

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”).

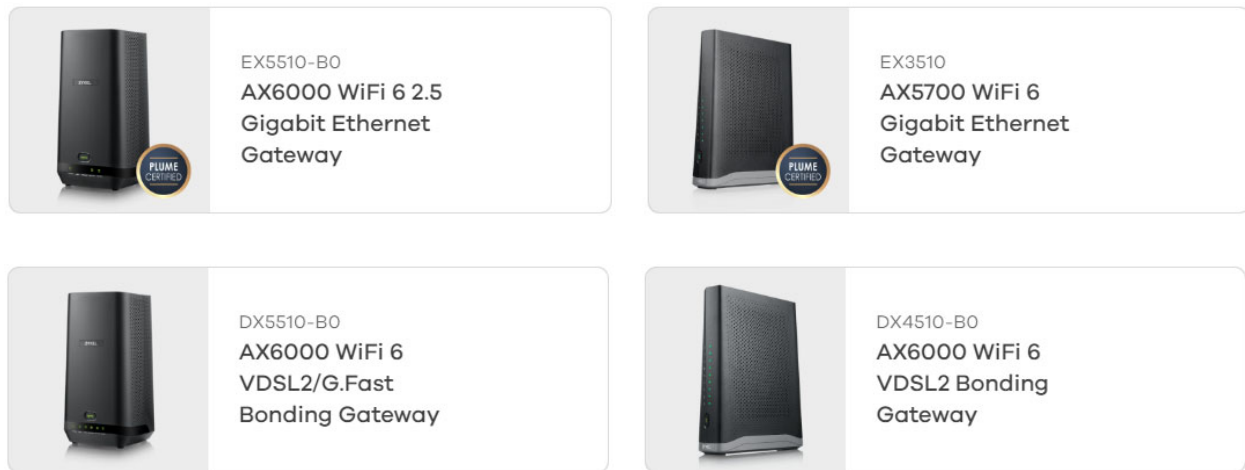
The Accused Instrumentalities are Zyxel’s Wi-Fi 6 devices that comply with the 802.11ax-2021 Wi-Fi 6 Standard, including its Wi-Fi 6 access points and Wi-Fi 6 stations. The following is a non-exhaustive listing of Zyxel’s Accused Instrumentalities based on publicly-available information, but this listing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

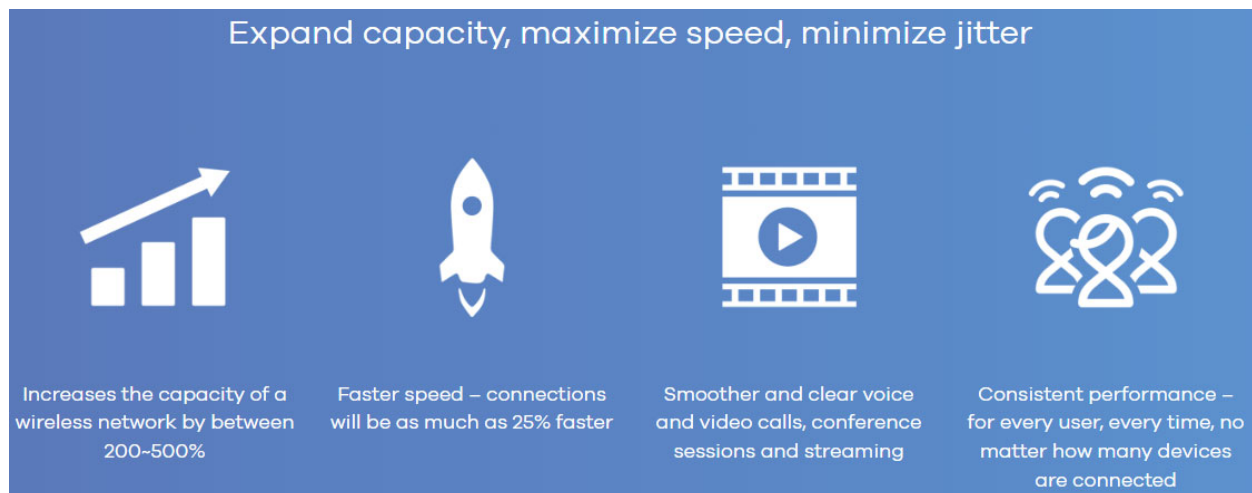


<https://service-provider.zyxel.com/na/en/wifi-6-solutions#featured-products>.

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,

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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

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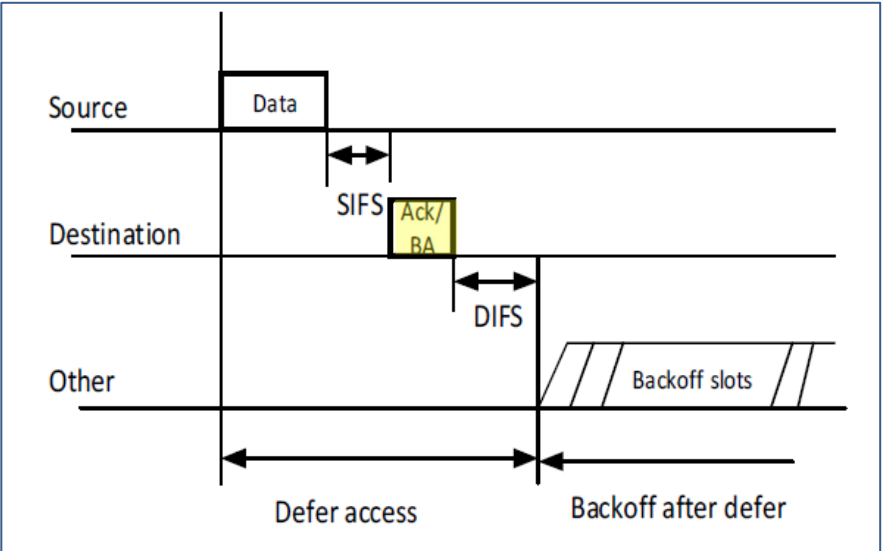
EXHIBIT F – Infringement Chart for U.S. Patent No. 9,917,679

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 Wi-Fi 6 High Efficiency Access Point 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 1-10 of United States Patent No. 9,917,679 (“the ’679 Patent”). Claims 1-5 primarily relate to Wi-Fi 6 Stations, while claims 6-10 primarily relate to Wi-Fi 6 Access Points.

Zyxel directly infringes method claims 1-10 by using the Accused Instrumentalities in the United States without a license. Zyxel also indirectly infringes method claims 1-10 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/na/en/products/network-extenders/wireless-extenders/wx3310-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.

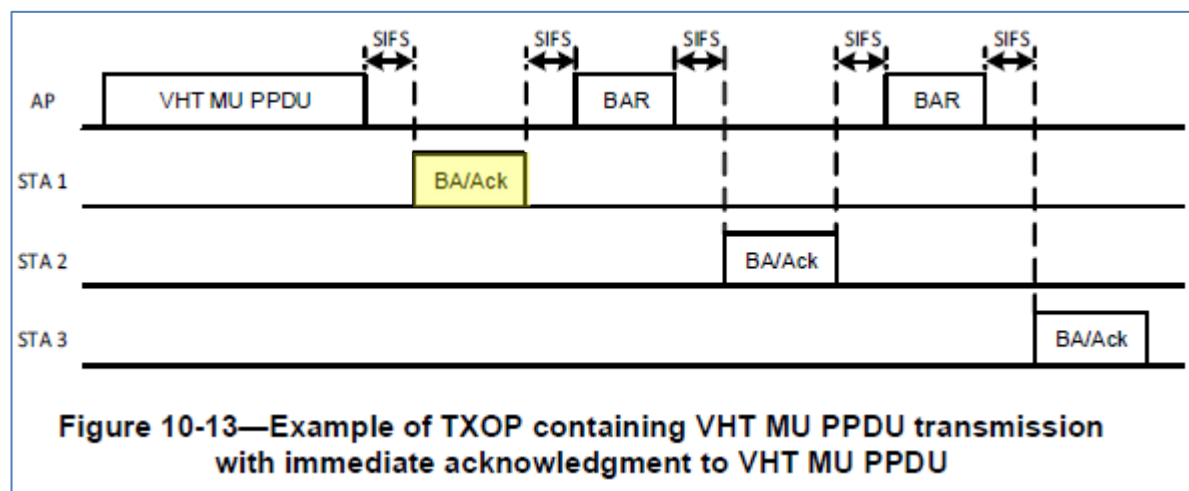
'679 Claim 1	Elements in Accused Instrumentality
1. [PRE] A method for transmitting an acknowledgement frame for notifying successful data reception by a station (STA) to an access point (AP) in a wireless local area network, the method comprising:	A Wi-Fi 6 High Efficiency Station Device transmits an acknowledgement frame for notifying successful data reception by a station (STA) to an access point (AP) in a wireless local area network, 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: • "10.3.2.11 Acknowledgment Procedure * * * * * A STA shall not transmit an Ack frame in response to a Management frame of subtype Action No Ack. A STA shall not transmit an Ack or BlockAck frame in response to a group addressed frame. An MPDU that does not require immediate acknowledgment is implicitly considered acknowledged, as if an explicit acknowledgment had been sent. Otherwise, <u>upon reception of a frame that requires immediate acknowledgment</u> and, for an AP, with the To DS subfield equal to 1, <u>a STA shall transmit an Ack or BlockAck frame after a SIFS, without regard to the busy/idle state of the medium.</u> (See Figure 10-12.):  Figure 10-12—Individually addressed data/Ack/BlockAck frame „

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

802.11ax-2021 at §10.3.2.11 Acknowledgment Procedure

- “10.3.2.13 MU Acknowledgment Procedure

The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU sent by an AP, except if the STA is an HE STA that follows the rules defined in 26.3 and in 26.4. Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. **Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-13 and Figure 10-14:**

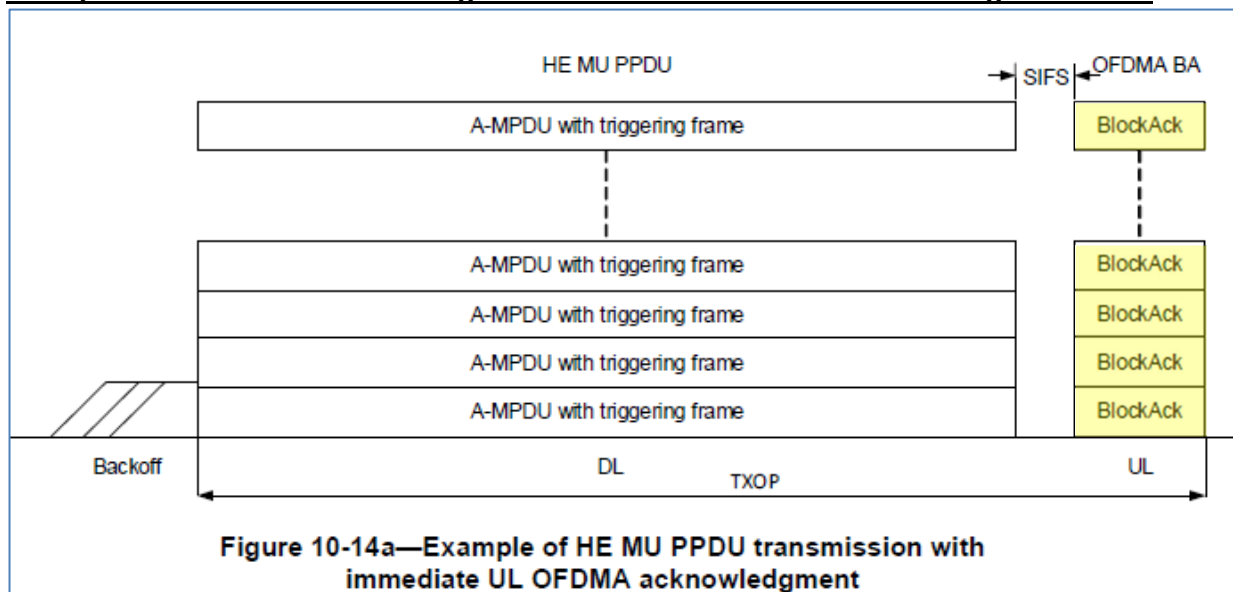


802.11ax-2021 at §10.3.2.13.1 Acknowledgment Procedure for DL MU PPDU in SU PPDU.

- “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 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:**



An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU. 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

- “26.4.4 Per-PPDU acknowledgment selection rules
26.4.4.1 General

A STA that transmits a PPDU can solicit different immediate responses for frames contained in the PPDU by using the Ack Policy Indicator subfield of QoS Data or QoS Null frames, the type of the frame, PPDU format, number of TIDs in the A-MPDU, and the EOF/Tag field setting of the A-MPDU delimiter.” 802.11ax-2021 at §26.4.4.1 Per -PPDU Acknowledgment Selection Rules, General.

- “26.4.5 HE block acknowledgment request and response rules

An HE AP may solicit BlockAck frame responses from multiple HE STAs using an MU-BAR Trigger frame or GCR MU-BAR Trigger frame. An HE AP shall not send a Multi-TID BlockAckReq (as part of a User Info field addressed to the STA in an MU-BAR Trigger frame or as a BlockAckReq frame) to a STA that has not indicated support for multi-TID A-MPDU. The Block Ack Bitmap length of the block ack sent in response to an eliciting Multi-TID BlockAckReq frame, BlockAckReq frame, GCR MU-BAR Trigger frame, or MU-BAR Trigger frame is determined as defined in 26.4.3.

An HE STA that receives a BlockAckReq frame or an MU-BAR Trigger frame that contains a Compressed BlockAckReq variant in the User Info field addressed to the STA or receives a GCR MU-BAR Trigger frame that contains a Compressed BlockAckReq variant in the Common Info field **shall respond with a Compressed BlockAck frame as defined in 10.25.6 or a Multi-STA BlockAck frame as defined in 26.4** with the Starting Sequence Number subfield set to the Starting Sequence Number subfield of the Block Ack Request Starting Sequence Control subfield and the length of the Block Ack Bitmap subfield calculated as defined in 26.4.3.

An HE STA that receives a Multi-TID BlockAckReq frame or an MU-BAR Trigger frame that contains a Multi-TID BlockAckReq variant in the User Info field addressed to the STA or receives a GCR MU-BAR Trigger frame that contains a Multi-TID BlockAckReq variant in the Common Info field **shall respond with a Multi-STA BlockAck frame** that contains a Per AID TID Info field with a Block Ack Bitmap subfield for each of the TIDs (with values less than 8) contained in the BlockAckReq frame, with the Starting Sequence Number subfield set to the Starting Sequence Number subfield of the Block Ack Request Starting Sequence Control subfield, and with the length of the Block Ack Bitmap subfield calculated as defined in 26.4.3.

A non-AP HE STA that responds to a Compressed BlockAckReq frame, Multi-TID BlockAckReq frame, MU-BAR Trigger frame, or GCR MU-BAR Trigger frame with a Multi-STA BlockAck frame shall set the Ack Type subfield of the Multi-STA BlockAck frame to 0.” 802.11ax-2021 at §26.4.5 HE Block Acknowledgment Request and Response Rules.

Section 26.4.4.3 of the Wi-Fi 6 Standard specifies how a STA can acknowledge receipt of a HE MU PPDU by immediately transmitting a SU PPDU. Section 26.4.4.4 of the Wi-Fi 6 Standard specifies how a STA can acknowledge receipt of a HE MU PPDU by immediately transmitting a HE TB PPDU. And Section 26.4.5 of

	the Wi-Fi 6 Standard specifies how STAs can acknowledge receipt of certain trigger frames by transmitting BlockAck frames. Wi-Fi Mesh Extenders operate as Wi-Fi 6 High Efficiency Station Devices when using Backhaul STA functionality to communicate with an AP device in a mesh network. Wi-Fi EasyMesh Specification v4.0 at 16-17, 21, Figs. 2, 3.
[A] receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame; and	A Wi-Fi 6 High Efficiency Station Device receives, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame, as shown by the following excerpts from the 802.11ax-2021 Standard: A Wi-Fi 6 downlink frame is processed according to the 802.11ax Standard. The HE PHY layer Scope section describes the HE PHY services: • “27.1.2 Scope The services provided to the MAC by the HE PHY consist of the following protocol functions: 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 PPDU bandwidth.” 802.11ax-2021 at §27.1.2 HE PHY Specification, Scope • “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. The HE PHY service is provided to the MAC through the PHY service primitives defined in Clause 8. The HE PHY service interface is described in 27.2.” 802.11ax-2021 at §27.1.3.1 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: • <u>“The PHY provides an interface to the MAC</u> through an extension of the generic PHY service interface defined in 8.3.4. <u>The interface includes TXVECTOR, RXVECTOR</u>, 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 • <u>“The HE PHY TXVECTOR and RXVECTOR</u> 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 N_{ss} is $NUM_STS / (STBC + 1)$.” 802.11ax-2021 at §8.3.4.4 PHY Service Specification, Vector Descriptions
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The PHY layer receive process is shown in the following figure:

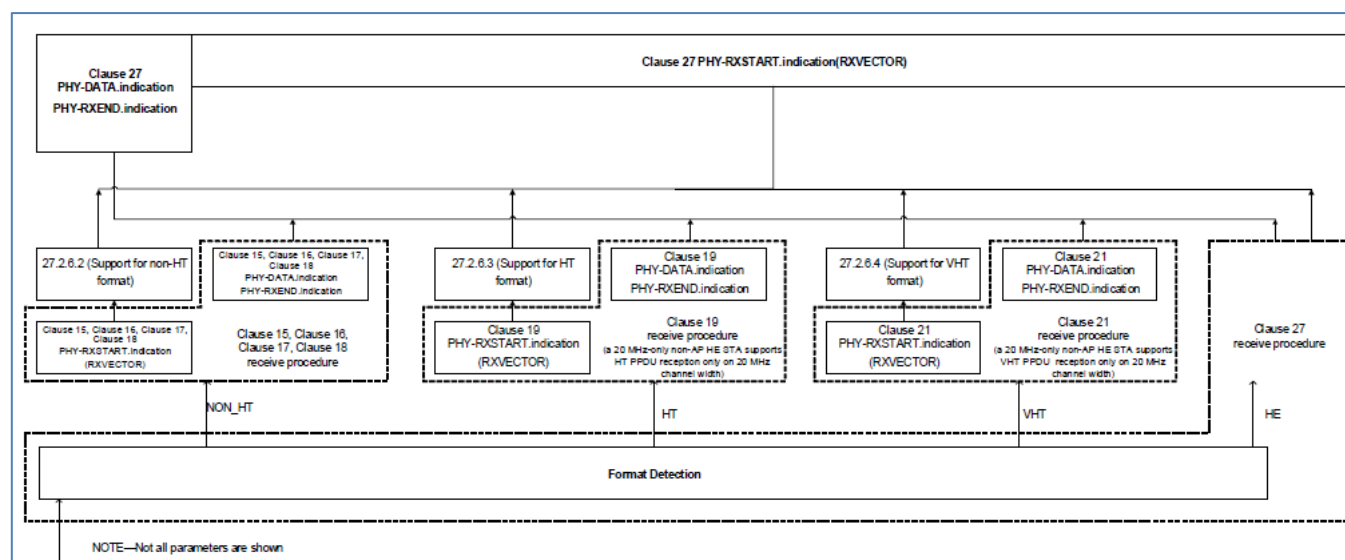


Figure 27-2—PHY interaction on receive for various PPDU formats

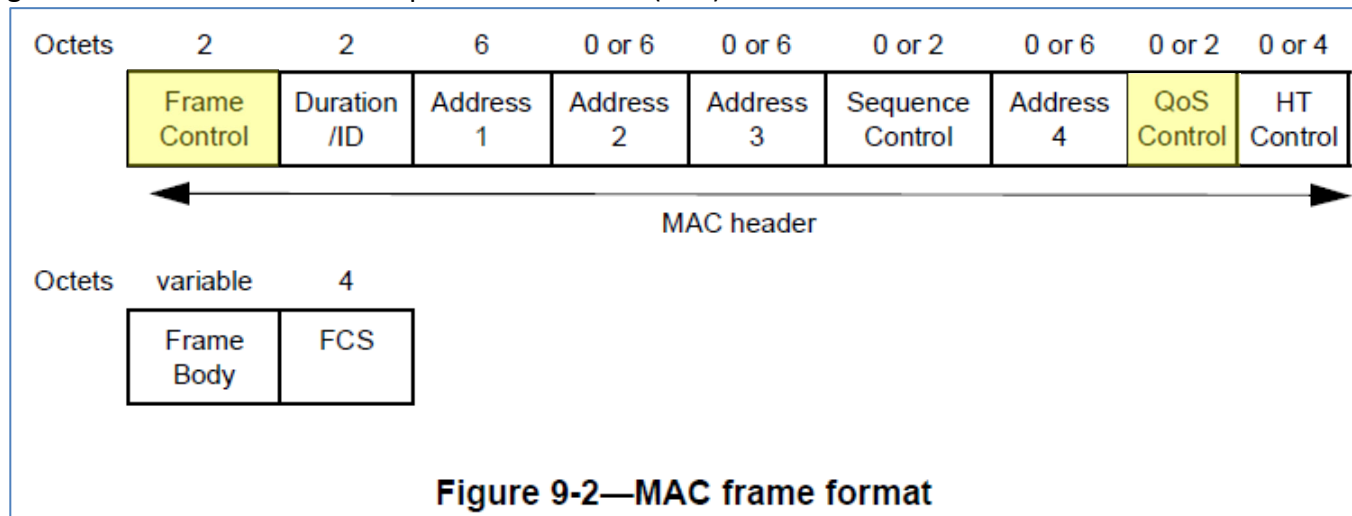
802.11ax-2021 at §27.2.6.1 Support for Non-HT, HT, and VHT Formats, General.

Section 27.3 of the Wi-Fi 6 standard describes the procedures for processing a received frame:

- “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 receiver, the PHY preamble is processed to aid in the detection, demodulation, and delivery of the PSDU.**”
802.11ax-2021 at §27.3.1 HE PHY, Introduction.
- “HE Receive Procedure
Typical PHY receive procedures are shown in Figure 27-59, Figure 27-60, **Figure 27-61**, and Figure 27-62, respectively.

802.11ax MAC frame formats comprise a MAC header with frame control information:

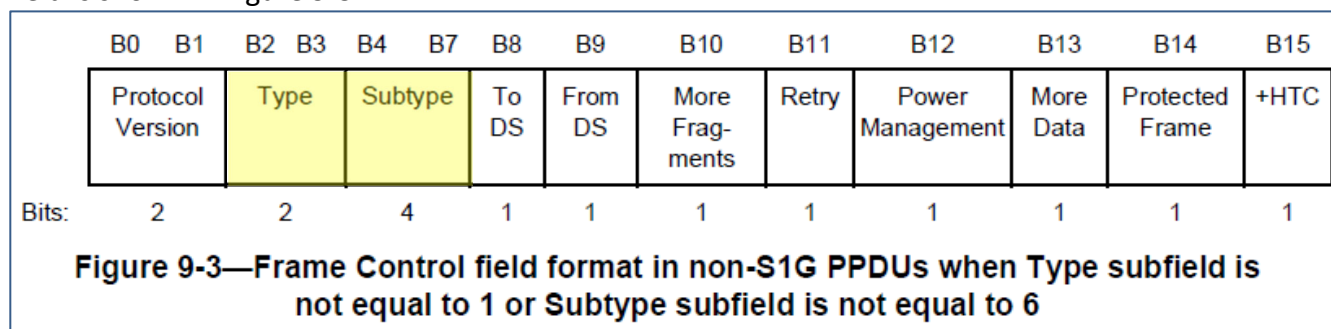
- **“Each frame consists of the following basic components:**
a) A MAC header, which comprises frame control, duration, address, optional sequence control information, **optional QoS Control information (QoS Data frames only)**, and optional HT Control fields (+HTC frames only);
 b) A variable length 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 §9.2.1 MAC Frame Formats, Basic Components.
- The QoS Control field identifies the TC or TS to which the frame belongs as well as various other QoS- related, A-MSDU related, and mesh-related information about the frame that varies by frame type, subtype, and type of transmitting STA. **The QoS Control field is present in all Data frames in which the QoS subfield of the Subtype subfield is equal to 1** (see 9.2.4.1.3). 802.11ax-2020 at § 9.2.4.5.1 QoS Control field structure
- “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...:



802.11ax-2021 at §9.2.3 MAC Frame Format, General Frame Format

Bit 7 of the MAC Frame Control Field indicates a QoS data frame:

- “**The first three subfields of the Frame Control field** of a PVO frame **are** Protocol Version, **Type**, and **Subtype**. The remaining subfields of the Frame Control field depend on the setting of the Type and Subtype subfields. For a frame carried in an non-S1G PPDU, when the Type subfield is not 1 or the Subtype subfield is not 6, the remaining subfields within the Frame Control field are To DS, From DS, More Fragments, Retry, Power Management, More Data, Protected Frame, and +HTC. In this case, the format of the Frame Control field is shown in Figure 9-3:



802.11ax-2021 at §9.2.4.1.1 Frame Control Field, General.

- “The Type and Subtype subfields together identify the function of the frame. There are three frame types: control, data, and management. Each of the frame types has several defined subtypes. **In Data frames, the most significant bit (MSB) of the Subtype subfield, B7, is defined as the QoS subfield.** Table 9-1 defines the valid combinations of type and subtype. (The numeric values in Table 9-1 are shown in binary.):

Table 9-1—Valid type and subtype combinations			
Type value B3 B2	Type description	Subtype value B7 B6 B5 B4	Subtype description
	*	*	*
10	Data	0000	Data
10	Data	0001	Reserved
10	Data	0010	Reserved
10	Data	0011	Reserved
10	Data	0100	Null
10	Data	0101	Reserved
10	Data	0110	Reserved
10	Data	0111	Reserved
10	Data	1000	QoS Data
10	Data	1001	QoS Data +CF-Ack
10	Data	1010	QoS Data +CF-Poll
10	Data	1011	QoS Data +CF-Ack +CF-Poll
10	Data	1100	QoS Null
10	Data	1101	Reserved
10	Data	1110	QoS CF-Poll
10	Data	1111	QoS CF-Ack +CF-Poll
11	Extension	0000	DMG Beacon
11	Extension	0001	SIG Beacon
11	Extension	0010–1111	Reserved

802.11ax-2021 at §9.2.4.1.3 Frame Control Field, Type and Subtype Subfields

The QoS Control field of the MAC header contains the Ack Policy Indicator subfield (at bits 5-6):

- “9.2.4.5.1 QoS Control Field Structure

The QoS Control field identifies the TC or TS to which the frame belongs as well as various other QoS-related, A-MSDU related, and mesh-related information about the frame that varies by frame type, subtype, and type of transmitting STA. The QoS Control field is present in all Data frames in which the QoS subfield of the Subtype subfield is equal to 1 (see 9.2.4.1.3). When not transmitted within a DMG PPDU, each QoS Control field comprises five or eight subfields, as defined for the particular sender (HC or non-AP STA) and frame type

and subtype. **The usage of these subfields and the various possible layouts of the QoS Control field are described in 9.2.4.5.2 to 9.2.4.5.12 and shown in Table 9-10:**

Table 9-10—QoS Control field

Applicable frame (sub)types	Bits 0–3	Bit 4	Bits 5–6	Bit 7	Bits 8	Bit 9	Bit 10	Bits 11–15
QoS CF-Poll and QoS CF-Ack +CF-Poll frames sent by HC	TID	EOSP	Ack Policy Indicator	Reserved	TXOP Limit			
QoS Data +CF-Poll and QoS Data +CF-Ack +CF-Poll frames sent by HC	TID	EOSP	Ack Policy Indicator	A-MSDU Present	TXOP Limit			
QoS Data and QoS Data +CF-Ack frames sent by HC	TID	EOSP	Ack Policy Indicator	A-MSDU Present	AP PS Buffer State			
QoS Null frames sent by HC	TID	EOSP	Ack Policy Indicator	Reserved	AP PS Buffer State			
QoS Data and QoS Data +CF-Ack frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA	TID	0	Ack Policy Indicator	A-MSDU Present	TXOP Duration Requested			
	TID	1	Ack Policy Indicator	A-MSDU Present	Queue Size			
QoS Null frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA	TID	0	Ack Policy Indicator	Reserved	TXOP Duration Requested			
	TID	1	Ack Policy Indicator	Reserved	Queue Size			
QoS Data and QoS Data +CF-Ack frames sent by TPU buffer STAs	TID	EOSP	Ack Policy Indicator	A-MSDU Present	Reserved			

Table 9-10—QoS Control field (continued)

Applicable frame (sub)types	Bits 0–3	Bit 4	Bits 5–6	Bit 7	Bits 8	Bit 9	Bit 10	Bits 11–15
QoS Null frames sent by TPU buffer STAs	TID	EOSP	Ack Policy Indicator	Reserved	Reserved			
QoS Data and QoS Data +CF-Ack frames sent by TPU sleep STAs	TID	Reserved	Ack Policy Indicator	A-MSDU Present	Reserved			
QoS Null frames sent by TPU sleep STAs	TID	Reserved	Ack Policy Indicator	Reserved	Reserved			
All frames sent by mesh STAs in a mesh BSS	TID	EOSP	Ack Policy Indicator	A-MSDU Present	Mesh Control Present	Mesh Power Save Level	RSPI	Reserved

802.11ax-2021 at §9.2.4.5.1 QoS Control Field Structure

The Ack Policy Indicator within the QoS Control Field indicates whether the STA who receives a HE MU PPDU will transmit its acknowledgment as an SU PPDU in single-user format or as a HE TB PPDU in multiple-user format. For example, if the ACK Policy Indicator of a MU PPDU is “00” indicating Normal Ack or Implicit BAR, then the STA will acknowledge reception in single-user format by use of a HE SU PPDU. But if the ACK Policy Indicator of a MU PPDU is “01” indicating HETP Ack, then the STA will acknowledge reception in multi-user format by use of a HE TB PPDU:

- “9.2.4.5.4 Ack Policy Indicator Subfield
The Ack Policy Indicator subfield, together with other information, as shown in Table 9-13, identifies the ack policy, i.e. the behavior followed upon the delivery of the MPDU:

Table 9-13—Ack policy

Ack policy	Ack Policy Indicator subfield		Other conditions	Meaning
	Bit 0	Bit 1		
Normal Ack	0	0	MPDU is a non-A-MPDU frame	Where the frame contains a fragment and both the originator and the addressed recipient support fragment BA: The addressed recipient returns an NDP BlockAck or BAT frame after a SIFS, according to the procedures defined in 10.3.2.12 and 10.47.2. Otherwise: The addressed recipient returns an Ack, STACK, or QoS +CF-Ack frame after a short interframe space (SIFS) period, according to the procedures defined in 10.3.2.11, 10.47.2, and 10.23.3.5. A non-DMG STA uses this ack policy for individually addressed QoS Null frames.
Implicit BAR	0	0	MPDU is not a non-A-MPDU frame NOTE—This MPDU is sent under a block ack agreement.	The addressed recipient returns a BlockAck, TACK or BAT frame, either individually or as part of an A-MPDU starting a SIFS after the PPDU carrying the frame, according to the procedures defined in 10.3.2.11, 10.25.6.5, 10.29.3, 10.29.4, 10.47.2, and 10.34.3.
No Ack	1	0	None	The addressed recipient takes no action upon receipt of the frame. More details are provided in 10.26. This ack policy is used in all individually addressed frames in which the sender does not require immediate acknowledgment. It is also used in all group addressed frames that use the QoS frame format except QoS Data frames with a TID for which a block ack agreement exists. It is not used for QoS Data frames with a TID for which a block ack agreement exists.

No Explicit Acknowledgment	0	1	Bit 6 of the Frame Control field (see 9.2.4.1.3) is equal to 1 <u>and the frame is not carried in an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains a frame that solicits a response in an HE TB PPDU</u>	There might be a response frame to the frame that is received, but it is neither the Ack frame nor any Data frame of subtype +CF-Ack. This ack policy is used for QoS CF-Poll and QoS CF-Ack +CF-Poll Data frames. NOTE—Bit 6 of the Frame Control field (see 9.2.4.1.3) indicates the absence of a Frame Body field in a QoS Data frame. ~~When~~ If equal to 1, the QoS Data frame contains no Frame Body field, and any response is generated in response to a QoS CF-Poll or QoS CF-Ack +CF-Poll frame, but does not signify an acknowledgment of data.
PSMP Ack	0	1	Bit 6 of the Frame Control field (see 9.2.4.1.3) is equal to 0 <u>and the frame is not carried in an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains a frame that solicits a response in an HE TB PPDU</u>	The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP downlink transmission time (PSMP-DTT) is to be received in a later PSMP uplink transmission time (PSMP-UTT). The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP-UTT is to be received in a later PSMP-DTT. See 10.30.2.7.
<u>HETP Ack</u>	<u>0</u>	<u>1</u>	<u>The frame is carried in an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains a frame that solicits a response in an HE TB PPDU</u>	<u>The addressed recipient returns an Ack, Compressed BlockAck, or Multi-STA BlockAck frame carried in an HE TB PPDU a SIFS after the PPDU, subject to reception of a triggering frame in the PPDU, as defined in 10.3.2.13.2 and 26.5.2.</u>
Block Ack	1	1	None	The addressed recipient takes no action upon the receipt of the frame except for recording the state. The recipient can expect a BlockAckReq frame or implicit block ack request in the future to which it responds using the procedure described in 10.25.

802.11ax-2021 at §9.2.4.5.4 Ack Policy Indicator Subfield (excerpted and annotated)

- “26.4.4.3 **Responding to an HE MU PPDU with an SU PPDU**
If an AP intends to solicit an immediate response in an SU PPDU, the following apply:

— **An AP shall set the Ack Policy Indicator subfield in the QoS Data and QoS Null frames to Normal Ack or Implicit BAR in at most one A-MPDU in the HE MU PPDU** (see 10.3.2.13.1 for an example of this sequence).

— The A-MPDUs in the HE MU PPDU shall not contain a Management frame that solicits acknowledgment.

An HE STA that receives an HE MU PPDU with an A-MPDU that contains MPDUs that solicit acknowledgment and that does not include a triggering frame shall respond using an SU PPDU as follows:

- a) If the A-MPDU carries only one MPDU and the MPDU is a tagged MPDU that is either a QoS Data frame or QoS Null frame with Normal Ack ack policy, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that is a QoS Data frame or a QoS Null frame with Normal Ack ack policy, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to Implicit BAR for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1.
- d) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with Implicit BAR ack policy addressed to it and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2.

NOTE—A control response frame carried in an SU PPDU that is an immediate response to an HE MU PPDU follows the rules defined in 10.6.6.5.

An AP that sends an HE MU PPDU shall not set the Ack Policy Indicator subfield to Normal Ack or Implicit BAR for any of the MPDUs carried in the HE MU PPDU if the PPDU containing a control response would occupy one or more 20 MHz channels where pre-HE modulated fields of the HE MU PPDU are not located.”
802.11ax-2021 at §26.4.4.3 Responding to an HE MU PPDU with an SU PPDU

- “26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU
An AP that sends an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains an MPDU that solicits an immediate response carried in an HE TB PPDU shall set the Ack Policy Indicator subfield to HETP Ack for each of the QoS Data frames for which it intends to solicit an immediate response (see 10.3.2.13.2). If a Management frame that solicits acknowledgment is carried in an HE MU PPDU, then the response is carried in an HE TB PPDU. A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains a QoS Data frame with HETP Ack ack policy addressed to it or contains a Management frame that solicits an immediate acknowledgment shall not respond, unless it has also received a triggering frame in the A-MPDU.

A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains one or more MPDUs soliciting acknowledgment and includes a triggering frame shall respond with an HE TB PPDU as follows:

- a) If the A-MPDU includes only one MPDU and the MPDU is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to HETP Ack for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1.
- d) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes a Management

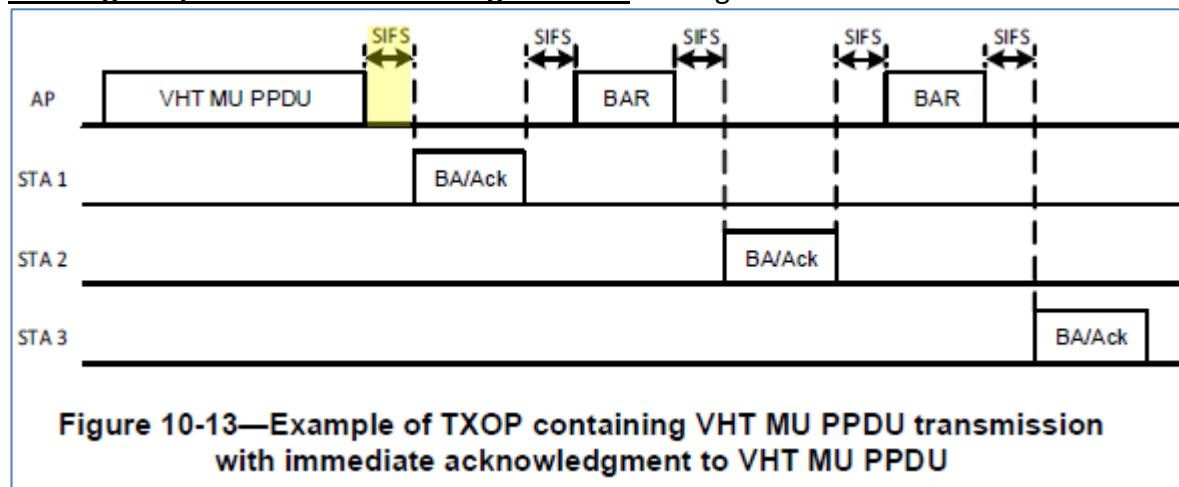
frame that solicits an acknowledgment and contains one or more QoS Data frames with HETP Ack or Implicit BAR ack policy, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2.

- e) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with HETP Ack ack policy and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame.” 802.11ax-2021 at §26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU.

The STA transmits the acknowledgment frame at a short interframe space (“SIFS”) time after the downlink frame:

- “10.3.2.13 MU Acknowledgment Procedure

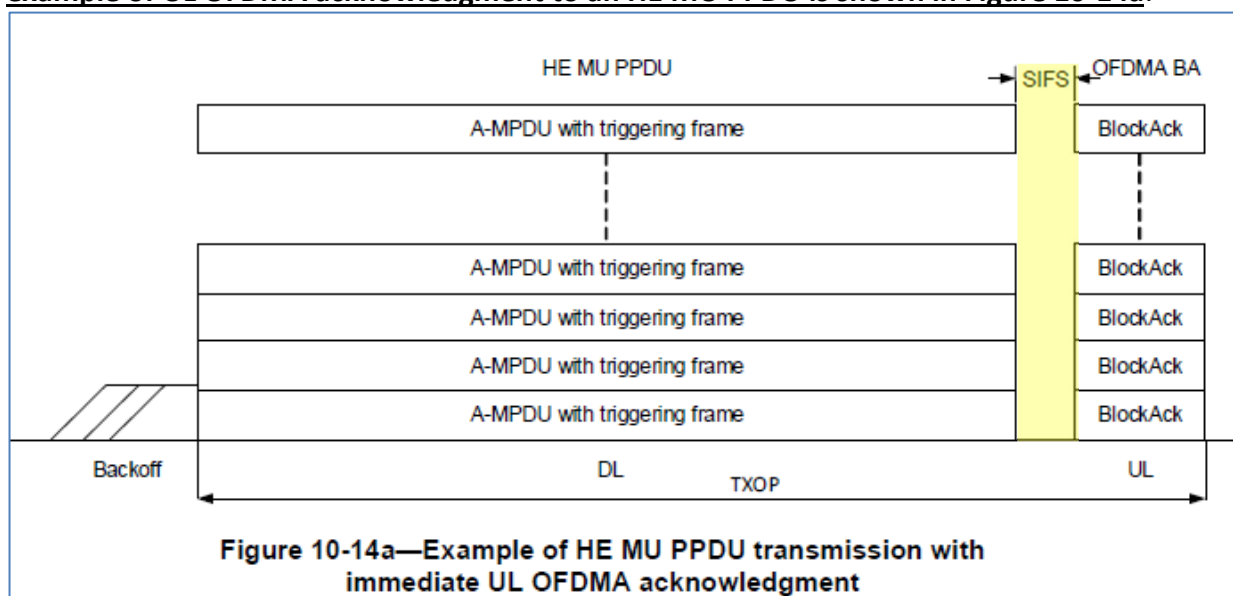
The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU sent by an AP, except if the STA is an HE STA that follows the rules defined in 26.3 and in 26.4. Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. **Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-13 and Figure 10-14:**



802.11ax-2021 at §10.3.2.13.1 Acknowledgment Procedure for DL MU PPDU in SU PPDU.

- “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. 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:**



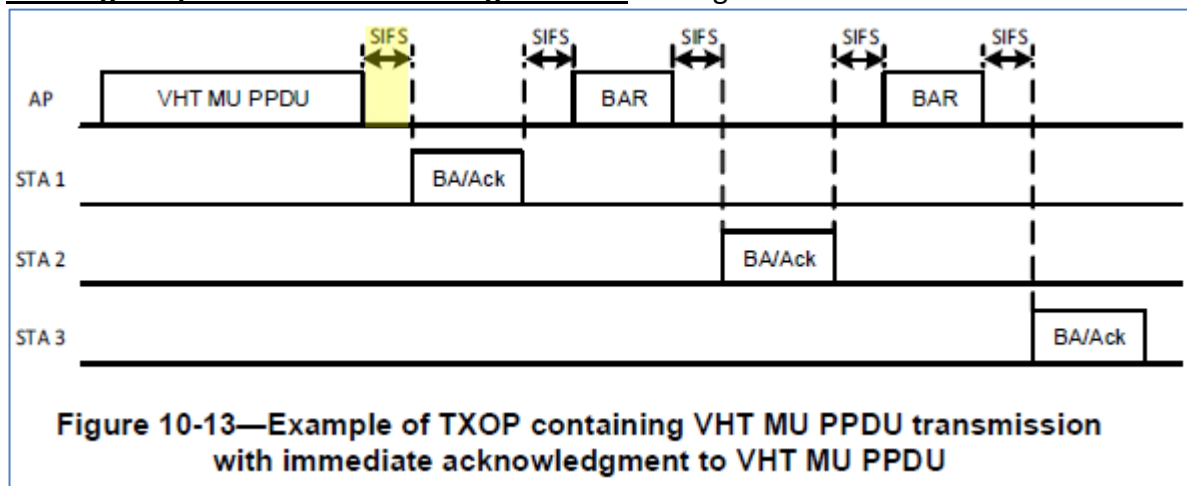
An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

[B] transmitting, to the AP, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame,	A Wi-Fi 6 High Efficiency Station Device transmits to the AP the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame, as shown by the following excerpts from the 802.11ax-2021 Standard: • <u>“A STA that transmits a PPDU can solicit different immediate responses for frames contained in the PPDU by using the Ack Policy Indicator subfield of QoS Data or QoS Null frames,</u> the type of the frame, PPDU format, number of TIDs in the A-MPDU, and the EOF/Tag field setting of the A-MPDU delimiter.” 802.11ax-2021 at §26.4.4.1 Per-PPDU Acknowledgment Selection Rules, General. • <u>“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,</u> of an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame, or of a Management frame that solicits acknowledgment, <u>shall send the immediate response</u> 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>“26.4.4.3 Responding to an HE MU PPDU with an SU PPDU</u> <u>If an AP intends to solicit an immediate response in an SU PPDU, the following apply:</u> — <u>An AP shall set the Ack Policy Indicator subfield in the QoS Data and QoS Null frames to Normal Ack or Implicit BAR in at most one A-MPDU in the HE MU PPDU</u> (see 10.3.2.13.1 for an example of this sequence). — The A-MPDUs in the HE MU PPDU shall not contain a Management frame that solicits acknowledgment. <u>An HE STA that receives an HE MU PPDU with an A-MPDU that contains MPDUs that solicit acknowledgment and that does not include a triggering frame shall respond using an SU PPDU</u> as follows: a) If the A-MPDU carries only one MPDU and the MPDU is a tagged MPDU that is either a QoS Data frame or QoS Null frame with Normal Ack ack policy, then the STA shall respond with an Ack frame. b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that is a QoS Data frame or a QoS Null frame with Normal Ack ack policy, then the HE STA shall respond with an Ack frame.
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	c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to Implicit BAR for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1. d) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with Implicit BAR ack policy addressed to it and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2. NOTE—A control response frame carried in an SU PPDU that is an immediate response to an HE MU PPDU follows the rules defined in 10.6.6.5. An AP that sends an HE MU PPDU shall not set the Ack Policy Indicator subfield to Normal Ack or Implicit BAR for any of the MPDUs carried in the HE MU PPDU if the PPDU containing a control response would occupy one or more 20 MHz channels where pre-HE modulated fields of the HE MU PPDU are not located.” 802.11ax-2021 at §26.4.4.3 Responding to an HE MU PPDU with an SU PPDU • “26.4.4.4 <u>Responding to an HE MU PPDU</u>, HE SU PPDU, or HE ER SU PPDU <u>with an HE TB PPDU</u> <u>An AP that sends an HE MU PPDU</u>, HE SU PPDU, or HE ER SU PPDU <u>that contains an MPDU that solicits an immediate response carried in an HE TB PPDU shall set the Ack Policy Indicator subfield to HETP Ack for each of the QoS Data frames for which it intends to solicit an immediate response (see 10.3.2.13.2).</u> If a Management frame that solicits acknowledgment is carried in an HE MU PPDU, then the response is carried in an HE TB PPDU. A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains a QoS Data frame with HETP Ack ack policy addressed to it or contains a Management frame that solicits an immediate acknowledgment shall not respond, unless it has also received a triggering frame in the A-MPDU. <u>A non-AP STA that receives an HE MU PPDU</u>, HE SU PPDU, or HE ER SU PPDU <u>with an A-MPDU that contains one or more MPDUs soliciting acknowledgment and includes a triggering frame shall respond with an HE TB PPDU</u> as follows:
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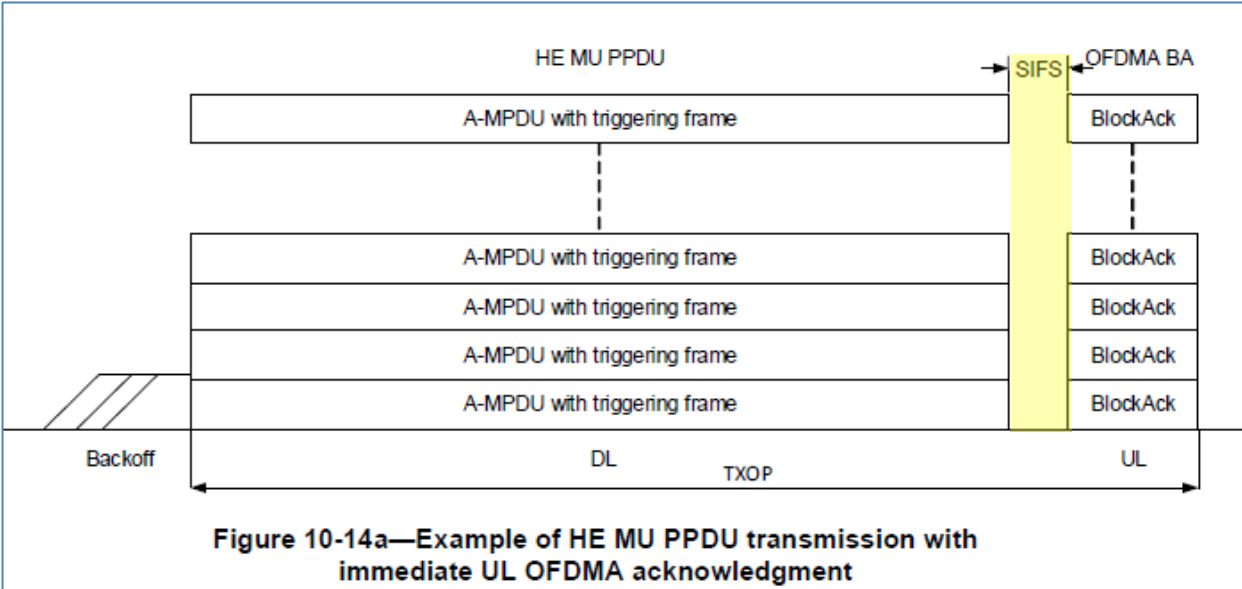
	a) If the A-MPDU includes only one MPDU and the MPDU is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the STA shall respond with an Ack frame. b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the HE STA shall respond with an Ack frame. c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to HETP Ack for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1. d) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes a Management frame that solicits an acknowledgment and contains one or more QoS Data frames with HETP Ack or Implicit BAR ack policy, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2. e) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with HETP Ack ack policy and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame.” 802.11ax-2021 at §26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU. • “10.3.2.13 MU Acknowledgment Procedure The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU sent by an AP, except if the STA is an HE STA that follows the rules defined in 26.3 and in 26.4. Responses to A-MPDUs within a VHT MU PPDU or an HE MU
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PPDU for DL transmission that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. **Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-13 and Figure 10-14:**



802.11ax-2021 at §10.3.2.13.1 Acknowledgment Procedure for DL MU PPDU in SU PPDU.

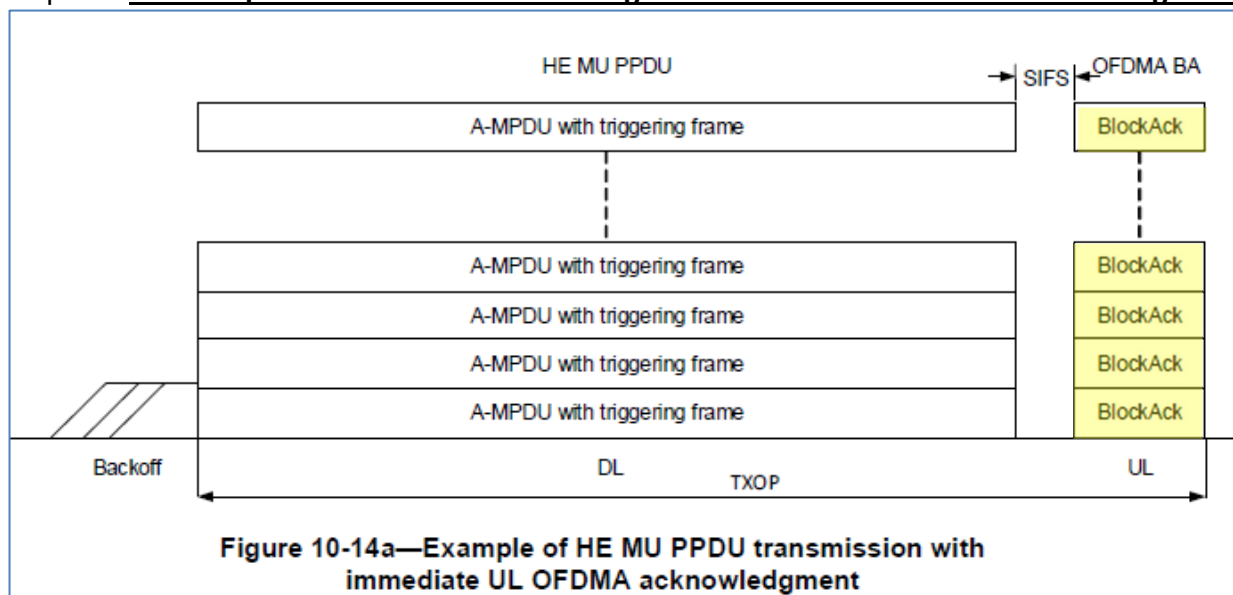
- “10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU format
A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame with HETP Ack ack policy, of an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame, or of a Management frame that solicits acknowledgment, shall send the immediate response according to the scheduling information that is carried either in the Trigger frame(s) or TRS Control subfield. 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 An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.
[C] wherein transmitting the acknowledgment frame comprises: when the acknowledgment information represents that the STA is requested to transmit the	A Wi-Fi 6 High Efficiency Station Device transmits to the AP the acknowledgement frame and, when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format and the STA is allocated a resource, the STA transmits the acknowledgement frame in the MU format on the allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard: • “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 transmission of response frames in an HE TB PPDU, 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).” 802.11ax-2021 at §26.5.2.1 UL MU Operation, General

acknowledgement frame in the MU format and the STA is allocated a resource, transmitting the acknowledgement frame in the MU format on the allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, and

- “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. 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:**



An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

- “26.4.4.4 **Responding to an HE MU PPDU**, HE SU PPDU, or HE ER SU PPDU **with an HE TB PPDU**. An AP that **sends an HE MU PPDU**, HE SU PPDU, or HE ER SU PPDU **that contains an MPDU that solicits an immediate**

response carried in an HE TB PPDU shall set the Ack Policy Indicator subfield to HETP Ack for each of the QoS Data frames for which it intends to solicit an immediate response (see 10.3.2.13.2). If a Management frame that solicits acknowledgment is carried in an HE MU PPDU, then the response is carried in an HE TB PPDU. A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains a QoS Data frame with HETP Ack ack policy addressed to it or contains a Management frame that solicits an immediate acknowledgment shall not respond, unless it has also received a triggering frame in the A-MPDU.

A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains one or more MPDUs soliciting acknowledgment and includes a triggering frame shall respond with an HE TB PPDU as follows:

- a) If the A-MPDU includes only one MPDU and the MPDU is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to HETP Ack for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1.
- d) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes a Management frame that solicits an acknowledgment and contains one or more QoS Data frames with HETP Ack or

	Implicit BAR ack policy, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2. e) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with HETP Ack ack policy and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame.” 802.11ax-2021 at §26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU.
[D] [wherein transmitting the acknowledgment frame comprises:] when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, transmitting the acknowledgement frame in SU format.	A Wi-Fi 6 High Efficiency Station Device transmits to the AP the acknowledgement frame and, when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, the STA transmits the acknowledgement frame in SU format, as shown by the following excerpts from the 802.11ax-2021 Standard: • “10.3.2.13 MU Acknowledgment Procedure The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU sent by an AP, except if the STA is an HE STA that follows the rules defined in 26.3 and in 26.4. Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. <u>Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-13</u> and Figure 10-14:

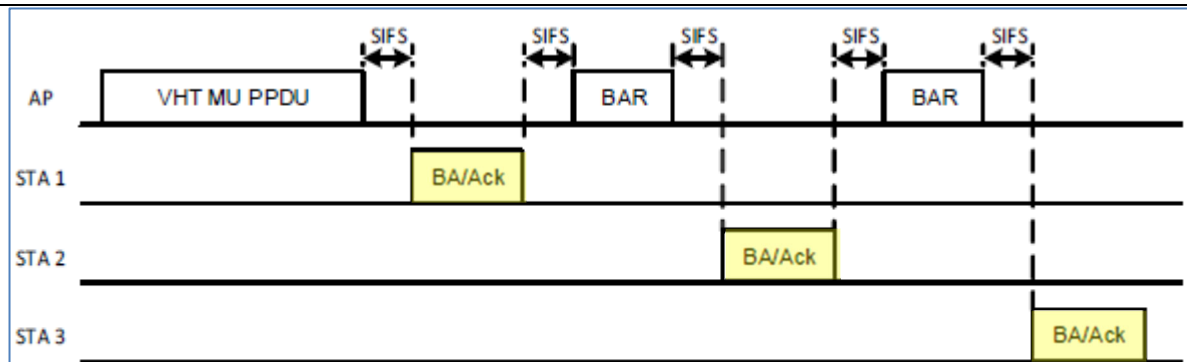


Figure 10-13—Example of TXOP containing VHT MU PPDU transmission with immediate acknowledgment to VHT MU PPDU

802.11ax-2021 at §10.3.2.13.1 Acknowledgment Procedure for DL MU PPDU in SU PPDU.

- **“26.4.4.3 Responding to an HE MU PPDU with an SU PPDU**

If an AP intends to solicit an immediate response in an SU PPDU, the following apply:

— An AP shall set the Ack Policy Indicator subfield in the QoS Data and QoS Null frames to Normal Ack or Implicit BAR in at most one A-MPDU in the HE MU PPDU (see 10.3.2.13.1 for an example of this sequence).

— The A-MPDUs in the HE MU PPDU shall not contain a Management frame that solicits acknowledgment. An HE STA that receives an HE MU PPDU with an A-MPDU that contains MPDUs that solicit acknowledgment and that does not include a triggering frame shall respond using an SU PPDU as follows:

- a) If the A-MPDU carries only one MPDU and the MPDU is a tagged MPDU that is either a QoS Data frame or QoS Null frame with Normal Ack ack policy, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that is a QoS Data frame or a QoS Null frame with Normal Ack ack policy, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator

	subfield equal to Implicit BAR for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1. d) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with Implicit BAR ack policy addressed to it and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.22. NOTE—A control response frame carried in an SU PPDU that is an immediate response to an HE MU PPDU follows the rules defined in 10.6.6.5. An AP that sends an HE MU PPDU shall not set the Ack Policy Indicator subfield to Normal Ack or Implicit BAR for any of the MPDUs carried in the HE MU PPDU if the PPDU containing a control response would occupy one or more 20 MHz channels where pre-HE modulated fields of the HE MU PPDU are not located.” 802.11ax-2021 at §26.4.4.3 Responding to an HE MU PPDU with an SU PPDU
‘679 Claim 2	Elements in Accused Instrumentality
2. The method according to claim 1, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.	A Wi-Fi 6 High Efficiency Station Device receives from the AP a downlink frame, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame, as shown by the following excerpts from the 802.11ax-2021 Standard: As shown above, in 802.11ax, soliciting information soliciting an uplink response may be performed using Triggering frames. Triggering frames are sent in the form of a Trigger Frame or a TRS Control subfield in a MAC header sent in a DL MU PPDU (or other DL PPDU). To determine whether a trigger information (<i>i.e.</i>, TRS Control) for an UL MU transmission is included in the MAC header, the STA decodes the MAC A-MPDU passed by the PHY. A STA transmits MAC frames using frame formats described in the 802.11 standard. Each MAC frame contains a header, a body, and a frame check sequence. MAC frame formats are described in §9.2: • “9.2 MAC frame formats

9.2.1 Basic components

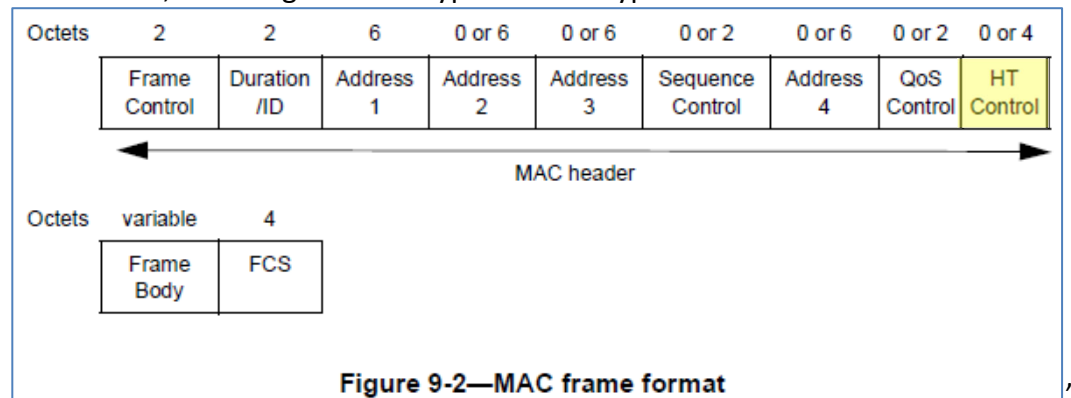
Each frame consists of the following basic components:

- 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 §§9.1 (Frame Formats, General Requirements)-9.2.1 (MAC Frame Formats, Basic Components).

The contents of the MAC header are shown in Figure 9-2 of 802.11. 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 MAC Frame Format, General Frame Format.

The HT Control field of the MAC header is described in 9.2.4.6 of 802.11:

- **“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 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. For an HE frame, B0-B1 are set to “11” to indicate the HE Variant of the field:

- “The format of the HT Control field transmitted by a non-CMMG STA is defined in Table 9-13b:

Table 9-13b—HT Control field format					
Variant	B0	B1	B2–B29	B30	B31
HT	0		HT Control Middle	AC Constraint	RDG/More PPDU
VHT	1	0	VHT Control Middle	AC Constraint	RDG/More PPDU
HE	1	1	A-Control		

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 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:

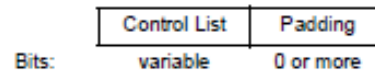


Figure 9-19a—A-Control subfield of the HE variant HT Control field format

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:

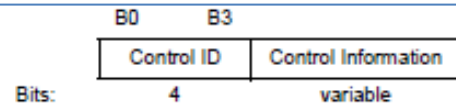


Figure 9-19b—Control subfield format

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:**

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

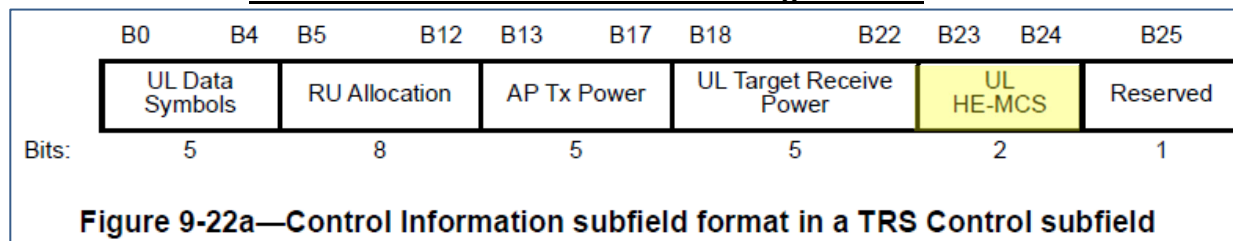
As shown above, the values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-22a (Control ID subfield values). The Control ID value “0” indicates the content of the Control Information subfield is Triggered response scheduling (TRS).

Triggering frames with a TRS control subfield may carry scheduling information for a Station to use for generating a response:

- “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). 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:**



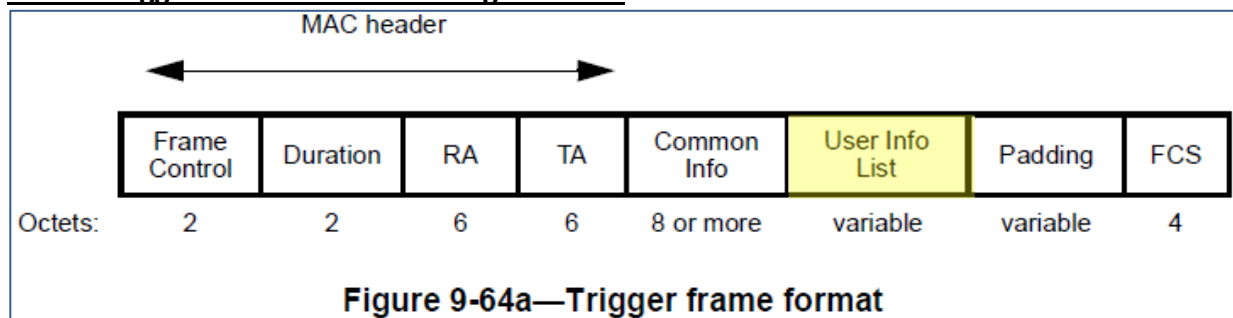
802.11ax-2021 at §9.2.4.6a.1 TRS Control

Modulation and Coding Scheme (MCS) information for the acknowledgement frame is contained in B23-B24 of the TRS control subfield “UL HE-MCS”:

- **“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).”** 802.11ax-2021 at §9.2.4.6a.1 TRS Control.

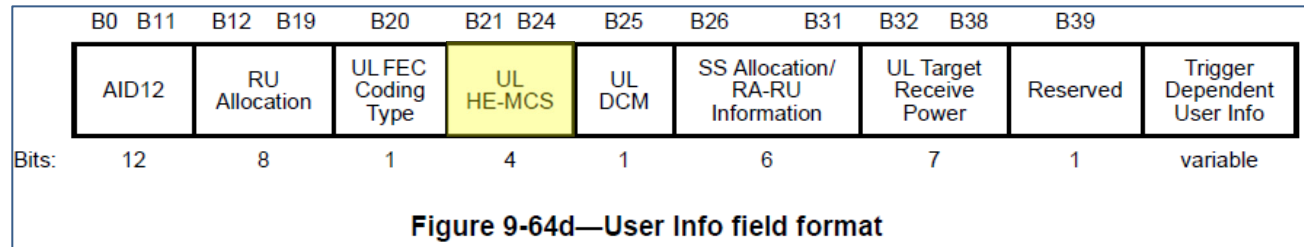
The trigger frame format is described as follows:

- “A Trigger frame allocates resources for and solicits one or more HE TB PPDU transmissions. The Trigger frame also carries other information required by the responding STA to send an HE TB PPDU. **The format for the Trigger frame is defined in Figure 9-64a:**



802.11ax-2021 at §9.3.1.22.1 Trigger Frame Format, General

- **“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:**



802.11ax-2021 at §9.3.1.22 Trigger Frame Format, General

- **“The UL HE-MCS subfield of the User Info field indicates the HE-MCS of the solicited HE TB PPDU. The encoding of the UL HE-MCS subfield is defined in 27.3.7.”** 802.11ax-2021 at §9.3.1.22 Trigger Frame Format, General
- “The HE-MCS is a compact representation of the modulation and coding used in the Data field of the PPDU. For an HE SU PPDU and an HE ER SU PPDU, it is carried in the HE-SIG-A field. For an HE MU PPDU, it is carried per user in the User Specific field of the HE-SIG-B field. For an HE TB PPDU, it is carried in the User Info field of the Trigger frame soliciting the HE TB PPDU.” 802.11ax-2021 at §27.3.7 HE modulation and coding schemes (HE-MCSs)

’679 Claim 3

Elements in Accused Instrumentality

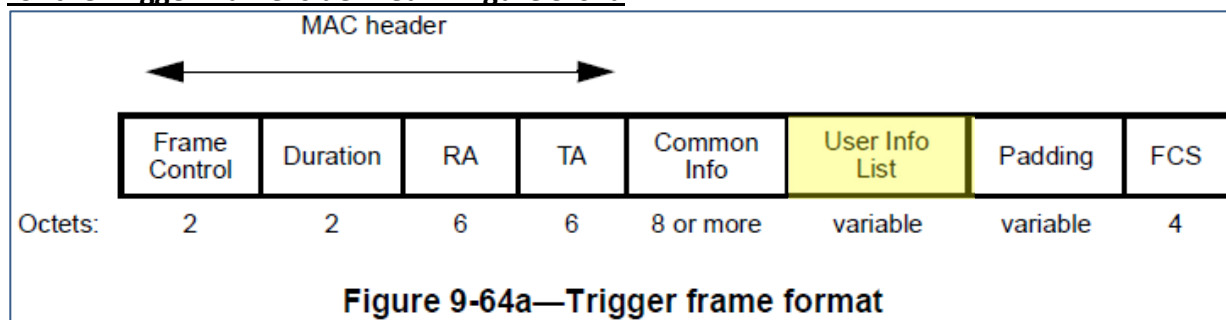
3. The method according to claim 2, wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA

A Wi-Fi 6 High Efficiency Station Device receives from the AP a downlink frame, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame, and wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard:

Two STAs receiving the same trigger frame can be assigned the same MCS:

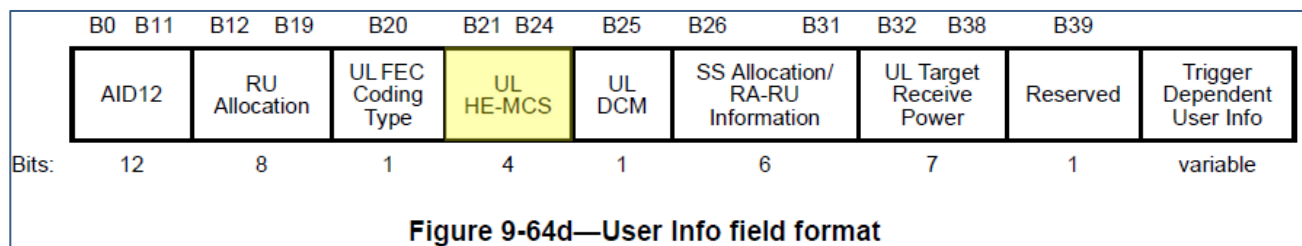
and the at least one other STA

- **“A Trigger frame allocates resources for and solicits one or more HE TB PPDU transmissions.** The Trigger frame also carries other information required by the responding STA to send an HE TB PPDU. **The format for the Trigger frame is defined in Figure 9-64a:**



802.11ax-2021 at §9.3.1.22.1 Trigger Frame Format, General

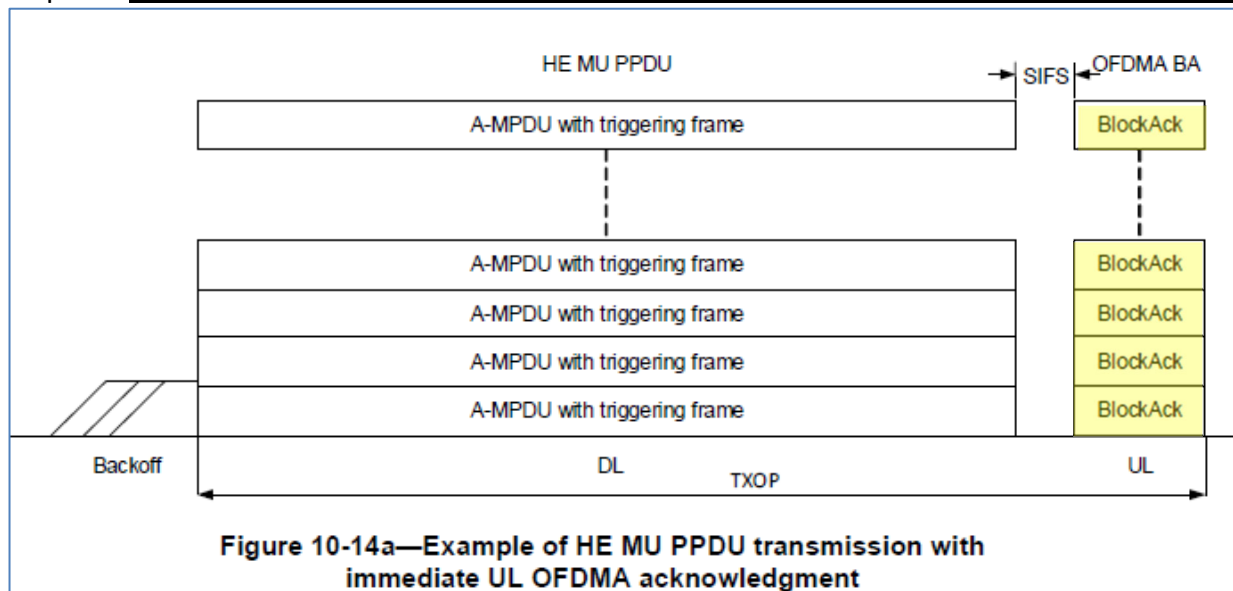
- **“The User Info field is defined in Figure 9-64d** for all Trigger frame variants, except the NFRP Trigger frame, which is defined in 9.3.1.22.9:



802.11ax-2021 at §9.3.1.22 Trigger Frame Format, General

- **“The UL HE-MCS subfield of the User Info field indicates the HE-MCS of the solicited HE TB PPDU. The encoding of the UL HE-MCS subfield is defined in 27.3.7.”** 802.11ax-2021 at §9.3.1.22 Trigger Frame Format, General
- “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. 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:



An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

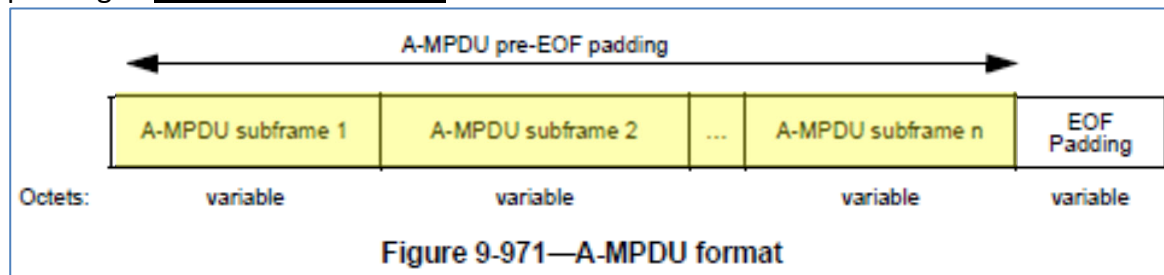
- “For an HE MU PPDU, [the MCS information] is carried per user in the User Specific field of the HE-SIG-B field.” 802.11ax-2021 at §27.3.7.

'679 Claim 4	Elements in Accused Instrumentality
4. The method according to claim 1, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA.	A Wi-Fi 6 High Efficiency Station Device receives from the AP a downlink frame, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard: “10.3.2.13.2 Acknowledgment procedure for DL MU PPDU in MU format <u>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</u>, 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. <u>An example of UL OFDMA acknowledgment to an HE MU PPDU is shown in Figure 10-14a:</u> Figure 10-14a—Example of HE MU PPDU transmission with immediate UL OFDMA acknowledgment An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack

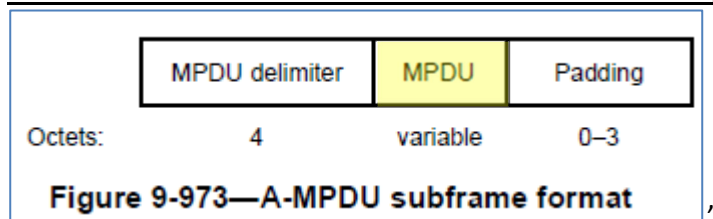
ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

- “9.7.1 A-MPDU format

An A-MPDU consists of a sequence of one or more A-MPDU subframes and a variable amount of EOF padding as **shown in Figure 9-971**:



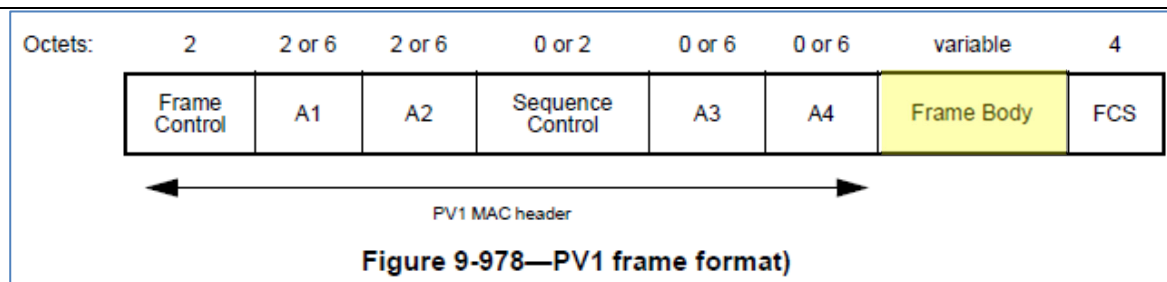
The structure of the A-MPDU subframe is shown in Figure 9-973.....:



802.11ax-2021 at §7.7.1 A-MPDU format.

- “**Each PV1 frame consists of the following basic components:**
 - a) A PV1 MAC header, which comprises frame control, address, optional sequence control information;
 - b) **A variable-length frame body, which contains information specific to the frame type;**
 - 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 §9.8.1 MAC frame format for PV1 frames, Basic Components
- “**Figure 9-978 depicts the general PV1 MAC frame format.** The first three fields (Frame Control, A1 and A2) and the last field FCS are always present in PV1 frames. The Sequence Control, A3, A4 and Frame body fields are optionally present. Each field is defined in 9.8.3:



802.11ax-2021 at §9.8.2 General PV1 Frame Format.

- “9.8.3.4 Frame Body Field
The Frame Body field is a variable-length field and is described in 9.2.4.7.” 802.11ax-2021 at §9.8.3.4 Frame Body Field.
- “9.2.4.7.1 Frame Body Field, General
The Frame Body field is a variable length field that contains information specific to individual frame types and subtypes. The minimum length of the frame body is 0 octets. The maximum length of the frame body is constrained or affected by the following:
 - **The maximum MMPDU, MSDU, A-MSDU, and MPDU sizes supported by the recipient(s) for the PPDU format in use, as specified in Table 9-25.....:**

**Table 9-25—Maximum data unit sizes (in octets) and durations
(in microseconds)**

	Non-HT non-VHT ~~non-HE~~ non-S1G non-DMG PPDU and non-HT duplicate PPDU	HT PPDU	VHT PPDU	<u>HE PPDU</u>	S1G PPDU	DMG PPDU
MMPDU size	2304	2304	See NOTE 1	<u>See NOTE 1</u>	See NOTE 1	2304
MSDU size	2304	2304	2304	<u>2304</u>	2304	7920
A-MSDU size	3839 or 4065 (see NOTE 2) (HT STA, see also Table 9-184), or N/A (non-HT STA, see also 10.11)	3839 or 7935 (see also Table 9-184)	See NOTE 3	<u>2.4 GHz band: 3839 or 7935 (see also Table 9-184)</u> <u>Otherwise: see NOTE 3</u>	See NOTE 3	7935
MPDU size	See NOTE 4	See NOTE 5	3895 or 7991 or 11 454 (see also Table 9-271)	<u>2.4 GHz band: see NOTE 5</u> <u>Otherwise: 3895 or 7991 or 11 454 (see also Table 9-271)</u> <u>See NOTE 7</u>	3895 or 7991 (see also Table 9-300)	See NOTE 5
PSDU size	$2^{12}-1$ (see Table 15-5, Table 16-4, Table 17-21, Table 18-5)	$2^{16}-1$ (see Table 19-25)	4 692 480 ($\sim 2^{22.16}$) (see Table 21-28)	<u>6 500 631</u> (<u>$\sim 2^{22.63}$</u>) (see <u>Table 27-54</u>)	797 160 ($\sim 2^{19.60}$) (see Table 23-40)	$2^{18}-1$ (see Table 20-30)

Table 9-25—Maximum data unit sizes (in octets) and durations (in microseconds) (continued)

	Non-HT non-VHT <u>non-HE</u> non-SIG non-DMG PPDU and non-HT duplicate PPDU	HT PPDU	VHT PPDU	<u>HE PPDU</u>	SIG PPDU	DMG PPDU
PPDU duration	See NOTE 6	5484 (HT_MF, see 10.27.4) or 10 000 (HT_GF, see Table 19-25)	5484 (see Table 21-28)	<u>5484</u> (see <u>Table 27-54</u>)	27 840 (see Table 23-40)	2000 (see Table 20-30)

NOTE 1—No direct constraint on the maximum MMPDU size; indirectly constrained by the maximum MPDU size (see 9.3.3.1).

NOTE 2—Indirect constraint from the maximum PSDU size: $2^{12}-1$ octets minus the minimum QoS Data frame overhead (26 octets for the MAC header and 4 octets for the FCS).

NOTE 3—No direct constraint on the maximum A-MSDU size; indirectly constrained by the maximum MPDU size.

NOTE 4—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum MSDU/MMPDU or (for HT STAs only) A-MSDU size.

NOTE 5—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A-MSDU size.

NOTE 6—No direct constraint on the maximum duration, but an L_LENGTH value above 2332 might not be supported by some receivers (see NOTE 2 in 10.27.4).

NOTE 7—The maximum MPDU size might be greater than the size declared as supported by the recipient if the MPDU is an HE Compressed Beamforming/CQI frame.

802.11ax-2021 at §9.2.4.7.1 Frame Body Field, General.

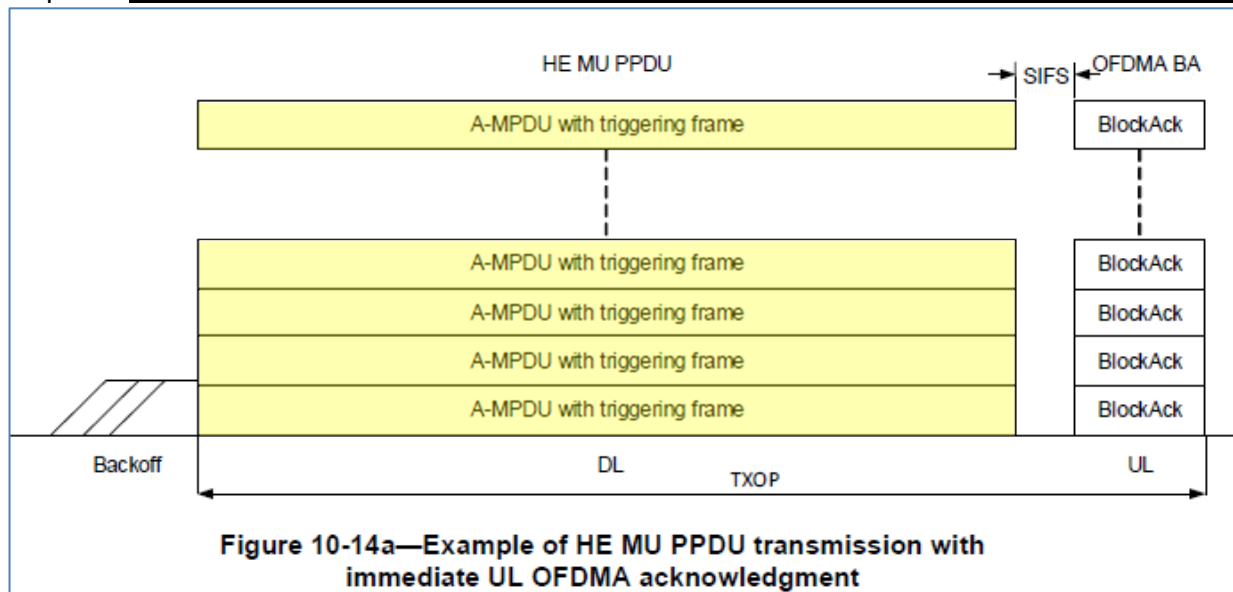
'679 Claim 5

Elements in Accused Instrumentality

5. The method according to claim 1, wherein the A Wi-Fi 6 High Efficiency Station Device receives from the AP a downlink frame, wherein the downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard:

downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA.

- “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. 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:**



An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

- “26.4.4.4 **Responding to an HE MU PPDU**, HE SU PPDU, or HE ER SU PPDU **with an HE TB PPDU** An AP that **sends an HE MU PPDU**, HE SU PPDU, or HE ER SU PPDU **that contains an MPDU that solicits an immediate**

response carried in an HE TB PPDU shall set the Ack Policy Indicator subfield to HETP Ack for each of the QoS Data frames for which it intends to solicit an immediate response (see 10.3.2.13.2). If a Management frame that solicits acknowledgment is carried in an HE MU PPDU, then the response is carried in an HE TB PPDU. A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains a QoS Data frame with HETP Ack ack policy addressed to it or contains a Management frame that solicits an immediate acknowledgment shall not respond, unless it has also received a triggering frame in the A-MPDU.

A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains one or more MPDUs soliciting acknowledgment and includes a triggering frame shall respond with an HE TB PPDU as follows:

- a) If the A-MPDU includes only one MPDU and the MPDU is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to HETP Ack for at least one MPDU, then the STA shall respond with a Compressed **BlockAck frame** as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, **the STA may respond with a Multi-STA BlockAck frame** with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1.
- d) If the HE STA supports **ack-enabled aggregation** by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes a Management frame that solicits an acknowledgment and contains one or more QoS Data frames with HETP Ack or

	Implicit BAR ack policy, then <u>the STA shall respond with a Multi-STA BlockAck frame</u> as defined in 26.4.2. e) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with HETP Ack ack policy and belonging to more than one block ack agreement, then the STA shall <u>respond with a Multi-STA BlockAck frame.</u>” 802.11ax-2021 at §26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU.
'679 Claim 6	Elements in Accused Instrumentality
6. [PRE] A method for receiving an acknowledgement frame for notifying successful data reception by an access point (AP) from a station (STA) in a wireless local area network, the method comprising:	A Wi-Fi 6 High Efficiency Access Point receives an acknowledgement frame for notifying successful data reception from a station (STA) in a wireless local area network, as shown by the following excerpts from the 802.11ax-2021 Standard: • “10.3.2.11 Acknowledgment Procedure * * * * * A STA shall not transmit an Ack frame in response to a Management frame of subtype Action No Ack. A STA shall not transmit an Ack or BlockAck frame in response to a group addressed frame. An MPDU that does not require immediate acknowledgment is implicitly considered acknowledged, as if an explicit acknowledgment had been sent. Otherwise, <u>upon reception of a frame that requires immediate acknowledgment</u> and, for an AP, with the To DS subfield equal to 1, <u>a STA shall transmit an Ack or BlockAck frame after a SIFS, without regard to the busy/idle state of the medium.</u> (See Figure 10-12.):

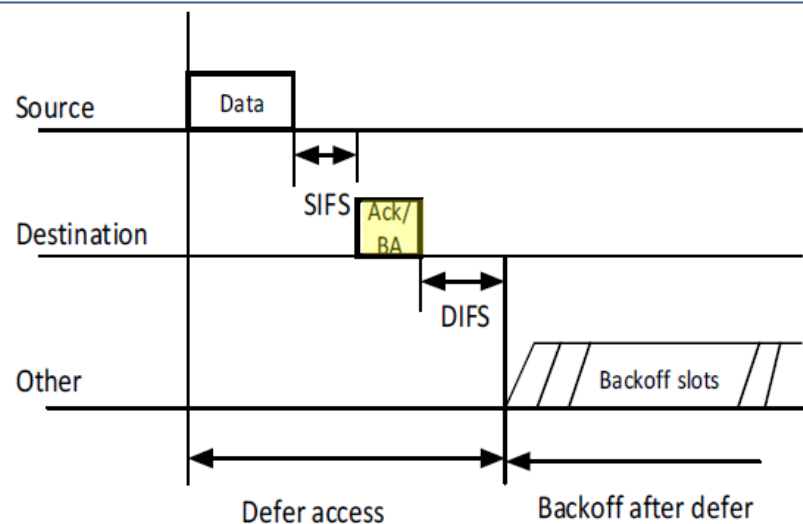


Figure 10-12—Individually addressed data/Ack/BlockAck frame „

802.11ax-2021 at §10.3.2.11 Acknowledgment Procedure

- “10.3.2.13 MU Acknowledgment Procedure

The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU sent by an AP, except if the STA is an HE STA that follows the rules defined in 26.3 and in 26.4. Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. **Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-13** and Figure 10-14:

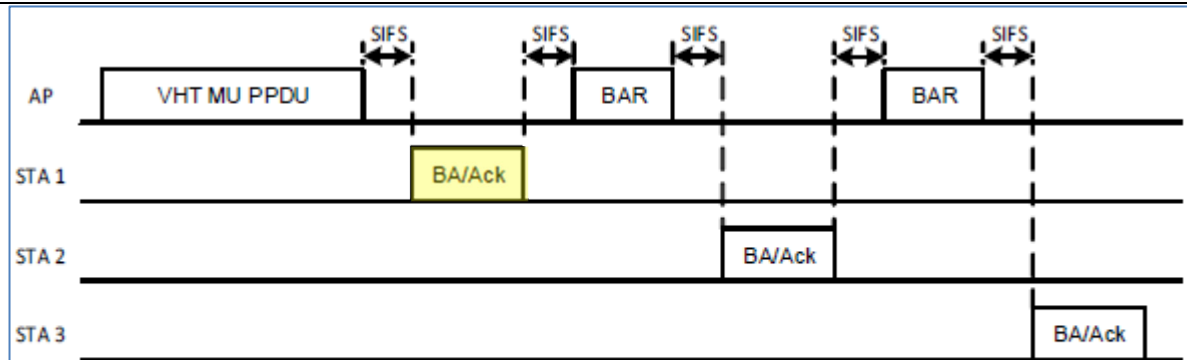
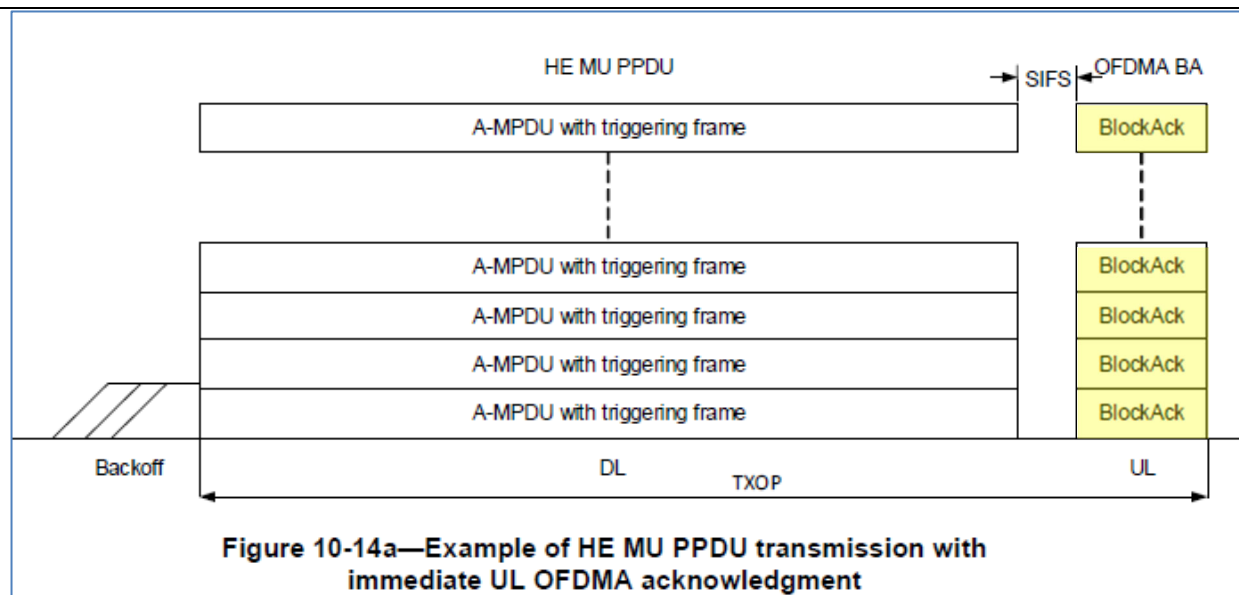


Figure 10-13—Example of TXOP containing VHT MU PPDU transmission with immediate acknowledgment to VHT MU PPDU

802.11ax-2021 at §10.3.2.13.1 Acknowledgment Procedure for DL MU PPDU in SU PPDU.

- “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. 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:

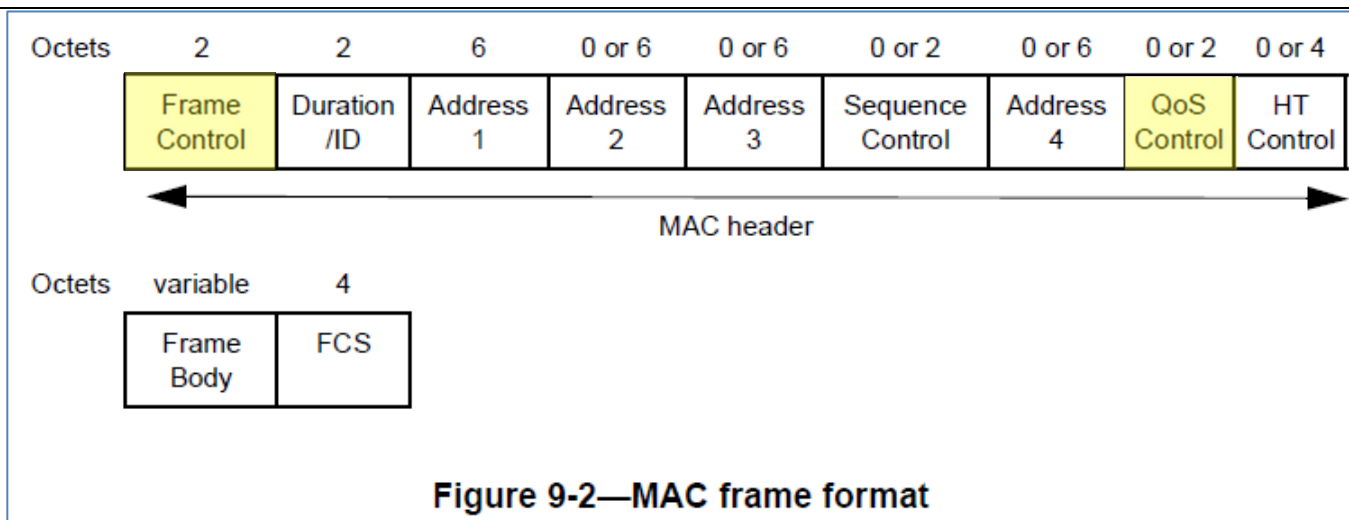


An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU. 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

- “26.4.4 Per-PPDU acknowledgment selection rules
26.4.4.1 General
A STA that transmits a PPDU can solicit different immediate responses for frames contained in the PPDU by using the Ack Policy Indicator subfield of QoS Data or QoS Null frames, the type of the frame, PPDU format, number of TIDs in the A-MPDU, and the EOF/Tag field setting of the A-MPDU delimiter.” 802.11ax-2021 at §26.4.4.1 Per -PPDU Acknowledgment Selection Rules, General.
- “26.4.5 HE block acknowledgment request and response rules
An HE AP may solicit BlockAck frame responses from multiple HE STAs using an MU-BAR Trigger frame or GCR MU-BAR Trigger frame. An HE AP shall not send a Multi-TID BlockAckReq (as part of a User Info

	field addressed to the STA in an MU-BAR Trigger frame or as a BlockAckReq frame) to a STA that has not indicated support for multi-TID A-MPDU. The Block Ack Bitmap length of the block ack sent in response to an eliciting Multi-TID BlockAckReq frame, BlockAckReq frame, GCR MU-BAR Trigger frame, or MU-BAR Trigger frame is determined as defined in 26.4.3. <u>An HE STA that receives a BlockAckReq frame or an MU-BAR Trigger frame</u> that contains a Compressed BlockAckReq variant in the User Info field addressed to the STA or receives a GCR MU-BAR Trigger frame that contains a Compressed BlockAckReq variant in the Common Info field <u>shall respond with a Compressed BlockAck frame as defined in 10.25.6 or a Multi-STA BlockAck frame as defined in 26.4</u> with the Starting Sequence Number subfield set to the Starting Sequence Number subfield of the Block Ack Request Starting Sequence Control subfield and the length of the Block Ack Bitmap subfield calculated as defined in 26.4.3. <u>An HE STA that receives a Multi-TID BlockAckReq frame or an MU-BAR Trigger frame</u> that contains a Multi-TID BlockAckReq variant in the User Info field addressed to the STA or receives a GCR MU-BAR Trigger frame that contains a Multi-TID BlockAckReq variant in the Common Info field <u>shall respond with a Multi-STA BlockAck frame</u> that contains a Per AID TID Info field with a Block Ack Bitmap subfield for each of the TIDs (with values less than 8) contained in the BlockAckReq frame, with the Starting Sequence Number subfield set to the Starting Sequence Number subfield of the Block Ack Request Starting Sequence Control subfield, and with the length of the Block Ack Bitmap subfield calculated as defined in 26.4.3. A non-AP HE STA that responds to a Compressed BlockAckReq frame, Multi-TID BlockAckReq frame, MU-BAR Trigger frame, or GCR MU-BAR Trigger frame with a Multi-STA BlockAck frame shall set the Ack Type subfield of the Multi-STA BlockAck frame to 0.” 802.11ax-2021 at §26.4.5 HE Block Acknowledgment Request and Response Rules. Section 26.4.4.3 of the Wi-Fi 6 Standard specifies how an AP can receive a SU PPDU acknowledgment from a STA that successfully receives a HE MU PPDU. Section 26.4.4.4 of the Wi-Fi 6 Standard specifies how an AP can receive a HE TB PPDU acknowledgment from a STA that successfully received a HE MU PPDU. And Section 26.4.5 of the Wi-Fi 6 Standard specifies how an AP can receive BlockAck frames from a STA that successfully receives certain trigger frames.
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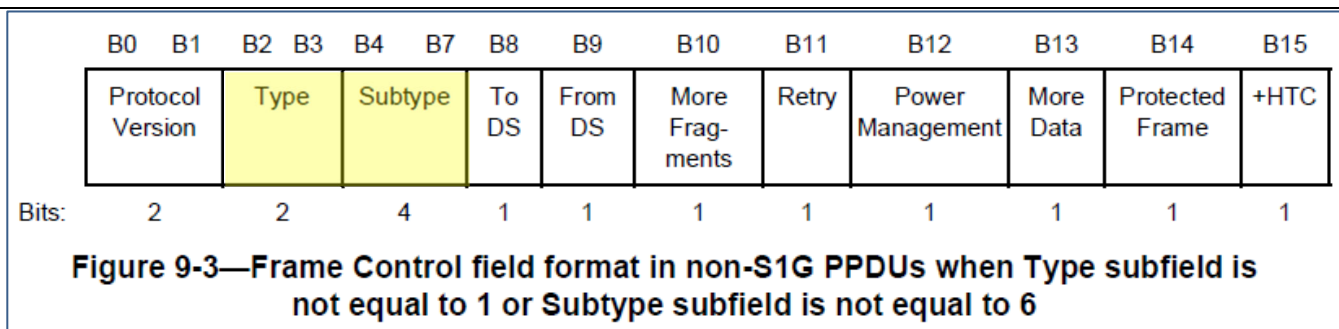
	Wi-Fi Mesh Extenders operate as Wi-Fi 6 High Efficiency Access Point Devices when using Fronthaul AP functionality to communicate with an STA device (including non-AP STA devices and devices that use Backhaul STA functionality) in a mesh network. Wi-Fi EasyMesh Specification v4.0 at 16-17, 21, Figs. 1, 2, 3. <i>See also</i> evidence and analysis for ‘679 Claim 1[PRE] & [B]
[A] transmitting, to the STA, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame; and	A Wi-Fi 6 High Efficiency Access Point transmits, to the STA, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame, as shown by the following excerpts from the 802.11ax-2021 Standard: 802.11ax MAC frame formats comprise a MAC header with frame control information: • <u>“Each frame consists of the following basic components:</u> <u>a) A MAC header, which comprises frame control</u>, duration, address, optional sequence control information, <u>optional QoS Control information (QoS Data frames only)</u>, 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 §9.2.1 MAC Frame Formats, Basic Components. • The QoS Control field identifies the TC or TS to which the frame belongs as well as various other QoS- related, A-MSDU related, and mesh-related information about the frame that varies by frame type, subtype, and type of transmitting STA. <u>The QoS Control field is present in all Data frames in which the QoS subfield of the Subtype subfield is equal to 1</u> (see 9.2.4.1.3). 802.11ax-2020 at § 9.2.4.5.1 QoS Control field structure • “The MAC frame format comprises a set of fields that occur in a fixed order in all frames. <u>Figure 9-2 depicts the general MAC frame format for protocol version 0 (PV0) MPDUs</u>, and Figure 9-978 (in 9.8.2) depicts the general MAC frame format for protocol version 1 (PV1) frames...:



802.11ax-2021 at §9.2.3 MAC Frame Format, General Frame Format

Bit 7 of the MAC Frame Control Field indicates a QoS data frame:

- **“The first three subfields of the Frame Control field** of a PVO frame **are** Protocol Version, **Type, and Subtype**. The remaining subfields of the Frame Control field depend on the setting of the Type and Subtype subfields. For a frame carried in a non-S1G PPDU, when the Type subfield is not 1 or the Subtype subfield is not 6, the remaining subfields within the Frame Control field are To DS, From DS, More Fragments, Retry, Power Management, More Data, Protected Frame, and +HTC. In this case, the format of the Frame Control field is shown in Figure 9-3:



802.11ax-2021 at §9.2.4.1.1 Frame Control Field, General.

- “The Type and Subtype subfields together identify the function of the frame. There are three frame types: control, data, and management. Each of the frame types has several defined subtypes. **In Data frames, the most significant bit (MSB) of the Subtype subfield, B7, is defined as the QoS subfield.** Table 9-1 defines the valid combinations of type and subtype. (The numeric values in Table 9-1 are shown in binary.):

Table 9-1—Valid type and subtype combinations

Type value B3 B2	Type description	Subtype value B7 B6 B5 B4	Subtype description
	*	*	*
10	Data	0000	Data
10	Data	0001	Reserved
10	Data	0010	Reserved
10	Data	0011	Reserved
10	Data	0100	Null
10	Data	0101	Reserved
10	Data	0110	Reserved
10	Data	0111	Reserved
10	Data	1000	QoS Data
10	Data	1001	QoS Data +CF-Ack
10	Data	1010	QoS Data +CF-Poll
10	Data	1011	QoS Data +CF-Ack +CF-Poll
10	Data	1100	QoS Null
10	Data	1101	Reserved
10	Data	1110	QoS CF-Poll
10	Data	1111	QoS CF-Ack +CF-Poll
11	Extension	0000	DMG Beacon
11	Extension	0001	S1G Beacon
11	Extension	0010–1111	Reserved

802.11ax-2021 at §9.2.4.1.3 Frame Control Field, Type and Subtype Subfields

The QoS Control field of the MAC header contains the Ack Policy Indicator subfield (at bits 5-6):

- “9.2.4.5.1 QoS Control Field Structure

The QoS Control field identifies the TC or TS to which the frame belongs as well as various other QoS-related, A-MSDU related, and mesh-related information about the frame that varies by frame type, subtype, and type of transmitting STA. The QoS Control field is present in all Data frames in which the QoS subfield of the Subtype subfield is equal to 1 (see 9.2.4.1.3). When not transmitted within a DMG PPDU, each QoS Control field comprises five or eight subfields, as defined for the particular sender (HC or non-AP STA) and frame type

and subtype. **The usage of these subfields and the various possible layouts of the QoS Control field are described in 9.2.4.5.2 to 9.2.4.5.12 and shown in Table 9-10:**

Table 9-10—QoS Control field

Applicable frame (sub)types	Bits 0–3	Bit 4	Bits 5–6	Bit 7	Bits 8	Bit 9	Bit 10	Bits 11–15
QoS CF-Poll and QoS CF-Ack +CF-Poll frames sent by HC	TID	EOSP	Ack Policy Indicator	Reserved	TXOP Limit			
QoS Data +CF-Poll and QoS Data +CF-Ack +CF-Poll frames sent by HC	TID	EOSP	Ack Policy Indicator	A-MSDU Present	TXOP Limit			
QoS Data and QoS Data +CF-Ack frames sent by HC	TID	EOSP	Ack Policy Indicator	A-MSDU Present	AP PS Buffer State			
QoS Null frames sent by HC	TID	EOSP	Ack Policy Indicator	Reserved	AP PS Buffer State			
QoS Data and QoS Data +CF-Ack frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA	TID	0	Ack Policy Indicator	A-MSDU Present	TXOP Duration Requested			
	TID	1	Ack Policy Indicator	A-MSDU Present	Queue Size			
QoS Null frames sent in a nonmesh BSS by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA	TID	0	Ack Policy Indicator	Reserved	TXOP Duration Requested			
	TID	1	Ack Policy Indicator	Reserved	Queue Size			
QoS Data and QoS Data +CF-Ack frames sent by TPU buffer STAs	TID	EOSP	Ack Policy Indicator	A-MSDU Present	Reserved			

Table 9-10—QoS Control field (continued)

Applicable frame (sub)types	Bits 0–3	Bit 4	Bits 5–6	Bit 7	Bits 8	Bit 9	Bit 10	Bits 11–15
QoS Null frames sent by TPU buffer STAs	TID	EOSP	Ack Policy Indicator	Reserved	Reserved			
QoS Data and QoS Data +CF-Ack frames sent by TPU sleep STAs	TID	Reserved	Ack Policy Indicator	A-MSDU Present	Reserved			
QoS Null frames sent by TPU sleep STAs	TID	Reserved	Ack Policy Indicator	Reserved	Reserved			
All frames sent by mesh STAs in a mesh BSS	TID	EOSP	Ack Policy Indicator	A-MSDU Present	Mesh Control Present	Mesh Power Save Level	RSPI	Reserved

802.11ax-2021 at §9.2.4.5.1 QoS Control Field Structure

The Ack Policy Indicator within the QoS Control Field indicates whether the STA who receives a HE MU PPDU will transmit its acknowledgment as an SU PPDU in single-user format or as a HE TB PPDU in multiple-user format. For example, if the ACK Policy Indicator of a MU PPDU is “00” indicating Normal Ack or Implicit BAR, then the STA will acknowledge reception in single-user format by use of a HE SU PPDU. But if the ACK Policy Indicator of a MU PPDU is “01” indicating HETP Ack, then the STA will acknowledge reception in multi-user format by use of a HE TB PPDU:

- “9.2.4.5.4 Ack Policy Indicator Subfield
The Ack Policy Indicator subfield, together with other information, as shown in Table 9-13, identifies the ack policy, i.e. the behavior followed upon the delivery of the MPDU:

Table 9-13—Ack policy

Ack policy	Ack Policy Indicator subfield		Other conditions	Meaning
	Bit 0	Bit 1		
Normal Ack	0	0	MPDU is a non-A-MPDU frame	Where the frame contains a fragment and both the originator and the addressed recipient support fragment BA: The addressed recipient returns an NDP BlockAck or BAT frame after a SIFS, according to the procedures defined in 10.3.2.12 and 10.47.2. Otherwise: The addressed recipient returns an Ack, STACK, or QoS +CF-Ack frame after a short interframe space (SIFS) period, according to the procedures defined in 10.3.2.11, 10.47.2, and 10.23.3.5. A non-DMG STA uses this ack policy for individually addressed QoS Null frames.
Implicit BAR	0	0	MPDU is not a non-A-MPDU frame NOTE—This MPDU is sent under a block ack agreement.	The addressed recipient returns a BlockAck, TACK or BAT frame, either individually or as part of an A-MPDU starting a SIFS after the PPDU carrying the frame, according to the procedures defined in 10.3.2.11, 10.25.6.5, 10.29.3, 10.29.4, 10.47.2, and 10.34.3.
No Ack	1	0	None	The addressed recipient takes no action upon receipt of the frame. More details are provided in 10.26. This ack policy is used in all individually addressed frames in which the sender does not require immediate acknowledgment. It is also used in all group addressed frames that use the QoS frame format except QoS Data frames with a TID for which a block ack agreement exists. It is not used for QoS Data frames with a TID for which a block ack agreement exists.

No Explicit Acknowledgment	0	1	Bit 6 of the Frame Control field (see 9.2.4.1.3) is equal to 1 <u>and the frame is not carried in an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains a frame that solicits a response in an HE TB PPDU</u>	There might be a response frame to the frame that is received, but it is neither the Ack frame nor any Data frame of subtype +CF-Ack. This ack policy is used for QoS CF-Poll and QoS CF-Ack +CF-Poll Data frames. NOTE—Bit 6 of the Frame Control field (see 9.2.4.1.3) indicates the absence of a Frame Body field in a QoS Data frame. ~~When~~ If equal to 1, the QoS Data frame contains no Frame Body field, and any response is generated in response to a QoS CF-Poll or QoS CF-Ack +CF-Poll frame, but does not signify an acknowledgment of data.
PSMP Ack	0	1	Bit 6 of the Frame Control field (see 9.2.4.1.3) is equal to 0 <u>and the frame is not carried in an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains a frame that solicits a response in an HE TB PPDU</u>	The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP downlink transmission time (PSMP-DTT) is to be received in a later PSMP uplink transmission time (PSMP-UTT). The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP-UTT is to be received in a later PSMP-DTT. See 10.30.2.7.
HETP Ack	0	1	<u>The frame is carried in an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains a frame that solicits a response in an HE TB PPDU</u>	<u>The addressed recipient returns an Ack, Compressed BlockAck, or Multi-STA BlockAck frame carried in an HE TB PPDU a SIFS after the PPDU, subject to reception of a triggering frame in the PPDU, as defined in 10.3.2.13.2 and 26.5.2.</u>
Block Ack	1	1	None	The addressed recipient takes no action upon the receipt of the frame except for recording the state. The recipient can expect a BlockAckReq frame or implicit block ack request in the future to which it responds using the procedure described in 10.25.

802.11ax-2021 at §9.2.4.5.4 Ack Policy Indicator Subfield (excerpted and annotated)

- “26.4.4.3 **Responding to an HE MU PPDU with an SU PPDU**
If an AP intends to solicit an immediate response in an SU PPDU, the following apply:

— **An AP shall set the Ack Policy Indicator subfield in the QoS Data and QoS Null frames to Normal Ack or Implicit BAR in at most one A-MPDU in the HE MU PPDU** (see 10.3.2.13.1 for an example of this sequence).

— The A-MPDUs in the HE MU PPDU shall not contain a Management frame that solicits acknowledgment.

An HE STA that receives an HE MU PPDU with an A-MPDU that contains MPDUs that solicit acknowledgment and that does not include a triggering frame shall respond using an SU PPDU as follows:

- a) If the A-MPDU carries only one MPDU and the MPDU is a tagged MPDU that is either a QoS Data frame or QoS Null frame with Normal Ack ack policy, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that is a QoS Data frame or a QoS Null frame with Normal Ack ack policy, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to Implicit BAR for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1.
- d) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with Implicit BAR ack policy addressed to it and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2.

NOTE—A control response frame carried in an SU PPDU that is an immediate response to an HE MU PPDU follows the rules defined in 10.6.6.5.

An AP that sends an HE MU PPDU shall not set the Ack Policy Indicator subfield to Normal Ack or Implicit BAR for any of the MPDUs carried in the HE MU PPDU if the PPDU containing a control response would occupy one or more 20 MHz channels where pre-HE modulated fields of the HE MU PPDU are not located.”
802.11ax-2021 at §26.4.4.3 Responding to an HE MU PPDU with an SU PPDU

- “26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU
An AP that sends an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU that contains an MPDU that solicits an immediate response carried in an HE TB PPDU shall set the Ack Policy Indicator subfield to HETP Ack for each of the QoS Data frames for which it intends to solicit an immediate response (see 10.3.2.13.2). If a Management frame that solicits acknowledgment is carried in an HE MU PPDU, then the response is carried in an HE TB PPDU. A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains a QoS Data frame with HETP Ack ack policy addressed to it or contains a Management frame that solicits an immediate acknowledgment shall not respond, unless it has also received a triggering frame in the A-MPDU.

A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains one or more MPDUs soliciting acknowledgment and includes a triggering frame shall respond with an HE TB PPDU as follows:

- a) If the A-MPDU includes only one MPDU and the MPDU is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to HETP Ack for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1.
- d) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes a Management

	frame that solicits an acknowledgment and contains one or more QoS Data frames with HETP Ack or Implicit BAR ack policy, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2. e) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with HETP Ack ack policy and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame.” 802.11ax-2021 at §26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU. Upon reception of a MAC layer frame, the AP’s PHY layer extracts the relevant information, as well as parameters used to transmit the frame: • “<u>The PHY provides an interface to the MAC</u> through an extension of the generic PHY service interface defined in 8.3.4. <u>The interface includes TXVECTOR, RXVECTOR</u>, 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 • “<u>The HE PHY TXVECTOR and RXVECTOR</u> 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 N_{SS} is $NUM_STS / (STBC + 1)$.” 802.11ax-2021 at §8.3.4.4 PHY Service Specification, Vector Descriptions The PHY layer transmit process is shown in the following figure:
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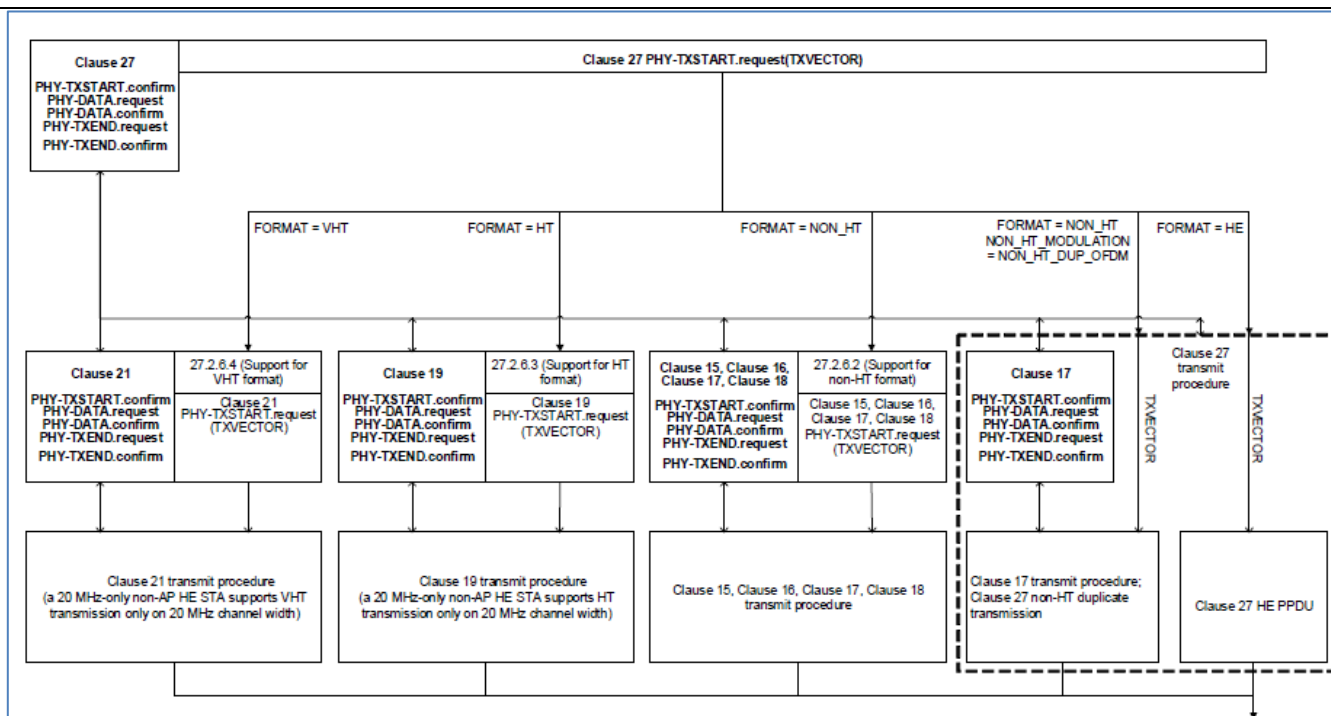


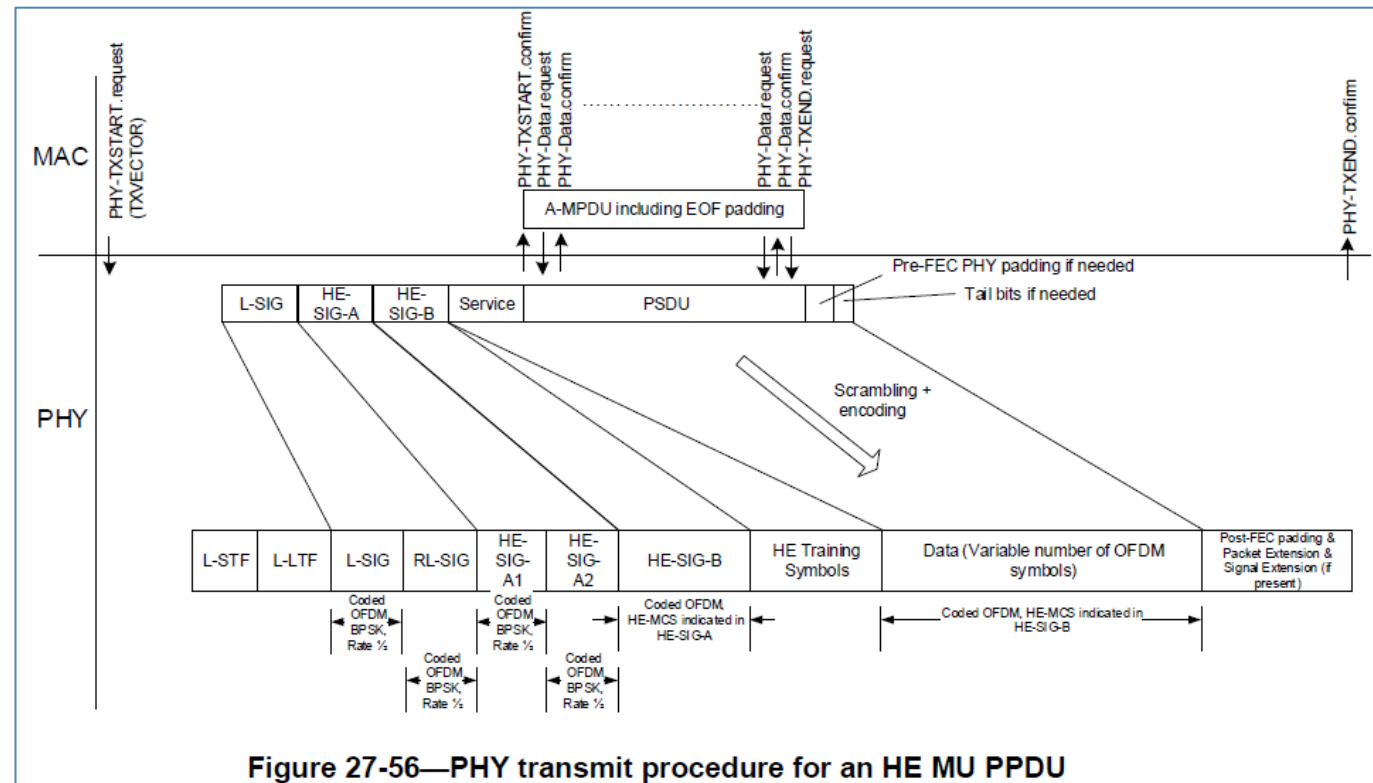
Figure 27-1—PHY interaction on transmit for various PPDU formats

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

Section 27.3 of the Wi-Fi 6 standard describes the procedures for transmitting a frame:

- “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 receiver, the PHY preamble is processed to aid in the detection, demodulation, and delivery of the PSDU.” 802.11ax-2021 at §27.3.1 HE PHY, Introduction.
- “27.3.21 HE transmit procedure

There are five options for the transmit PHY procedure. The first four options, for which typical transmit procedures are shown in Figure 27-54, Figure 27-55, **Figure 27-56**, and Figure 27-57, **are selected if the FORMAT field of the PHY-TXSTART.request(TXVECTOR) primitive is equal to HE_SU, HE MU, HE_ER_SU, or HE_TB, respectively.** These transmit procedures do not describe the operation of optional features, such as DCM....



802.11ax-2021 at §27.3.21 HE Transmit Procedure

- **“In all options, in order to transmit data, the MAC generates a PHY-TXSTART.request primitive, which causes the PHY entity to enter the transmit state.** Further, the PHY is set to operate at the appropriate frequency through station management via the PLME, as specified in 27.4. Other transmit parameters, such as HE-MCS, coding types, and transmit power, are set via the PHY-SAP using the

PHYTXSTART.request(TXVECTOR) primitive, as described in 27.2.2. After transmitting a PPDU that carries a Trigger frame, the MAC sublayer issues a PHY-TRIGGER.request with a TRIGVECTOR parameter that provides the PHY entity with the information needed to demodulate the expected HE TB PPDU response. The remainder of this subclause applies to the first four options.

The PHY indicates the state of the primary channel and other channels (if any) via the PHY-CCA.indication primitive (see 21.3.18.5 and 8.3.5.12). **Transmission of the PPDU shall be initiated by the PHY after receiving the PHY-TXSTART.request(TXVECTOR) primitive. The TXVECTOR parameters for the PHYTXSTART.request primitive are specified in Table 27-1.** 802.11ax-2021 at §27.3.21 HE Transmit Procedure

The STA transmits the acknowledgment frame at a short interframe space (“SIFS”) time after the downlink frame:

- “10.3.2.13 MU Acknowledgment Procedure

The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU sent by an AP, except if the STA is an HE STA that follows the rules defined in 26.3 and in 26.4. Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. **Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-13** and Figure 10-14:

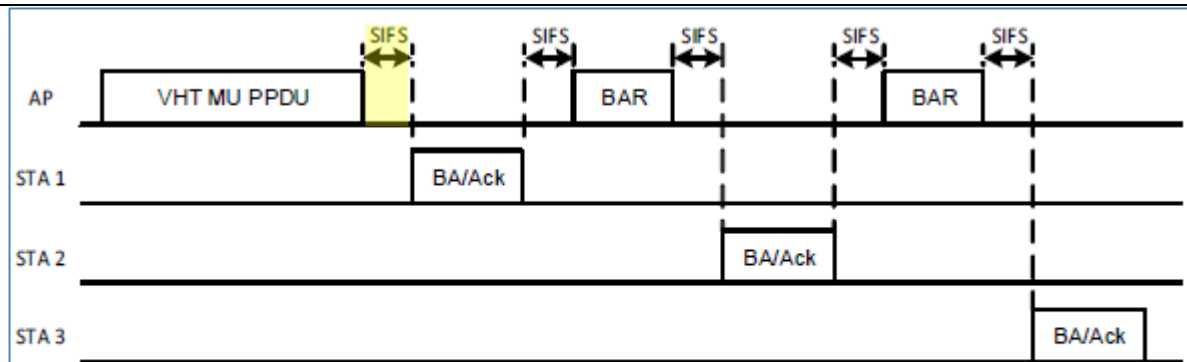
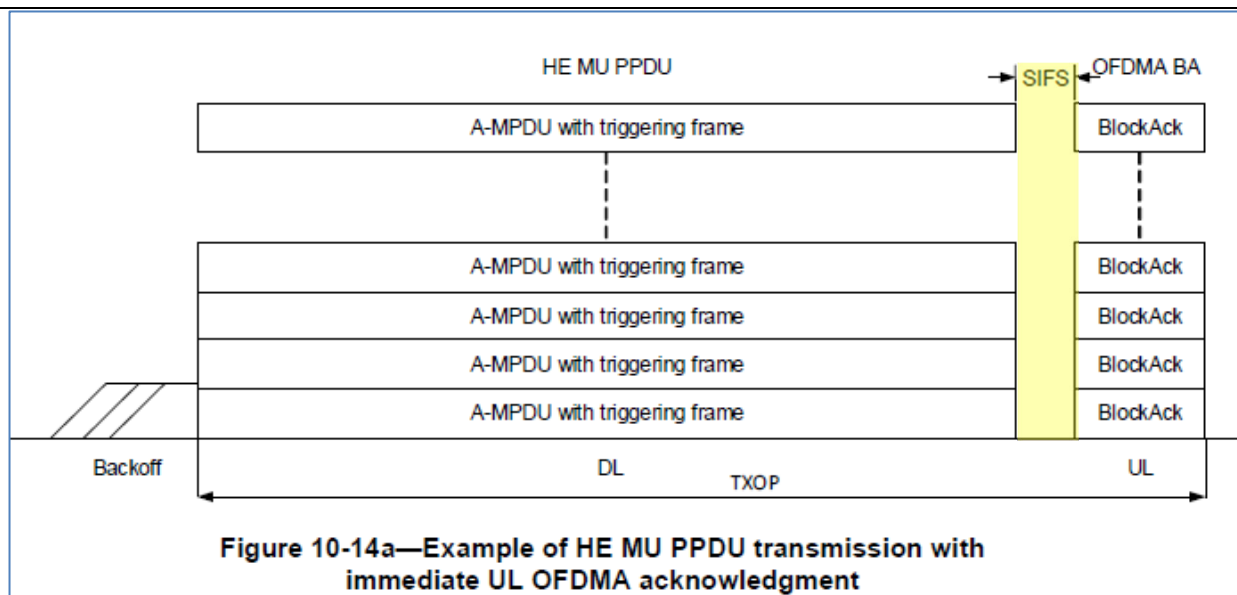


Figure 10-13—Example of TXOP containing VHT MU PPDU transmission with immediate acknowledgment to VHT MU PPDU

802.11ax-2021 at §10.3.2.13.1 Acknowledgment Procedure for DL MU PPDU in SU PPDU.

- “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. 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:



An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

See also evidence and analysis for ‘679 Claim 1[A]-[B]

[B] receiving, from the STA, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame,

A Wi-Fi 6 High Efficiency Access Point receives, from the STA, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame, and when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format, the Wi-Fi 6 High Efficiency Access Point receives the acknowledgement frame in the MU format on an allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard:

- **“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 transmission of response

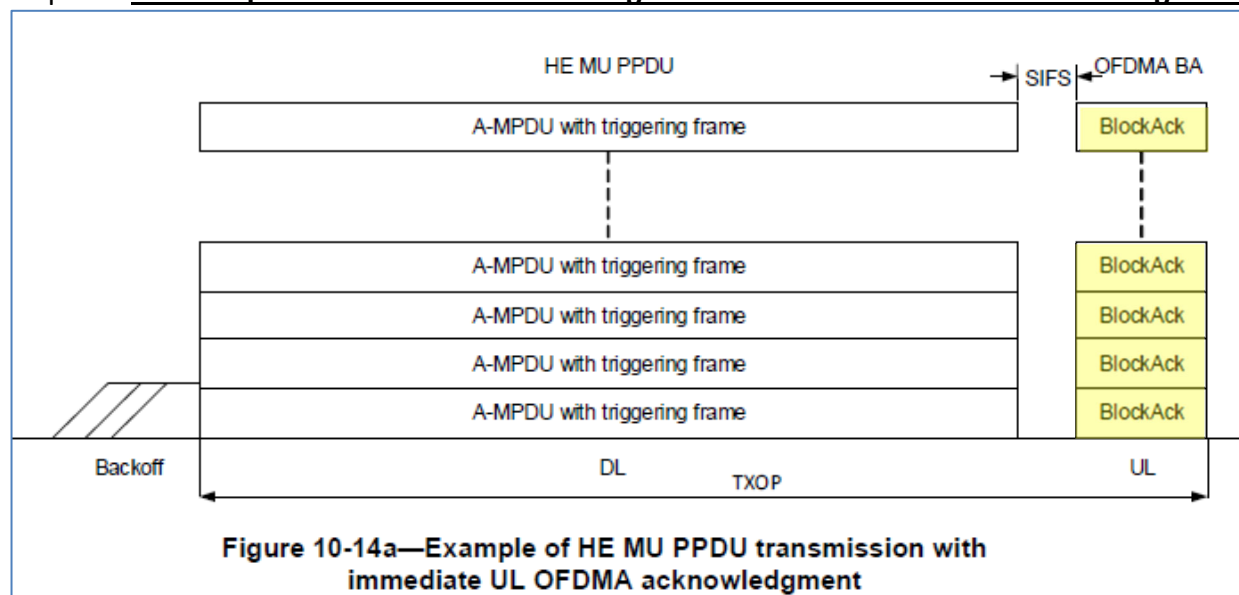
wherein receiving the acknowledgment frame comprises:

when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format, receiving the acknowledgement frame in the MU format on an allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, and

frames in an HE TB PPDU, 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).” 802.11ax-2021 at §26.5.2.1 UL MU Operation, General

- “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. 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:**



An AP may use an MU-BAR Trigger frame or a GCR MU-BAR Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frames with Block Ack ack policy or from which the AP has not received immediate acknowledgment frames after sending QoS Data frames with HETP Ack ack policy in an HE MU PPDU.” 802.11ax-2021 at §10.3.2.13.2 Acknowledgment Procedure for DL MU PPDU in MU Format.

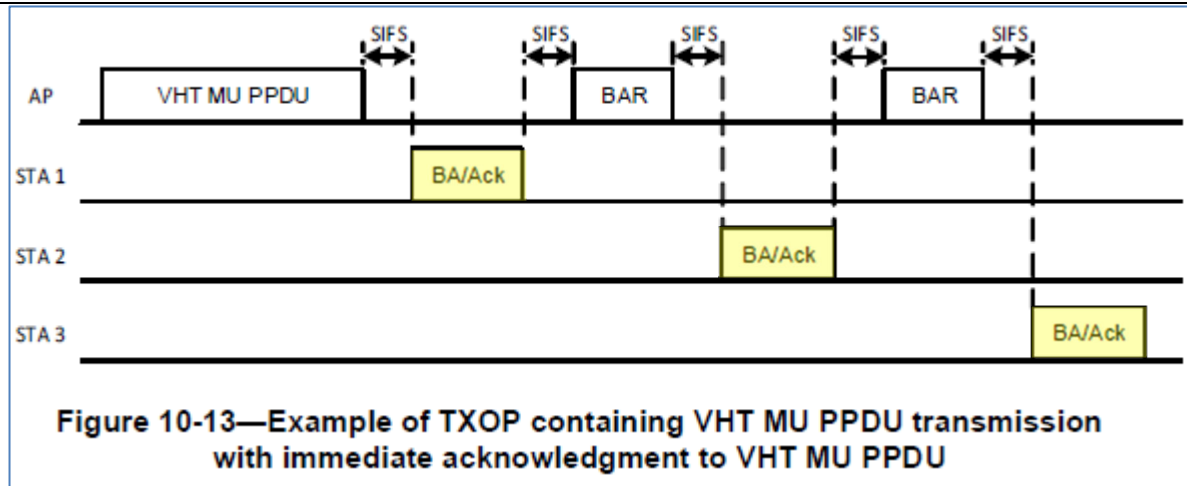
- “26.4.4.4 **Responding to an HE MU PPDU**, HE SU PPDU, or HE ER SU PPDU **with an HE TB PPDU**. An AP that **sends an HE MU PPDU**, HE SU PPDU, or HE ER SU PPDU **that contains an MPDU that solicits an immediate response carried in an HE TB PPDU shall set the Ack Policy Indicator subfield to HETP Ack for each of the QoS Data frames for which it intends to solicit an immediate response (see 10.3.2.13.2)**. If a Management frame that solicits acknowledgment is carried in an HE MU PPDU, then the response is carried in an HE TB PPDU. A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an A-MPDU that contains a QoS Data frame with HETP Ack ack policy addressed to it or contains a Management frame that solicits an immediate acknowledgment shall not respond, unless it has also received a triggering frame in the A-MPDU.

A non-AP STA that receives an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU **with an A-MPDU that contains one or more MPDUs soliciting acknowledgment and includes a triggering frame shall respond with an HE TB PPDU** as follows:

- a) If the A-MPDU includes only one MPDU and the MPDU is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that either is a QoS Data or QoS Null frame with HETP Ack ack policy or is a Management frame that solicits acknowledgment, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator subfield equal to HETP Ack for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1.
- d) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes a Management

	frame that solicits an acknowledgment and contains one or more QoS Data frames with HETP Ack or Implicit BAR ack policy, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.2. e) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with HETP Ack ack policy and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame.” 802.11ax-2021 at §26.4.4.4 Responding to an HE MU PPDU, HE SU PPDU, or HE ER SU PPDU with an HE TB PPDU. <i>See also evidence and analysis for ‘679 Claim 1[A]-[C]</i>
[C] [receiving, from the STA, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame, wherein receiving the acknowledgement frame comprises:] when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, receiving the	A Wi-Fi 6 High Efficiency Access Point receives, from the STA, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame, and when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, the Wi-Fi 6 High Efficiency Access Point receives the acknowledgement frame in SU format, as shown by the following excerpts from the 802.11ax-2021 Standard: • <u>“UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP HE STAs.</u> A non-AP HE STA shall follow the rules in this subclause for the transmission of response frames in an HE TB PPDU, 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).” 802.11ax-2021 at §26.5.2.1 UL MU Operation, General • <u>“10.3.2.13 MU Acknowledgment Procedure</u> The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU sent by an AP, except if the STA is an HE STA that follows the rules defined in 26.3 and in 26.4. Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. <u>Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-13</u> and Figure 10-14:

acknowledgement frame in SU format.



802.11ax-2021 at §10.3.2.13.1 Acknowledgment Procedure for DL MU PPDU in SU PPDU.

- “26.4.4.3 Responding to an HE MU PPDU with an SU PPDU

If an AP intends to solicit an immediate response in an SU PPDU, the following apply:

— An AP shall set the Ack Policy Indicator subfield in the QoS Data and QoS Null frames to Normal Ack or Implicit BAR in at most one A-MPDU in the HE MU PPDU (see 10.3.2.13.1 for an example of this sequence).

— The A-MPDUs in the HE MU PPDU shall not contain a Management frame that solicits acknowledgment. An HE STA that receives an HE MU PPDU with an A-MPDU that contains MPDUs that solicit acknowledgment and that does not include a triggering frame shall respond using an SU PPDU as follows:

- a) If the A-MPDU carries only one MPDU and the MPDU is a tagged MPDU that is either a QoS Data frame or QoS Null frame with Normal Ack ack policy, then the STA shall respond with an Ack frame.
- b) If the HE STA supports ack-enabled aggregation by setting the Ack-Enabled Aggregation Support subfield in the HE MAC Capabilities Information field to 1, and if the A-MPDU includes more than one MPDU, only one of which solicits acknowledgment and the MPDU that solicits acknowledgment is a tagged MPDU that is a QoS Data frame or a QoS Null frame with Normal Ack ack policy, then the HE STA shall respond with an Ack frame.
- c) If the A-MPDU does not include a tagged MPDU but does include one or more untagged MPDUs that are QoS Data frames belonging to the same block ack agreement and with the Ack Policy Indicator

	subfield equal to Implicit BAR for at least one MPDU, then the STA shall respond with a Compressed BlockAck frame as defined in 10.25.6.5. Alternatively, if all the MPDUs carried in the eliciting A-MPDU were received, the STA may respond with a Multi-STA BlockAck frame with the Ack Type set to 1 and the TID field set to 14 as defined in 26.4.2 if the originator of the A-MPDU has indicated support for the all ack context by setting the All Ack Support subfield in the HE MAC Capabilities Information field to 1. d) If the HE STA supports multi-TID aggregation and if the A-MPDU includes two or more QoS Data frames with Implicit BAR ack policy addressed to it and belonging to more than one block ack agreement, then the STA shall respond with a Multi-STA BlockAck frame as defined in 26.4.22. NOTE—A control response frame carried in an SU PPDU that is an immediate response to an HE MU PPDU follows the rules defined in 10.6.6.5. An AP that sends an HE MU PPDU shall not set the Ack Policy Indicator subfield to Normal Ack or Implicit BAR for any of the MPDUs carried in the HE MU PPDU if the PPDU containing a control response would occupy one or more 20 MHz channels where pre-HE modulated fields of the HE MU PPDU are not located.” 802.11ax-2021 at §26.4.4.3 Responding to an HE MU PPDU with an SU PPDU <i>See also</i> evidence and analysis for ‘679 Claim 1[A]-[B], [D]
‘679 Claim 7	Elements in Accused Instrumentality
7. The method according to claim 6, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.	A Wi-Fi 6 High Efficiency Access Point transmits, to the STA, a downlink frame, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See</i> evidence and analysis for ‘679 Claim 2

‘679 Claim 8	Elements in Accused Instrumentality
8. The method according to claim 7, wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA.	A Wi-Fi 6 High Efficiency Access Point transmits, to the STA, a downlink frame, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame, and wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis for ‘679 Claim 3.</i>
‘679 Claim 9	Elements in Accused Instrumentality
9. The method according to claim 6, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA.	A Wi-Fi 6 High Efficiency Access Point transmits, to the STA, a downlink frame, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis for ‘679 Claim 4.</i>
‘679 Claim 10	Elements in Accused Instrumentality
10. The method according to claim 6, wherein the downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA.	A Wi-Fi 6 High Efficiency Access Point transmits, to the STA, a downlink frame, wherein the downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard: <i>See evidence and analysis for ‘679 Claim 5.</i>