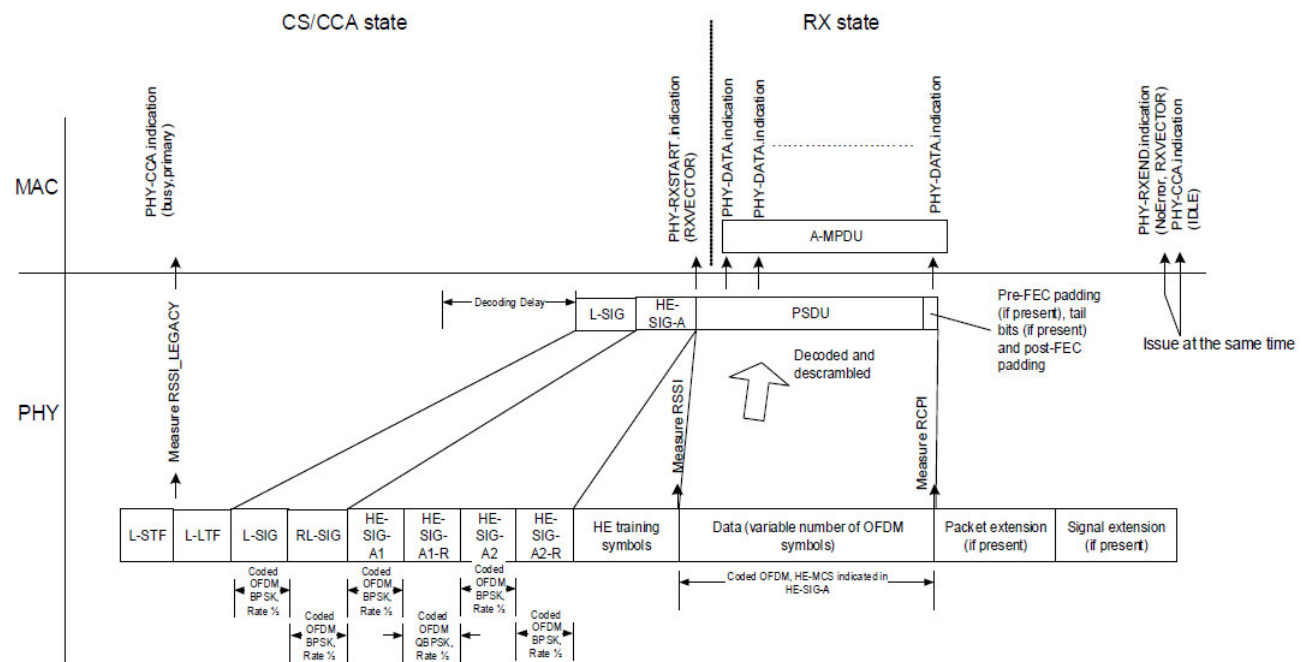


Figure 27-60—PHY receive procedure for an HE ER SU PPDU

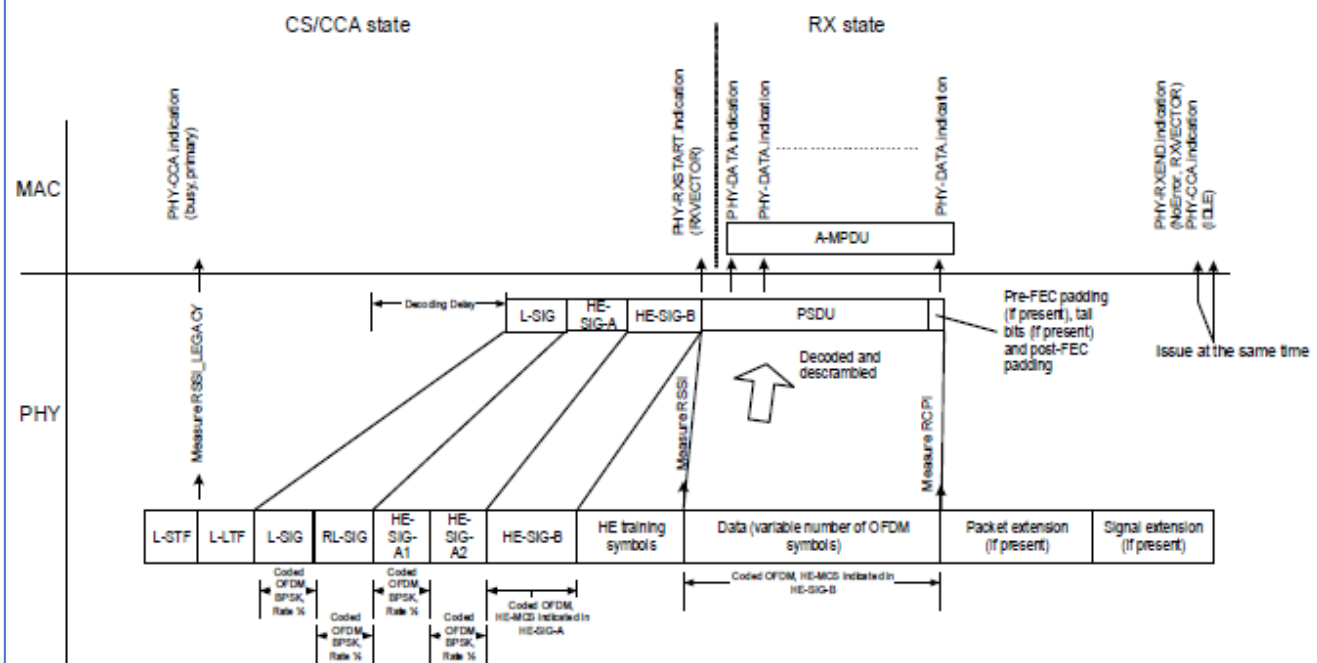


Figure 27-61—PHY receive procedure for an HE MU PPDU

	Otherwise, for detecting the HE preamble, the PHY entity shall search for L-SIG and RL-SIG fields in order to set the maximum duration of the data stream. If an RL-SIG field is detected, the PHY entity should check the parity bit and RATE fields in the L-SIG and RL-SIG fields.... If a valid parity bit and the RATE with 6 Mb/s in non-HT are indicated in L-SIG and RL-SIG and the LENGTH field value in L-SIG and RL-SIG meets the condition that the remainder is 1 after LENGTH divided by 3, the PHY entity should begin receiving the sequence of HE-SIG-A, HE-STF, and HE-LTF for HE SU PPDU and HE TB PPDU as shown in Figure 27-59 (PHY receive procedure for an HE SU PPDU) and Figure 27-62 (PHY receive procedure for an HE TB PPDU), respectively. After RL-SIG, the PHY entity shall receive two symbols of HE-SIG-A immediately followed by HE-STF. The PHY entity shall check CRC of the HE-SIG-A field. If the CRC check is valid, the PHY entity shall report TXOP, BSS color and check Format field, and continue to receive HE-STF. The PHY entity shall report to the MAC entity the predicted duration of the TXOP in the HE-SIG-A field. The PHY entity shall check the BSS color in the HE-SIG-A field. If the BSS color does not contain an intended value, the PHY entity shall issue a PHY-RXSTART.indication(RXVECTOR) and then issue a PHY-RXEND.indication(Filtered).... The PHY entity shall receive the HE-STF for 4 μs after HE-SIG-A.... If a valid parity bit of L-SIG and RL-SIG is indicated and the LENGTH field value in L-SIG and RL-SIG meet the condition that the remainder is 2 after LENGTH divided by 3, the PHY entity should detect the signal constellations in the second symbol after RL-SIG. If the constellation is BPSK, the PHY entity shall continue receiving the sequence of HE-SIG-A, HE-SIG-B, HE-STF, and HE-LTF for an HE MU PPDU shown in Figure 27-61 (PHY receive procedure for an HE MU PPDU). After the RL-SIG field, the PHY entity shall receive two symbols of the HE-SIG-A field immediately followed by the HE-SIG-B field.... Except in an HE sounding NDP and HE TB feedback NDP, a Data field follows the HE-STF and HE-LTF fields. The number of symbols in the Data field and the packet extension duration are computed from Equation (27-119) and Equation (27-120), respectively. The received PSDU bits are assembled into octets, decoded, and present to the MAC using a series of PHY-DATA.indication(DATA) primitive exchanges. Any final bits that cannot be assembled into a complete octet are considered pad bits and discarded. After the reception of the final bit of the last PSDU octet, and possible padding and tail bits, the PHY entity shall check whether packet extension and/or signal extension is applied. If packet extension and/or signal extension is applied, the PHY entity shall wait until the packet extension and/or signal extension expires before returning to the RX IDLE
--	--

	state, as shown in Figure 27-63 (PHY receive state machine if midambles are not present).” 802.11ax-2021 at §27.3.22 HE Receive Procedure. • “All of the MPDUs within an A-MPDU are addressed to the same RA. All of the MPDUs within an A-MPDU have the same TA. All QoS Data frames within an A-MPDU that have a TID for which an HT-immediate block ack agreement exists have the same value for the Ack Policy Indicator subfield of the QoS Control field.” 802.11ax-2021 at §9.7.3 A-MPDU contents • <i>See also</i> Table 27-1—TXVECTOR and RXVECTOR parameters “STA_ID ... Indicates the list of STA-IDs for an HE MU PPDU”). 802.11ax-2021 at §27.2.2 TXVECTOR and RXVECTOR parameters
8[C] processing a first MAC Protocol Data Units (MPDU) in the downlink multi-user frame to determine acknowledgement information indicating properties of a first multi-user acknowledgement frame;	A Wi-Fi 6 High Efficiency Station Device processes a first MAC Protocol Data Units (MPDU) in the downlink multi-user frame to determine acknowledgement information indicating properties of a first multi-user acknowledgement frame, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A], 1[E], 8[B], above.</i> In 802.11ax, triggering frames are used to solicit an uplink response frame from wireless Stations. Triggering frames are defined as either a Trigger frame or a frame containing a TRS Control subfield: • <u>“triggering frame: A trigger frame or a frame carrying a TRS Control subfield.”</u> 802.11ax-2021 at §3.2 Definitions Specific to IEEE 802.11. An AP STA transmits MAC frames as part of a downlink transmission using frame formats described in 802.11ax-2021. Each MAC frame contains a header, a body, and a frame check sequence. MAC frame formats are described in §9 of the Wi-Fi 6 Standard, as follows: • “9. Frame formats 9.1 General requirements <u>The format of the MAC frames is specified in this clause.</u> A STA shall be able to properly construct a subset of the frames specified in this clause for transmission and to decode a (potentially different) subset of the frames specified in this clause upon validation following reception. The particular subset

of these frames that a STA constructs and decodes is determined by the functions supported by that particular STA. A STA shall be able to validate every received frame using the frame check sequence (FCS) and to interpret certain fields from the MAC headers of all frames. A STA shall transmit frames using only the frame formats described in Clause 9.

9.2 MAC frame formats

9.2.1 Basic components

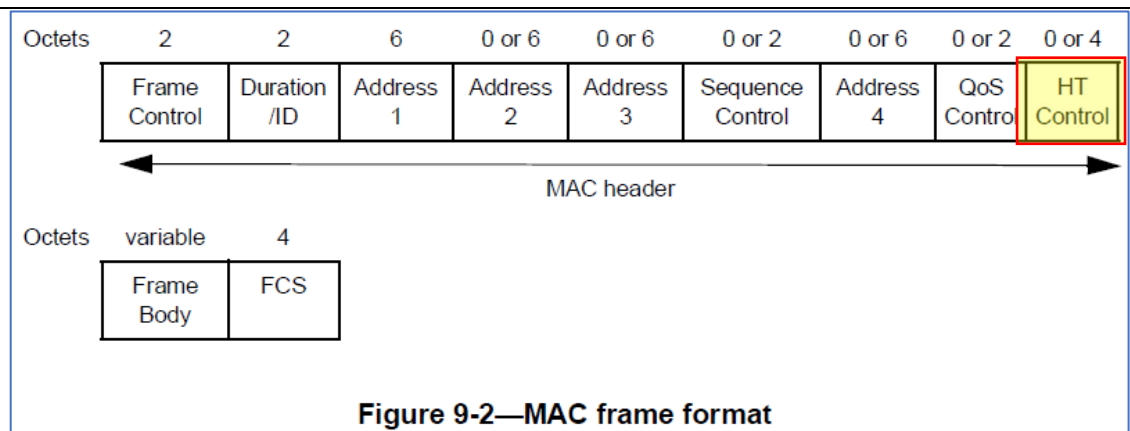
Each frame consists of the following basic components:

- a) **A MAC header, which comprises** frame control, duration, address, optional sequence control information, optional QoS Control information (QoS Data frames only), and **optional HT Control fields** (+HTC frames only);
 - b) A variable length *frame body*, which contains information specific to the frame *type* and *subtype*;
 - c) An *FCS*, which contains a 32-bit CRC based on ITU-T Recommendation V.42 [B55] (see 9.2.4.8).”
- 802.11ax-2021 at §9 Frame Formats

The contents of the MAC header are shown in Figure 9-2 of the Wi-Fi 6 Standard. Note that the header may include an “HT Control” field:

- “9.2.3 General frame format

The MAC frame format comprises a set of fields that occur in a fixed order in all frames. Figure 9-2 depicts the general MAC frame format for protocol version 0 (PV0) MPDUs, and Figure 9-978 (in 9.8.2) depicts the general MAC frame format for protocol version 1 (PV1) frames. The first 2 bits of the first subfield (Protocol Version) of the Frame Control field and the last field (FCS) in Figure 9-2 are present in all PV0 MPDUs and PV1 MPDUs, including reserved types and subtypes.



802.11ax-2021 at §9.2.3 General Frame Format

The HT Control field of the MAC header is described in §9.2.4.6 of the Wi-Fi 6 Standard:

- “The HT Control field is always present in a Control Wrapper frame and is present in QoS Data, QoS Null, and Management frames as determined by the +HTC subfield of the Frame Control field as defined in 9.2.4.1.10.

NOTE 1—The only control frame subtype for which HT Control field is present is the Control Wrapper frame. A Control frame that is described as +HTC (e.g., an RTS+HTC, CTS+HTC, BlockAck+HTC or BlockAckReq+HTC frame) implies the use of the Control Wrapper frame to carry that Control frame.”

802.11ax-2021 at §9.2.4.6.1 HT Control Field, General.

The HT Control field (originally introduced for HT frames) has been extended to accommodate VHT and HE frames. The variant in use is indicated by bits B0 and B1, the Variant field bits, as shown in Table 9-13b of IEEE 802.11ax-2021. For an HE frame, bits B0-B1 are set to 11 to indicate the HE Variant of the field:

Table 9-13b—HT Control field format

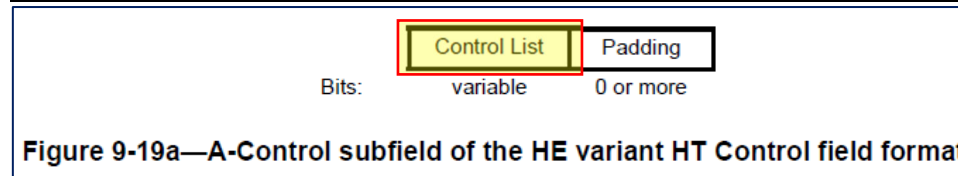
<u>Variant</u>	<u>B0</u>	<u>B1</u>	<u>B2–B29</u>	<u>B30</u>	<u>B31</u>
<u>HT</u>	<u>0</u>	<u>HT Control Middle</u>		<u>AC Constraint</u>	<u>RDG/More PPDU</u>
<u>VHT</u>	<u>1</u>	<u>0</u>	<u>VHT Control Middle</u>	<u>AC Constraint</u>	<u>RDG/More PPDU</u>
<u>HE</u>	<u>1</u>	<u>1</u>	<u>A-Control</u>		

- “802.11ax-2021 at §9.2.4.6.1 HT Control Field, General.

For 802.11ax HE frames, the HE Variant of the HT Control field contains an A-Control subfield in bits B2-B31, as described in §9.2.4.6.3a:

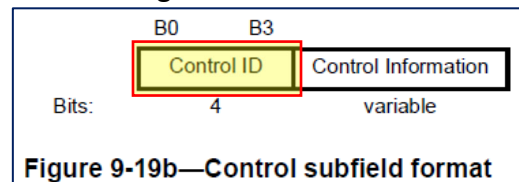
- “9.2.4.6.3a HE variant

The format of the A-Control subfield of the HE variant HT Control field is shown in Figure 9-19a.



The A-Control subfield is 30 bits in length.

The Control List subfield contains one or more Control subfields. The format of each Control subfield is shown in Figure 9-19b.



802.11ax-2021 at §9.2.4.6.3a HE Variant

The Control ID subfield indicates the type of information carried in the Control Information subfield. The length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-22a (Control ID subfield values). See 802.11ax-2021 at § 9.2.4.6.3a HE variant.

As shown in Table 9-22a, the Control ID value 0 indicates the content of the Control Information subfield is Triggered response scheduling (TRS):

Table 9-22a—Control ID subfield values

Control ID value	Meaning	Length of the Control Information subfield (bits)	Content of the Control Information subfield
0	Triggered response scheduling (TRS)	26	See 9.2.4.6a.1.
1	Operating mode (OM)	12	See 9.2.4.6a.2.
2	HE link adaptation (HLA)	26	See 9.2.4.6a.3.
3	Buffer status report (BSR)	26	See 9.2.4.6a.4.
4	UL power headroom (UPH)	8	See 9.2.4.6a.5.
5	Bandwidth query report (BQR)	10	See 9.2.4.6a.6.
6	Command and status (CAS)	8	See 9.2.4.6a.7.
7–14	Reserved		
15	Ones need expansion surely (ONES)	26	Set to all 1s.

• “ ”

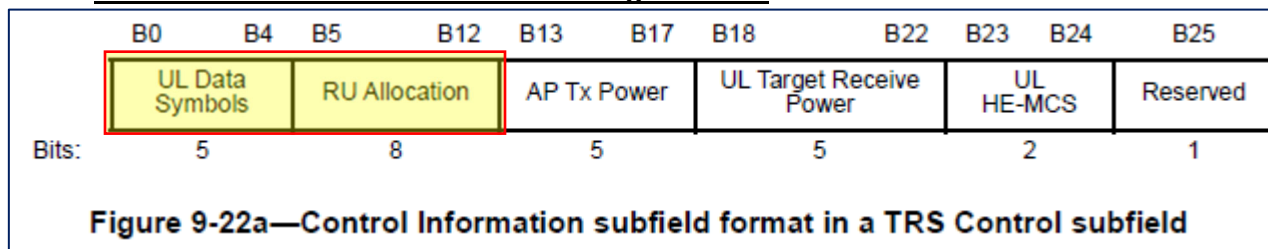
802.11ax-2021 at §9.2.4.6.3a HE Variant

Triggering frames with a TRS control subfield carry acknowledgement information for a Station to use for generating a response, as shown in § 9.2.4.6a.1 of the Wi-Fi 6 Standard:

- “9.2.4.6a.1 TRS Control

The Control Information subfield in a TRS Control subfield contains triggered response scheduling (TRS) information for soliciting an HE TB PPDU that follows an HE MU PPDU, HE SU PPDU or HE ER SU

PPDU carrying the Control subfield (see 26.5.2.2 [Rules for soliciting UL MU frames]). See 26.5.2.4 [A-MPDU contents in an HE TB PPDU] for details on allowed content in an A-MPDU carried in an HE TB PPDU. **The format of the subfield is shown in Figure 9-22a:**



802.11ax-2021 at § 9.2.4.6a.1 TRS Control

- **“The UL Data Symbols subfield indicates the number of OFDM symbols in the Data field of the HE TB PPDU response and is set to the number of OFDM symbols minus 1.**

The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE TB PPDU response and the encoding is defined in 9.3.1.22.1 (General).

The AP Tx Power subfield indicates the AP’s combined transmit power at the transmit antenna connector of all the antennas used to transmit the triggering PPDU in units of dBm / 20 MHz. The transmit power in dBm/20 MHz, P_{TX} , is calculated as $P_{TX} = -20 + 2 \times F_{val}$, where F_{val} is the value of the AP Tx Power subfield, except for the value 31, which is reserved.

The UL Target Receive Power subfield indicates the expected receive signal power, measured at the AP’s antenna connector and averaged over the antennas, for the HE portion of the HE TB PPDU transmitted on the assigned RU as defined in Table 9-24a (UL Target Receive Power subfield in TRS Control field).

The UL HE-MCS subfield indicates the HE-MCS, in the range HE-MCS 0 to 3, to be used by the receiving STA for the HE TB PPDU is set to the HE-MCS index (see 27.5 (Parameters for HE-MCSs)).” 802.11ax-2021 at § 9.2.4.6a.1 TRS Control

See also evidence and analysis at Claim 1[A] (a Trigger Frame carries acknowledgement information).

8[D] generating the first multi-user acknowledgment

A Wi-Fi 6 High Efficiency Station Device generates the first multi-user acknowledgment frame based on the acknowledgement information, as shown by the following excerpts from the 802.11ax-2021 Standard:

frame based on the acknowledgement information; and	See evidence and analysis at Claim 1[G] above. The TRS Control subfield is used to solicit an HE TB PPDU, which follows the PPDU containing the TRS Control field: • “9.2.4.6a.1 TRS Control <u>The Control Information subfield in a TRS Control subfield contains triggered response scheduling (TRS) information for soliciting an HE TB PPDU</u> that follows an HE MU PPDU, HE SU PPDU or HE ER SU PPDU carrying the Control subfield (see 26.5.2.2 [Rules for soliciting UL MU frames]). See 26.5.2.4 [A-MPDU contents in an HE TB PPDU] for details on allowed content in an A-MPDU carried in an HE TB PPDU. The format of the subfield is shown in Figure 9-22a. 802.11ax-2021 at §9.2.4.6a.1 TRS Control Acknowledgement information for the TRS field is described above in the preceding limitation. As explained in §26.5.2.3.4 (TXVECTOR parameters for HE TB PPDU response to TRS Control subfield) of the Wi-Fi 6 Standard, the STA transmitting an HE TB PPDU in response to a frame containing a TRS Control subfield uses the following TXVECTOR parameters: • “6.5.2.3.4 TXVECTOR parameters for HE TB PPDU response to TRS Control subfield <u>A non-AP STA transmitting an HE TB PPDU in response to a frame containing a TRS Control subfield shall set the TXVECTOR parameters as follows:</u> — The FORMAT parameter is set to HE_TB. — The TRIGGER_METHOD parameter is set to TRS. — <u>The L_LENGTH parameter is computed as described in Equation (27-11) using the TXTIME value. The TXTIME is defined by Equation (27-136) where NSYM is set to FVAL + 1, where FVAL is the value of the UL Data Symbols subfield of the TRS Control subfield.</u> — <u>The RU_ALLOCATION and MCS parameters are set to the values of the RU Allocation and UL HE-MCS subfields of the TRS Control subfield, respectively.</u> — The CH_BANDWIDTH parameter is set to the value of the RXVECTOR parameter CH_BANDWIDTH of the soliciting DL HE PPDU (see Table 27-1). — The BSS_COLOR and DCM parameters are set to the values of the RXVECTOR parameters BSS_COLOR and DCM of the soliciting DL HE PPDU, respectively.
--	---

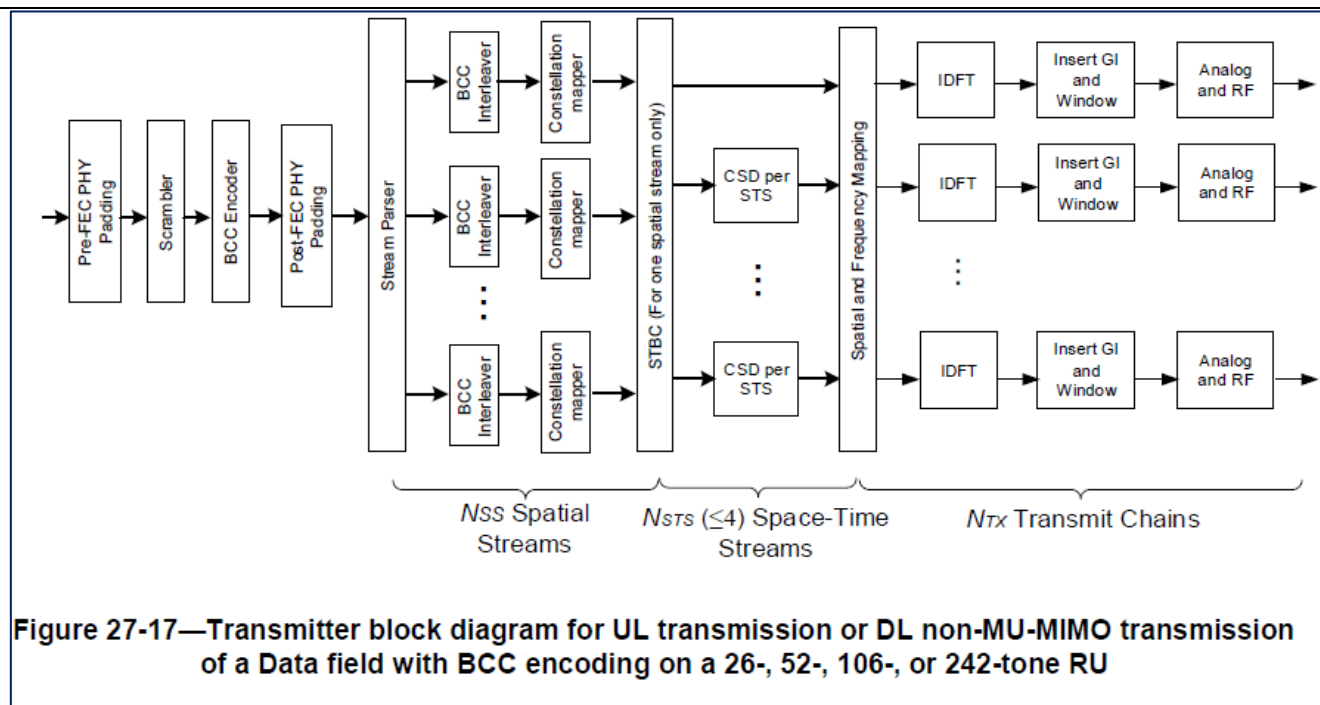
- The DOPPLER parameter is set to 0, and the MIDAMBLE_PERIODICITY parameter is absent.
- The NUM_HE_LTF parameter is set to 1.
- The STARTING_STS_NUM parameter is set to 0.
- The STBC parameter is set to 0, and the NUM_STS parameter is set to 1 (the HE_LTF_MODE parameter is not present).
- The FEC_CODING parameter is set to BCC_CODING if the RU Allocation subfield indicates an RU that is smaller than a 484-tone RU; otherwise, it is set to LDPC_CODING.
- The LDPC_EXTRA_SYMBOL parameter is set to 0 if the RU Allocation subfield indicates less than a 484-tone RU; otherwise, it is set to 1.
- The SPATIAL_REUSE parameter is set to PSR_AND_NON_SRG_OBSS_PD_PROHIBITED.
- The DEFAULT_PE_DURATION parameter is set to the default PE duration value for UL MU response scheduling, which is indicated by the AP in the Default PE Duration subfield of the HE Operation element it transmits.
- The TXOP_DURATION parameter is set as defined in 26.11.5.
- The HE_SIG_A2_RESERVED parameter is set to 511 (all 1s).
- If the RXVECTOR parameters HE_LTF_TYPE and GI_TYPE of HE MU PPDU carrying the frame with the TRS Control subfield are either 4xHE-LTF and 3u2s_GI, respectively, or 2xHE-LTF and 1u6s_GI, respectively, then the HE_LTF_TYPE and GI_TYPE parameters are set to 4xHE-LTF and 3u2s_GI, respectively. Otherwise, the HE_LTF_TYPE and GI_TYPE parameters are set to 2xHE-LTF and 1u6s_GI, respectively.
- The TXPWR_LEVEL_INDEX parameter is set to a value based on the computed transmission power (see 27.3.15.2) for an HE TB PPDU and the value of the AP Tx Power subfield of the TRS Control subfield and the UL Target Receive Power subfield of the TRS Control subfield.” 802.11ax-2021 at §26.5.2.3.4 TXVECTOR Parameters for HE TB PPDU Response to TRS Control Subfield

HE TB PPDUs are transmitted on the uplink in response to triggering frames:

- “27.3.2.6 Resource allocation for an HE TB PPDU
UL MU transmissions are preceded by a triggering frame from the AP. The triggering frame indicates the parameters, such as the duration of the HE TB PPDU, RU allocation, target RSSI, and HE-MCS (see 9.3.1.22, 9.2.4.6a.1, and 26.5.2.3), **required to transmit an HE TB PPDU.**” 802.11ax-2021 at §27.3.2.6 Resource Allocation for an HE TB PPDU

HE TB PPDU are used in UL transmission in response to triggering frames. By way of example, the text below shows an encoding for UL transmission of an HE TB PPDU:

- **“Figure 27-17 shows the transmitter blocks for the UL transmission** or DL non-MU-MIMO transmission of a Data field with BCC encoding **on a 26-, 52-, 106-, or 242-tone RU** for a single frequency segment if the number of spatial streams is less than or equal to 4. **Figure 27-17 applies to the Data field of an HE MU PPDU that is transmitted on an RU allocated to a single user, the Data field of an HE SU PPDU, and the Data field of an HE TB PPDU** (regardless of whether it is spatially multiplexed with other users). The DCM tone mapper, which is part of the constellation mapper, is applied only if DCM is indicated for the RU. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks and the blocks to the right of, and including, the spatial mapping block is also used to generate the HE-LTF fields. This is illustrated in Figure 27-32 (in 27.3.11.10). A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks and the blocks to the right of, and including, the spatial and frequency mapping block of Figure 27-17 is also used to generate the HE-STF field. **This figure also applies to the Data field with BCC encoding in an HE TB PPDU.**



802.11ax-2021 at §27.3.5 Transmitter Block Diagram

- See also 802.11ax-2021 at § 10.3.2.13.2 showing acknowledgements generated by trigger frames at Figure 10-41a and HE TB PPDUs generated in response to a trigger frame at Figure 10-14b.

8[E] transmitting the first multi-user acknowledgement frame to the access point to acknowledge the downlink multi-user frame,

A Wi-Fi 6 High Efficiency Station Device transmits the first multi-user acknowledgement frame to the access point to acknowledge the downlink multi-user frame, as shown by the following excerpts from the 802.11ax-2021 Standard:

See evidence and analysis at Claim 8[D], above.

8[F] wherein the first multi-user

A Wi-Fi 6 High Efficiency Station Device transmits the first multi-user acknowledgement frame wherein the first multi-user acknowledgement frame is transmitted simultaneously to a second multi-user

acknowledgement frame is transmitted simultaneously to a second multi-user acknowledgement frame transmitted by a second station.	acknowledgement frame transmitted by a second station, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[H], above.</i> The uplink HE TB PPDU follows the rules set forth in Wi-Fi 6 for Non-AP station behavior for UL MU operation. <i>See</i> 802.11ax-2021 at §26.7.3 Rules for HE Sounding Protocol Sequences. The station, operating in UL MU (uplink multi-user) mode, simultaneously transmits the HE TB PPDU response frame, such as a BlockAck: • <u>“UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP HE STAs. A non-AP HE STA shall follow the rules in this subclause for the <u>transmission of response frames in an HE TB PPDU</u>, unless the Trigger frame is an MU-RTS Trigger frame, in which case the response is a CTS frame sent in a non-HT PPDU (see 26.2.6).”</u> 802.11ax-2021 at §26.5.2.1 UL MU Operation, General. • <i>See also</i> §10.3.2.13.2 and Figure 10-14a (shown above).
CLAIM 9	ELEMENTS IN ACCUSED INSTRUMENTALITY
9[A]. The method of claim 8, wherein the first MPDU is located in a first resource unit of the downlink multi-user frame allocated to the first station, wherein the downlink multi-user frame includes a second resource unit that contains a second MPDU that	A Wi-Fi 6 High Efficiency Station Device performs the method of claim 8, wherein the first MPDU is located in a first resource unit of the downlink multi-user frame allocated to the first station, wherein the downlink multi-user frame includes a second resource unit that contains a second MPDU that includes acknowledgement information for the second multi-user acknowledgement frame, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A], 1[B] and 8, above.</i> As shown above, each A-MPDU is associated with a resource unit and each A-MPDU contains acknowledgement information for the acknowledgement frame associated with the user to whom the RU is addressed.

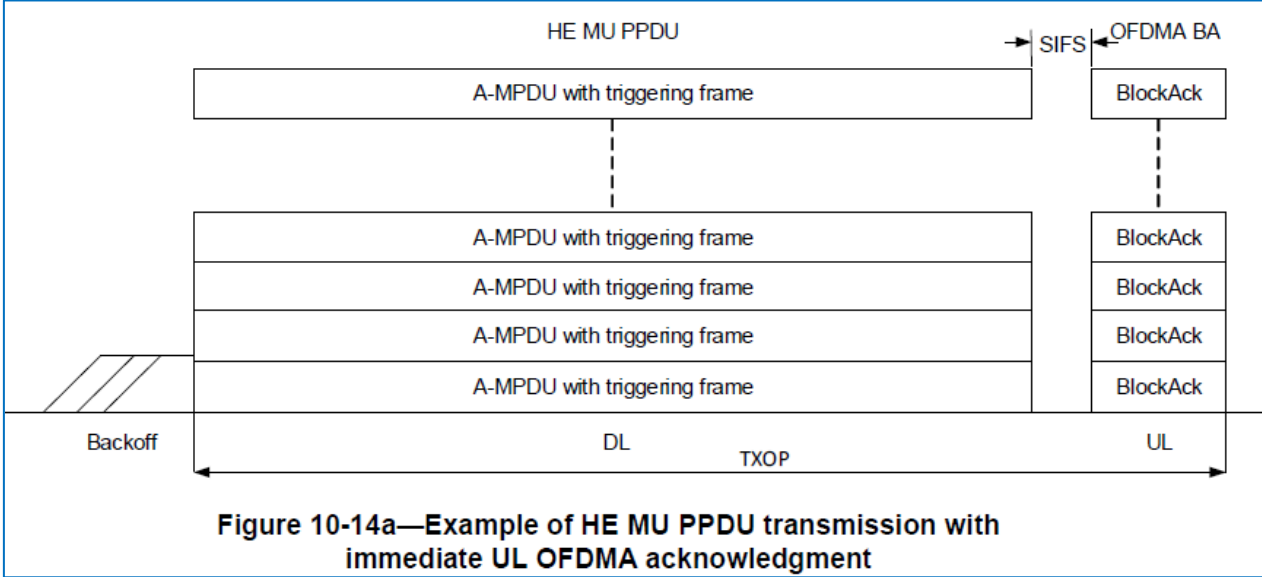
includes acknowledgement information for the second multi-user acknowledgement frame.	
CLAIM 10	ELEMENTS IN ACCUSED INSTRUMENTALITY
10[A]. The method of claim 9, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement frame together form a multi-user acknowledgement frame for acknowledging the downlink multi-user frame.	A Wi-Fi 6 High Efficiency Station Device performs the method of claim 9, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement frame together form a multi-user acknowledgement frame for acknowledging the downlink multi-user frame, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8[F], above.</i> The first and second multi-user acknowledgement frame are sent simultaneously on different RUs such that the first and second frame collectively form a multi-user acknowledgement frame for acknowledging the downlink multi-user frame. Figure 10-14a—Example of HE MU PPDU transmission with immediate UL OFDMA acknowledgment • “ 802.11ax-2021 at § 10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU Format. ”

CLAIM 11		ELEMENTS IN ACCUSED INSTRUMENTALITY	
11[A]. The method of claim 8, wherein processing the first MPDU comprises:		A Wi-Fi 6 High Efficiency Station Device performs the method of claim 8, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8, above.</i>	
11[B] extracting the acknowledgement information indicating the properties of the first multi-user acknowledgement frame from a header of the first MPDU.		A Wi-Fi 6 High Efficiency Station Device extracts the acknowledgement information indicating the properties of the first multi-user acknowledgement frame from a header of the first MPDU, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A], 3[A] and 8[C], above.</i>	
CLAIM 12		ELEMENTS IN ACCUSED INSTRUMENTALITY	
12[A]. The method of claim 11, wherein the header is a MAC header of the first MPDU.		A Wi-Fi 6 High Efficiency Station Device performs the method of claim 11, wherein the header is a MAC header of the first MPDU, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A], 3[A] and 8[C], above.</i>	
CLAIM 13		ELEMENTS IN ACCUSED INSTRUMENTALITY	
13[A]. The method of claim 8, wherein processing the MPDU comprises:		A Wi-Fi 6 High Efficiency Station Device performs the method of claim 8, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8, above.</i>	
13[B] extracting the acknowledgement information indicating the properties of the first multi-user		A Wi-Fi 6 High Efficiency Station Device extracts the acknowledgement information indicating the properties of the first multi-user acknowledgement frame transmission from a payload of the first MPDU, wherein the first MPDU is a unicast trigger frame, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8[C], above.</i>	

acknowledgement frame transmission from a payload of the first MPDU, wherein the first MPDU is a unicast trigger frame.	The MPDU is unicast because it is not broadcast (<i>i.e.</i> the MPDU is addressed to a particular receiver address). “All of the MPDUs within an A-MPDU are addressed to the same RA.” 802.11ax-2021 at §9.7.3 A-MPDU contents The MPDU is a trigger frame. <i>See</i> evidence and analysis at Claim 1[A], 8[C], and 8[D], above.
CLAIM 14 ELEMENTS IN ACCUSED INSTRUMENTALITY	
14[A]. The method of claim 13, further comprising:	A Wi-Fi 6 High Efficiency Station Device performs the method of claim 13, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See</i> evidence and analysis at Claim 13, above.
14[B] processing a second MPDU in a same resource unit as the first MPDU, wherein the second MPDU includes data intended for the first station.	A Wi-Fi 6 High Efficiency Station Device processes a second MPDU in a same resource unit as the first MPDU, wherein the second MPDU includes data intended for the first station, as shown by the following excerpts from the 802.11ax-2021 Standard: An A-MPDU can contain multiple MPDUs within its RU, each MPDU addressed to the same first station: “All of the MPDUs within an A-MPDU are addressed to the same RA. All of the MPDUs within an A-MPDU have the same TA.” 802.11ax-2021 at §9.7.3 A-MPDU contents <i>See</i> evidence and analysis at Claim 1[D], above.
CLAIM 15 ELEMENTS IN ACCUSED INSTRUMENTALITY	
15[A]. The method of claim 13, wherein the trigger frame instigates the first station to transmit the	A Wi-Fi 6 High Efficiency Station Device performs the method of claim 13, wherein the trigger frame instigates the first station to transmit the first multi-user acknowledgement after an interframe spacing period following receipt of the downlink multi-user frame, as shown by the following excerpts from the 802.11ax-2021 Standard:

first multi-user acknowledgement after an interframe spacing period following receipt of the downlink multi-user frame.	See evidence and analysis at Claim 5[A] and 13, above.
CLAIM 16 ELEMENTS IN ACCUSED INSTRUMENTALITY	
16[A]. The method of claim 8, further comprising:	A Wi-Fi 6 High Efficiency Station Device performs the method of claim 8, as shown by the following excerpts from the 802.11ax-2021 Standard: See evidence and analysis at Claim 8, above.
16[B] receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first and second station, wherein the first multi-user acknowledgement frame is transmitted after receipt of and in response to the multi-user block acknowledgement request frame.	A Wi-Fi 6 High Efficiency Station Device receives a multi-user block acknowledgement request frame that solicits acknowledgements from the first and second station, wherein the first multi-user acknowledgement frame is transmitted after receipt of and in response to the multi-user block acknowledgement request frame, as shown by the following excerpts from the 802.11ax-2021 Standard: • “10.3.2.11 Acknowledgment procedure The following frames require immediate acknowledgment: — Individually addressed Management frames other than Action No Ack frames — Individually addressed non-QoS Data frames — Individually addressed QoS Data frames with Normal Ack or Implicit BAR ack policy — BlockAck frames not sent in immediate response to A-MPDU — BlockAckReq frames — PS-Poll frames, which can be acknowledged by generating a Data frame” 802.11ax-2021 at §10.3.2.11 Acknowledgment Procedure • “10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU format A non-AP STA shall not set the ack policy to HETP Ack. A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame with HETP Ack ack policy, of an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame, or of a Management frame that solicits acknowledgment, <u>shall send</u>

	<u>the immediate response according to the scheduling information that is carried either in the Trigger frame(s) or TRS Control subfield.</u> If a Basic Trigger frame (see 9.3.1.22) or frame carrying a TRS Control subfield (see 9.2.4.6a.1) is <u>not received, then the STA shall not respond.</u> An example of UL OFDMA acknowledgment to an HE MU PPDU is shown in Figure 10-14a. • “An <u>AP that transmits a PPDU may solicit an HE TB PPDU from one or more non-AP STAs</u> through one of the following mechanisms: ... — Including in the PPDU one or more individually addressed frames that include a TRS Control subfield and that are carried in one of the following: — An S-MPDU that solicits an immediate Ack frame (see 10.12.8). — An A-MPDU that solicits an immediate BlockAck frame (see 10.25.6.7). — A multi-TID A-MPDU that solicits an immediate Multi-STA BlockAck frame (see 26.6.3).” 802.11ax-2021 at §26.5.2.2.1 Rules for Soliciting UL MU Frames The acknowledgement procedure for a DL MU PPDU is described in 10.3.2.13.2: • “10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU format A non-AP STA shall not set the ack policy to HETP Ack. A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame with HETP Ack ack policy, of an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame, or of a Management frame that solicits acknowledgment, shall send the immediate response according to the scheduling information that is carried either in the Trigger frame(s) or TRS Control subfield. If a Basic Trigger frame (see 9.3.1.22) or frame carrying a TRS Control subfield (see 9.2.4.6a.1) is not received, then the STA shall not respond. An example of UL OFDMA acknowledgment to an HE MU PPDU is shown in Figure 10-14a.
--	--

	 Figure 10-14a—Example of HE MU PPDU transmission with immediate UL OFDMA acknowledgment 802.11ax-2021 at § 10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU Format. As shown in Figure 10-14a, the OFDMA acknowledgement is transmitted in response to the HE MU PPDU.
CLAIM 18	ELEMENTS IN ACCUSED INSTRUMENTALITY
18[A]. A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:	A Wi-Fi 6 High Efficiency Station Device transmits an uplink acknowledgment, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8[A], above.</i>
18[B] receiving a downlink multi-user frame addressed to a plurality of stations,	A Wi-Fi 6 High Efficiency Station Device receives a downlink multi-user frame addressed to a plurality of stations, including the first station, wherein the downlink multi-user frame is received from an access point in the wireless network, as shown by the following excerpts from the 802.11ax-2021 Standard:

including the first station, wherein the downlink multi-user frame is received from an access point in the wireless network;	<i>See evidence and analysis at Claim 8[B], above.</i>
18[C] receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information indicating properties of a first multi-user acknowledgement frame;	A Wi-Fi 6 High Efficiency Station Device receives a multi-user block acknowledgement request frame that solicits acknowledgements from the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information indicating properties of a first multi-user acknowledgement frame, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at 8[B] and 8[C], above.</i>
18[D] generating the first multi-user acknowledgment frame based on the acknowledgement information; and	A Wi-Fi 6 High Efficiency Station Device generates the first multi-user acknowledgment frame based on the acknowledgement information, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8[D], above.</i>

18[E] acknowledging the receipt of the downlink multi-user frame by transmitting the first multi-user acknowledgement frame to the access point,	A Wi-Fi 6 High Efficiency Station Device acknowledges the receipt of the downlink multi-user frame by transmitting the first multi-user acknowledgement frame to the access point, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8[E], above.</i>
18[F] wherein the first multi-user acknowledgement frame is transmitted simultaneously with a second multi-user acknowledgement frame generated and transmitted by the second station.	A Wi-Fi 6 High Efficiency Station Device performs a method wherein the first multi-user acknowledgement frame is transmitted simultaneously with a second multi-user acknowledgement frame generated and transmitted by the second station, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 8[F], above.</i>
CLAIM 19 ELEMENTS IN ACCUSED INSTRUMENTALITY	
19[A]. The method of claim 18, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or single user transmission and (2) resource scheduling	A Wi-Fi 6 High Efficiency Station Device performs the method of claim 18, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or single user transmission and (2) resource scheduling information for the first multi-user acknowledgement transmission, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 1[A] and 18, above.</i>

information for the first multi-user acknowledgement transmission.	
CLAIM 20 ELEMENTS IN ACCUSED INSTRUMENTALITY	
20[A]. The method of claim 18, wherein the acknowledgment scheduling information includes properties of the second multi-user acknowledgement frame generated and transmitted by the second station, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement together form a multi-user transmission.	A Wi-Fi 6 High Efficiency Station Device performs the method of claim 18, wherein the acknowledgment scheduling information includes properties of the second multi-user acknowledgement frame generated and transmitted by the second station, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement together form a multi-user transmission, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis at Claim 9[A], 10[A], and 18, above.</i>