

ACCESS POINT, STATION, AND INFORMATION TRANSMISSION METHOD

BACKGROUND OF DISCLOSURE

5 1. Field of the Disclosure

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

2. Description of the Related Art

10 **[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.

20 **[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.

30 **[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 (EHT) 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.

35 **[0005]** IEEE 802.11be EHT WLAN supports a bandwidth (BW) up to 320 MHz. It is expected that high efficiency (HE) STAs will exist with EHT STAs in a same EHT basic service set (BSS). In order to maximize throughput of an EHT BSS with large BW (e.g. 320 MHz), an aggregated physical layer (PHY) protocol data unit (A-PPDU) has been proposed.

[0006] No specified method for aggregating different formats of physical layer (PHY) protocol data units (PPDUs) in the A-PPDU is provided. How to generate the A-PPDU in the EHT BSS with large BW is an open issue. For example, formats of HE PPDU and EHT PPDU in the A-PPDU and/or bandwidth allocation in the A-PPDU are unclear and not defined.

40 **[0007]** Therefore, there is a need for an access point (AP), a station (STA), and an information transmission method, which can solve issues in the prior art, aggregate different formats of PPDUs, achieve extremely high throughput (EHT), provide a good communication performance, and/or provide high reliability.

SUMMARY

[0008] An object of the present disclosure is to propose an access point (AP), a station (STA), and an information transmission method, which can solve issues in the prior art, aggregate different formats of PPDU, achieve extremely high throughput (EHT), provide a good communication performance, and/or provide high reliability.

5 **[0009]** In a first aspect of the present disclosure, an information transmission method comprises configuring, by an access point (AP), an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission to a set of stations (STAs), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and
10 determining, by the AP, an uplink transmission from a STA of the set of STAs, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.

[0010] In a second aspect of the present disclosure, an information transmission method comprises determining, by a station (STA) of a set of STAs, an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission from an access point (AP), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a
15 number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and transmitting, by the STA, an uplink transmission to the AP, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.

[0011] In a third aspect of the present disclosure, an access point (AP) comprises a memory, a transceiver, and a processor coupled to the memory and the transceiver. The processor is configured to: configure an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission to a set of stations (STAs), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and determine an uplink transmission from a
20 STA of the set of STAs, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.

[0012] In a fourth aspect of the present disclosure, a station (STA) comprises a memory, a transceiver, and a processor coupled to the memory and the transceiver. The processor is configured to determine an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission from an access point (AP), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second
30 symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU. The transceiver is configured to transmit, to the AP, an uplink transmission, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.

[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.

35 **[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.

40 **[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.

5 **[0019]** FIG. 1 is a schematic diagram illustrating an example of 320 MHz bandwidth (BW) frequency-domain (FD) A-PPDU (FD-A-PPDU) according to an embodiment of the present disclosure.

[0020] FIG. 2A is a schematic diagram illustrating an example of high efficiency (HE) single user (SU) PPDU format according to an embodiment of the present disclosure.

10 **[0021]** FIG. 2B is a schematic diagram illustrating an example of HE multi-user (MU) PPDU format according to an embodiment of the present disclosure.

[0022] FIG. 2C is a schematic diagram illustrating an example of HE extended range (ER) SU PPDU format according to an embodiment of the present disclosure.

[0023] FIG. 2D is a schematic diagram illustrating an example of HE trigger-based (TB) PPDU format according to an embodiment of the present disclosure.

15 **[0024]** FIG. 3A is a schematic diagram illustrating an example of extremely high throughput (EHT) MU PPDU format according to an embodiment of the present disclosure.

[0025] FIG. 3B is a schematic diagram illustrating an example of EHT TB PPDU format according to an embodiment of the present disclosure.

20 **[0026]** FIG. 4 is a schematic diagram illustrating an example of a wireless communications system according to an embodiment of the present disclosure.

[0027] FIG. 5 is a schematic diagram illustrating an example of a wireless communications system according to another embodiment of the present disclosure.

[0028] FIG. 6 is a schematic diagram illustrating an example of a wireless communications system according to another embodiment of the present disclosure.

25 **[0029]** FIG. 7 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.

[0030] FIG. 8 is a flowchart illustrating an information transmission method performed by an AP according to an embodiment of the present disclosure.

30 **[0031]** FIG. 9 is a flowchart illustrating an information transmission method performed by a STA according to another embodiment of the present disclosure.

[0032] FIG. 10 is a schematic diagram illustrating an example of 160 MHz BW FD-A-PPDU according to an embodiment of the present disclosure.

[0033] FIG. 11A is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in an EHT basic service set (BSS) for option 1A according to an embodiment of the present disclosure.

35 **[0034]** FIG. 11B is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in an EHT BSS for option 1B according to an embodiment of the present disclosure.

[0035] FIG. 11C is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in an EHT BSS for option 1C according to an embodiment of the present disclosure.

40 **[0036]** FIG. 11D is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in an EHT BSS for option 1D according to an embodiment of the present disclosure.

[0037] FIG. 11E is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in an EHT BSS for option 1E according to an embodiment of the present disclosure.

[0038] FIG. 12A is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in a post-EHT BSS for option 2A according to an embodiment of the present disclosure.

5 [0039] FIG. 12B is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in a post-EHT BSS for option 2B according to an embodiment of the present disclosure.

[0040] FIG. 12C is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in a post-EHT BSS for option 2C according to an embodiment of the present disclosure.

10 [0041] FIG. 12D is a schematic diagram illustrating an example of 320 MHz BW FD-A-PPDU in a post-EHT BSS for option 2D according to an embodiment of the present disclosure.

[0042] FIG. 13 is a block diagram of a system for wireless communication according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

15 [0043] 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.

[0044] Institute of electrical and electronics engineers (IEEE) 802.11be extremely high throughput (EHT) WLAN supports a bandwidth (BW) up to 320 MHz. It is expected that high efficiency (HE) stations (STAs) will exist with
20 extremely high throughput (EHT) STAs in a same EHT basic service set (BSS). In order to maximize throughput of an EHT BSS with large BW (e.g. 320 MHz), an aggregated physical layer (PHY) protocol data unit (A-PPDU) in some embodiments of the present disclosure has been proposed.

[0045] FIG. 1 illustrates an example of 320 MHz bandwidth (BW) frequency-domain (FD) A-PPDU (FD-A-PPDU) according to an embodiment of the present disclosure. FIG. 1 illustrates that, in some embodiments, a FD-A-PPDU
25 consists of multiple PPDU's such as PPDU-1 and PPDU-2. Each PPDU occupies one or more non-overlapping 80 MHz frequency segments. The PPDU's are orthogonal in frequency domain symbol-by-symbol. Each PPDU can have different PPDU formats, e.g. HE PPDU, EHT PPDU, etc.

[0046] FIG. 2A illustrates an example of high efficiency (HE) single user (SU) PPDU format according to an embodiment of the present disclosure. FIG. 2B illustrates an example of HE multi-user (MU) PPDU format according to
30 an embodiment of the present disclosure. FIG. 2C illustrates an example of HE extended range (ER) SU PPDU format according to an embodiment of the present disclosure. FIG. 2D illustrates an example of HE trigger-based (TB) PPDU format according to an embodiment of the present disclosure. HE PPDU has four formats: HE SU PPDU, HE ER SU PPDU, HE MU PPDU, and HE TB PPDU. The HE SU PPDU format as illustrated in FIG. 2A is used for SU transmission and, in this format, the HE-SIG-A field is not repeated. The HE MU PPDU format illustrated in FIG. 2B is used for
35 transmission to one or more users if the PPDU is not a response of a triggering frame. In the HE MU PPDU, HE SIGNAL A field (HE-SIG-A) is not repeated, and HE SIGNAL B field (HE-SIG-B) is present in this format. The HE ER SU PPDU format illustrated in FIG. 2C is used for extended range SU transmission and, in this format, the HE-SIG-A is twice as long as the HE-SIG-A in other HE PPDU formats. The HE ER SU PPDU supports only a single 242-tone or 106-tone resource unit (RU) within primary 20 MHz channel. The HE TB PPDU format illustrated in FIG. 2D is used for a
40 transmission that is a response to a triggering frame from an AP. The format of the HE TB PPDU is the same as the HE SU PPDU except that the duration of the HE-STF field in the HE TB PPDU is twice the duration of the HE-STF field in the HE SU PPDU.

[0047] For a HE PPDU, each HE long training field (HE-LTF) symbol has the same guard interval (GI) duration as each data symbol, which is 0.8 μ s, 1.6 μ s, or 3.2 μ s. The HE-LTF field comprises three types: 1x HE-LTF, 2x HE-LTF, and 4x HE-LTF. The duration of each 1x HE-LTF, 2x HE-LTF, or 4x HE-LTF symbol without GI is 3.2 μ s, 6.4 μ s, or 12.8 μ s. Only 2x HE-LTF and 4x HE-LTF are supported in HE MU PPDU. Each data symbol without GI is 12.8 μ s.

5 [0048] FIG. 3A illustrates an example of extremely high throughput (EHT) MU PPDU format according to an embodiment of the present disclosure. FIG. 3B illustrates an example of EHT TB PPDU format according to an embodiment of the present disclosure. EHT PPDU has two formats: EHT MU PPDU and EHT TB PPDU. The EHT MU PPDU format as illustrated in FIG. 3A is used for transmission to one or more users if the PPDU is not a response of a triggering frame. The EHT-SIG field is present in the EHT MU PPDU. The EHT TB PPDU format as illustrated in FIG.
10 3B is used for a transmission that is a response to a triggering frame from an AP. The EHT-SIG field is not present in the EHT TB PPDU. The duration of the EHT-STF field in the EHT TB PPDU is twice the duration of the EHT-STF field in the EHT MU PPDU.

[0049] For an EHT PPDU, each EHT-LTF symbol has the same GI duration as each data symbol, which is 0.8 μ s, 1.6 μ s, or 3.2 μ s. The EHT-LTF field comprises three types: 1x EHT-LTF, 2x EHT-LTF, and 4x EHT-LTF. The duration of
15 each 1x EHT-LTF, 2x EHT-LTF, or 4x EHT-LTF symbol without GI is 3.2 μ s, 6.4 μ s, or 12.8 μ s. Each data symbol without GI is 12.8 μ s.

[0050] In an EHT BSS, HE SU PPDU, HE ER SU PPDU, HE MU PPDU, and EHT MU PPDU can be used for downlink SU transmission while HE MU PPDU and EHT MU PPDU can be used for downlink MU transmission. On the other hand, HE SU PPDU, HE ER SU PPDU, HE MU PPDU, and EHT MU PPDU can be used for uplink SU
20 transmission while HE TB PPDU and EHT TB PPDU can be used for uplink MU transmission.

[0051] 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
25 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
30 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.

[0052] Techniques are disclosed for wireless devices to support multiplexing clients of different generations in trigger-based transmissions. For example, an access point (AP) that supports multiple generations of station (STA) may
35 support uplink transmissions in, for example, an extremely-high throughput (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 stations (STAs). For example, an AP in an EHT system may provide coverage for EHT STAs, as well as legacy (or high efficiency (HE)) STAs. The AP may multiplex
40 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.

[0053] To trigger uplink transmissions from one or more STAs of different generations, the AP may transmit a triggering frame. The triggering frame may be formatted as a legacy triggering frame so that HE STAs may detect and

process the triggering frame to determine uplink transmissions. The AP may include resource unit (RU) allocations in the triggering frame. An STA may receive the triggering 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).

5 The AP may include an additional indication in the triggering 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).

[0054] 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 triggering 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 triggering 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 triggering 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 triggering frame. Additionally, if the triggering frame does not indicate the wider EHT bandwidth, an EHT STA may utilize this legacy bandwidth field to determine the resources for transmission.

20 **[0055]** FIG. 4 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 wireless local area network (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.

[0056] 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. 35 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. 40 In some other implementations, peer-to-peer connections or ad hoc networks may be implemented within the WLAN 100.

[0057] FIG. 5 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. 4. The AP 10-a may transmit a triggering frame 210 including an RU allocation table indication 215 on the downlink 205 to the STAs 20.

[0058] 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.

[0059] 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 (such as, space-time-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.

[0060] In some implementations, AP 10-a may transmit a triggering frame 210 to one or more STAs 20 (such as, STA 20-a and STA 20-b). In some implementations, the triggering frame may solicit an uplink transmission from the STAs 20. However, the triggering frame 210 may be received by an EHT STA 20-a and HE STA 20-b. The triggering frame 210 may be configured to solicit an uplink transmission from only HE STAs 20-b. In some implementations, triggering frame 210 may be configured to solicit an uplink transmission from EHT STAs 20-a. In some other implementations, the triggering 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.

[0061] FIG. 6 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 triggering 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.

[0062] In some implementations, an EHT AP 10 may serve both HE STAs 20 and EHT STAs 20. The EHT AP 10 may send a triggering 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 triggering frame may respond with trigger-based PPDU. In some implementations, an EHT AP 10 may trigger HE STAs 20 (and not EHT STAs 20) by sending an HE triggering frame format. In some implementations, an EHT AP 10 may trigger EHT STAs 20 (and not EHT STAs 20) by sending an HE triggering frame format or an HE triggering 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 triggering frame format including some field or bit allocation adjustments.

[0063] The triggering 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 triggering frame 310. In some implementations, triggering frame 310 may solicit an uplink orthogonal frequency division multiple access (OFDMA) transmission or an OFDMA with multi-user with multiple-input multiple-output (MU-MIMO) transmission.

[0064] FIG. 7 illustrates one or more stations (STAs) 20 and an access point (AP) 10 of communication in a wireless communications system 700 according to an embodiment of the present disclosure. FIG. 7 illustrates that, the wireless communications system 700 includes an access point (AP) 10 and one or more stations (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.

[0065] 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.

[0066] In some embodiments, the processor 11 is configured to: configure an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission to a set of stations (STAs), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and determine an uplink transmission from a STA of the set of STAs, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission. This can solve issues in the prior art, aggregate different formats of PPDU, achieve extremely high throughput (EHT), provide a good communication performance, and/or provide high reliability.

[0067] In some embodiments, the processor 21 is configured to determine an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission from an access point (AP), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU. The transceiver 23 is configured to transmit, to the AP, an uplink transmission, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission. This can solve issues in the prior art, aggregate different formats of PPDU, achieve extremely high throughput (EHT), provide a good communication performance, and/or provide high reliability.

[0068] FIG. 8 illustrates an information transmission method 800 performed by an AP according to an embodiment of the present disclosure. In some embodiments, the method 800 includes: a block 802, configuring, by an access point (AP), an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission to a set of stations

(STAs), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and a block 804, determining, by the AP, an uplink transmission from a STA of the set of STAs, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission. This can solve issues in the prior art, aggregate different formats of PPDU, achieve extremely high throughput (EHT), provide a good communication performance, and/or provide high reliability.

[0069] FIG. 9 illustrates an information transmission method 900 performed by a STA according to an embodiment of the present disclosure. In some embodiments, the method 900 includes: a block 902, determining, by a station (STA) of a set of STAs, an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission from an access point (AP), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and a block 904, transmitting, by the STA, an uplink transmission to the AP, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission. This can solve issues in the prior art, aggregate different formats of PPDU, achieve extremely high throughput (EHT), provide a good communication performance, and/or provide high reliability.

[0070] In some embodiments, the A-PPDU used for downlink transmission to the set of STAs is configured in a basic service set (BSS) with a bandwidth. In some embodiments, the BSS comprises an extremely high throughput (EHT) BSS. In some embodiments, the bandwidth is greater than 80 MHz. In some embodiments, the bandwidth is greater than or equal to 160 MHz. In some embodiments, the bandwidth is greater than or equal to 320 MHz. In some embodiments, the A-PPDU comprises a frequency-domain (FD) A-PPDU (FD-A-PPDU). In some embodiments, the first PPDU comprises a high efficiency (HE) multi-user (MU) PPDU. In some embodiments, a number of the HE MU PPDU is equal to one. In some embodiments, the at least one second PPDU comprises at least one EHT MU PPDU.

[0071] In some embodiments, a number of the at least one EHT MU PPDU is equal to one or two. In some embodiments, the first symbols comprise HE SIGNAL B field (HE-SIG-B) symbols. In some embodiments, the second symbols comprise EHT SIGNAL field (EHT-SIG) symbols. In some embodiments, the first field comprises a HE Long Training field (HE-LTF). In some embodiments, the second field comprises an EHT-LTF. In some embodiments, a number of HE-LTF symbols is same as or different from a number of EHT-LTF symbols. In some embodiments, when the number of HE-LTF symbols is same as the number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a different duration or a same duration from each data symbol. In some embodiments, each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 3.2 μ s or 6.4 μ s or 12.8 μ s. In some embodiments, when the number of HE-LTF symbols is different from the number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a same duration from each data symbol. In some embodiments, each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 12.8 μ s.

[0072] In some embodiments, pre-HE modulated fields of the HE MU PPDU and pre-EHT modulated fields of the EHT MU PPDU can be kept orthogonal in frequency domain symbol-by-symbol. In some embodiments, the FD-A-PPDU used for downlink transmission does not comprise a HE single user (SU) PPDU. In some embodiments, pre-HE modulated fields of the HE SU PPDU and pre-EHT modulated fields of the EHT MU PPDU cannot be kept orthogonal in frequency domain symbol-by-symbol. In some embodiments, the FD-A-PPDU used for downlink transmission does not comprise both of a HE extended range (ER) SU PPDU and the EHT MU PPDU. In some embodiments, the A-PPDU used for trigger-based uplink transmission comprises one or more first trigger-based (TB) PPDU and one or more second TB PPDU if each first symbol has a same symbol duration and a same GI duration as each second symbol. In some

embodiments, one or more first TB PPDU comprise one or more HE trigger-based (TB) PPDU and one or more second TB PPDU comprise one or more EHT TB PPDU. In some embodiments, pre-HE modulated fields of the first TB PPDU and pre-EHT modulated fields of the second TB PPDU can be kept orthogonal in frequency domain symbol-by-symbol. In some embodiments, the A-PPDU used for trigger-based uplink transmission does not comprise a HE SU PPDU, a HE ER SU PPDU, and/or a HE MU PPDU. In some embodiments, the HE SU PPDU, the HE ER SU PPDU, and/or the HE MU PPDU is disallowed for trigger-based uplink transmission. In some embodiments, the uplink transmission is determined in a first bandwidth channel if the STA is a first type of STA and/or is determined in a second bandwidth channel if the STA is a second type of STA and/or is determined in a third bandwidth channel if the STA is a third type of STA.

[0073] In some embodiments, the first type of STA comprises a HE STA, and the first bandwidth channel comprises a primary 80 MHz channel (P80). In some embodiments, the second type of STA comprises an EHT STA, and the second bandwidth channel comprises a non-primary 80 MHz channel and/or the third type of STA comprises a post-EHT STA, and the third bandwidth channel comprises a non-primary 80 MHz channel. In some embodiments, the non-primary 80 MHz channel comprises an 80 MHz frequency segment outside the P80. In some embodiments, the non-primary 80 MHz channel comprises a secondary 80 MHz channel (S80) in a 160 MHz channel or a 320 MHz channel. In some embodiments, for downlink transmission, the HE STA needs to process pre-HE modulated fields of the HE MU PPDU within the P80; while the EHT STA needs to process pre-EHT modulated fields of the EHT MU PPDU within the 80 MHz frequency segment the EHT STA parks. In some embodiments, within each of the P80 and the S80, a single 20 MHz subchannel which is not a primary 20 MHz channel (P20) may be punctured. In some embodiments, an 80 MHz bandwidth (BW) HE MU PPDU to which preamble puncturing may be applied is transmitted in the P80 while an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in the S80. In some embodiments, within each of the P80 and the S80, two consecutive 20 MHz subchannels which do not include P20 may be punctured. In some embodiments, if the punctured two 20 MHz subchannels constitute a secondary 40 MHz subchannel (S40), a 40 MHz BW HE MU PPDU is transmitted in a primary 40 MHz subchannel (S40). In some embodiments, if the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80.

[0074] In some embodiments, if the punctured two 20 MHz subchannels constitute a 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80. In some embodiments, if the punctured two 20 MHz subchannels cross the two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80. In some embodiments, in a 320 MHz BW FD-A-PPDU, a BW allocated to the at least one HE STA is P80 or primary 160 MHz channel (P160); while a BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of secondary 160 MHz channel (S160), S160, a combination of S80 and one of two 80 MHz frequency segments of S160, or a combination of S80 and S160. In some embodiments, a number of EHT MU PPDU in a 320 MHz BW FD-A-PPDU depends on a BW allocation to the at least one EHT STA in the FD-A-PPDU. In some embodiments, when the BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of S160 or S160, there is a single EHT MU PPDU in the FD-A-PPDU.

[0075] In some embodiments, when the BW allocated to the at least one EHT STA is a combination of S80 and one of two 80 MHz frequency segments of S160, there are two EHT MU PPDU. In some embodiments, when the BW allocated to the at least one EHT STA is a combination of S80 and S160, there is one or two EHT MU PPDU in the FD-A-PPDU. In some embodiments, for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options: option 1A: when S80 is punctured, a BW allocated to the at least one HE STA is P80 and a BW allocated to the at least one EHT STA is S160; option 1B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is the other 80 MHz frequency segment of S160; option 1C: when one of two 80 MHz frequency segments of S160 is punctured,

the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA is S80 and the other 80 MHz frequency segment of S160; option 1D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is S160; or option 1E: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA is S80 and S160.

[0076] In some embodiments, the 320 MHz BW FD-A-PPDU comprise the HE MU PPDU, the EHT MU PPDU, and a post-EHT MU PPDU. In some embodiments, for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options: option 2A: when S80 is punctured, the BW allocated to the at least one HE STA is P80 and BWs allocated to the at least one EHT STA and the at least one post-EHT STA are two 80 MHz frequency segments of S160, respectively; option 2B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA and the at least one post-EHT STA are S80 and the other 80 MHz frequency segment of S160, respectively; option 2C: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one EHT STA is S160, and the BW allocated to the at least one post-EHT STA is S80; or option 2D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one post-EHT STA is S160, and the BW allocated to the at least one EHT STA is S80. In some embodiments, for trigger-based uplink transmission, the FD-A-PPDU comprises one or more HE TB PPDU, and one or more EHT TB PPDU in an EHT BSS and/or the FD-A-PPDU comprises one or more HE TB PPDU, one or more EHT TB PPDU, and one or more post-EHT TB PPDU in a post-EHT BSS.

[0077] Formats of HE PPDU and EHT PPDU in a FD-A-PPDU:

[0078] According to some embodiments of the present invention, in an EHT BSS with a large BW (e.g. 160 MHz or 320 MHz), a FD-A-PPDU used for downlink transmission may comprise a single HE MU PPDU and one or two EHT MU PPDU if the number of HE-SIG-B symbols is equal to the number of EHT-SIG symbols and/or the HE-LTF field has a same symbol duration and a same GI duration as the EHT-LTF field.

[0079] The number of HE-LTF symbols may be the same as or different from the number of EHT-LTF symbols. When the number of HE-LTF symbols is the same as the number of EHT-LTF symbols, each HE-LTF/EHT-LTF symbol may have a different duration or a same duration from each data symbol. In other words, each HE-LTF/EHT-LTF symbol without GI may be 6.4 μ s or 12.8 μ s. When the number of HE-LTF symbols is different from the number of EHT-LTF symbols, each HE-LTF/EHT-LTF symbol shall have a same duration as each data symbol. In other words, each HE-LTF/EHT-LTF symbol without GI shall be 12.8 μ s. As a result, the pre-HE modulated fields of a HE MU PPDU and the pre-EHT modulated fields of an EHT MU PPDU can be kept orthogonal in frequency domain symbol-by-symbol.

[0080] According to some embodiments of the present invention, a FD-A-PPDU used for downlink transmission shall not comprise a HE SU PPDU since the pre-HE modulated fields of a HE SU PPDU and the pre-EHT modulated fields of an EHT MU PPDU cannot be kept orthogonal in frequency domain symbol-by-symbol.

[0081] According to some embodiments of the present invention, although it is possible to keep the pre-HE modulated fields of a HE ER SU PPDU and the pre-EHT modulated fields of an EHT MU PPDU orthogonal in frequency domain symbol-by-symbol if the number of EHT-SIG symbols is two and each HE-LTF symbol has a same symbol duration and a same GI duration as each EHT-LTF symbol, it does not make sense to enable a FD-A-PPDU comprising a HE ER SU PPDU and an EHT MU PPDU since there is lack of use cases for such a FD-A-PPDU.

[0082] According to some embodiments of the present invention, in an EHT BSS with a large BW (e.g. 160 MHz or 320 MHz), a FD-A-PPDU used for trigger-based uplink transmission may comprise one or more HE TB PPDU and one or

more EHT TB PPDU if each HE-LTF symbol has a same symbol duration and a same GI duration as each EHT-LTF symbol.

[0083] Further, the number of HE-LTF symbols may be the same as or different from the number of EHT-LTF symbols. When the number of HE-LTF symbols is the same as the number of EHT-LTF symbols, each HE-LTF/EHT-LTF symbol may have a different duration or a same duration from each data symbol. In other words, each HE-LTF/EHT-LTF symbol without GI may be 3.2 μ s, 6.4 μ s or 12.8 μ s. When the number of HE-LTF symbols is different from the number of EHT-LTF symbols, each HE-LTF/EHT-LTF symbol shall have a same duration as each data symbol. In other words, each HE-LTF/EHT-LTF symbol without GI shall be 12.8 μ s. As a result, the pre-HE modulated fields of a HE TB PPDU and the pre-EHT modulated fields of an EHT TB PPDU can be kept orthogonal in frequency domain symbol-by-symbol.

[0084] According to some embodiments of the present invention, a FD-A-PPDU used for trigger-based uplink transmission shall not comprise a HE SU PPDU, a HE ER SU PPDU or a HE MU PPDU since they are disallowed for trigger-based uplink transmission.

[0085] Bandwidth allocation in a FD-A-PPDU:

[0086] For downlink transmission, a HE STA only needs to process the pre-HE modulated fields of a HE MU PPDU within primary 80 MHz channel (P80); while an EHT STA only needs to process the pre-EHT modulated fields of an EHT MU PPDU within an 80 MHz frequency segment it parks. As a result, for a FD-A-PPDU comprising a HE PPDU and one or two EHT PPDU, each intended HE STA shall park in P80 while each intended EHT STA shall park in one of non-primary 80 MHz channel(s) via an enhanced SST (subchannel selective transmission) operation mechanism. A non-primary 80 MHz channel is an 80 MHz frequency segment outside P80, e.g. secondary 80 MHz channel (S80) in a 160 MHz or 320 MHz channel.

[0087] FIG. 10 illustrates an example of 160 MHz BW FD-A-PPDU according to an embodiment of the present disclosure. According to some embodiments of the present invention, for a 160 MHz BW FD-A-PPDU as illustrated in FIG. 10, BW allocated to HE STAs is P80 while BW allocated to EHT STAs is S80. Each intended HE STA shall park in P80 while each intended EHT STA shall park in S80. Within each of P80 and S80, in one embodiment, a single 20 MHz subchannel which is not P20 may be punctured. In this case, an 80 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P80 while an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S80.

[0088] In another embodiment, two consecutive 20 MHz subchannels which do not include P20 may be punctured. In this case, if the punctured two 20 MHz subchannels constitute secondary 40 MHz subchannel (S40), a 40 MHz BW HE MU PPDU is transmitted in P40. If the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80. On the other hand, if the punctured two 20 MHz subchannels constitute a 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80. If the punctured two 20 MHz subchannels cross the two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80.

[0089] According to some embodiments of the present invention, in a 320 MHz BW FD-A-PPDU, the BW allocated to HE STAs is P80 or primary 160 MHz channel (P160); while the BW allocated to EHT STAs is one of two 80 MHz frequency segments of secondary 160 MHz channel (S160), S160, a combination of S80 and one of two 80 MHz frequency segments of S160 or a combination of S80 and S160. The number of EHT MU PPDU in a 320 MHz BW FD-A-PPDU depends on how the BW is allocated to EHT STAs in the FD-A-PPDU. When the BW allocated to EHT STAs is one of two 80 MHz frequency segments of S160 or S160, there is a single EHT MU PPDU in the FD-A-PPDU.

When the BW allocated to EHT STAs is a combination of S80 and one of two 80 MHz frequency segments of S160, there are two EHT MU PPDU in the FD-A-PPDU. When the BW allocated to EHT STAs is a combination of S80 and S160, there is one or two EHT MU PPDU in the FD-A-PPDU.

[0090] According to some embodiments of the present invention, for a 320 MHz BW FD-A-PPDU, there may have the following five options for BW allocation in the FD-A-PPDU:

[0091] Option 1A: When S80 is punctured, BW allocated to HE STAs is P80 and BW allocated to EHT STAs is S160, as illustrated in FIG. 11A.

[0092] Option 1B: When one of two 80 MHz frequency segments of S160 is punctured, BW allocated to HE STAs is P160 and BW allocated to EHT STAs is the other 80 MHz frequency segment of S160, as illustrated in FIG. 11B.

[0093] Option 1C: When one of two 80 MHz frequency segments of S160 is punctured, BW allocated to HE STAs is P80 and BW allocated to EHT STAs is S80 and the other 80 MHz frequency segment of S160, as illustrated in FIG. 11C.

[0094] Option 1D: When none of 80 MHz frequency segments is punctured, BW allocated to HE STAs is P160 and BW allocated to EHT STAs is S160, as illustrated in FIG. 11D.

[0095] Option 1E: When none of 80 MHz frequency segments is punctured, BW allocated to HE STAs is P80 and BW allocated to EHT STAs is S80 and S160, as illustrated in FIG. 11E.

[0096] Option 1B is typically applicable to use cases where more HE STAs than EHT STAs exist in an EHT BSS, which may occur when EHT STAs start shipping to markets. Option 1D is typically applicable to use cases where similar number of HE STAs and EHT STAs exist in an EHT BSS. Option 1A, Option 1C and Option 1E are typically applicable to use cases where more EHT STAs than HE STAs exist in an EHT BSS, which may occur when EHT STAs dominate Wi-Fi markets.

[0097] According to some embodiments of the present invention, regarding Option 1A for a 320 MHz BW FD-A-PPDU, each intended HE STA shall park in P80 while each intended EHT STA shall park in one of two 80 MHz frequency segments of S160. Within P80 or each of the two 80 MHz frequency segments of S160, in one embodiment, a single 20 MHz subchannel which is not P20 may be punctured. In this case, an 80 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P80 while a 160 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S160.

[0098] In another embodiment, within P80 or each of the two 80 MHz frequency segments of S160, two consecutive 20 MHz subchannels which do not include P20 may be punctured. In this case, if the punctured two 20 MHz subchannels constitute S40, a 40 MHz BW HE MU PPDU is transmitted in P40. If the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80. On the other hand, a 160 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S160.

[0099] According to some embodiments of the present invention, regarding Option 1B for a 320 MHz BW FD-A-PPDU, each intended HE STA shall park in P80 while each intended EHT STA shall park in the unpunctured 80 MHz frequency segment of S160. Within P80, S80 or the unpunctured 80 MHz frequency segment of S160, in one embodiment, a single 20 MHz subchannel which is not P20 may be punctured. In this case, a 160 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P160 while an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S160.

[0100] In another embodiment, within P80, S80 or the unpunctured 80 MHz frequency segment of S160, two consecutive 20 MHz subchannels which do not include P20 may be punctured. In this case, a 160 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P160. On the other hand, if the punctured two 20 MHz subchannels constitute one 40 MHz subchannel of the unpunctured 80 MHz frequency segment of S160, a 40 MHz

BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of the unpunctured 80 MHz frequency segment of S160. If the punctured two 20 MHz subchannels cross the two 40 MHz subchannels of the unpunctured 80 MHz frequency segment of S160, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in the unpunctured 80 MHz frequency segment of S160.

5 **[0101]** According to some embodiments of the present invention, regarding Option 1C for a 320 MHz BW FD-A-PPDU, each intended HE STA shall park in P80 while each intended EHT STA shall park in S80 or the unpunctured 80 MHz frequency segment of S160. Within P80, S80 or the unpunctured 80 MHz frequency segment of S160, in one embodiment, a single 20 MHz subchannel which is not P20 may be punctured. In this case, an 80 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P80. On the other hand, an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S80 and another 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in the unpunctured 80 MHz frequency segment of S160.

15 **[0102]** In another embodiment, within P80, S80 or the unpunctured 80 MHz frequency segment of S160, two consecutive 20 MHz subchannels which do not include P20 may be punctured. In this case, if the punctured two 20 MHz subchannels constitute S40, a 40 MHz BW HE MU PPDU is transmitted in P40. If the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80. On the other hand, if the punctured two 20 MHz subchannels constitute one 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80. If the punctured two 20 MHz subchannels cross two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80. If the punctured two 20 MHz subchannels constitute one 40 MHz subchannel of the unpunctured 80 MHz frequency segment of S160, another 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of the unpunctured 80 MHz frequency segment of S160. If the punctured two 20 MHz subchannels cross two 40 MHz subchannels of the unpunctured 80 MHz frequency segment of S160, another 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in the unpunctured 80 MHz frequency segment of S160.

25 **[0103]** According to some embodiments of the present invention, regarding Option 1D for a 320 MHz BW FD-A-PPDU, each intended HE STA shall park in P80 while each intended EHT STA shall park in one of two 80 MHz frequency segments of S160. Within P80, S80 or each of the two 80 MHz frequency segments of S160, in one embodiment, a single 20 MHz subchannel which is not P20 may be punctured. In this case, a 160 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P160. On the other hand, a 160 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S160.

30 **[0104]** In another embodiment, within P80, S80 or each of the two 80 MHz frequency segments of S160, two consecutive 20 MHz subchannels which do not include P20 may be punctured. In this case, a 160 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P160. On the other hand, a 160 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S160.

35 **[0105]** According to some embodiments of the present invention, regarding Option 1E for a 320 MHz BW FD-A-PPDU, each intended HE STA shall park in P80 while each intended EHT STA shall park in S80 or one of two 80 MHz frequency segments of S160. Within P80, S80 or each of the two 80 MHz frequency segments of S160, in one embodiment, a single 20 MHz subchannel which is not P20 may be punctured. In this case, an 80 MHz BW HE MU PPDU to which preamble puncturing may be applied is transmitted in P80. On the other hand, a 320 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80 and S160. Alternatively, an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S80 and another 160 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in S160. Compared to a 320 MHz BW EHT MU PPDU transmitted in

S80 and S160, two separate 80 MHz and 160 MHz BW EHT MU PPDU transmitted in S80 and S160 may result in lower EHT-SIG overhead. However, in two separate 80 MHz and 160 MHz BW EHT MU PPDU transmitted in S80 and S160, EHT STAs intended by the 80 MHz BW EHT MU PPDU transmitted in S80 cannot be scheduled in S160, vice versa, which reduces scheduling flexibility.

- 5 **[0106]** In another embodiment, within P80, S80 or each of the two 80 MHz frequency segments of S160, two consecutive 20 MHz subchannels which do not include P20 may be punctured. In this case, if the punctured two 20 MHz subchannels constitute S40, a 40 MHz BW HE MU PPDU is transmitted in P40. If the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80. On the other hand, a 320 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80 and S160.
- 10 Alternatively, if the punctured two 20 MHz subchannels constitute one 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80. If the punctured two 20 MHz subchannels cross two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80. If the punctured two 20 MHz subchannels constitute one 40 MHz subchannel of the unpunctured 80 MHz frequency segment of S160, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of the unpunctured 80 MHz frequency segment of S160. If the punctured two 20 MHz subchannels cross two 40 MHz subchannels of the unpunctured 80 MHz frequency segment of S160, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in the unpunctured 80 MHz frequency segment of S160.

- [0107]** Post-EHT WLAN will be the next-generation WLAN immediately after EHT WLAN. According to some embodiments of the present invention, HE STAs, EHT STAs, and post-EHT STAs may coexist in a post-EHT BSS in future. To improve system throughput in a post-EHT BSS, a 320 MHz BW FD-A-PPDU may comprise a HE MU PPDU, an EHT MU PPDU and a post-EHT MU PPDU regardless of how BW is allocated to HE STAs, EHT STAs and post-EHT STAs. There may have the following four options for BW allocation in a 320 MHz FD-A-PPDU:

- [0108]** Option 2A: When S80 is punctured, BW allocated to HE STAs is P80 and BW allocated to EHT STAs and post-EHT STAs are two 80 MHz frequency segments of S160, respectively, as illustrated in FIG. 12A.

- 25 **[0109]** Option 2B: When one of two 80 MHz frequency segments of S160 is punctured, BW allocated to HE STAs is P80 and BW allocated to EHT STAs and post-EHT STAs are S80 and the other 80 MHz frequency segment of S160, respectively, as illustrated in FIG. 12B.

- [0110]** Option 2C: When none of 80 MHz frequency segments is punctured, BW allocated to HE STAs is P80, BW allocated to EHT STAs is S160, and BW allocated to post-EHT STAs is S80, as illustrated in FIG. 12C.

- 30 **[0111]** Option 2D: When none of 80 MHz frequency segments is punctured, BW allocated to HE STAs is P80, BW allocated to post-EHT STAs is S160, and BW allocated to EHT STAs is S80, as illustrated in FIG. 12D.

- [0112]** It can be expected that when post-EHT STAs start shipping to markets, EHT STAs will dominate Wi-Fi markets and HE STAs will gradually fade out. According to the present invention, in a FD-A-PPDU, BW allocated to HE STAs shall not be larger than that allocated to EHT STAs or post-EHT STAs. Option 2C is typically applicable to use cases where more EHT STAs than post-EHT STAs and HE STAs exist in a post-EHT BSS, which may occur when post-EHT STAs just start shipping to markets. Option 2A and Option 2B are typically applicable to use cases where similar number of HE STAs, EHT STAs and post-EHT STAs exist in a post-EHT BSS. Option 2D is typically applicable to use cases where more post-EHT STAs than HE STAs and EHT-STAs exist in a post-EHT BSS, which may occur when post-EHT STAs dominate Wi-Fi markets.

- 40 **[0113]** According to some embodiments of the present invention, for trigger-based uplink transmission, a FD-A-PPDU may comprise one or more HE TB PPDU and one or more EHT TB PPDU in an EHT BSS. A FD-A-PPDU may comprise one or more HE TB PPDU, one or more EHT TB PPDU and one or more post-EHT TB PPDU in a post-EHT

BSS. For trigger-based uplink transmission in an EHT BSS, BW can be allocated to HE STAs and EHT STAs in a FD-A-PPDU in a similar manner to downlink transmission as illustrated in FIG. 11A to FIG. 11E. For trigger-based uplink transmission in a post-EHT BSS, BW can be allocated to HE STAs, EHT STAs and post-EHT STAs in a FD-A-PPDU in a similar manner to downlink transmission as illustrated in FIG. 12A to FIG. 12D.

5 [0114] In summary, some embodiments of the present disclosure address formats of HE PPDU and EHT PPDU as well as BW allocation in a FD-A-PPDU. According to some embodiments of the present disclosure, a FD-A-PPDU may comprise a HE MU PPDU and one or two EHT MU PPDU for downlink transmission if the number of HE-SIG-B symbols is equal to the number of EHT-SIG symbols and the HE-LTF field has a same symbol duration and a same GI duration as the EHT-LTF field. When the number of HE-LTF symbols is different from the number of EHT-LTF symbols, 10 each HE-LTF/EHT-LTF symbol shall have a same duration as each data symbol. In a 320 MHz BW FD-A-PPDU, the BW allocated to HE STAs is primary 80 MHz channel (P80) or primary 160 MHz channel (P160); while the BW allocated to EHT STAs is one of two 80 MHz frequency segments of secondary 160 MHz channel (S160), S160, a combination of secondary 80 MHz channel (S80) and one of two 80 MHz frequency segments of S160 or a combination of S80 and S160. The number of EHT MU PPDU in a 320 MHz BW FD-A-PPDU depends on how the BW is allocated to EHT STAs in 15 the FD-A-PPDU. When the BW allocated to EHT STAs is one of two 80 MHz frequency segments of S160 or S160, there is a single EHT MU PPDU in the FD-A-PPDU. When the BW allocated to EHT STAs is a combination of S80 and one of two 80 MHz frequency segments of S160, there are two EHT MU PPDU in the FD-A-PPDU. When the BW allocated to EHT STAs is a combination of S80 and S160, there is one or two EHT MU PPDU in the FD-A-PPDU.

20 [0115] According to some embodiments of the present disclosure, in a FD-A-PPDU, the BW can be allocated to HE STAs and EHT STAs flexibly according to the number of HE STAs and EHT STAs in an EHT BSS. Further, in a FD-A-PPDU, one or two EHT MU PPDU can be transmitted according to the tradeoff between scheduling flexibility and overhead reduction. As a result, system throughput in the EHT BSS can be improved as much as possible.

25 [0116] Commercial interests for some embodiments are as follows. 1. Solving issues in the prior art. 2. Aggregating different formats of PPDU. 3. Achieving extremely high throughput (EHT). 4. Improving system throughput in an EHT BSS. 5. Providing a good communication performance. 6. Providing a high reliability. 7. 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 30 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.

35 [0117] FIG. 13 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. 13 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 40 memory/storage to enable various applications and/or operating systems running on the system.

[0118] 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.

[0119] 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.

[0120] 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.

[0121] 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.

[0122] 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.

[0123] 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.

[0124] 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.

[0125] 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.

[0126] 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.

[0127] 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. An information transmission method, comprising:
 configuring, by an access point (AP), an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission to a set of stations (STAs), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a
 5 number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and
 determining, by the AP, an uplink transmission from a STA of the set of STAs, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.
- 10 2. The information transmission method of claim 1, wherein the A-PPDU used for downlink transmission to the set of STAs is configured in a basic service set (BSS) with a bandwidth.
3. The information transmission method of claim 2, wherein the BSS comprises an extremely high throughput (EHT) BSS.
4. The information transmission method of claim 2 or 3, wherein the bandwidth is greater than 80 MHz.
5. The information transmission method of claim 4, wherein the bandwidth is greater than or equal to 160 MHz.
- 15 6. The information transmission method of claim 4 or 5, wherein the bandwidth is greater than or equal to 320 MHz.
7. The information transmission method of any one of claims 1 to 6, wherein the A-PPDU comprises a frequency-domain (FD) A-PPDU (FD-A-PPDU).
8. The information transmission method of any one of claims 1 to 7, wherein the first PPDU comprises a high efficiency (HE) multi-user (MU) PPDU.
- 20 9. The information transmission method of claim 6, wherein a number of the HE MU PPDU is equal to one.
10. The information transmission method of any one of claims 1 to 9, wherein the at least one second PPDU comprises at least one EHT MU PPDU.
11. The information transmission method of claim 10, wherein a number of the at least one EHT MU PPDU is equal to one or two.
- 25 12. The information transmission method of any one of claims 1 to 11, wherein the first symbols comprise HE SIGNAL B field (HE-SIG-B) symbols.
13. The information transmission method of any one of claims 1 to 12, wherein the second symbols comprise EHT SIGNAL field (EHT-SIG) symbols.
14. The information transmission method of any one of claims 1 to 13, wherein the first field comprises a HE Long Training field (HE-LTF).
- 30 15. The information transmission method of any one of claims 1 to 14, wherein the second field comprises an EHT-LTF.
16. The information transmission method of claim 15, wherein a number of HE-LTF symbols is same as or different from a number of EHT-LTF symbols.
17. The information transmission method of claim 16, wherein when the number of HE-LTF symbols is same as the
 35 number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a different duration or a same duration from each data symbol.
18. The information transmission method of claim 17, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 3.2 μ s or 6.4 μ s or 12.8 μ s.
19. The information transmission method of claim 16, wherein when the number of HE-LTF symbols is different from the
 40 number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a same duration from each data symbol.
20. The information transmission method of claim 19, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 12.8 μ s.

21. The information transmission method of any one of claims 16 to 20, wherein pre-HE modulated fields of the HE MU PPDU and pre-EHT modulated fields of the EHT MU PPDU can be kept orthogonal in frequency domain symbol-by-symbol.
22. The information transmission method of any one of claims 16 to 21, wherein the FD-A-PPDU used for downlink transmission does not comprise a HE single user (SU) PPDU.
23. The information transmission method of claim 22, wherein pre-HE modulated fields of the HE SU PPDU and pre-EHT modulated fields of the EHT MU PPDU cannot be kept orthogonal in frequency domain symbol-by-symbol
24. The information transmission method of any one of claims 16 to 23, wherein the FD-A-PPDU used for downlink transmission does not comprise both of a HE extended range (ER) SU PPDU and the EHT MU PPDU.
25. The information transmission method of any one of claims 1 to 24, wherein the A-PPDU used for trigger-based uplink transmission comprises one or more first trigger-based (TB) PPDU and one or more second TB PPDU if each first symbol has a same symbol duration and a same GI duration as each second symbol.
26. The information transmission method of claim 25, wherein one or more first TB PPDU comprise one or more HE trigger-based (TB) PPDU and one or more second TB PPDU comprise one or more EHT TB PPDU.
27. The information transmission method of claim 25 or 26, wherein pre-HE modulated fields of the first TB PPDU and pre-EHT modulated fields of the second TB PPDU can be kept orthogonal in frequency domain symbol-by-symbol.
28. The information transmission method of any one of claims 25 to 27, wherein the A-PPDU used for trigger-based uplink transmission does not comprise a HE SU PPDU, a HE ER SU PPDU, and/or a HE MU PPDU.
29. The information transmission method of claim 28, wherein the HE SU PPDU, the HE ER SU PPDU, and/or the HE MU PPDU is disallowed for trigger-based uplink transmission.
30. The information transmission method of any one of claims 1 to 29, wherein the uplink transmission is determined in a first bandwidth channel if the STA is a first type of STA and/or is determined in a second bandwidth channel if the STA is a second type of STA and/or is determined in a third bandwidth channel if the STA is a third type of STA.
31. The information transmission method of claim 30, wherein the first type of STA comprises a HE STA, and the first bandwidth channel comprises a primary 80 MHz channel (P80).
32. The information transmission method of claim 30 or 31, wherein the second type of STA comprises an EHT STA, and the second bandwidth channel comprises a non-primary 80 MHz channel and/or the third type of STA comprises a post-EHT STA, and the third bandwidth channel comprises a non-primary 80 MHz channel.
33. The information transmission method of claim 32, wherein the non-primary 80 MHz channel comprises an 80 MHz frequency segment outside the P80.
34. The information transmission method of claim 33, wherein the non-primary 80 MHz channel comprises a secondary 80 MHz channel (S80) in a 160 MHz channel or a 320 MHz channel.
35. The information transmission method of claim 33 or 34, wherein for downlink transmission, the HE STA needs to process pre-HE modulated fields of the HE MU PPDU within the P80; while the EHT STA needs to process pre-EHT modulated fields of the EHT MU PPDU within the 80 MHz frequency segment the EHT STA parks.
36. The information transmission method of claim 34 or 35, wherein within each of the P80 and the S80, a single 20 MHz subchannel which is not a primary 20 MHz channel (P20) may be punctured.
37. The information transmission method of claim 36, wherein an 80 MHz bandwidth (BW) HE MU PPDU to which preamble puncturing may be applied is transmitted in the P80 while an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in the S80.
38. The information transmission method of claim 34 or 35, wherein within each of the P80 and the S80, two consecutive 20 MHz subchannels which do not include P20 may be punctured.
39. The information transmission method of claim 38, wherein if the punctured two 20 MHz subchannels constitute a

secondary 40 MHz subchannel (S40), a 40 MHz BW HE MU PPDU is transmitted in a primary 40 MHz subchannel (S40).

40. The information transmission method of claim 38 or 39, wherein if the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80.

5 41. The information transmission method of any one of claims 38 to 40, wherein if the punctured two 20 MHz subchannels constitute a 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80.

42. The information transmission method of any one of claims 38 to 41, wherein if the punctured two 20 MHz subchannels cross the two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing
10 applied is transmitted in S80.

43. The information transmission method of any one of claims 38 to 42, wherein in a 320 MHz BW FD-A-PPDU, a BW allocated to the at least one HE STA is P80 or primary 160 MHz channel (P160); while a BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of secondary 160 MHz channel (S160), S160, a combination of S80 and one of two 80 MHz frequency segments of S160, or a combination of S80 and S160.

15 44. The information transmission method of claim 43, wherein a number of EHT MU PPDU in a 320 MHz BW FD-A-PPDU depends on a BW allocation to the at least one EHT STA in the FD-A-PPDU.

45. The information transmission method of claim 43 or 44, wherein when the BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of S160 or S160, there is a single EHT MU PPDU in the FD-A-PPDU.

20 46. The information transmission method of any one of claims 43 to 45, wherein when the BW allocated to the at least one EHT STA is a combination of S80 and one of two 80 MHz frequency segments of S160, there are two EHT MU PPDU in the FD-A-PPDU.

47. The information transmission method of any one of claims 43 to 45, wherein when the BW allocated to the at least one EHT STA is a combination of S80 and S160, there is one or two EHT MU PPDU in the FD-A-PPDU.

25 48. The information transmission method of any one of claims 38 to 47, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:

option 1A: when S80 is punctured, a BW allocated to the at least one HE STA is P80 and a BW allocated to the at least one EHT STA is S160;

option 1B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is the other 80 MHz frequency segment of S160;

30 option 1C: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA is S80 and the other 80 MHz frequency segment of S160;

option 1D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is S160; or

35 option 1E: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA is S80 and S160.

49. The information transmission method of any one of claims 38 to 48, wherein the 320 MHz BW FD-A-PPDU comprise the HE MU PPDU, the EHT MU PPDU, and a post-EHT MU PPDU.

50. The information transmission method of claim 49, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:

40 option 2A: when S80 is punctured, the BW allocated to the at least one HE STA is P80 and BWs allocated to the at least one EHT STA and the at least one post-EHT STA are two 80 MHz frequency segments of S160, respectively;

option 2B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA and the at least one post-EHT STA are S80 and the other 80

MHz frequency segment of S160, respectively;

option 2C: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one EHT STA is S160, and the BW allocated to the at least one post-EHT STA is S80; or

5 option 2D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one post-EHT STA is S160, and the BW allocated to the at least one EHT STA is S80.

51. The information transmission method of claim 49 or 50, wherein for trigger-based uplink transmission, the FD-A-PPDU comprises one or more HE TB PPDU, and one or more EHT TB PPDU in an EHT BSS and/or the FD-A-PPDU comprises one or more HE TB PPDU, one or more EHT TB PPDU, and one or more post-EHT TB PPDU in a post-EHT BSS.

10 52. An information transmission method, comprising:
determining, by a station (STA) of a set of STAs, an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission from an access point (AP), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second
15 field of the second PPDU; and

transmitting, by the STA, an uplink transmission to the AP, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.

53. The information transmission method of claim 52, wherein the A-PPDU used for downlink transmission to the set of STAs is configured in a basic service set (BSS) with a bandwidth.

20 54. The information transmission method of claim 53, wherein the BSS comprises an extremely high throughput (EHT) BSS.

55. The information transmission method of claim 53 or 54, wherein the bandwidth is greater than 80 MHz.

56. The information transmission method of claim 55, wherein the bandwidth is greater than or equal to 160 MHz.

57. The information transmission method of claim 55 or 56, wherein the bandwidth is greater than or equal to 320 MHz.

25 58. The information transmission method of any one of claims 52 to 57, wherein the A-PPDU comprises a frequency-domain (FD) A-PPDU (FD-A-PPDU).

59. The information transmission method of any one of claims 52 to 58, wherein the first PPDU comprises a high efficiency (HE) multi-user (MU) PPDU.

60. The information transmission method of claim 57, wherein a number of the HE MU PPDU is equal to one.

30 61. The information transmission method of any one of claims 52 to 60, wherein the at least one second PPDU comprises at least one EHT MU PPDU.

62. The information transmission method of claim 61, wherein a number of the at least one EHT MU PPDU is equal to one or two.

35 63. The information transmission method of any one of claims 52 to 62, wherein the first symbols comprise HE SIGNAL B field (HE-SIG-B) symbols.

64. The information transmission method of any one of claims 52 to 63, wherein the second symbols comprise EHT SIGNAL field (EHT-SIG) symbols.

65. The information transmission method of any one of claims 52 to 64 wherein the first field comprises a HE Long Training field (HE-LTF).

40 66. The information transmission method of any one of claims 52 to 65, wherein the second field comprises an EHT-LTF.

67. The information transmission method of claim 66, wherein a number of HE-LTF symbols is same as or different from a number of EHT-LTF symbols.

68. The information transmission method of claim 67, wherein when the number of HE-LTF symbols is same as the

number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a different duration or a same duration from each data symbol.

69. The information transmission method of claim 68, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 3.2 μ s or 6.4 μ s or 12.8 μ s.

5 70. The information transmission method of claim 67, wherein when the number of HE-LTF symbols is different from the number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a same duration from each data symbol.

71. The information transmission method of claim 70, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 12.8 μ s.

10 72. The information transmission method of any one of claims 67 to 71, wherein pre-HE modulated fields of the HE MU PPDU and pre-EHT modulated fields of the EHT MU PPDU can be kept orthogonal in frequency domain symbol-by-symbol.

73. The information transmission method of any one of claims 67 to 72, wherein the FD-A-PPDU used for downlink transmission does not comprise a HE single user (SU) PPDU.

15 74. The information transmission method of claim 73, wherein pre-HE modulated fields of the HE SU PPDU and pre-EHT modulated fields of the EHT MU PPDU cannot be kept orthogonal in frequency domain symbol-by-symbol

75. The information transmission method of any one of claims 67 to 74, wherein the FD-A-PPDU used for downlink transmission does not comprise both of a HE extended range (ER) SU PPDU and the EHT MU PPDU.

20 76. The information transmission method of any one of claims 52 to 75, wherein the A-PPDU used for trigger-based uplink transmission comprises one or more first trigger-based (TB) PPDU and one or more second TB PPDU if each first symbol has a same symbol duration and a same GI duration as each second symbol.

77. The information transmission method of claim 76, wherein one or more first TB PPDU and one or more second TB PPDU comprise one or more HE trigger-based (TB) PPDU and one or more second TB PPDU comprise one or more EHT TB PPDU.

25 78. The information transmission method of claim 76 or 77, wherein pre-HE modulated fields of the first TB PPDU and pre-EHT modulated fields of the second TB PPDU can be kept orthogonal in frequency domain symbol-by-symbol.

79. The information transmission method of any one of claims 76 to 78, wherein the A-PPDU used for trigger-based uplink transmission does not comprise a HE SU PPDU, a HE ER SU PPDU, and/or a HE MU PPDU.

80. The information transmission method of claim 79, wherein the HE SU PPDU, the HE ER SU PPDU, and/or the HE MU PPDU is disallowed for trigger-based uplink transmission.

30 81. The information transmission method of any one of claims 52 to 80, wherein the uplink transmission is transmitted in a first bandwidth channel if the STA is a first type of STA and/or is transmitted in a second bandwidth channel if the STA is a second type of STA and/or is transmitted in a third bandwidth channel if the STA is a third type of STA.

82. The information transmission method of claim 81, wherein the first type of STA comprises a HE STA, and the first bandwidth channel comprises a primary 80 MHz channel (P80).

35 83. The information transmission method of claim 81 or 82, wherein the second type of STA comprises an EHT STA, and the second bandwidth channel comprises a non-primary 80 MHz channel and/or the third type of STA comprises a post-EHT STA, and the third bandwidth channel comprises a non-primary 80 MHz channel.

84. The information transmission method of claim 83, wherein the non-primary 80 MHz channel comprises an 80 MHz frequency segment outside the P80.

40 85. The information transmission method of claim 84, wherein the non-primary 80 MHz channel comprises a secondary 80 MHz channel (S80) in a 160 MHz channel or a 320 MHz channel.

86. The information transmission method of claim 84 or 85, wherein for downlink transmission, the HE STA needs to process pre-HE modulated fields of the HE MU PPDU within the P80; while the EHT STA needs to process pre-EHT

modulated fields of the EHT MU PPDU within the 80 MHz frequency segment the EHT STA parks.

87. The information transmission method of claim 85 or 86, wherein within each of the P80 and the S80, a single 20 MHz subchannel which is not a primary 20 MHz channel (P20) may be punctured.

5 88. The information transmission method of claim 87, wherein an 80 MHz bandwidth (BW) HE MU PPDU to which preamble puncturing may be applied is transmitted in the P80 while an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in the S80.

89. The information transmission method of claim 85 or 86, wherein within each of the P80 and the S80, two consecutive 20 MHz subchannels which do not include P20 may be punctured.

10 90. The information transmission method of claim 89, wherein if the punctured two 20 MHz subchannels constitute a secondary 40 MHz subchannel (S40), a 40 MHz BW HE MU PPDU is transmitted in a primary 40 MHz subchannel (S40).

91. The information transmission method of claim 89 or 90, wherein if the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80.

15 92. The information transmission method of any one of claims 89 to 91, wherein if the punctured two 20 MHz subchannels constitute a 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80.

93. The information transmission method of any one of claims 89 to 92, wherein if the punctured two 20 MHz subchannels cross the two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80.

20 94. The information transmission method of any one of claims 89 to 93, wherein in a 320 MHz BW FD-A-PPDU, a BW allocated to the at least one HE STA is P80 or primary 160 MHz channel (P160); while a BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of secondary 160 MHz channel (S160), S160, a combination of S80 and one of two 80 MHz frequency segments of S160, or a combination of S80 and S160.

25 95. The information transmission method of claim 94, wherein a number of EHT MU PPDU's in a 320 MHz BW FD-A-PPDU depends on a BW allocation to the at least one EHT STA in the FD-A-PPDU.

96. The information transmission method of claim 94 or 95, wherein when the BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of S160 or S160, there is a single EHT MU PPDU in the FD-A-PPDU.

30 97. The information transmission method of any one of claims 94 to 96, wherein when the BW allocated to the at least one EHT STA is a combination of S80 and one of two 80 MHz frequency segments of S160, there are two EHT MU PPDU's in the FD-A-PPDU.

98. The information transmission method of any one of claims 94 to 96, wherein when the BW allocated to the at least one EHT STA is a combination of S80 and S160, there is one or two EHT MU PPDU's in the FD-A-PPDU.

99. The information transmission method of any one of claims 89 to 98, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:

35 option 1A: when S80 is punctured, a BW allocated to the at least one HE STA is P80 and a BW allocated to the at least one EHT STA is S160;

option 1B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is the other 80 MHz frequency segment of S160;

40 option 1C: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA is S80 and the other 80 MHz frequency segment of S160;

option 1D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is S160; or

option 1E: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80

and the BW allocated to the at least one EHT STA is S80 and S160.

100. The information transmission method of any one of claims 89 to 99, wherein the 320 MHz BW FD-A-PPDU comprise the HE MU PPDU, the EHT MU PPDU, and a post-EHT MU PPDU.

5 101. The information transmission method of claim 100, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:

option 2A: when S80 is punctured, the BW allocated to the at least one HE STA is P80 and BWs allocated to the at least one EHT STA and the at least one post-EHT STA are two 80 MHz frequency segments of S160, respectively;

option 2B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA and the at least one post-EHT STA are S80 and the other 80 MHz frequency segment of S160, respectively;

option 2C: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one EHT STA is S160, and the BW allocated to the at least one post-EHT STA is S80; or

option 2D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one post-EHT STA is S160, and the BW allocated to the at least one EHT STA is S80.

15 102. The information transmission method of claim 100 or 101, wherein for trigger-based uplink transmission, the FD-A-PPDU comprises one or more HE TB PPDU, and one or more EHT TB PPDU in an EHT BSS and/or the FD-A-PPDU comprises one or more HE TB PPDU, one or more EHT TB PPDU, and one or more post-EHT TB PPDU in a post-EHT BSS.

103. An access point (AP), comprising:

20 a memory;

a transceiver; and

a processor coupled to the memory and the transceiver;

wherein the processor is configured to:

25 configure an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission to a set of stations (STAs), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and determine an uplink transmission from a STA of the set of STAs, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.

30 104. The AP of claim 103, wherein the A-PPDU used for downlink transmission to the set of STAs is configured in a basic service set (BSS) with a bandwidth.

105. The AP of claim 104, wherein the BSS comprises an extremely high throughput (EHT) BSS.

106. The AP of claim 104 or 105, wherein the bandwidth is greater than 80 MHz.

107. The AP of claim 106, wherein the bandwidth is greater than or equal to 160 MHz.

35 108. The AP of claim 106 or 10, wherein the bandwidth is greater than or equal to 320 MHz.

109. The AP of any one of claims 103 to 108, wherein the A-PPDU comprises a frequency-domain (FD) A-PPDU (FD-A-PPDU).

110. The AP of any one of claims 103 to 109, wherein the first PPDU comprises a high efficiency (HE) multi-user (MU) PPDU.

40 111. The AP of claim 108, wherein a number of the HE MU PPDU is equal to one.

112. The AP of any one of claims 103 to 111, wherein the at least one second PPDU comprises at least one EHT MU PPDU.

113. The AP of claim 112, wherein a number of the at least one EHT MU PPDU is equal to one or two.

114. The AP of any one of claims 103 to 113, wherein the first symbols comprise HE SIGNAL B field (HE-SIG-B) symbols.
115. The AP of any one of claims 103 to 114, wherein the second symbols comprise EHT SIGNAL field (EHT-SIG) symbols.
- 5 116. The AP of any one of claims 103 to 115, wherein the first field comprises a HE Long Training field (HE-LTF).
117. The AP of any one of claims 103 to 116, wherein the second field comprises an EHT-LTF.
118. The AP of claim 117, wherein a number of HE-LTF symbols is same as or different from a number of EHT-LTF symbols.
119. The AP of claim 118, wherein when the number of HE-LTF symbols is same as the number of EHT-LTF symbols,
- 10 each HE-LTF symbol and/or each EHT-LTF symbol has a different duration or a same duration from each data symbol.
120. The AP of claim 119, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 3.2 μ s or 6.4 μ s or 12.8 μ s.
121. The AP of claim 118, wherein when the number of HE-LTF symbols is different from the number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a same duration from each data symbol.
- 15 122. The AP of claim 121, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 12.8 μ s.
123. The AP of any one of claims 118 to 122, wherein pre-HE modulated fields of the HE MU PPDU and pre-EHT modulated fields of the EHT MU PPDU can be kept orthogonal in frequency domain symbol-by-symbol.
124. The AP of any one of claims 118 to 123, wherein the FD-A-PPDU used for downlink transmission does not comprise
- 20 a HE single user (SU) PPDU.
125. The AP of claim 124, wherein pre-HE modulated fields of the HE SU PPDU and pre-EHT modulated fields of the EHT MU PPDU cannot be kept orthogonal in frequency domain symbol-by-symbol
126. The AP of any one of claims 118 to 125, wherein the FD-A-PPDU used for downlink transmission does not comprise both of a HE extended range (ER) SU PPDU and the EHT MU PPDU.
- 25 127. The AP of any one of claims 103 to 126, wherein the A-PPDU used for trigger-based uplink transmission comprises one or more first trigger-based (TB) PPDU and one or more second TB PPDU if each first symbol has a same symbol duration and a same GI duration as each second symbol.
128. The AP of claim 127, wherein one or more first TB PPDU comprise one or more HE trigger-based (TB) PPDU and one or more second TB PPDU comprise one or more EHT TB PPDU.
- 30 129. The AP of claim 127 or 128, wherein pre-HE modulated fields of the first TB PPDU and pre-EHT modulated fields of the second TB PPDU can be kept orthogonal in frequency domain symbol-by-symbol.
130. The AP of any one of claims 127 to 129, wherein the A-PPDU used for trigger-based uplink transmission does not comprise a HE SU PPDU, a HE ER SU PPDU, and/or a HE MU PPDU.
131. The AP of claim 130, wherein the HE SU PPDU, the HE ER SU PPDU, and/or the HE MU PPDU is disallowed for
- 35 trigger-based uplink transmission.
132. The AP of any one of claims 103 to 131, wherein the uplink transmission is determined in a first bandwidth channel if the STA is a first type of STA and/or is determined in a second bandwidth channel if the STA is a second type of STA and/or is determined in a third bandwidth channel if the STA is a third type of STA.
133. The AP of claim 132, wherein the first type of STA comprises a HE STA, and the first bandwidth channel comprises a
- 40 primary 80 MHz channel (P80).
134. The AP of claim 132 or 133, wherein the second type of STA comprises an EHT STA, and the second bandwidth channel comprises a non-primary 80 MHz channel and/or the third type of STA comprises a post-EHT STA, and the third bandwidth channel comprises a non-primary 80 MHz channel.

135. The AP of claim 134, wherein the non-primary 80 MHz channel comprises an 80 MHz frequency segment outside the P80.
136. The AP of claim 135, wherein the non-primary 80 MHz channel comprises a secondary 80 MHz channel (S80) in a 160 MHz channel or a 320 MHz channel.
- 5 137. The AP of claim 135 or 136, wherein for downlink transmission, the HE STA needs to process pre-HE modulated fields of the HE MU PPDU within the P80; while the EHT STA needs to process pre-EHT modulated fields of the EHT MU PPDU within the 80 MHz frequency segment the EHT STA parks.
138. The AP of claim 136 or 137, wherein within each of the P80 and the S80, a single 20 MHz subchannel which is not a primary 20 MHz channel (P20) may be punctured.
- 10 139. The AP of claim 138, wherein an 80 MHz bandwidth (BW) HE MU PPDU to which preamble puncturing may be applied is transmitted in the P80 while an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in the S80.
140. The AP of claim 136 or 137, wherein within each of the P80 and the S80, two consecutive 20 MHz subchannels which do not include P20 may be punctured.
- 15 141. The AP of claim 139, wherein if the punctured two 20 MHz subchannels constitute a secondary 40 MHz subchannel (S40), a 40 MHz BW HE MU PPDU is transmitted in a primary 40 MHz subchannel (S40).
142. The AP of claim 140 or 141, wherein if the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80.
143. The AP of any one of claims 140 to 142, wherein if the punctured two 20 MHz subchannels constitute a 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80.
- 20 144. The AP of any one of claims 140 to 143, wherein if the punctured two 20 MHz subchannels cross the two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80.
145. The AP of any one of claims 140 to 144, wherein in a 320 MHz BW FD-A-PPDU, a BW allocated to the at least one HE STA is P80 or primary 160 MHz channel (P160); while a BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of secondary 160 MHz channel (S160), S160, a combination of S80 and one of two 80 MHz frequency segments of S160, or a combination of S80 and S160.
- 25 146. The AP of claim 145, wherein a number of EHT MU PPDU in a 320 MHz BW FD-A-PPDU depends on a BW allocation to the at least one EHT STA in the FD-A-PPDU.
147. The AP of claim 145 or 146, wherein when the BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of S160 or S160, there is a single EHT MU PPDU in the FD-A-PPDU.
- 30 148. The AP of any one of claims 145 to 147, wherein when the BW allocated to the at least one EHT STA is a combination of S80 and one of two 80 MHz frequency segments of S160, there are two EHT MU PPDU in the FD-A-PPDU.
149. The AP of any one of claims 145 to 147, wherein when the BW allocated to the at least one EHT STA is a combination of S80 and S160, there is one or two EHT MU PPDU in the FD-A-PPDU.
- 35 150. The AP of any one of claims 140 to 149, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:
- option 1A: when S80 is punctured, a BW allocated to the at least one HE STA is P80 and a BW allocated to the at least one EHT STA is S160;
- 40 option 1B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is the other 80 MHz frequency segment of S160;
- option 1C: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA is S80 and the other 80 MHz frequency segment of S160;

option 1D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P160 and the BW allocated to the at least one EHT STA is S160; or

option 1E: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA is S80 and S160.

5 151. The AP of any one of claims 140 to 150, wherein the 320 MHz BW FD-A-PPDU comprise the HE MU PPDU, the EHT MU PPDU, and a post-EHT MU PPDU.

152. The AP of claim 151, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:

10 option 2A: when S80 is punctured, the BW allocated to the at least one HE STA is P80 and BWs allocated to the at least one EHT STA and the at least one post-EHT STA are two 80 MHz frequency segments of S160, respectively;

option 2B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the at least one HE STA is P80 and the BW allocated to the at least one EHT STA and the at least one post-EHT STA are S80 and the other 80 MHz frequency segment of S160, respectively;

15 option 2C: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one EHT STA is S160, and the BW allocated to the at least one post-EHT STA is S80; or

option 2D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the at least one post-EHT STA is S160, and the BW allocated to the at least one EHT STA is S80.

20 153. The AP of claim 151 or 152, wherein for trigger-based uplink transmission, the FD-A-PPDU comprises one or more HE TB PPDU, and one or more EHT TB PPDU in an EHT BSS and/or the FD-A-PPDU comprises one or more HE TB PPDU, one or more EHT TB PPDU, and one or more post-EHT TB PPDU in a post-EHT BSS.

154. A station (STA), comprising:

a memory;

a transceiver; and

a processor coupled to the memory and the transceiver;

25 wherein the processor is configured to determine an aggregated physical layer (PHY) protocol data unit (A-PPDU) used for downlink transmission from an access point (AP), wherein the A-PPDU comprises a first PPDU and at least one second PPDU if a number of first symbols of the first PPDU is equal to a number of second symbols of the second PPDU and/or a first field of the first PPDU has a same symbol duration and/or a same guard interval (GI) duration as a second field of the second PPDU; and

30 wherein the transceiver is configured to transmit, to the AP, an uplink transmission, wherein the uplink transmission is in response to the A-PPDU used for downlink transmission.

155. The STA of claim 154, wherein the A-PPDU used for downlink transmission to the STA is configured in a basic service set (BSS) with a bandwidth.

156. The STA of claim 155, wherein the BSS comprises an extremely high throughput (EHT) BSS.

35 157. The STA of claim 155 or 156, wherein the bandwidth is greater than 80 MHz.

158. The STA of claim 157, wherein the bandwidth is greater than or equal to 160 MHz.

159. The STA of claim 157 or 158, wherein the bandwidth is greater than or equal to 320 MHz.

160. The STA of any one of claims 154 to 159, wherein the A-PPDU comprises a frequency-domain (FD) A-PPDU (FD-A-PPDU).

40 161. The STA of any one of claims 154 to 160, wherein the first PPDU comprises a high efficiency (HE) multi-user (MU) PPDU.

162. The STA of claim 159, wherein a number of the HE MU PPDU is equal to one.

163. The STA of any one of claims 154 to 162, wherein the at least one second PPDU comprises at least one EHT MU

PPDU.

164. The STA of claim 163, wherein a number of the at least one EHT MU PPDU is equal to one or two.

165. The STA of any one of claims 154 to 164, wherein the first symbols comprise HE SIGNAL B field (HE-SIG-B) symbols.

5 166. The STA of any one of claims 154 to 165, wherein the second symbols comprise EHT SIGNAL field (EHT-SIG) symbols.

167. The STA of any one of claims 154 to 166, wherein the first field comprises a HE Long Training field (HE-LTF).

168. The STA of any one of claims 154 to 167, wherein the second field comprises an EHT-LTF.

10 169. The STA of claim 168, wherein a number of HE-LTF symbols is same as or different from a number of EHT-LTF symbols.

170. The STA of claim 169, wherein when the number of HE-LTF symbols is same as the number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a different duration or a same duration from each data symbol.

171. The STA of claim 170, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 3.2 μ s or 6.4 μ s or 12.8 μ s.

15 172. The STA of claim 169, wherein when the number of HE-LTF symbols is different from the number of EHT-LTF symbols, each HE-LTF symbol and/or each EHT-LTF symbol has a same duration from each data symbol.

173. The STA of claim 172, wherein each HE-LTF symbol without a GI and/or each EHT-LTF symbol without a GI comprises 12.8 μ s.

20 174. The STA of any one of claims 169 to 173, wherein pre-HE modulated fields of the HE MU PPDU and pre-EHT modulated fields of the EHT MU PPDU can be kept orthogonal in frequency domain symbol-by-symbol.

175. The STA of any one of claims 169 to 174, wherein the FD-A-PPDU used for downlink transmission does not comprise a HE single user (SU) PPDU.

176. The STA of claim 175, wherein pre-HE modulated fields of the HE SU PPDU and pre-EHT modulated fields of the EHT MU PPDU cannot be kept orthogonal in frequency domain symbol-by-symbol

25 177. The STA of any one of claims 169 to 176, wherein the FD-A-PPDU used for downlink transmission does not comprise both of a HE extended range (ER) SU PPDU and the EHT MU PPDU.

178. The STA of any one of claims 154 to 177, wherein the A-PPDU used for trigger-based uplink transmission comprises one or more first trigger-based (TB) PPDU and one or more second TB PPDU if each first symbol has a same symbol duration and a same GI duration as each second symbol.

30 179. The STA of claim 178, wherein one or more first TB PPDU comprise one or more HE trigger-based (TB) PPDU and one or more second TB PPDU comprise one or more EHT TB PPDU.

180. The STA of claim 178 or 179, wherein pre-HE modulated fields of the first TB PPDU and pre-EHT modulated fields of the second TB PPDU can be kept orthogonal in frequency domain symbol-by-symbol.

35 181. The STA of any one of claims 178 to 180, wherein the A-PPDU used for trigger-based uplink transmission does not comprise a HE SU PPDU, a HE ER SU PPDU, and/or a HE MU PPDU.

182. The STA of claim 181, wherein the HE SU PPDU, the HE ER SU PPDU, and/or the HE MU PPDU is disallowed for trigger-based uplink transmission.

40 183. The STA of any one of claims 154 to 182, wherein the uplink transmission is transmitted in a first bandwidth channel if the STA is a first type of STA and/or is transmitted in a second bandwidth channel if the STA is a second type of STA and/or is transmitted in a third bandwidth channel if the STA is a third type of STA.

184. The STA of claim 183, wherein the first type of STA comprises a HE STA, and the first bandwidth channel comprises a primary 80 MHz channel (P80).

185. The STA of claim 183 or 184, wherein the second type of STA comprises an EHT STA, and the second bandwidth

channel comprises a non-primary 80 MHz channel and/or the third type of STA comprises a post-EHT STA, and the third bandwidth channel comprises a non-primary 80 MHz channel.

186. The STA of claim 185, wherein the non-primary 80 MHz channel comprises an 80 MHz frequency segment outside the P80.

5 187. The STA of claim 186, wherein the non-primary 80 MHz channel comprises a secondary 80 MHz channel (S80) in a 160 MHz channel or a 320 MHz channel.

188. The STA of claim 186 or 187, wherein for downlink transmission, the HE STA needs to process pre-HE modulated fields of the HE MU PPDU within the P80; while the EHT STA needs to process pre-EHT modulated fields of the EHT MU PPDU within the 80 MHz frequency segment the EHT STA parks.

10 189. The STA of claim 187 or 188, wherein within each of the P80 and the S80, a single 20 MHz subchannel which is not a primary 20 MHz channel (P20) may be punctured.

190. The STA of claim 189, wherein an 80 MHz bandwidth (BW) HE MU PPDU to which preamble puncturing may be applied is transmitted in the P80 while an 80 MHz BW EHT MU PPDU to which preamble puncturing may be applied is transmitted in the S80.

15 191. The STA of claim 187 or 188, wherein within each of the P80 and the S80, two consecutive 20 MHz subchannels which do not include P20 may be punctured.

192. The STA of claim 191, wherein if the punctured two 20 MHz subchannels constitute a secondary 40 MHz subchannel (S40), a 40 MHz BW HE MU PPDU is transmitted in a primary 40 MHz subchannel (S40).

20 193. The STA of claim 191 or 192, wherein if the punctured two 20 MHz subchannels cross P40 and S40, an 80 MHz BW HE MU PPDU with preamble puncturing applied is transmitted in P80.

194. The STA of any one of claims 191 to 193, wherein if the punctured two 20 MHz subchannels constitute a 40 MHz subchannel of S80, a 40 MHz BW EHT MU PPDU is transmitted in the other 40 MHz subchannel of S80.

195. The STA of any one of claims 191 to 194, wherein if the punctured two 20 MHz subchannels cross the two 40 MHz subchannels of S80, an 80 MHz BW EHT MU PPDU with preamble puncturing applied is transmitted in S80.

25 196. The STA of any one of claims 191 to 195, wherein in a 320 MHz BW FD-A-PPDU, a BW allocated to the at least one HE STA is P80 or primary 160 MHz channel (P160); while a BW allocated to the at least one EHT STA is one of two 80 MHz frequency segments of secondary 160 MHz channel (S160), S160, a combination of S80 and one of two 80 MHz frequency segments of S160, or a combination of S80 and S160.

30 197. The STA of claim 196, wherein a number of EHT MU PPDU's in a 320 MHz BW FD-A-PPDU depends on a BW allocation to the at least one EHT STA in the FD-A-PPDU.

198. The STA of claim 196 or 197, wherein when the BW allocated to the EHT STA is one of two 80 MHz frequency segments of S160 or S160, there is a single EHT MU PPDU in the FD-A-PPDU.

199. The STA of any one of claims 196 to 198, wherein when the BW allocated to the EHT STA is a combination of S80 and one of two 80 MHz frequency segments of S160, there are two EHT MU PPDU's in the FD-A-PPDU.

35 200. The STA of any one of claims 196 to 195, wherein when the BW allocated to the EHT STA is a combination of S80 and S160, there is one or two EHT MU PPDU's in the FD-A-PPDU.

201. The STA of any one of claims 191 to 200, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:

option 1A: when S80 is punctured, a BW allocated to the HE STA is P80 and a BW allocated to the EHT STA is S160;

40 option 1B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the HE STA is P160 and the BW allocated to the EHT STA is the other 80 MHz frequency segment of S160;

option 1C: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the HE STA is P80 and the BW allocated to the EHT STA is S80 and the other 80 MHz frequency segment of S160;

option 1D: when none of 80 MHz frequency segments is punctured, the BW allocated to the HE STA is P160 and the BW allocated to the EHT STA is S160; or

option 1E: when none of 80 MHz frequency segments is punctured, the BW allocated to the HE STA is P80 and the BW allocated to the EHT STA is S80 and S160.

5 202. The STA of any one of claims 191 to 201, wherein the 320 MHz BW FD-A-PPDU comprise the HE MU PPDU, the EHT MU PPDU, and a post-EHT MU PPDU.

203. The STA of claim 202, wherein for the 320 MHz BW FD-A-PPDU, the BW allocation in the FD-A-PPDU comprises at least one of the following options:

10 option 2A: when S80 is punctured, the BW allocated to the HE STA is P80 and BWs allocated to the EHT STA and the post-EHT STA are two 80 MHz frequency segments of S160, respectively;

option 2B: when one of two 80 MHz frequency segments of S160 is punctured, the BW allocated to the HE STA is P80 and the BW allocated to the EHT STA and the post-EHT STA are S80 and the other 80 MHz frequency segment of S160, respectively;

15 option 2C: when none of 80 MHz frequency segments is punctured, the BW allocated to the HE STA is P80, the BW allocated to the EHT STA is S160, and the BW allocated to the post-EHT STA is S80; or

option 2D: when none of 80 MHz frequency segments is punctured, the BW allocated to the at least one HE STA is P80, the BW allocated to the post-EHT STA is S160, and the BW allocated to the EHT STA is S80.

20 204. The STA of claim 202 or 203, wherein for trigger-based uplink transmission, the FD-A-PPDU comprises one or more HE TB PPDU, and one or more EHT TB PPDU in an EHT BSS and/or the FD-A-PPDU comprises one or more HE TB PPDU, one or more EHT TB PPDU, and one or more post-EHT TB PPDU in a post-EHT BSS.

205. 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 102.

206. A chip, comprising:

25 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 102.

207. 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 102.

208. 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 102.

30 209. A computer program, wherein the computer program causes a computer to execute the method of any one of claims 1 to 102.

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