EXTREMELY HIGH THROUGHPUT ACCESS POINT, EXTREMELY HIGH THROUGHPUT STATION, AND WIRELESS COMMUNICATION METHOD

BACKGROUND OF DISCLOSURE

1. Field of the Disclosure

[0001] The present disclosure relates to the field of communication systems, and more particularly, to an extremely high throughput (EHT) access point (AP), an EHT station (STA), and a wireless communication method, which can provide a good communication performance and/or provide high reliability.

2. Description of the Related Art

[0002] Communication systems such as wireless communication systems are widely deployed to provide various types of communication content such as voice, video, packet data, messaging, broadcast, and so on. These communication systems may be multiple-access systems capable of supporting communication with multiple users by sharing available system resources (such as, time, frequency, and power). A wireless network, for example a wireless local area network (WLAN), such as a Wi-Fi (institute of electrical and electronics engineers (IEEE) 802.11) network may include an access point (AP) that may communicate with one or more stations (STAs) or mobile devices. The WLAN enables a user to wirelessly access an internet based on radio frequency technology in a home, an office, or a specific service area using a portable terminal such as a personal digital assistant (PDA), a laptop computer, a portable multimedia player (PMP), a smartphone, etc. The AP may be coupled to a network, such as the internet, and may enable a mobile device to communicate via the network (or communicate with other devices coupled to the AP). A wireless device may communicate with a network device bi-directionally. For example, in a WLAN, a STA may communicate with an associated AP via downlink and uplink. The downlink may refer to a communication link from the AP to the STA, and the uplink may refer to a communication link from the STA to the AP.

[0003] In recent times, to support increased numbers of devices supporting WLAN, such as smartphones, more APs have been deployed. Despite increase in use of WLAN devices supporting the IEEE 802.11ax high efficiency (HE) WLAN standard, that provide high performance relative to WLAN devices supporting the legacy IEEE 802.11g/n/ac standard, a WLAN system supporting higher performance is required due to WLAN users' increased use of high volume content such as a ultra-high definition video. Although a conventional WLAN system has aimed at increase of bandwidth and improvement of a peak transmission rate, actual users thereof could not feel drastic increase of such performance.

[0004] In a task group called IEEE 802.11be, extremely high throughput (EHT) WLAN standardization is under discussion. The EHT WLAN aims at achieving extremely high throughput and/or improving performance felt by users demanding high-capacity, high-rate services while supporting simultaneous access of numerous stations in an environment in which a plurality of APs is densely deployed and coverage areas of APs overlap.

[0005] IEEE 802.11ax HE WLAN supports a bandwidth (BW) up to 160 MHz and supports the number of spatial streams in a multi-user multiple input multiple output (MU-MIMO) transmission up to 8. In order to achieve significant throughput improvement over IEEE 802.11ax HE WLAN, IEEE 802.11be EHT WLAN extends maximum BW support from 160 MHz to 320 MHz and extends the support of maximum number of spatial streams in a MU-MIMO transmission from 8 to 16. In addition, it is expected that HE STAs will exist with EHT STAs in a same EHT BSS.

[0006] In IEEE 802.11be EHT WLAN, for facilitating orthogonal frequency division multiple access (OFDMA) transmission and non-OFDMA MU-MIMO transmission, a trigger based (TB) sounding procedure needs to be executed between an EHT AP and two or more STAs. However, it is an open issue to design an efficient TB sounding procedure for IEEE 802.11be EHT WLAN.

[0007] Therefore, there is a need for an extremely high throughput (EHT) access point (AP), an EHT station (STA), and a wireless communication method, which can solve issues in the prior art, reduce implementation complexity in TB sounding, achieve extremely high throughput, provide good communication performance, and/or provide high reliability.

SUMMARY

[0008] An object of the present disclosure is to propose an extremely high throughput (EHT) access point (AP), an EHT station (STA), and a wireless communication method, which can solve issues in the prior art, reduce implementation complexity in TB sounding, achieve extremely high throughput, provide good communication performance, and/or provide high reliability.

[0009] In a first aspect of the present disclosure, a wireless communication method comprises performing a trigger based (TB) sounding procedure, by an extremely high throughput (EHT) access point (AP), wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between the EHT AP and stations (STAs) comprising at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising EHT STAs only.

[0010] In a second aspect of the present disclosure, a wireless communication method comprises performing a trigger based (TB) sounding procedure, by an extremely high throughput (EHT) station (STA), wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between an EHT access point (AP) and stations (STAs) comprising the EHT STA and at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising the EHT STA and no any HE STAs.

[0011] In a third aspect of the present disclosure, an extremely high throughput (EHT) access point (AP) comprises a memory, a transceiver, and a processor coupled to the memory and the transceiver. The processor is configured to perform a trigger based (TB) sounding procedure, wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between the EHT AP and stations (STAs) comprising at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising EHT STAs only.

[0012] In a fourth aspect of the present disclosure, an extremely high throughput (EHT) station (STA) comprises a memory, a transceiver, and a processor coupled to the memory and the transceiver. The processor is configured to perform a trigger based (TB) sounding procedure, wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between an EHT access point (AP) and STAs comprising the EHT STA and at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising the EHT STA and no any HE STAs.

[0013] In a fifth aspect of the present disclosure, a non-transitory machine-readable storage medium has stored thereon instructions that, when executed by a computer, cause the computer to perform the above method.

[0014] In a sixth aspect of the present disclosure, a chip includes a processor, configured to call and run a computer program stored in a memory, to cause a device in which the chip is installed to execute the above method.

[0015] In a seventh aspect of the present disclosure, a computer readable storage medium, in which a computer program is stored, causes a computer to execute the above method.

[0016] In an eighth aspect of the present disclosure, a computer program product includes a computer program, and the computer program causes a computer to execute the above method.

[0017] In a ninth aspect of the present disclosure, a computer program causes a computer to execute the above method.

BRIEF DESCRIPTION OF DRAWINGS

[0018] In order to illustrate the embodiments of the present disclosure or related art more clearly, the following figures will be described in the embodiments are briefly introduced. It is obvious that the drawings are merely some embodiments of the present disclosure, a person having ordinary skill in this field can obtain other figures according to these figures without paying the premise.

[0019] FIG. 1 is a schematic diagram illustrating an example extremely high throughput (EHT) trigger based (TB) sounding procedure executed between an EHT access point (AP) and two EHT stations (STAs) according to an embodiment of the present disclosure.

[0020] FIG. 2 is a schematic diagram illustrating a trigger frame format according to an embodiment of the present disclosure.

[0021] FIG. 3A is a schematic diagram illustrating a high efficiency (HE) TB physical layer protocol data unit (PPDU) format according to an embodiment of the present disclosure.

[0022] FIG. 3B is a schematic diagram illustrating an EHT TB PPDU format according to an embodiment of the present disclosure.

[0023] FIG. 4 is a schematic diagram illustrating an EHT sounding null data packet (NDP) format according to an embodiment of the present disclosure.

[0024] FIG. 5 is a schematic diagram illustrating an example of a wireless communications system according to an embodiment of the present disclosure.

[0025] FIG. 6 is a schematic diagram illustrating an example of a wireless communications system according to another embodiment of the present disclosure.

[0026] FIG. 7 is a schematic diagram illustrating an example of a wireless communications system according to another embodiment of the present disclosure.

[0027] FIG. 8 is a block diagram of one or more stations (STAs) and an access point (AP) of communication in a wireless communications system according to an embodiment of the present disclosure.

[0028] FIG. 9 is a flowchart illustrating a wireless communication method performed by an AP according to an embodiment of the present disclosure.

[0029] FIG. 10 is a flowchart illustrating a wireless communication method performed by a STA according to another embodiment of the present disclosure.

[0030] FIG. 11 is a schematic diagram illustrating a first example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to a first embodiment of the present disclosure.

[0031] FIG. 12A is a schematic diagram illustrating a format of common information field of beamforming report poll (BFRP) trigger frame according to the first embodiment of the present disclosure.

[0032] FIG. 12B is a schematic diagram illustrating a format of HE user information field of BFRP trigger frame according to the first embodiment of the present disclosure.

[0033] FIG. 13 is a schematic diagram illustrating a second example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to the first embodiment of the present disclosure.

[0034] FIG. 14A is a schematic diagram illustrating an example format of common information field of EHT BFRP trigger frame according to the first embodiment of the present disclosure.

[0035] FIG. 14B is a schematic diagram illustrating an example format of EHT user information field of EHT BFRP trigger frame according to the first embodiment of the present disclosure.

[0036] FIG. 14C is a schematic diagram illustrating an example format of special user information field of EHT BFRP trigger frame according to the first embodiment of the present disclosure.

[0037] FIG. 15 is a schematic diagram illustrating a first example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to a second embodiment of the present disclosure.

[0038] FIG. 16 is a schematic diagram illustrating an example format of common information field of enhanced BFRP trigger frame with enhanced trigger frame flag subfield set to 0 according to the second embodiment of the present disclosure.

[0039] FIG. 17 is a schematic diagram illustrating a second example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to the second embodiment of the present disclosure.

[0040] FIG. 18 is a schematic diagram illustrating an example format of common information field of enhanced BFRP trigger frame with enhanced trigger frame flag subfield set to 1 according to the second embodiment of the present disclosure.

[0041] FIG. 19A is a schematic diagram illustrating a first example format of EHT user information field of enhanced BFRP trigger frame according to the second embodiment of the present disclosure.

[0042] FIG. 19B is a schematic diagram illustrating a second example format of EHT user information field of enhanced BFRP trigger frame according to the second embodiment of the present disclosure.

[0043] FIG. 19C is a schematic diagram illustrating a third example format of EHT user information field of enhanced BFRP trigger frame according to the second embodiment of the present disclosure.

[0044] FIG. 20A is a schematic diagram illustrating a first example format of special user information field of enhanced BFRP trigger frame according to the second embodiment of the present disclosure.

[0045] FIG. 20B is a schematic diagram illustrating a second example format of special user info field of enhanced BFRP trigger frame according to the second embodiment of the present disclosure.

[0046] FIG. 21 is a block diagram of a system for wireless communication according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0047] Embodiments of the present disclosure are described in detail with the technical matters, structural features, achieved objects, and effects with reference to the accompanying drawings as follows. Specifically, the terminologies in the embodiments of the present disclosure are merely for describing the purpose of the certain embodiment, but not to limit the disclosure.

[0048] Table 1:

Abbreviation	Full name
IEEE	Institute of Electrical and Electronics Engineers
WLAN	Wireless local area network
BSS	Basic service set
AP	Access point
STA	Station
PHY	Physical layer
MAC	Medium access control layer
MPDU	MAC protocol data unit
PPDU	PHY protocol data unit
HT	High throughput

HE	High efficiency
EHT	Extremely high throughput
MU-MIMO	Multi-user multiple input multiple output
OFDMA	Orthogonal frequency division multiple access
TB	Trigger based
L-LTF	Non-HT Long Training field
L-STF	Non-HT Short Training field
L-SIG	Non-HT SIGNAL field
RL-SIG	Repeated L-SIG
HE-SIG-A	HE SIGNAL A field
U-SIG	Universal SIGNAL field
HE-STF	HE Short Training field
HE-LTF	HE Long Training field
EHT-STF	EHT Short Training field
EHT-LTF	EHT Long Training field
PE	Packet Extension field
BW	Bandwidth
GI	Guard interval
MCS	Modulation and coding scheme
RU	Resource unit
MRU	Multiple resource unit
SIFS	Short interframe spacing
BF	Beamforming
BFRP	Beamforming Report Poll
NDP	Null data packet
STBC	Space-time block coding
CQI	Channel quality indicator

[0049] Institute of electrical and electronics engineers (IEEE) 802.11be extremely high throughput (EHT) wireless local area network (WLAN) supports a bandwidth (BW) up to 320 MHz and a maximum number of spatial streams up to 16. It is expected that high efficiency (HE) stations (STAs) will exist with EHT STAs in a same EHT basic service set (BSS). In IEEE 802.11be EHT WLAN, for facilitating orthogonal frequency division multiple access (OFDMA) transmission and non-OFDMA multi-user multiple input multiple output (MU-MIMO) transmission, a trigger based (TB) sounding procedure needs to be executed between an EHT AP and two or more STAs.

[0050] FIG. 1 illustrates an example EHT TB sounding procedure executed between an EHT access point (AP) and two EHT stations (STAs) according to an embodiment of the present disclosure. The EHT TB sounding procedure comprises the following steps: transmitting, by the EHT AP, an EHT NDP (null data packet) announcement frame to the EHT STAs such as STA1 and STA2, transmitting, by the EHT AP, an EHT sounding NDP to the EHT STAs, transmitting, by the EHT

AP, a trigger frame to the EHT STAs to solicit TB PPDU (physical layer protocol data unit) transmissions from the EHT STAs, and receiving, by the EHT AP, TB PPDUs from the EHT STAs.

[0051] FIG. 2 illustrates a trigger frame format according to an embodiment of the present disclosure. The trigger frame format comprises a common information field and a user information list field comprising one or more user information fields. The formats of the common information field and the user information field depend on the type of the trigger frame.

[0052] FIG. 3A illustrates a HE TB PPDU format according to an embodiment of the present disclosure. FIG. 3B illustrates an EHT TB PPDU format according to an embodiment of the present disclosure. In a HE TB PPDU, L-STF field, L-LTF field, L-SIG field, RL-SIG field, and HE-SIG-A field are called pre-HE modulated fields while HE-STF field, HE-LTF field, data field, and PE field are called HE modulated fields. In an EHT TB PPDU, L-STF field, L-LTF field, L-SIG field, RL-SIG field, and U-SIG field are called pre-EHT modulated fields while EHT-STF field, EHT-LTF field, data field, and PE field are called EHT modulated fields. Each HE-LTF symbol or EHT-LTF symbol has the same GI duration as each data symbol, which is 0.8 μs, 1.6 μs, or 3.2 μs. The HE-LTF field comprises three types: 1x HE-LTF, 2x HE-LTF, and 4x HE-LTF. Similarly, the EHT-LTF field comprises three types: 1x EHT-LTF, 2x EHT-LTF, and 4x EHT-LTF. The duration of each 1x HE-LTF/EHT-LTF, 2x HE-LTF/EHT-LTF, or 4x HE-LTF/EHT-LTF symbol without GI is 3.2 μs, 6.4 μs, or 12.8 μs. Each data symbol without GI is 12.8 μs. The PE field duration of a HE TB PPDU is 0 μs, 4 μs, 8 μs, 12 μs, or 16 μs; while the PE field duration of an EHT TB PPDU is 0 μs, 4 μs, 8 μs, 12 μs, 16 μs, or 20 μs.

[0053] FIG. 4 illustrates an EHT sounding NDP format according to an embodiment of the present disclosure. In an EHT sounding NDP, L-STF field, L-LTF field, L-SIG field, RL-SIG field, U-SIG field, and EHT-SIG field are called pre-EHT modulated fields while EHT-STF field, EHT-LTF field, and PE field are called EHT modulated fields. Each EHT-LTF symbol has a GI duration of 0.8 μs or 1.6 μs. The EHT-LTF field comprises two types: 2x EHT-LTF and 4x EHT-LTF. The duration of each 2x EHT-LTF or 4x EHT-LTF symbol without GI is 6.4 μs or 12.8 μs. The PE field duration of an EHT sounding NDP is 4 μs or 8 μs.

[0054] The following description is directed to certain implementations for the purposes of describing the innovative aspects of the present disclosure. However, a person having ordinary skill in the art will readily recognize that the teachings herein can be applied in a multitude of different ways. The described implementations may be implemented in any device, system, or network that is capable of transmitting and receiving radio frequency (RF) signals according to any of the IEEE 802.11 standards, the Bluetooth® standard, code division multiple access (CDMA), frequency division multiple access (FDMA), time division multiple access (TDMA), global system for mobile communications (GSM), GSM/general packet radio service (GPRS), enhanced data GSM environment (EDGE), terrestrial trunked radio (TETRA), wideband-CDMA (W-CDMA), evolution data optimized (EV-DO), 1×EV-DO, EV-DO Rev A, EV-DO Rev B, high speed packet access (HSPA), high speed downlink packet access (HSDPA), high speed uplink packet access (HSUPA), evolved high speed packet access (HSPA+), long term evolution (LTE), AMPS, or other known signals that are used to communicate within a wireless, cellular or internet of things (IOT) network, such as a system utilizing 3G, 4G, or 5G, or further implementations thereof, technology.

[0055] Techniques are disclosed for wireless devices to support multiplexing clients of different generations in trigger-based transmissions. For example, an AP that supports multiple generations of STA may support uplink transmissions in, for example, an EHT wireless communications system. EHT systems also may be referred to as ultra-high throughput (UHT) systems, next generation Wi-Fi systems, or next big thing (NBT) systems, and may support coverage for multiple types of mobile STAs. For example, an AP in an EHT system may provide coverage for EHT STAs, as well as legacy (or HE) STAs. The AP may multiplex boy EHT STAs and HE STAs in trigger-based uplink transmissions. That is, the AP may operate using techniques to provide backwards compatibility for HE STAs, while providing additional functionality for EHT STAs.

[0056] To trigger uplink transmissions from one or more STAs of different generations, the AP may transmit a trigger frame. The trigger frame may be formatted as a legacy trigger frame so that HE STAs may detect and process the trigger

frame to determine uplink transmissions. The AP may include resource unit (RU) allocations in the trigger frame. An STA may receive the trigger frame, identify the RU allocation corresponding to that STA, and may transmit an uplink transmission to the AP using the allocated resources. Legacy STAs may support transmitting in a narrower bandwidth (for example, 160 megahertz (MHz)) than EHT STAs (which may transmit in a 320 MHz bandwidth). The AP may include an additional indication in the trigger frame for EHT STAs, so that the EHT STAs may identify the bandwidth to use (for example, the legacy bandwidth or the greater EHT bandwidth).

[0057] In some implementations, the AP and EHT STAs may use a new EHT RU allocation table when operating in the larger bandwidth. An EHT STA receiving the trigger frame may use a same RU allocation field as HE STAs to determine the RU allocation index, but may use a different table to look up an entry corresponding to the RU allocation index. In some other implementations, the AP may include an additional bit in the trigger frame to indicate to EHT STAs whether to use a primary or a secondary 160 MHz portion of the 320 MHz bandwidth. The EHT STAs may use a legacy RU allocation table, which also may include an additional entry corresponding to this wider bandwidth. In yet some other implementations, the AP may order the RU allocations in the trigger frame in increasing order. An EHT STA may parse the user information for multiple STAs, and may sum the allocated resources for each STA preceding the resource allocation for that EHT STA. The EHT STA may determine the resources for transmission based on the sum and the ordering of the allocations. In each of these implementations, legacy STAs may utilize legacy operations to determine a bandwidth for transmission based on a bandwidth field in the trigger frame. Additionally, if the trigger frame does not indicate the wider EHT bandwidth, an EHT STA may utilize this legacy bandwidth field to determine the resources for transmission.

[0058] FIG. 5 illustrates an example of a wireless communications system according to an embodiment of the present disclosure. The wireless communications system may be an example of a WLAN 100 (also known as a Wi-Fi network) (such as next generation, next big thing (NBT), ultra-high throughput (UHT) or EHT Wi-Fi network) configured in accordance with various aspects of the present disclosure. As described herein, the terms next generation, NBT, UHT, and EHT may be considered synonymous and may each correspond to a Wi-Fi network supporting a high volume of space-time-streams. The WLAN 100 may include an AP 10 and multiple associated STAs 20, which may represent devices such as mobile stations, personal digital assistant (PDAs), other handheld devices, netbooks, notebook computers, tablet computers, laptops, display devices (such as TVs, computer monitors, etc.), printers, etc. The AP 10 and the associated stations 20 may represent a basic service set (BSS) or an extended service set (ESS). The various STAs 20 in the network can communicate with one another through the AP 10. Also illustrated is a coverage area 110 of the AP 10, which may represent a basic service area (BSA) of the WLAN 100. An extended network station (not shown) associated with the WLAN 100 may be connected to a wired or wireless distribution system that may allow multiple APs 10 to be connected in an ESS.

[0059] In some embodiments, a STA 20 may be located in the intersection of more than one coverage area 110 and may associate with more than one AP 10. A single AP 10 and an associated set of STAs 20 may be referred to as a BSS. An ESS is a set of connected BSSs. A distribution system (not shown) may be used to connect APs 10 in an ESS. In some cases, the coverage area 110 of an AP 10 may be divided into sectors (also not shown). The WLAN 100 may include APs 10 of different types (such as a metropolitan area, home network, etc.), with varying and overlapping coverage areas 110. Two STAs 20 also may communicate directly via a direct wireless link 125 regardless of whether both STAs 20 are in the same coverage area 110. Examples of direct wireless links 120 may include Wi-Fi direct connections, Wi-Fi tunneled direct link setup (TDLS) links, and other group connections. STAs 20 and APs 10 may communicate according to the WLAN radio and baseband protocol for physical and media access control (MAC) layers from IEEE 802.11 and versions including, but not limited to, 802.11b, 802.11g, 802.11a, 802.11n, 802.11ac, 802.11ad, 802.11ah, 802.11ax, 802.11ay, etc. In some other implementations, peer-to-peer connections or ad hoc networks may be implemented within the WLAN 100.

[0060] FIG. 6 illustrates an example of a wireless communications system according to another embodiment of the present disclosure. The wireless communications system 200 may be an example of a next generation or EHT Wi-Fi system, and may include an AP 10-a and STAs 20-a and 20-b, and a coverage area 110-a, which may be examples of components described with respect to FIG. 5. The AP 10-a may transmit a trigger frame 210 including an RU allocation table indication 215 on the downlink 205 to the STAs 20.

[0061] In some implementations, a wireless communications system 200 may be a next generation Wi-Fi system (such as, an EHT system). In some implementations, wireless communications system 200 may also support multiple communications systems. For instance, wireless communications system 200 may support EHT communications and HE communications. In some implementations, the STA 20-a and the STA 20-b may be different types of STAs. For example, the STA 20-a may be an example of an EHT STA, while the STA 20-b may be an example of an HE STA. The STA 20-b may be referred to as a legacy STA.

[0062] In some instances, EHT communications may support a larger bandwidth than legacy communications. For instance, EHT communications may occur over an available bandwidth of 320 MHz, whereas legacy communications may occur over an available bandwidth of 160 MHz. Additionally, EHT communications may support higher modulations than legacy communications. For instance, EHT communications may support 4K quadrature amplitude modulation (QAM), whereas legacy communications may support 1024 QAM. EHT communications may support a larger number of spatial streams than legacy systems. In one non-limiting illustrative example, EHT communications may support 16 spatial streams, whereas legacy communications may support 8 spatial streams. In some cases, EHT communications may occur a 2.4 GHz channel, a 5 GHz channel, or a 6 GHz channel in unlicensed spectrum.

[0063] In some implementations, AP 10-a may transmit a trigger frame 210 to one or more STAs 20 (such as, STA 20-a and STA 20-b). In some implementations, the trigger frame may solicit an uplink transmission from the STAs 20. However, the trigger frame 210 may be received by an EHT STA 20-a and HE STA 20-b. The trigger frame 210 may be configured to solicit an uplink transmission from only HE STAs 20-b. In some implementations, trigger frame 210 may be configured to solicit an uplink transmission from EHT STAs 20-a. In some other implementations, the trigger frame 210 may be configured to solicit an uplink transmission from one or more EHT STAs 20-a and one or more HE STAs 20-b.

[0064] FIG. 7 illustrates an example of a wireless communications system according to another embodiment of the present disclosure. The wireless communications system 300 may be an example of a post-EHT Wi-Fi system, and may include an AP 10-b. AP 10-b may be an example of a post-EHT AP 10. The wireless communications system 300 may include HE STA 20-c, EHT STA 20-d, and post-EHT STA 20-e, and a coverage area 110-b, which may be examples of components described with respect to FIGS. 5 and 6. The AP 10-b may transmit a trigger frame 310 including an RU allocation table indication 315 on the downlink 305 to the STAs 20. In some implementations, STAs 20 may be referred to as clients.

[0065] In some implementations, an EHT AP 10 may serve both HE STAs 20 and EHT STAs 20. The EHT AP 10 may send a trigger frame that may trigger a response from HE STAs 20 only, from EHT STAs 20 only, or from both HE STAs 20 and EHT STAs 20. STAs 20 that are scheduled in the trigger frame may respond with TB PPDUs. In some implementations, an EHT AP 10 may trigger HE STAs 20 by sending an HE trigger frame format. In some implementations, an EHT AP 10 may trigger EHT STAs 20 by sending an HE trigger frame format or an HE trigger frame format including some field or bit allocation adjustments. In some implementations, an EHT AP 10 may trigger EHT STAs 20 and HE STAs 20 by sending an HE trigger frame format including some field or bit allocation adjustments.

[0066] The trigger frame 310 may solicit a response from one or more EHT STAs 20 or one or more HE STAs 20, or both. In some implementations, STAs 20 may not transmit unsolicited uplink transmissions in response to trigger frame 310.

In some implementations, trigger frame 310 may solicit an uplink OFDMA transmission or an OFDMA with MU-MIMO transmission.

[0067] FIG. 8 illustrates one or more STAs 20 and an AP 10 of communication in a wireless communications system 700 according to an embodiment of the present disclosure. FIG. 8 illustrates that, the wireless communications system 700 includes an AP 10 and one or more STAs 20. The AP 10 may include a memory 12, a transceiver 13, and a processor 11 coupled to the memory 12, the transceiver 13. The one or more STAs 20 may include a memory 22, a transceiver 23, and a processor 21 coupled to the memory 22, the transceiver 23. The processor 11 or 21 may be configured to implement proposed functions, procedures and/or methods described in this description. Layers of radio interface protocol may be implemented in the processor 11 or 21. The memory 12 or 22 is operatively coupled with the processor 11 or 21 and stores a variety of information to operate the processor 11 or 21. The transceiver 13 or 23 is operatively coupled with the processor 11 or 21, and the transceiver 13 or 23 transmits and/or receives a radio signal.

[0068] The processor 11 or 21 may include application-specific integrated circuit (ASIC), other chipset, logic circuit and/or data processing device. The memory 12 or 22 may include read-only memory (ROM), random access memory (RAM), flash memory, memory card, storage medium and/or other storage device. The transceiver 13 or 23 may include baseband circuitry to process radio frequency signals. When the embodiments are implemented in software, the techniques described herein can be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. The modules can be stored in the memory 12 or 22 and executed by the processor 11 or 21. The memory 12 or 22 can be implemented within the processor 11 or 21 or external to the processor 11 or 21 in which case those can be communicatively coupled to the processor 11 or 21 via various means as is known in the art.

[0069] In some embodiments, the processor 11 is configured to perform a TB sounding procedure, wherein the TB sounding procedure comprises a HE TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between the EHT AP and STAs comprising at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising EHT STAs only. This can solve issues in the prior art, reduce implementation complexity in TB sounding, achieve extremely high throughput, provide good communication performance, and/or provide high reliability.

[0070] In some embodiments, the processor 21 is configured to perform a TB sounding procedure, wherein the TB sounding procedure comprises a HE TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between an EHT AP and STAs comprising the EHT STA and at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising the EHT STA and no any HE STAs. This can solve issues in the prior art, reduce implementation complexity in TB sounding, achieve extremely high throughput, provide good communication performance, and/or provide high reliability.

[0071] FIG. 9 illustrates a wireless communication method 800 performed by an EHT AP according to an embodiment of the present disclosure. In some embodiments, the method 800 includes: a block 802, performing a TB sounding procedure, by the EHT AP, wherein the TB sounding procedure comprises a HE TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between the EHT AP and STAs comprising at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising EHT STAs only. This can solve issues in the prior art, reduce implementation complexity in TB sounding, achieve extremely high throughput, provide good communication performance, and/or provide high reliability.

[0072] In some embodiments, the EHT TB sounding procedure comprises at least one of the followings: transmitting, by the EHT AP, an EHT NDP announcement frame to the EHT STAs, transmitting, by the EHT AP, an EHT sounding NDP to the EHT STAs, transmitting, by the EHT AP, a trigger frame to the EHT STAs to solicit TB PPDU transmissions from the EHT STAs, and receiving, by the EHT AP, TB PPDUs from the EHT STAs. In some embodiments, the TB PPDUs are

HE TB PPDUs or EHT TB PPDUs. In some embodiments, in the EHT TB sounding procedure, after transmitting the trigger frame by the EHT AP to the EHT STAs, whether the EHT AP receives the HE TB PPDUs or the EHT TB PPDUs from the EHT STAs depends on a setting of a trigger type subfield of a common information field of the trigger frame. In some embodiments, when the trigger type subfield of the common information field of the trigger frame is set to indicate a beamforming report poll (BFRP) variant of the trigger frame, the EHT AP receives the HE TB PPDUs from the EHT STAs. In some embodiments, when the trigger type subfield of the common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame, the EHT AP receives the EHT TB PPDUs.

[0073] In some embodiments, in the EHT TB sounding procedure, after transmitting the trigger frame by the EHT AP to the EHT STAs, whether the EHT AP receives the HE TB PPDUs or the EHT TB PPDUs from the EHT STAs depends on a setting of a first subfield of a common information field of the trigger frame, the first subfield is different from a trigger type subfield of the common information field of the trigger frame, the trigger type subfield is set to indicate a BFRP variant of the trigger frame and the first subfield is set to indicate whether the trigger frame is an existing trigger frame or an enhanced trigger frame. In some embodiments, when the first subfield is set to indicate the existing trigger frame, the EHT AP receives the HE TB PPDUs from the EHT STAs. In some embodiments, when the first subfield is set to indicate the enhanced trigger frame, the EHT AP receives the EHT TB PPDUs from the EHT STAs. In some embodiments, the first subfield comprises an enhanced trigger frame flag subfield.

[0074] FIG. 10 illustrates a wireless communication method 900 performed by an EHT STA according to an embodiment of the present disclosure. In some embodiments, the method 900 includes: a block 902, performing a TB sounding procedure, by the EHT STA, wherein the TB sounding procedure comprises a HE TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between an EHT AP and STAs comprising the EHT STA and at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising the EHT STA and no any HE STAs. This can solve issues in the prior art, reduce implementation complexity in TB sounding, achieve extremely high throughput, provide good communication performance, and/or provide high reliability.

[0075] In some embodiments, the EHT TB sounding procedure comprises at least one of the followings: receiving, by the EHT STA, an EHT NDP announcement frame from the EHT AP, receiving, by the EHT STA, an EHT sounding NDP from the EHT AP, receiving, by the EHT STA, a trigger frame from the EHT AP to solicit a TB PPDU transmission from the EHT STA, or transmitting, by the EHT STA, TB PPDU to the EHT AP. In some embodiments, the TB PPDU is a HE TB PPDU or an EHT TB PPDU. In some embodiments, in the EHT TB sounding procedure, after receiving the trigger frame from the EHT AP, whether the EHT STA transmits the HE TB PPDU or the EHT TB PPDU depends on a setting of a trigger type subfield of a common information field of the trigger frame. In some embodiments, when the trigger type subfield of the common information field of the trigger frame is set to indicate a BFRP variant of the trigger frame, the EHT STA transmits the HE TB PPDU. In some embodiments, when the trigger type subfield of the common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame, the EHT STA transmits the EHT TB PPDU.

[0076] In some embodiments, in the EHT TB sounding procedure, after receiving the trigger frame from the EHT AP, whether the EHT STA transmits the HE TB PPDU or the EHT TB PPDU depends on a setting of a first subfield of a common information field of the trigger frame, the first subfield is different from a trigger type subfield of the common information field of the trigger frame, the trigger type subfield is set to indicate a BFRP variant of the trigger frame and the first subfield is set to indicate whether the trigger frame is an existing trigger frame or an enhanced trigger frame. In some embodiments, when the first subfield is set to indicate the existing trigger frame, the EHT STA transmits the HE TB PPDU. In some embodiments, when the first subfield is set to indicate the enhanced trigger frame, the EHT STA transmits the EHT TB PPDU. In some embodiments, the first subfield comprises an enhanced trigger frame flag subfield.

[0077] Embodiment 1:

[0078] According to a first embodiment, in an EHT TB sounding procedure, after receiving a trigger frame from an EHT AP, whether two or more EHT STAs transmit HE TB PPDUs or EHT TB PPDUs depends on a trigger type subfield setting of a common information field of the trigger frame. When the trigger type subfield of common information field of the trigger frame is set to indicate a BFRP variant of the trigger frame, the two or more EHT STAs transmit the HE TB PPDUs. When the trigger type subfield of common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame, the two or more EHT STAs transmit the EHT TB PPDUs.

[0079] FIG. 11 illustrates a first example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to the first embodiment, wherein a trigger type subfield of a common information field of a trigger frame is set to indicate a BFRP variant of the trigger frame, i.e. the trigger frame is a BFRP trigger frame defined in the IEEE 802.11ax standard. FIG. 12A illustrates a format of the common information field of a BFRP trigger frame wherein a trigger type subfield is set to 1 to indicate a BFRP variant of the trigger frame. A BFRP trigger frame comprises a single type of user information field, i.e. HE user information field. FIG. 12B illustrates a format of a HE user information field of a BFRP trigger frame wherein a feedback segment retransmission bitmap subfield indicates requested feedback segments of a HE compressed BF report. The feedback segment retransmission bitmap subfield of any user information field in a BFRP trigger frame shall be set to all ones to indicate all feedback segments are requested when the BFRP trigger frame is transmitted as a part of EHT TB sounding since the EHT AP shall not poll an EHT STA more than once in EHT TB sounding.

[0080] FIG. 13 illustrates a second example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to the first embodiment, wherein the trigger type subfield of common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame. For example, the new BFRP variant of the trigger frame may be an EHT BFRP variant of the trigger frame, i.e. the trigger frame is an EHT BFRP trigger frame. A format of a common information field of an EHT BFRP trigger frame is illustrated in FIG. 14A, wherein the trigger type subfield is set to a first value within [8, 15] (e.g. 8) to indicate an EHT BFRP variant of the trigger frame, a MU-MIMO EHT-LTF mode subfield is set to 0 to indicate single stream pilot EHT-LTF mode for the solicited EHT TB PPDU, and the UL STBC (space-time block coding) subfield is set to 0 to indicate no STBC encoding for the solicited EHT TB PPDU. This is because only single stream pilots are supported for EHT-LTF field of EHT TB PPDU and no STBC is supported for EHT TB PPDU.

[0081] The EHT BFRP trigger frame comprises two types of user information fields, including EHT user information field and special user information field. An example format of EHT user information field of EHT BFRP trigger frame is illustrated in FIG. 14B. The RU allocation subfield of the EHT user information field, together with the PS160 subfield, indicates the RU or MRU at which an EHT TB PPDU is to be transmitted by the EHT STA indicated by the AID12 subfield. It should be noted that the feedback segment retransmission bitmap subfield in the HE user information field of BFRP trigger frame as illustrated in FIG. 12B is not present in the EHT user information field of EHT BFRP trigger frame. The special user information field carries necessary U-SIG subfields of the solicited EHT TB PPDU. The special user info field is located immediately after the common information field in EHT BFRP trigger frame. An example format of special user information field of EHT BFRP trigger frame is illustrated in FIG. 14C, where the AID12 subfield of a user information field is set to a second value (e.g. 2007) to indicate the special user info field.

[0082] Embodiment 2:

[0083] According to a second embodiment, in an EHT TB sounding procedure, after receiving a trigger frame from an EHT AP, whether two or more EHT STAs transmit HE TB PPDUs or EHT TB PPDUs depends on a setting of a subfield other than a trigger type subfield of common information field of the trigger frame wherein the trigger type subfield is set to indicate a BFRP variant of the trigger frame and the subfield indicates whether the trigger frame is an existing trigger frame or an enhanced trigger frame, i.e. the trigger frame is an enhanced BFRP trigger frame. For example, the subfield is

set to 0 to indicate an existing trigger frame, and the subfield is set to 1 to indicate an enhanced trigger frame. When the subfield is set to indicate an existing trigger frame, the two or more EHT STAs transmit the HE TB PPDUs. When the subfield is set to indicate an enhanced trigger frame, the two or more EHT STAs transmit the EHT TB PPDUs. The subfield may be an enhanced trigger frame flag subfield.

[0084] FIG. 15 illustrates a first example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to the second embodiment wherein the subfield (e.g. enhanced trigger frame flag subfield) of the enhanced BFRP trigger frame is set to 0. The example format of common information field of the enhanced BFRP trigger frame with the enhanced trigger frame flag subfield set to 0 according to the second embodiment is illustrated in FIG. 16. The enhanced BFRP trigger frame with the enhanced trigger frame flag subfield set to 0 comprises one or more HE user information field as illustrated in FIG. 12B.

[0085] FIG. 17 illustrates an example EHT TB sounding procedure executed between an EHT AP and two EHT STAs according to the second embodiment wherein the subfield (e.g. enhanced trigger frame flag subfield) of the enhanced BFRP trigger frame is set to 1.

[0086] The example format of common information field of the enhanced BFRP trigger frame with the enhanced trigger frame flag subfield set to 1 according to the second embodiment is illustrated in FIG. 18. An uplink (UL) bandwidth (BW) subfield and an UL spatial reuse subfield are reserved, a MU-MIMO EHT-LTF mode subfield is set to 0 to indicate single stream pilot EHT-LTF mode for the solicited EHT TB PPDU, and an UL STBC subfield is set to 0 to indicate no STBC encoding for the solicited EHT TB PPDU. This is because PPDU bandwidth information and spatial reuse information of the solicited EHT TB PPDU are carried in the special user information field, only single stream pilots are supported for EHT TB PPDU, and no STBC is supported for EHT PPDU.

[0087] The enhanced BFRP trigger frame with the enhanced trigger frame flag subfield set to 1 comprises one or more EHT user information field and one special user information field. Three example formats of EHT user information field are illustrated in FIG. 13A to FIG. 13C, respectively. In the three examples of EHT user information field, RU allocation subfield and PS160 subfield indicate RU or MRU at which an EHT TB PPDU is to be transmitted by the EHT STA indicated by the AID12 subfield. In the first example of EHT user information field, a feedback segment retransmission bitmap subfield in the HE user information field is not present. In the second example of EHT user information field, the feedback segment retransmission bitmap subfield in the HE user information field is replaced by an 8-bit reserved subfield. In the third example of EHT user information field, the feedback segment retransmission bitmap subfield in the HE user information field is present and set to all ones. Compared with the second and third examples of EHT user information field, the first example of EHT user information field has the least signaling overhead.

[0088] The special user information field carries necessary U-SIG subfields of the solicited EHT TB PPDU. The special user information field is located immediately after the common information field in enhanced BFRP trigger frame with the enhanced trigger frame flag subfield set to 1. Two example formats of the special user information field are illustrated in FIG. 20A and FIG. 20B. The AID12 subfield of a user information field is set to a second value (e.g. 2007) to indicate the special user information field. Compared with the special user information field of first example format, the special user information field of second example format has an extra 8-bit reserved subfield. In order to keep the same size of EHT user information field and special user information field, the EHT user information field of first example format shall not be included in a same enhanced BFRP trigger frame as the special user information field of second example format; and the EHT user information field of second or third example format shall not be include in a same enhanced BFRP trigger frame as the special user information field of first example format.

[0089] In summary, according to some embodiments, in IEEE 802.11be EHT WLAN, a HE TB sounding procedure is executed between an EHT AP and two or more STAs which include at least one HE STA according to the IEEE 802.11ax

standard; while an EHT TB sounding procedure is executed between an EHT AP and two or more STAs which include EHT STAs only. As a result, implementation complexity in TB sounding for IEEE 802.11be EHT WLAN is minimized. According to some embodiments, an EHT TB sounding procedure executed between an EHT AP and two or more EHT STAs comprises the following steps. At the beginning of the EHT TB sounding procedure, the EHT AP transmits an EHT NDP announcement frame to the two or more EHT STAs. The EHT NDP Announcement frame is purposed to start the EHT TB sounding procedure and instruct each of the two or more EHT STAs how to prepare sounding feedback, e.g. compressed BF report. Upon SIFS after transmitting the EHT NDP announcement frame, the EHT AP transmits an EHT sounding NDP to the two or more EHT STAs, and each of the two or more EHT STAs determines the sounding feedback from the received EHT sounding NDP according to the instruction in the previously received EHT NDP announcement frame. Upon SIFS after transmitting the EHT sounding NDP, the EHT AP transmits a trigger frame to solicit simultaneous TB PPDU transmissions from the two or more EHT STAs. The trigger frame includes the TB PPDU transmission parameters for each of the two or more EHT STAs. Upon SIFS after receiving the trigger frame, the two or more EHT STAs may prepare TB PPDUs which includes EHT compressed beamforming/CQI (channel quality indicator) frames carrying the respective sounding feedback according to the respective transmission parameters in the received Trigger frame and simultaneously transmit the TB PPDUs to the EHT AP, wherein the TB PPDUs are either HE TB PPDUs or EHT TB PPDUs. It may be beneficial for better coexistence with HE STAs to transmit EHT compressed Beamforming/CQI frames in HE TB PPDUs. On the other hand, it may be instrumental for improving transmission efficiency to transmit EHT compressed beamforming/CQI frames in EHT TB PPDUs.

[0090] Commercial interests for some embodiments are as follows. 1. Solving issues in the prior art. 2. Reducing implementation complexity in TB sounding. 3. Achieving extremely high throughput. 4. Providing a good communication performance. 5. Providing a high reliability. 6. Some embodiments of the present disclosure are used by chipset vendors, communication system development vendors, automakers including cars, trains, trucks, buses, bicycles, moto-bikes, helmets, and etc., drones (unmanned aerial vehicles), smartphone makers, communication devices for public safety use, AR/VR device maker for example gaming, conference/seminar, education purposes. Some embodiments of the present disclosure are a combination of “techniques/processes” that can be adopted in communication specification and/ or communication standards such as IEEE specification and/or to standards create an end product. Some embodiments of the present disclosure propose technical mechanisms.

[0091] FIG. 21 is a block diagram of an example system 700 for wireless communication according to an embodiment of the present disclosure. Embodiments described herein may be implemented into the system using any suitably configured hardware and/or software. FIG. 21 illustrates the system 700 including a radio frequency (RF) circuitry 710, a baseband circuitry 720, an application circuitry 730, a memory/storage 740, a display 750, a camera 760, a sensor 770, and an input/output (I/O) interface 780, coupled with each other at least as illustrated. The application circuitry 730 may include a circuitry such as, but not limited to, one or more single-core or multi-core processors. The processors may include any combination of general-purpose processors and dedicated processors, such as graphics processors, application processors. The processors may be coupled with the memory/storage and configured to execute instructions stored in the memory/storage to enable various applications and/or operating systems running on the system.

[0092] The baseband circuitry 720 may include circuitry such as, but not limited to, one or more single-core or multi-core processors. The processors may include a baseband processor. The baseband circuitry may handle various radio control functions that enables communication with one or more radio networks via the RF circuitry. The radio control functions may include, but are not limited to, signal modulation, encoding, decoding, radio frequency shifting, etc. In some embodiments, the baseband circuitry may provide for communication compatible with one or more radio technologies. For example, in some embodiments, the baseband circuitry may support communication with an evolved universal terrestrial radio access network (EUTRAN) and/or other wireless metropolitan area networks (WMAN), a wireless local area network

(WLAN), a wireless personal area network (WPAN). Embodiments in which the baseband circuitry is configured to support radio communications of more than one wireless protocol may be referred to as multi-mode baseband circuitry.

[0093] In various embodiments, the baseband circuitry 720 may include circuitry to operate with signals that are not strictly considered as being in a baseband frequency. For example, in some embodiments, baseband circuitry may include circuitry to operate with signals having an intermediate frequency, which is between a baseband frequency and a radio frequency. The RF circuitry 710 may enable communication with wireless networks using modulated electromagnetic radiation through a non-solid medium. In various embodiments, the RF circuitry may include switches, filters, amplifiers, etc. to facilitate the communication with the wireless network. In various embodiments, the RF circuitry 710 may include circuitry to operate with signals that are not strictly considered as being in a radio frequency. For example, in some embodiments, RF circuitry may include circuitry to operate with signals having an intermediate frequency, which is between a baseband frequency and a radio frequency.

[0094] In various embodiments, the transmitter circuitry, control circuitry, or receiver circuitry discussed above with respect to the AP or STA may be embodied in whole or in part in one or more of the RF circuitry, the baseband circuitry, and/or the application circuitry. As used herein, "circuitry" may refer to, be part of, or include an Application Specific Integrated Circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group), and/or a memory (shared, dedicated, or group) that execute one or more software or firmware programs, a combinational logic circuit, and/or other suitable hardware components that provide the described functionality. In some embodiments, the electronic device circuitry may be implemented in, or functions associated with the circuitry may be implemented by, one or more software or firmware modules. In some embodiments, some or all of the constituent components of the baseband circuitry, the application circuitry, and/or the memory/storage may be implemented together on a system on a chip (SOC). The memory/storage 740 may be used to load and store data and/or instructions, for example, for system. The memory/storage for one embodiment may include any combination of suitable volatile memory, such as dynamic random access memory (DRAM)), and/or non-volatile memory, such as flash memory.

[0095] In various embodiments, the I/O interface 780 may include one or more user interfaces designed to enable user interaction with the system and/or peripheral component interfaces designed to enable peripheral component interaction with the system. User interfaces may include, but are not limited to a physical keyboard or keypad, a touchpad, a speaker, a microphone, etc. Peripheral component interfaces may include, but are not limited to, a non-volatile memory port, a universal serial bus (USB) port, an audio jack, and a power supply interface. In various embodiments, the sensor 770 may include one or more sensing devices to determine environmental conditions and/or location information related to the system. In some embodiments, the sensors may include, but are not limited to, a gyro sensor, an accelerometer, a proximity sensor, an ambient light sensor, and a positioning unit. The positioning unit may also be part of, or interact with, the baseband circuitry and/or RF circuitry to communicate with components of a positioning network, e.g., a global positioning system (GPS) satellite.

[0096] In various embodiments, the display 750 may include a display, such as a liquid crystal display and a touch screen display. In various embodiments, the system 700 may be a mobile computing device such as, but not limited to, a laptop computing device, a tablet computing device, a netbook, an ultrabook, a smartphone, an AR/VR glasses, etc. In various embodiments, system may have more or less components, and/or different architectures. Where appropriate, methods described herein may be implemented as a computer program. The computer program may be stored on a storage medium, such as a non-transitory storage medium.

[0097] A person having ordinary skill in the art understands that each of the units, algorithm, and steps described and disclosed in the embodiments of the present disclosure are realized using electronic hardware or combinations of software for computers and electronic hardware. Whether the functions run in hardware or software depends on the condition of application and design requirement for a technical plan. A person having ordinary skill in the art can use different ways to

realize the function for each specific application while such realizations should not go beyond the scope of the present disclosure. It is understood by a person having ordinary skill in the art that he/she can refer to the working processes of the system, device, and unit in the above-mentioned embodiment since the working processes of the above-mentioned system, device, and unit are basically the same. For easy description and simplicity, these working processes will not be detailed.

[0098] It is understood that the disclosed system, device, and method in the embodiments of the present disclosure can be realized with other ways. The above-mentioned embodiments are exemplary only. The division of the units is merely based on logical functions while other divisions exist in realization. It is possible that a plurality of units or components are combined or integrated in another system. It is also possible that some characteristics are omitted or skipped. On the other hand, the displayed or discussed mutual coupling, direct coupling, or communicative coupling operate through some ports, devices, or units whether indirectly or communicatively by ways of electrical, mechanical, or other kinds of forms. The units as separating components for explanation are or are not physically separated. The units for display are or are not physical units, that is, located in one place or distributed on a plurality of network units. Some or all of the units are used according to the purposes of the embodiments. Moreover, each of the functional units in each of the embodiments can be integrated in one processing unit, physically independent, or integrated in one processing unit with two or more than two units.

[0099] If the software function unit is realized and used and sold as a product, it can be stored in a readable storage medium in a computer. Based on this understanding, the technical plan proposed by the present disclosure can be essentially or partially realized as the form of a software product. Or, one part of the technical plan beneficial to the conventional technology can be realized as the form of a software product. The software product in the computer is stored in a storage medium, including a plurality of commands for a computational device (such as a personal computer, a server, or a network device) to run all or some of the steps disclosed by the embodiments of the present disclosure. The storage medium includes a USB disk, a mobile hard disk, a read-only memory (ROM), a random access memory (RAM), a floppy disk, or other kinds of media capable of storing program codes.

[0100] While the present disclosure has been described in connection with what is considered the most practical and preferred embodiments, it is understood that the present disclosure is not limited to the disclosed embodiments but is intended to cover various arrangements made without departing from the scope of the broadest interpretation of the appended claims.

What is claimed is:

1. A wireless communication method, comprising:

performing a trigger based (TB) sounding procedure, by an extremely high throughput (EHT) access point (AP), wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between the EHT AP and stations (STAs) comprising at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising EHT STAs only.

2. The wireless communication method of claim 1, wherein the EHT TB sounding procedure comprises at least one of the followings:

transmitting, by the EHT AP, an EHT NDP (null data packet) announcement frame to the EHT STAs;

transmitting, by the EHT AP, an EHT sounding NDP to the EHT STAs;

transmitting, by the EHT AP, a trigger frame to the EHT STAs to solicit TB PPDU (physical layer protocol data unit) transmissions from the EHT STAs; and

receiving, by the EHT AP, TB PPDUs from the EHT STAs.

3. The wireless communication method of claim 2, wherein the TB PPDUs are HE TB PPDUs or EHT TB PPDUs.

4. The wireless communication method of claim 3, wherein in the EHT TB sounding procedure, after transmitting the trigger frame by the EHT AP to the EHT STAs, whether the EHT AP receives the HE TB PPDUs or the EHT TB PPDUs from the EHT STAs depends on a setting of a trigger type subfield of a common information field of the trigger frame.

5. The wireless communication method of claim 4, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a beamforming report poll (BFRP) variant of the trigger frame, the EHT AP receives the HE TB PPDUs from the EHT STAs.

6. The wireless communication method of claim 5, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame, the EHT AP receives the EHT TB PPDUs.

7. The wireless communication method of claim 3, wherein in the EHT TB sounding procedure, after transmitting the trigger frame by the EHT AP to the EHT STAs, whether the EHT AP receives the HE TB PPDUs or the EHT TB PPDUs from the EHT STAs depends on a setting of a first subfield of a common information field of the trigger frame, the first subfield is different from a trigger type subfield of the common information field of the trigger frame, the trigger type subfield is set to indicate a BFRP variant of the trigger frame and the first subfield is set to indicate whether the trigger frame is an existing trigger frame or an enhanced trigger frame.

8. The wireless communication method of claim 7, wherein when the first subfield is set to indicate the existing trigger frame, the EHT AP receives the HE TB PPDUs from the EHT STAs.

9. The wireless communication method of claim 7, wherein when the first subfield is set to indicate the enhanced trigger frame, the EHT AP receives the EHT TB PPDUs from the EHT STAs.

10. The wireless communication method of any one of claims 7 to 9, wherein the first subfield comprises an enhanced trigger frame flag subfield.

11. A wireless communication method, comprising:

performing a trigger based (TB) sounding procedure, by an extremely high throughput (EHT) station (STA), wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between an EHT access point (AP) and STAs comprising the EHT STA and at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising the EHT STA and no any HE STAs.

12. The wireless communication method of claim 11, wherein the EHT TB sounding procedure comprises at least one of the followings:

receiving, by the EHT STA, an EHT NDP (null data packet) announcement frame from the EHT AP;

receiving, by the EHT STA, an EHT sounding NDP from the EHT AP;

receiving, by the EHT STA, a trigger frame from the EHT AP to solicit a TB PPDU (physical layer protocol data unit) transmission from the EHT STA; and

transmitting, by the EHT STA, TB PPDU to the EHT AP.

13. The wireless communication method of claim 12, wherein the TB PPDU is a HE TB PPDU or an EHT TB PPDU.

14. The wireless communication method of claim 13, wherein in the EHT TB sounding procedure, after receiving the trigger frame from the EHT AP, whether the EHT STA transmits the HE TB PPDU or the EHT TB PPDU depends on a setting of a trigger type subfield of a common information field of the trigger frame.

15. The wireless communication method of claim 14, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a beamforming report poll (BFRP) variant of the trigger frame, the EHT STA transmits the HE TB PPDU.

16. The wireless communication method of claim 15, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame, the EHT STA transmits the EHT TB PPDU.

17. The wireless communication method of claim 13, wherein in the EHT TB sounding procedure, after receiving the trigger frame from the EHT AP, whether the EHT STA transmits the HE TB PPDU or the EHT TB PPDU depends on a setting of a first subfield of a common information field of the trigger frame, the first subfield is different from a trigger type subfield of the common information field of the trigger frame, the trigger type subfield is set to indicate a BFRP variant of the trigger frame and the first subfield is set to indicate whether the trigger frame is an existing trigger frame or an enhanced trigger frame.

18. The wireless communication method of claim 17, wherein when the first subfield is set to indicate the existing trigger frame, the EHT STA transmits the HE TB PPDU.

19. The wireless communication method of claim 17, wherein when the first subfield is set to indicate the enhanced trigger frame, the EHT STA transmits the EHT TB PPDU.

20. The wireless communication method of any one of claims 17 to 19, wherein the first subfield comprises an enhanced trigger frame flag subfield.

21. An extremely high throughput (EHT) access point (AP), comprising:

a memory;

a transceiver; and

a processor coupled to the memory and the transceiver;

wherein the processor is configured to perform a trigger based (TB) sounding procedure, wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between the EHT AP and stations (STAs) comprising at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising EHT STAs only.

22. The EHT AP of claim 21, wherein the EHT TB sounding procedure comprises at least one of the followings:

transmitting, by the EHT AP, an EHT NDP (null data packet) announcement frame to the EHT STAs;

transmitting, by the EHT AP, an EHT sounding NDP to the EHT STAs;

transmitting, by the EHT AP, a trigger frame to the EHT STAs to solicit TB PPDU (physical layer protocol data unit) transmissions from the EHT STAs; and

receiving, by the EHT AP, TB PPDUs from the EHT STAs.

23. The EHT AP of claim 22, wherein the TB PPDUs are HE TB PPDUs or EHT TB PPDUs.

24. The EHT AP of claim 23, wherein in the EHT TB sounding procedure, after transmitting the trigger frame by the EHT AP to the EHT STAs, whether the EHT AP receives the HE TB PPDUs or the EHT TB PPDUs from the EHT STAs depends

on a setting of a trigger type subfield of a common information field of the trigger frame.

25. The EHT AP of claim 24, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a beamforming report poll (BFRP) variant of the trigger frame, the EHT AP receives the HE TB PPDUs from the EHT STAs.

26. The EHT AP of claim 25, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame, the EHT AP receives the EHT TB PPDUs.

27. The EHT AP of claim 23, wherein in the EHT TB sounding procedure, after transmitting the trigger frame by the EHT AP to the EHT STAs, whether the EHT AP receives the HE TB PPDUs or the EHT TB PPDUs from the EHT STAs depends on a setting of a first subfield of a common information field of the trigger frame, the first subfield is different from a trigger type subfield of the common information field of the trigger frame, the trigger type subfield is set to indicate a BFRP variant of the trigger frame and the first subfield is set to indicate whether the trigger frame is an existing trigger frame or an enhanced trigger frame.

28. The EHT AP of claim 27, wherein when the first subfield is set to indicate the existing trigger frame, the EHT AP receives the HE TB PPDUs from the EHT STAs.

29. The EHT AP of claim 27, wherein when the first subfield is set to indicate the enhanced trigger frame, the EHT AP receives the EHT TB PPDUs from the EHT STAs.

30. The EHT AP of any one of claims 27 to 29, wherein the first subfield comprises an enhanced trigger frame flag subfield.

31. An extremely high throughput (EHT) station (STA), comprising:

a memory;

a transceiver; and

a processor coupled to the memory and the transceiver;

wherein the processor is configured to perform a trigger based (TB) sounding procedure, wherein the TB sounding procedure comprises a high efficiency (HE) TB sounding procedure and an EHT TB sounding procedure, the HE TB sounding procedure is executed between an EHT access point (AP) and STAs comprising the EHT STA and at least one HE STA, the EHT TB sounding procedure is executed between the EHT AP and STAs comprising the EHT STA and no any HE STAs.

32. The EHT STA of claim 31, wherein the EHT TB sounding procedure comprises at least one of the followings:

receiving, by the EHT STA, an EHT NDP (null data packet) announcement frame from the EHT AP;

receiving, by the EHT STA, an EHT sounding NDP from the EHT AP;

receiving, by the EHT STA, a trigger frame from the EHT AP to solicit a TB PPDU (physical layer protocol data unit) transmission from the EHT STA; and

transmitting, by the EHT STA, TB PPDU to the EHT AP.

33. The EHT STA of claim 32, wherein the TB PPDU is a HE TB PPDU or an EHT TB PPDU.

34. The EHT STA of claim 33, wherein in the EHT TB sounding procedure, after receiving the trigger frame from the EHT AP, whether the EHT STA transmits the HE TB PPDU or the EHT TB PPDU depends on a setting of a trigger type subfield of a common information field of the trigger frame.

35. The EHT STA of claim 34, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a beamforming report poll (BFRP) variant of the trigger frame, the EHT STA transmits the HE TB PPDU.

36. The EHT STA of claim 35, wherein when the trigger type subfield of the common information field of the trigger frame is set to indicate a new BFRP variant of the trigger frame, the EHT STA transmits the EHT TB PPDU.

37. The EHT STA of claim 33, wherein in the EHT TB sounding procedure, after receiving the trigger frame from the EHT AP, whether the EHT STA transmits the HE TB PPDU or the EHT TB PPDU depends on a setting of a first subfield of a common information field of the trigger frame, the first subfield is different from a trigger type subfield of the common information field of the trigger frame, the trigger type subfield is set to indicate a BFRP variant of the trigger frame and the

first subfield is set to indicate whether the trigger frame is an existing trigger frame or an enhanced trigger frame.

38. The EHT STA of claim 37, wherein when the first subfield is set to indicate the existing trigger frame, the EHT STA transmits the HE TB PPDU.

39. The EHT STA of claim 37, wherein when the first subfield is set to indicate the enhanced trigger frame, the EHT STA transmits the EHT TB PPDU.

40. The EHT STA of any one of claims 37 to 39, wherein the first subfield comprises an enhanced trigger frame flag subfield.

41. A non-transitory machine-readable storage medium having stored thereon instructions that, when executed by a computer, cause the computer to perform the method of any one of claims 1 to 20.

42. A chip, comprising:

a processor, configured to call and run a computer program stored in a memory, to cause a device in which the chip is installed to execute the method of any one of claims 1 to 20.

43. A computer readable storage medium, in which a computer program is stored, wherein the computer program causes a computer to execute the method of any one of claims 1 to 20.

44. A computer program product, comprising a computer program, wherein the computer program causes a computer to execute the method of any one of claims 1 to 20.

45. A computer program, wherein the computer program causes a computer to execute the method of any one of claims 1 to 20.