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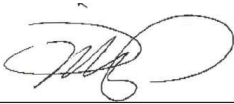
I served as Chief Examiner of the certified court interpreter test for the State of California and as a contract translator and interpreter for various federal agencies through the U.S. Department of State for more than a decade. I served as an instructor at the University of California at Berkeley and the Middlebury Institute of International Studies at Monterey (MIIS) Graduate Program in Translation.

I have more than 30 years of experience translating thousands of technical, legal, and business documents from Korean to English submitted to, among others, Korean judicial authorities, U.S. federal courts, the U.S. International Trade Commission (ITC), and the USPTO Patent Trial and Appeal Board (PTAB).

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Executed this 4th day of June 2025 in Contra Costa County of the State of California.

By: 
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(12) Published PCT International Patent Application

(19) World Intellectual Property
Organization
International Bureau
(43) International Publication Date
Sept. 9, 2016 (09/09/2016)



(10) International Publication Number
WO 2016/140546 A1

(51) International Patent Classification:

H04W 72/12 (2009.01) **H04L 1/00** (2006.01)
H04W 72/04 (2009.01) **H04L 1/16** (2006.01)
H04W 74/08 (2009.01)

(21) International Application No.: PCT/KR2016/002199

(22) International Filing Date: Mar. 4, 2016 (03/04/2016)

(25) Filing Language: Korean

(26) Publication Language: Korean

(30) Priority Data

10-2015-0030369 March 14, 2015 (03/14/2015) KR
10-2015-0036754 March 17, 2015 (03/17/2015) KR
10-2015-0066670 May 13, 2015 (05/13/2015) KR

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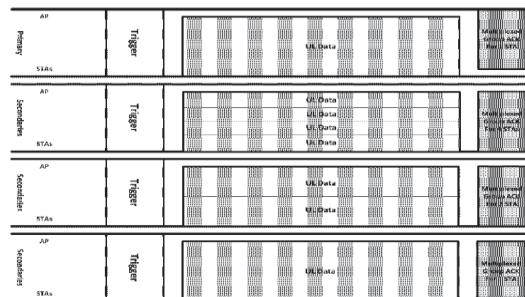
(81) Designated States (requiring each type of available state
protection unless otherwise indicated): AE, AG, AL,
AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW,
BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK,
DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH,
GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG,
KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA,
MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG,
NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS,
RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY,
TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC,
VN, ZA, ZM, ZW.

(84) Designated States (requiring each type of available
region protection unless otherwise indicated): ARIPO
(BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD,
SL, ST, SZ, TZ, UG, ZM, ZW), Eurasia (AM, AZ, BY,
KG, KZ, RU, TJ, TM), Europe (AL, AT, BE, BG, CH,
CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE,
IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO,
RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI,
CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD,
TG).

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(54) Title: WIRELESS COMMUNICATION TERMINAL AND WIRELESS COMMUNICATION METHOD FOR MULTI-USER
CONCURRENT TRANSMISSION [in English]

(54) Title of the Invention: WIRELESS COMMUNICATION TERMINAL AND WIRELESS COMMUNICATION METHOD FOR
MULTI-USER CONCURRENT TRANSMISSION [in Korean]



(57) Abstract: The present invention relates to a wireless communication terminal and wireless communication method for efficiently managing concurrent data transmission by multiple terminals. To this end, the present invention provides a base wireless communication terminal and a wireless communication method using the same, the base wireless communication terminal comprising: a transceiver unit for transmitting or receiving a wireless signal; and a processor for controlling an operation of the base wireless communication terminal, wherein the processor transmits a trigger frame for triggering multi-user uplink data transmission by multiple terminals, receives multi-user uplink data through resources allocated to the multiple terminals, and transmits a block response through the resources, in response to the received multi-user uplink data, and wherein the transmission of the block response in each of the resources is terminated at the same time point. [in English]

(57) Abstract:

[See continued pages]



This publication:

- includes an international search report (Article 21(3) of the Treaty).
- is disclosed before the deadline for correction of claims; If a written correction is filed, it will be disclosed separately (Rule 48.2(h))

The present invention relates to a wireless communication terminal and wireless communication method for efficiently managing concurrent data transmission by multiple terminals. To this end, the present invention provides a base wireless communication terminal and a wireless communication method using the same, the base wireless communication terminal comprising: a transceiver unit for transmitting or receiving a wireless signal; and a processor for controlling an operation of the base wireless communication terminal, wherein the processor transmits a trigger frame for triggering multi-user uplink data transmission by multiple terminals, receives multi-user uplink data through resources allocated to the multiple terminals, and transmits a block response through the resources, in response to the received multi-user uplink data, and wherein the transmission of the block response in each of the resources is terminated at the same time point.

Specification

Title of the Invention: WIRELESS COMMUNICATION TERMINAL AND WIRELESS COMMUNICATION METHOD FOR MULTI-USER CONCURRENT TRANSMISSION

Technical Field

- [1] The present invention relates to a wireless communication terminal and a wireless communication method for simultaneous multi-user transmission, and more particularly to a wireless communication terminal and a wireless communication method for efficiently managing simultaneous data transmission of a plurality of terminals.

Background Art

- [2] In recent years, as mobile devices have become increasingly popular, wireless local area network (WLAN) technology has gained much attention for providing fast wireless Internet services to them. Wireless LAN technology is a technology that enables mobile devices such as smartphones, smart pads, laptop computers, portable multimedia players, embedded devices, etc., to access the Internet wirelessly in homes, businesses, or specific service coverage areas based on wireless communication technology at short distances.
- [3] Since the Institute of Electrical and Electronics Engineers (IEEE) 802.11 supported early WLAN technologies using the 2.4 GHz frequency, standards for a variety of technologies are in use or under development. First, IEEE 802.11b supports communication speeds of up to 11 Mbps while using frequencies in the 2.4 GHz band. IEEE 802.11a, which was commercialized after IEEE 802.11b, uses frequencies in the 5 GHz band instead of the 2.4 GHz band, which reduces the impact of interference compared to frequencies in the 2.4 GHz band, which is highly congested, and uses OFDM technology to increase communication speeds up to 54 Mbps. However, IEEE 802.11a has the disadvantage of shorter communication distances compared to IEEE 802.11b. IEEE 802.11g, like IEEE 802.11b, uses frequencies in the 2.4 GHz band to realize communication speeds of up to 54 Mbps, and has received considerable attention because it satisfies backward compatibility, but it also has an advantage over IEEE 802.11a in terms of communication distance.
- [4] IEEE 802.11n is a technical specification designed to overcome the limitations on communication speed that have been pointed out as a weakness in wireless LANs. IEEE 802.11n aims to increase the speed and reliability of networks and extend the operating distance of wireless networks. More specifically, IEEE 802.11n supports High Throughput (HT), with data throughput rates of up to 540 Mbps or higher, and is based on Multiple Inputs and Multiple Outputs (MIMO) technology, which uses multiple antennas at both the transmit and receive ends to minimize transmission errors and optimize data rates. The standard can also use a coding scheme that transmits multiple redundant copies of the data to increase data reliability.
- [5] As WLANs have become more widespread and applications have diversified, there has been a need for new WLAN systems to support higher throughput (Very High Throughput, VHT) than the

data rates supported by IEEE 802.11n. Of these, IEEE 802.11ac supports a wide bandwidth (80 MHz to 160 MHz) in the 5 GHz frequency. Although the IEEE 802.11ac standard is only defined in the 5 GHz band, early 11ac chipsets will also support operation in the 2.4 GHz band for backward compatibility with existing 2.4 GHz band products. In theory, the standard allows for multi-station WLAN speeds of at least 1 Gbps and maximum single-link speeds of at least 500 Mbps. This is achieved by the air interface concepts embraced in 802.11n, including wider wireless frequency bandwidth (up to 160 MHz), more MIMO spatial streams (up to eight), multi-user MIMO, and higher density modulation (up to 256 QAM). There is also IEEE 802.11ad, which uses the 60 GHz band to transmit data instead of the conventional 2.4 GHz/5 GHz. IEEE 802.11ad uses technology to deliver speeds of up to 7 Gbps at maximum, making it ideal for streaming large amounts of data or video, such as uncompressed HD video. However, the 60 GHz frequency band is difficult to penetrate due to obstacles, so it can only be used between devices in close proximity.

- [6] On the other hand, as a next-generation wireless LAN standard after 802.11ac and 802.11ad, discussions continue to be held to provide high-efficiency and high-performance wireless LAN communication technology in high-density environments. In other words, in the next-generation wireless LAN environment, high-frequency efficient communication must be provided indoors and outdoors in the presence of high-density stations and access points (APs), and various technologies are required to realize this.

Detailed Description of the Invention

Technical Problem to Be Solved by the Invention

- [7] The present invention is aimed at providing high efficiency/high-performance wireless LAN communication in high density environments as described above.
- [8] Furthermore, the present invention aims to reduce the possibility of collision of data transmission of a plurality of terminals in a dense user environment and to provide a stable data communication environment.
- [9] The present invention also aims to provide a method for a plurality of terminals to efficiently perform simultaneous multi-user transmissions.

Means to Solve the Problem

- [10] To solve the above problems, the present disclosure provides a wireless communication method of a terminal and a wireless communication terminal as described below.
- [11] First, according to an embodiment of the present invention, the base wireless communication terminal includes a transceiver that transmits and receives wireless signals; and a processor that controls the operation of the base wireless communication terminal, the processor transmitting a trigger frame that triggers multi-user uplink data transmission of multiple terminals, receiving multi-user uplink data through resources allocated to the multiple terminals, and in response to

the above-mentioned multi-user uplink data, the block response is transmitted through the above-mentioned resources, but the transmission of the block response from each of the above-mentioned resources is provided by a base wireless communication terminal that terminates at the same time.

- [12] The processor performs padding on the block response transmitted through at least one resource to ensure the end time of the block response transmission to coincide at each resource.
- [13] The processor further inserts duplicate response information into the block response transmitted over the at least one resource to coincide with the end of the block response transmission on the respective resource.
- [14] Before the Frame Check Sequence (FCS) field in the trigger frame above, the preset padding is performed.
- [15] The transmission of the trigger frame shall terminate at the same time on each resource to which the trigger frame is transmitted.
- [16] The above resources are channels or subchannels.
- [17] The transmission packet of the above multi-user uplink data includes legacy preambles and non-legacy preambles, and the above legacy preambles are received as common information in 20 MHz channel units.
- [18] The non-legacy preamble described above includes HE-SIG-A and the remaining fields, wherein HE-SIG-A is received as common information in units of 20 MHz channels, and the remaining fields of the non-legacy preamble are received as individual information for each resource assigned to each terminal.
- [19] The remaining fields of the above non-legacy preamble include HE-STF and HE-LTF.
- [20] The multi-user upstream data transfers from each of the resources terminate at the same time.
- [21] Padding is performed on the above-mentioned uplink data transmitted through at least one resource, and the above-mentioned multi-user uplink data transmission is terminated at the same time.
- [22] In accordance with an embodiment of the present invention, there is also provided a wireless communication method of a base wireless communication terminal, the wireless communication method comprising: transmitting a trigger frame triggering transmission of multi-user uplink data of a plurality of terminals; receiving the multi-user uplink data via resources assigned to the plurality of terminals; and transmitting a block response via the resources in response to the received multi-user uplink data, wherein transmission of the block response on each of the resources terminates at the same time.

Effect of the Invention

- [23] Embodiments of the present invention enable efficient multi-user uplink transmission in contention-based channel access systems.
- [24] Furthermore, embodiments of the present invention can reduce unnecessary channel occupancy during multi-user uplink transmission and network-wide efficiency.

- [25] Furthermore, according to embodiments of the present invention, malfunctions of the WLAN network can be prevented by aligning the length of block responses transmitted on the plurality of channels, while at the same time freeing up time for the transmission of control frames by the AP.
- [26] Embodiments of the present invention can increase the overall resource utilization in a contention-based channel access system and improve the performance of a WLAN system.

Brief Description of the Drawings

- [27] FIG. 1 illustrates a WLAN system according to one embodiment of the present invention.
- [28] FIG. 2 illustrates a WLAN system according to another embodiment of the present invention.
- [29] FIG. 3 is a block diagram illustrating the configuration of a station according to one embodiment of the present invention.
- [30] FIG. 4 is a block diagram illustrating the configuration of an access point according to one embodiment of the present invention.
- [31] FIG. 5 schematically illustrates the process by which an STA establishes a link with an AP.
- [32] FIG. 6 shows the Carrier Sense Multiple Access (CSMA)/Collision Avoidance (CA) method used in WLAN communications.
- [33] FIG. 7 shows how the Distributed Coordination Function (DCF) is performed using Request to Send (RTS) and Clear to Send (CTS) frames.
- [34] FIG. 8 illustrates a WLAN network according to one embodiment of the present invention.
- [35] FIG. 9 illustrates a sequence of steps in which a multi-user uplink transmission is performed in accordance with an embodiment of the present invention.
- [36] FIG. 10 illustrates an ACK transmission method for multi-user uplink transmission, according to one embodiment of the present invention.
- [37] FIG. 11 illustrates a method of setting up a NAV for multi-user uplink transmission according to an embodiment of the present invention.
- [38] FIG. 12 illustrates a frequency masking method based on the frequency bandwidth used.
- [39] FIG. 13 illustrates a method of setting a guard band according to an embodiment of the present invention.
- [40] FIG. 14 illustrates how a non-legacy terminal transmits a legacy preamble during multi-user uplink data transmission.
- [41] FIG. 15 illustrates how non-legacy preamble is organized during multi-user data transfer.
- [42] FIG. 16 illustrates a method for performing multi-user uplink transmission according to an embodiment of the present invention.
- [43] FIG. 17 illustrates the structure of a multiplexed group response according to an embodiment of the present invention.
- [44] FIG. 18 illustrates a method of transmitting a multiplexed group response according to an embodiment of the present invention.
- [45] FIG. 19 illustrates a method for aligning the length of a block response according to an embodiment of the present invention.
- [46] FIG. 20 illustrates a method of frame length alignment with padding in a multi-user simultaneous transmission process according to an embodiment of the present invention.

- [47] FIG. 21 illustrates a multiplexed block response transmission method when a plurality of channels are used for multi-user uplink transmission.

Embodiments of the Invention

- [48] The terms used in this specification have been chosen to be as generic as possible in current common usage, taking into account their function in the invention, but they may vary according to the intent, custom, or practice of those skilled in the art or the emergence of new technologies. In addition, in certain cases, the terms have been chosen arbitrarily by the applicant, in which case their meaning will be set forth in the description of the invention. It is therefore intended that the terms used in this specification should be construed in light of their substantive meaning and the context of the specification as a whole, and not merely as a designation of a term.
- [49] Throughout the specification, when a configuration is the to be "connected" to another configuration, this includes not only being "directly connected" but also being "electrically connected" with other components in between. Also, when we say that a configuration "includes" a particular component, we mean that it may include additional components, not that it excludes other components, unless specifically stated to the contrary. In addition, any qualification of "same or greater than" or "same or less than" with respect to a particular threshold may be replaced by "greater than" or "less than", respectively, as appropriate, depending on the embodiment.
- [50] This application claims priority to Korean Patent Application Nos. 10-2015-0030369, 10-2015-0036754, and 10-2015-0066670, and the embodiments and descriptions set forth in each of these applications, which are the basis for priority, are incorporated by reference into the detailed description of this application.
- [51] FIG. 1 illustrates a wireless LAN system according to one embodiment of the present invention. A wireless LAN system includes one or more Basic Service Sets (BSS), which represent a set of devices that can communicate with each other by successfully synchronizing. Generally, BSS can be divided into infrastructure BSS (IBSS) and independent BSS (IBSS), and of these two, FIG. 1 shows an infrastructure BSS.
- [52] As shown in FIG. 1, the infrastructure BSS (BSS1, BSS2) comprises one or more stations (STA1, STA2, STA3, STA4, STA5), access points (PCP/AP-1, PCP/AP-2) that are stations that provide distribution services, and a distribution system (DS) that connects multiple access points (PCP/AP-1, PCP/AP-2).
- [53] A station (STA) is any device that includes a medium access control (MAC) and physical layer interface to the wireless medium as defined by the IEEE 802.11 standard, and broadly includes both non-access point (non-AP) stations as well as access points (APs). In addition, the term "terminal" may be used herein to refer to a non-AP STA, an AP, or both. A station for wireless

communication includes a processor and a transmit/receive unit, and may further include a user interface and a display unit, depending on the embodiment. The processor may generate frames for transmission over the wireless network, process frames received over the wireless network, and perform various other processing to control the station. The transmitter and receiver are functionally coupled to the processor and transmit and receive frames over the wireless network for the station.

- [54] An access point (AP) is an entity that provides access to a distribution system (DS) via a wireless medium for stations associated with it. In principle, communication between non-AP stations in the infrastructure BSS is normally done via an AP, but if a direct link is set up, direct communication is also possible between non-AP stations. In the present invention, AP is used in a concept that includes a Personal BSS Coordination Point (PCP), and can broadly include concepts such as a centralized controller, a base station (BS), a node-B, a base transceiver system (BTS), or a site controller. In the present invention, an AP may also be referred to as a base wireless terminal, and the term base wireless terminal may be used in a broad sense to include APs, base stations, eNodeBs (eNBs), and transmission points (TPs). Furthermore, the base wireless communication terminal may include various types of wireless communication terminals that allocate communication medium resources and perform scheduling in communications with a plurality of wireless communication terminals.
- [55] Multiple infrastructure BSSs may be connected via a distribution system (DS). In this case, the plurality of BSSs connected through the distribution system is referred to as an Extended Service Set (ESS).
- [56] FIG. 2 illustrates an independent BSS, which is a wireless LAN system according to another embodiment of the present invention. In the embodiment of FIG. 2, portions of the embodiment of FIG. 1 that are identical or corresponding to the embodiment of FIG. 2 are intended to skip redundant description.
- [57] BSS3, shown in FIG. 2, is an independent BSS and does not contain an AP, so all stations (STA6, STA7) are not connected to an AP. An independent BSS does not allow access to the distribution system and forms a self-contained network. In an independent BSS, each station (STA6, STA7) can be directly connected to each other.
- [58] FIG. 3 is a block diagram illustrating the configuration of a station 100 according to one embodiment of the present invention.
- [59] As shown, a station 100 according to an embodiment of the present invention may include a processor 110, a transceiver 120, a user interface 140, a display unit 150, and memory 160.
- [60] First, the transceiver 120 transmits and receives wireless signals, such as WLAN packets, and may be built into or external to the station 100. According to an embodiment, the transceiver 120

may include at least one transmit and receive module utilizing different frequency bands. For example, the transceiver 120 may include transmit and receive modules in different frequency bands, such as 2.4 GHz, 5 GHz, and 60 GHz. According to one embodiment, the station 100 may include transmit and receive modules utilizing frequency bands above 6 GHz, and transmit and receive modules utilizing frequency bands below 6 GHz. Each transceiver module can perform wireless communication with APs or external stations according to the WLAN specifications of the frequency band supported by that transceiver module. The transceiver 120 may operate only one transceiver module at a time or may operate multiple transceiver modules together at the same time, depending on the performance and requirements of the station 100. When the station 100 includes a plurality of transmitter and receiver modules, each transmitter and receiver module may be independent, or the plurality of modules may be integrated into a single chip.

[61] Next, the user interface 140 includes various forms of input/output means provided on the station 100. That is, the user interface 140 can receive input from a user using various input means, and the processor 110 can control the station 100 based on the received user input. In addition, the user interface 140 may utilize various output means to perform outputs based on instructions from the processor 110.

[62] Next, the display unit 150 outputs an image on a display screen. The display unit 150 may output various display objects, such as content executed by the processor 110 or a user interface based on control instructions from the processor 110. Furthermore, the memory 160 stores control programs used by the station 100 and various data accordingly. These control programs may include connection programs required for the station 100 to perform connections with APs or external stations.

[63] The processor 110 of the present invention can execute various instructions or programs and process data inside the station 100. Further, the processor 110 may control each unit of the station 100 described above, and may control data transmission and reception between the units. According to an embodiment of the present invention, the processor 110 may execute a program for connecting with an AP stored in the memory 160 and receive a communication setting message transmitted by the AP. Further, the processor 110 may read information about the priority condition of the station 100 included in the communication establishment message, and may request access to the AP based on the information about the priority condition of the station 100. The processor 110 of the present invention may refer to a main control unit of the station 100, or may refer to a control unit for individually controlling some configuration of the station 100, such as the transceiver 120 or the like, depending on the embodiment. The processor 110 controls various operations of transmitting and receiving wireless signals of the station 100 according to embodiments of the present invention. Specific embodiments of the present invention will be described hereinafter.

- [64] The station 100 illustrated in FIG. 3 is a block diagram according to one embodiment of the present invention, wherein the separated blocks represent logically distinct elements of the device. Accordingly, the elements of the device described above may be mounted on a single chip or on a plurality of chips, depending on the design of the device. For example, the processor 110 and the transmitter/receiver 120 may be integrated into a single chip or may be implemented on separate chips. Furthermore, in embodiments of the present invention, some configurations of the station 100, such as the user interface 140 and the display unit 150, may be optionally provided in the station 100.
- [65] FIG. 4 is a block diagram illustrating the configuration of an AP 200 according to one embodiment of the present invention.
- [66] As shown in the figure, the AP 200 according to an embodiment of the present invention may include a processor (210), a transceiver (220), and a memory (260). In FIG. 4, for the configuration of the AP 200 that is the same or equivalent to the configuration of the station 100 in FIG. 3, redundant descriptions are omitted.
- [67] Referring to FIG. 4, the AP 200 according to the present invention comprises a transceiver 220 for operating a BSS in at least one frequency band. As mentioned in the embodiment of FIG. 3, the transceiver 220 of the AP 200 may also include multiple transceiver modules using different frequency bands. In other words, the AP 200 according to an embodiment of the present invention can be equipped with two or more transceiver modules of different frequency bands, such as 2.4 GHz, 5 GHz, or 60 GHz. Preferably, the AP 200 may be equipped with a transceiver module using a frequency band of 6 GHz or higher and a transceiver module using a frequency band of 6 GHz or lower. Each transceiver module can perform wireless communication with a station according to the wireless LAN standard of the frequency band supported by the transceiver module. The transceiver unit 220 can operate only one transceiver module at a time or multiple transceiver modules simultaneously depending on the performance and requirements of the AP 200.
- [68] Next, the memory 260 stores control programs used by the AP 200 and various data associated therewith. These control programs may include an access program that manages access to the station. In addition, the processor 210 controls each unit of the AP 200 and may control the transmission and reception of data between the units. According to an embodiment of the present invention, the processor 210 may execute a program for connecting with a station stored in the memory 260 and transmit a communication setup message for one or more stations. The communication establishment message may include information about connection priority conditions for each station. Further, the processor 210 performs the connection setting according to the connection request of the station. The processor 210 controls various operations of transmitting and receiving wireless signals of the AP 200 according to embodiments of the present invention. Specific embodiments will be described later.
- [69] FIG. 5 schematically illustrates the process by which an STA establishes a link with an AP.

- [70] Referring to FIG. 5, the link between the STA 100 and the AP 200 is established in three steps: scanning, authentication, and combination. First, the scanning step is a step in which the STA 100 obtains access information of the BSS operated by the AP 200. Methods for performing scanning include a passive scanning method that utilizes only beacon messages S101 periodically transmitted by the AP 200 to obtain information, and an active scanning method in which the STA 100 transmits a probe request to the AP S103 and receives a probe response from the AP S105 to obtain access information.
- [71] After successfully receiving the wireless access information in the scanning step, the STA 100 transmits an authentication request S107a and receives an authentication response from the AP 200 S107b to perform the authentication step. After the authentication step is performed, the STA 100 sends a combination request S109a and receives a combination response from the AP 200 S109b to perform the combination step. In this specification, combination basically refers to wireless combination, but the present invention is not limited thereto and combination in a broad sense may include both wireless and wired combination.
- [72] Furthermore, an 802.1X-based authentication step S111 and an IP address acquisition step S113 via DHCP may be performed. In FIG. 5, the authentication server 300 is a server that handles 802.1X-based authentication with the STA 100, which may be physically coupled to the AP 200 or may exist as a separate server.
- [73] FIG. 6 shows the Carrier Sense Multiple Access (CSMA)/Collision Avoidance (CA) method used in WLAN communications.
- [74] Before transmitting data, a terminal performing WLAN communication performs carrier sensing to check whether the channel is occupied or busy. If a wireless signal of a certain strength or higher is detected, the channel is determined to be busy, and the device delays access to the channel. This process is called Clear Channel Assessment (CCA), and the level at which such a signal is detected is called the CCA threshold. If a device receives a wireless signal above the CCA threshold and the device is the intended recipient, the device will process the received wireless signal. On the other hand, if no wireless signal is detected on the channel or a wireless signal with a strength less than the CCA threshold is detected, the channel is determined to be idle.
- [75] When the channel is determined to be idle, each terminal that has data to transmit performs a backoff procedure after a time that depends on the InterFrame Space (IFS) of each terminal, such as an Arbitration IFS (AIFS), a PIFS (PCF IFS), and the like. In some embodiments, the AIFS may be used in a configuration that replaces the conventional DCF IFS (DIFS). Each terminal waits for a random number of slot times allocated to the terminal to decrease during an interval of idleness of the channel, and the terminal that exhausts the slot time attempts to access the channel.

The window during which each device performs the backoff procedure is called the contention window band.

- [76] If a particular terminal successfully accesses the channel, it can transmit data over the channel. However, if the accessing terminal collides with another terminal, the colliding terminals are each assigned a new random number and the backoff procedure is performed again. According to one embodiment, the new random number assigned to each terminal may be determined within a range ($2 \times CW$) that is twice the range (contention window, CW) of the random number previously assigned to that terminal. Meanwhile, each terminal attempts to access by performing the backoff procedure again in the next contention window interval, wherein each terminal performs the backoff procedure from the slot time remaining in the previous contention window interval. In this way, each terminal performing WLAN communication can avoid collisions with each other for a particular channel.
- [77] FIG. 7 illustrates how a Distributed Coordination Function (DCF) is performed using Request to Send (RTS) and Clear to Send (CTS) frames.
- [78] The APs and STAs in the BSS compete for the right to transmit data. After the data transmission in the previous phase is completed, each terminal with data to transmit performs a backoff procedure by decrementing a randomized backoff counter (or backoff timer) assigned to each terminal after the AIFS timeout. When the backoff counter expires, the transmitting terminal sends a Request to Send (RTS) frame to indicate that it has data to transmit. In the embodiment of FIG. 7, an STA1 that has a competitive advantage with minimal backoff may send an RTS frame after the backoff counter expires. The RTS frame includes information such as a receiver address, a transmitter address, and duration. After receiving the RTS frame, the receiving terminal (i.e., the AP in FIG. 7) waits for the Short IFS (SIFS) time and sends a Clear to Send (CTS) frame to inform the transmitting terminal (STA1) that data transmission is available. The CTS frame includes information such as the receiver address and duration. At this time, the receiver address of the CTS frame can be set to be the same as the transmitter address of the corresponding RTS frame, that is, the address of the transmission terminal (STA1).
- [79] After receiving the CTS frame, the sending terminal (STA1) transmits the data after the SIFS time. When the data transmission is complete, the receiving terminal (AP) sends an acknowledgment (ACK) frame after the SIFS time to indicate that the data transmission is complete. If the response frame is received within the preset time, the sending terminal considers the data transmission to be successful. However, if the response frame is not received within the preset time, the sending terminal is considered to have failed to transmit the data. Meanwhile, during the above transmission process, the neighboring terminals that have received at least one of the RTS frame and the CTS frame set the NAV (Network Allocation Vector) and do not perform data transmission until the set NAV expires. At this time, the NAV of each terminal may be set based on the duration field of the received RTS frame or CTS frame.

- [80] In the aforementioned data transmission process, if the RTS frame or CTS frame of the terminals is not normally transmitted to the target terminal (i.e., the terminal with the receiver address) due to interference or collision, the subsequent process is interrupted. The transmission terminal (STA1) that transmitted the RTS frame considers that data transmission is not possible, and it is assigned a new random number and participates in the next round of competition. At this time, the newly assigned random number can be determined within the range of twice the previously set random number range (competition window, CW) as described above ($2 \times CW$).
- [81] Multi-user uplink transmission
- [82] FIG. 8 illustrates a wireless LAN network according to one embodiment of the present disclosure. In FIG. 8, the BSS consists of an AP and a plurality of STAs (STA1, STA2, STA3, STA4) coupled thereto. The blocks shown with each terminal represent the channel state measured at that terminal. Shaded blocks represent channels in an occupied state, while white blocks represent channels in an idle state.
- [83] When utilizing Orthogonal Frequency Division Multiple Access (OFDMA) or Multi Input Multi Output (MIMO), a wireless communication terminal may transmit data to a plurality of wireless communication terminals simultaneously. In addition, a wireless communication terminal may receive data from a plurality of wireless communication terminals simultaneously. For example, a multi-user downlink transmission may be performed in which an AP transmits data to a plurality of STAs simultaneously, and a multi-user uplink transmission may be performed in which a plurality of STAs transmit data to an AP simultaneously.
- [84] In order for multi-user uplink transmission to be performed, the channel used by each STA performing the uplink transmission and the timing of the start of transmission must be adjusted. However, in a wireless LAN environment where multiple BSSs are located in close proximity to each other, as shown in Figure 8, the channel conditions measured may differ depending on the location of each terminal within the same BSS. In other words, the channels that each terminal can access may differ depending on the influence of the adjacent external BSS of each terminal. In addition, whether each STA has data for uplink transmission changes in real time. Therefore, in order to efficiently schedule multi-user uplink transmission, the status information of each STA must be delivered to the AP.
- [85] According to an embodiment of the present invention, information for scheduling multi-user uplink transmission can be directed via preambles of packets and/or pre-set fields of MAC headers. For example, an STA can indicate information for multi-user uplink scheduling through the preamble of an uplink packet or a pre-configured field in the MAC header, and transmit this information to an AP. At this time, the information for multi-user uplink scheduling can include at least one of the following: buffer status information of each STA, and channel status information measured by each STA. The buffer status information of the STA can indicate at least one of the following: whether the STA has uplink data to transmit, the access class (AC) of the uplink data, and the size (or transmission time) of the uplink data.

- [86] FIG. 9 illustrates a series of steps according to an embodiment of the present invention in which multi-user uplink transmission is performed. As mentioned above, the multi-user uplink transmission process can be managed by an AP because multiple terminals must transmit data simultaneously. Therefore, APs must obtain the buffer status information of each STA before the start of multi-user uplink transmission and deliver the correct transmission timing information to each STA in order to allocate resources and prevent data collisions. The buffer status information of the STA can indicate at least one of the following: whether the STA has uplink data to transmit, the access category of the uplink data, and the size (or transmission time) of the uplink data. The delivery of information for each of these STAs can be performed through the initialization phase S210 and the scheduling phase S220 for multi-user uplink transmission.
- [87] According to an embodiment of the present invention, the scheduling step S220 for multi-user uplink transmission may be performed first to collect relevant information, and the step S210 may be if certain conditions are satisfied. Alternatively, depending on a temporal condition, initialization step S210 may be performed first and the scheduling step S220 may be performed afterward to collect relevant information. The initialization step S210 and the scheduling step S220 include the AP and the STA information about channels. In one embodiment, the AP may first communicate the available channel information to a plurality of STAs, and the plurality of STAs may feedback to the AP the channel information that is available to their respective STAs among the channels available to the AP. The specific operation method of the initialization step S210 and the scheduling step S220 in an embodiment of the present invention is not According to one embodiment, the initialization step S210 and the scheduling step S220 may be performed in an integrated
- [88] After the initialization step S210 and the scheduling step S220 are performed, multi-user uplink data transmission step S230 is performed. At least one STA that has been assigned a channel or subchannel by the AP transmits uplink data simultaneously at a time specified by the AP. The STAs may perform the uplink data transmission in 20 MHz channel increments or in broadband channel increments or larger. Additionally, non-legacy STAs may perform uplink data transmission in subchannel increments smaller than 20 MHz. In embodiments of the present disclosure, the term “resource” may be used to encompass a channel or subchannel allocated to an STA. Upon receiving the uplink data from the STA, the AP transmits an acknowledgment (ACK) in response S240. If the uplink data transmission is performed on a subchannel basis, a plurality of STAs may transmit uplink data on a single channel. In this case, the AP may transmit a group ACK on that channel to transmit ACKs for the plurality of STAs that transmitted the uplink data.
- [89] In a dense BSS environment, if multiple external BSSs affect the system, the channels available to each device may differ depending on the geographic location of the wireless device. Therefore, the number of devices that can transmit data on each channel may differ. In this case, as shown in FIG. 9, the airtime during which actual uplink data transmission is performed may differ for each channel. However, if an AP cannot simultaneously transmit and receive data,

while receiving uplink data on a channel with long airtime, the AP cannot transmit an ACK to another channel that has completed uplink data transmission. Therefore, STAs using channels with short airtime may wait to receive ACKs by performing zero padding until the end of uplink data transmission on the channel with the longest airtime S250. That is, padding is performed on uplink data transmitted over at least one channel so that multi-user uplink data transmission on each channel can end at the same time.

[90] However, when zero padding is performed, the channel will be occupied by STAs that are not involved in data transmission, resulting in lower overall efficiency. In addition, the terminals of other BSSs that use the channel as their main channel suffer a direct performance reduction because they cannot communicate during the zero padding period. Therefore, an ACK transmission method is needed to further improve the data transmission efficiency of terminals.

[91] FIG. 10 illustrates an ACK transmission method for multi-user uplink transmission according to one embodiment of the present disclosure. When the multi-user uplink transmission is completed, the AP transmits a multiplexed group response in response S244. At this time, the AP may transmit the multiplexed group response to a first channel having the longest airtime among the plurality of channels over which the multi-user uplink transmission was performed. According to one embodiment, the first channel with the longest airtime may be the main channel of the corresponding BSS.

[92] STAs that are assigned a channel other than the first channel as the uplink data transmission channel may set an ACK timer at the end of the uplink data transmission on that channel and wait to receive the ACK until the set ACK timer expires S242. In this case, the other channel may be a channel other than the first channel with the longest airtime, i.e., a subchannel of the corresponding BSS. The ACK timer of each channel indicates the time from the completion of the upstream data transmission of that channel until the multiplexed group response is transmitted. To set the ACK timer, each STA needs to obtain information about when to send the multiplexed group response. The transmission timing information of the multiplexed group ACK can be communicated to each STA that will perform the uplink data transmission in the initialization stage S210 and/or the scheduling stage S220 described above. According to one embodiment, the STA for which the ACK timer is set can save power by entering sleep mode until the timer expires.

[93] According to an embodiment of the present invention, each subchannel can be returned immediately after the end of the uplink data transmission. Therefore, terminals in the external BSS used as the main channel can access the channel and transmit data earlier. Therefore, the spectrum efficiency of the entire network can be improved.

[94] FIG. 11 illustrates a method of setting up a NAV for multi-user uplink transmission, according to an embodiment of the present disclosure. In the embodiment of FIG. 11, portions that are the same or corresponding to the embodiment of FIG. 10 described above are intended to omit redundant description.

- [95] According to an embodiment of the present invention, a NAV configuration frame can be transmitted to protect the multi-user uplink transmission process. First, the AP transmits the first NAV configuration frame at the start of the multi-user uplink transmission S310. The actual transmission length of the multi-user uplink transmission may vary depending on the length of the uplink data of the STAs and the resource allocation results. Therefore, the duration field value of the first NAV configuration frame can be set to the duration of the initialization phase and the scheduling phase. The first NAV setting frame can use the pre-defined format of RTS or CTS. According to one embodiment, the first NAV setting frame can use one of the predefined multi-user RTS, RTS-to-self, CTS-to-self, and CTS-to-group.
- [96] After the resource of each STA is completed in the step, the airtime during which the uplink data transmission is performed for each channel is calculated. Therefore, a second NAV setup frame is transmitted S320 to set the NAV for the period during which the multi-user uplink transmission and the group ACK transmission are performed. The second NAV setup frame may be transmitted simultaneously by a plurality of STAs that are allocated resources and participate in the multi-user uplink data transmission. Alternatively, the plurality of STAs and the AP may simultaneously transmit the second NAV setup frame. According to one embodiment, the second NAV setup frame may be configured in a CTS frame format. In this case, the second NAV setup frame transmitted simultaneously by the plurality of STAs and/or APs may be set to the same waveform.
- [97] Based on the transmitted first NAV setting frame and the second NAV setting frame, the NAVs of the neighboring terminals are set S330, S340. Since the second NAV setup frame with the same waveform is transmitted simultaneously in 20 MHz channel increments, the neighboring terminals, including legacy terminals, can receive the second NAV setup frame and set their NAV. If the simultaneously transmitted secondary NAV setup frames have the same waveform for each channel, the secondary NAV setup frame may have duration information that reflects the airtime of the corresponding channel. Therefore, a terminal of an external BSS that has acquired the NAV information set for a particular channel can access that channel immediately after the NAV time has ended.
- [98] On the other hand, when multiplexed group responses are used, as in the embodiment of FIG. 10, STAs that transmit uplink data over the minor channel receive multiplexed group responses over the major channel. If the STAs only set their NAVs for the minor channel over which they transmit uplink data, the terminals of the external BSS adjacent to the STAs may consider the major channel to be idle and may access the major channel. In this case, the STA that sent the uplink data over the minor channel may not receive the multiplexed group response sent over the major channel.
- [99] Thus, according to an embodiment of the present invention, STAs transmitting uplink data over the minor channel transmit a second NAV setup frame over the major channel and the minor channel. In this case, the main channel on which the second NAV setup frame is transmitted is the main channel of the BSS to which the STA belongs. Also, the secondary channel on which the second NAV setup frame is transmitted is the secondary channel on which the STA transmits uplink data. Referring to FIG. 11, STA4 and STA5 that transmit uplink data

over the minor channel also transmit a second NAV setup frame over the major channel as well as over the minor channel S320. In this way, the STAs provide additional protection not only for the minor channel over which the uplink data is transmitted, but also for the major channel over which the multiplexed group response is transmitted. The value of the duration field in the second NAV setup frame sent to the main channel is set to the time until the transmission of the multiplexed group response is complete. The duration field value of the second NAV setup frame sent to the minor channel is set to the time when the uplink data transmission of the minor channel is completed. Meanwhile, STA1, STA2, and STA3 transmitting uplink data over the main channel do not require transmission of additional second NAV setup frames to channels other than the main channel.

[100] FIG. 12 illustrates the frequency masking method according to the frequency bandwidth used. In a wireless LAN system, the frequency masking technique is used to minimize the mutual interference effects when different terminals communicate through adjacent channels. Frequency masking is used to determine the boundary frequencies (i.e., the minimum and maximum frequencies) of the channel currently in use. It is implemented by intentionally reducing the transmission power. Therefore, the form of frequency masking differs depending on the bandwidth in which the data transmission is performed. In other words, the spectrum mask 410 of a packet transmitted through a 40 MHz channel has a different form from the spectrum mask 420 of a packet transmitted through two adjacent 20 MHz channels. In particular, each spectrum mask 410, 420 has a difference in the presence or absence of guard band 430 in the center frequency portion of the 40 MHz channel.

[101] FIG. 13 illustrates a method of setting a guard band according to an embodiment of the present invention.

[102] FIG. 13(a) illustrates a situation where data 440 is transmitted as a channel of the first band, and data 440 is transmitted as a channel of the second band only after a certain point in time. In an embodiment of the present invention, the second band has a narrower bandwidth than the first band. For example, the first band may represent a 40 MHz bandwidth, and the second band may represent a 20 MHz bandwidth. According to an embodiment of the present invention, the transmission bandwidth may be changed during transmission of data 440 according to the scheduling of data transmission and the results of resource allocation. Even if the transmission bandwidth is changed in this way, the spectrum mask of the RF chain can be maintained in its original form. In other words, if the transmission band of the data is changed from the first band to the second band, data 440 without guard band 442 can be transmitted. At this time, if the terminal of the external BSS (OBSS: Overlapping Basic Service Set) attempts to transmit to the idle band of the first band, interference may occur due to the absence of guard band 442 for data transmitted to the second band.

[103] FIG. 13(b) illustrates an embodiment in which data is transmitted by establishing a guard band 450 between two adjacent baseband channels. According to one embodiment of the present invention, when multi-user data transmission is performed, the data 440a, 440b assigned to each terminal may be transmitted below the baseband. In this case, the multi-user data transmission includes multi-user uplink data transmission and multi-user downlink data transmission. Further, the base band may be a 20 MHz band, and the present invention is not limited thereto. As such, a guard band 450 per base band may be formed by preventing a single terminal from being allocated resources exceeding the base band.

- [104] According to another embodiment of the present invention, when multi-user data transmission is performed, each terminal may be allowed an allocation of data in a wide band that exceeds the base band. However, the terminal may perform nulling on the frequency components of the broadband data that correspond to the guard band 450 on a per-baseband basis to prevent interference with external BSS terminals.
- [105] According to another embodiment of the present invention, if the transmission band changes from the first band to the second band during data transmission, the terminal can transmit data by setting the guard band 450 based on the changed second band. In other words, if the transmission bandwidth decreases during data transmission, the terminal transmits data by setting the spectrum mask based on the reduced transmission bandwidth.
- [106] According to another embodiment of the present invention, multi-user data transmission may be performed using a plurality of sub-bands within the first band. Each of the sub-bands has a narrower bandwidth than the first band. The plurality of subbands may be contiguous channels, or may be non-contiguous channels. Further, each subband may be set to the same bandwidth, or each subband may be set to a different bandwidth. According to an embodiment of the present invention, the terminal transmits multi-user data by setting guard bands 450 and based on each subband over which data is transmitted.
- [107] FIG. 14 and FIG. 15 show a method for constructing a preamble of a non-legacy packet according to an embodiment of the present invention. More specifically, FIG. 14 shows a method for transmitting a legacy preamble (L-preamble) of a non-legacy terminal during a multi-user uplink data transmission. In addition, FIG. 15 shows a method for constructing a non-legacy preamble during a multi-user downlink data transmission.
- [108] The legacy preamble is decodable on legacy terminals and includes the legacy short training field (L-STF), the legacy long training field (L-LTF), and the legacy signal field (L-SIG). A non-legacy preamble is a field that can only be recognized by non-legacy terminals (e.g., 802.11ax wireless LAN terminals) after the legacy preamble, and may include HE-SIG-A (HE signal A field), HE-SIG-B (HE signal B field), HE-STF (HE short training field), and HE-LTF (HE long training field).
- [109] Non-legacy wireless LAN packets include both legacy preambles for legacy terminals and non-legacy preambles for non-legacy terminals. Legacy preambles and non-legacy preambles are inserted at the beginning of non-legacy PSDUs (PHY Service Data Units). While 64 FFTs were supported in legacy wireless LAN systems, 256 FFTs may be supported in non-legacy wireless LAN systems. Therefore, at least part of the non-legacy preamble may be composed of 256 FFT-based OFDM symbols. When multiple non-legacy STAs perform multi-user uplink data transmission, each STA transmits at least part of the information in the non-legacy preamble through the subchannel assigned to that STA. However, since legacy preambles are

transmitted in 20 MHz channel units, a method is needed for STAs that have been allocated resources on a subchannel basis to transmit legacy preambles within that channel.

- [110] According to one embodiment of the present invention, as shown in FIG. 14(a), a representative STA selected from among a plurality of STAs can transmit a legacy preamble 510 on behalf of multiple STAs assigned to the same 20 MHz channel. Various methods can be used to select a representative STA from multiple STAs. According to one embodiment, the STA with the highest RSSI (received signal strength indication) among multiple STAs assigned to the same 20 MHz channel can transmit a legacy preamble 510 for multi-user uplink data transmission. According to another embodiment, the STA assigned to the first subchannel among multiple subchannels assigned within the same 20 MHz channel can transmit a legacy preamble 510 for multi-user uplink data transmission.
- [111] The representative STA transmits a legacy preamble 510 in 20 MHz increments, followed by a non-legacy preamble 520 through the subchannel assigned to that STA. The remaining STAs, other than the representative STA, transmit the non-legacy preamble 520 through the subchannel assigned to that STA after the representative STA transmits the legacy preamble 510. Multiple STAs transmit the non-legacy preamble 520 through the subchannel assigned to each of them at the same time.
- [112] According to another embodiment of the present invention, as shown in FIG. 14(b), multiple STAs assigned to the same 20 MHz channel can simultaneously transmit a legacy preamble 510. At this time, the legacy preamble 510 transmitted by multiple STAs at the same time is set to the same waveform. Each STA transmits a legacy preamble 510 in 20 MHz units set to the same waveform, and then transmits a non-legacy preamble 520 through the subchannel assigned to the STA. To this end, the AP can transmit information corresponding to the legacy preamble 510 to each STA during the scheduling process. The AP receives the legacy preamble 510 as common information in 20 MHz units from at least one STA.
- [113] FIG. 15 illustrates a method of constructing a non-legacy preamble, according to an embodiment of the present invention. In the embodiment of FIG. 15, portions that are identical or corresponding to the embodiment of FIG. 14 described above are intended to omit redundant description.
- [114] FIG. 15(a) illustrates one embodiment of a non-legacy preamble. Some of the fields in the non-legacy preamble, such as HE-SIG-A 522, may be composed of the same 64 FFT-based OFDM symbols as in the legacy preamble 510. According to one embodiment of the present invention, HE-SIG-A 522 of the non-legacy preamble can be transmitted in common in units of 20 MHz channels. STAs that perform multi-user uplink data transmission transmit the legacy preamble 510 and HE-SIG-A 522 with the same information in 20 MHz channel units. In other words, the AP receives HE-SIG-A 522 as common information in 20 MHz channel units from at least one STA.

In addition, the STAs transmit the remaining field 524 of the non-legacy preamble through the subchannel assigned to the STA. In other words, the AP receives the remaining fields 524 of the non-legacy preamble as individual information for each subchannel assigned to each STA. At this time, the remaining fields 524 of the non-legacy preamble include HE-STF and HE-LTF.

- [115] FIG. 15(b) illustrates another embodiment of a non-legacy preamble. According to another embodiment of the present invention, HE-SIG-A 522 of the non-legacy preamble can be transmitted on a subchannel basis. STAs performing multi-user uplink data transmission transmit legacy preambles 510 having the same information on a 20 MHz channel basis. In addition, the STAs mentioned above can transmit non-legacy preambles 522, 524 through the subchannels assigned to the STA. An STA that has been assigned multiple subchannels as resources can transmit the same HE-SIG-A 522 redundantly through each of the assigned subchannels.
- [116] On the other hand, FIG. 15 describes how to configure a non-legacy preamble in a multi-user uplink data transmission scenario, but the above method can be applied to multi-user downlink data transmission in the same way. The HE-SIG-A 522 of the non-legacy preamble contains the information required to interpret non-legacy packets. For example, HE-SIG-A 522 may include an indicator indicating whether the packet is an upstream or downstream packet. According to an embodiment of the present invention, HE-SIG-A may be duplicated in 20 MHz increments when data is transmitted over a broadband channel.
- [117] FIG. 16 illustrates a method of performing multi-user uplink transmission, according to an embodiment of the present disclosure. In the embodiment of FIG. 16, portions that are the same as or correspond to the embodiments of FIGS. 9 and 10 described above are intended to omit redundant description.
- [118] In a non-legacy WLAN system, the multi-user uplink transmission may be initiated by a trigger frame, i.e., the initialization step S210 of FIG. 9 may be performed by the transmission of a trigger frame by an AP. The STAs performing the multi-user uplink transmission simultaneously transmit uplink data after the IFS established from the transmission of the trigger frame. The trigger frame indicates the start time of the multi-user uplink transmission and may indicate the channel or subchannel information assigned to each uplink transmission STA. STAs that have been assigned a channel or subchannel by the AP transmit upstream data simultaneously at the time specified by the AP. When the multi-user uplink transmission is complete, the AP sends a multiplexed group response in response.
- [119] According to an embodiment of the present invention, the trigger frame may include information for setting the NAV of a multi-user upstream data transmission process. If the trigger frame follows the legacy frame format, the NAV of the legacy terminals may be set based on the value of the duration field in the MAC header of the trigger frame. According to a further embodiment of the present disclosure, in order to set the NAV for hidden nodes located in the vicinity of the uplink STAs, the AP may increase the coverage of the trigger frame over the coverage of the normal frame. For example, the AP may transmit the trigger frame with increased power than the normal frame. Alternatively, the AP can apply a stronger modulation

- and coding scheme (MCS) for trigger frames compared to normal frames.
- [120] FIG. 17 illustrates the structure of a multiplexed group response according to an embodiment of the present invention. According to an embodiment of the present invention, the multiplexed group response may have the frame format of a block response (BA).
- [120] A multiplexed group response includes a Block Answer Control (BA Control) field and a Block Answer Information (BA Information) field, and can represent block answer information for multiple STAs through at least one of the above fields. The Block Response Info field is set to a variable length and may include the Per TID Info field, the Block ACK Starting Sequence Control field, and the Block ACK Bitmap field. The Per TID information field includes the Reserved field (Bo-B11) and the TID Value field (B12-B15).
- [122] According to an embodiment of the present invention, the reserved field in the Per TID information field can be used to indicate response information for multiple STAs. More specifically, the reserved field includes AID information of the STA to be received and an indicator indicating whether the block is responded to. For example, the reserved field may consist of 12 bits (B0 to B11). Among these, a specific bit, such as B11, can indicate whether the frame is a block response or a general ACK. In addition, the remaining bits of the reserved field, such as the 11 bits from B0 to B11, can indicate the AID information of the STA to which the frame is to be received.
- [123] The block response information field having the aforementioned configuration may be repeated for each traffic ID (TID). Since the block response information field has a variable length, the AID for all STAs participating in the multi-user uplink transmission can be inserted into the block response information field through the reserved field. For example, the block response information field is allocated for each STA and can be repeated as many times as the number of STAs to be received. Therefore, the AID for each STA, the block response start sequence control field, and the block response bitmap field may be included in the block response information field. On the other hand, if the reserved field indicator B11 indicates a general ACK, the block response start sequence control field and the block response bitmap field may be omitted from the block response information field.
- [124] According to an embodiment of the present invention, information directing a BA (Multi-STA BA) for a plurality of STAs may be included in a block response control field. More specifically, the block response control field may include a Multi-TID field B1, a Compressed Bitmap field B2, and Reserved fields B3 through B11, where at least one of the fields may indicate whether the frame is a Multi-STA BA. For example, certain bits of the Reserved fields (B3 through B11) may be used as bits to indicate a Multi-STA BA.
- [125] FIG. 18 illustrates a method of transmitting a multiplexed group response, according to an embodiment of the present disclosure. In embodiments of the present disclosure, the multiplexed group response includes a BA for a plurality of STAs (Multi-STA BA) as described above.

- [126] As in the above-described embodiment, the uplink data for each channel in the multi-user uplink transmission may be terminated at the same time. At this time, the AP sends a group response that is multiplexed to each channel to which the multi-user uplink data has been transmitted to indicate the completion of transmission. However, as shown in FIG. 18, if the number of STAs allocated to each channel is different, at least some of the information in the multiplexed group response transmitted to each channel may differ in length. As described in FIG. 17, the block response information field of the multiplexed group response has a variable length, and the length may be longer as the number of allocated STAs increases. In addition, some fields, such as the block response start sequence control field and the block response bitmap field, may be omitted depending on whether the reserved field's indicator directs the block response. However, according to an embodiment of the present invention, L-SIG and HE-SIG-A may be duplicated with common information in 20 MHz units when data is transmitted over a broadband channel. Therefore, the multiplexed group responses transmitted to each channel must have the same length based on the PPDU length field value included in the L-SIG.
- [127] FIG. 19 illustrates a method for length alignment of block responses, according to an embodiment of the present disclosure. In an embodiment of the present invention, the block response includes a multiplexed group response and a Multi-STA BA. In the embodiment of FIG. 19, portions that are identical or corresponding to the embodiment of FIG. 17 described above are intended to omit redundant description.
- [128] The AP sends a block response in response to the multi-user upstream data. The AP may transmit the block response to a plurality of STAs using multi-user downlink transmission. According to an embodiment of the present disclosure, the AP may transmit the block response for the corresponding STA on the channel over which the multi-user uplink data was transmitted.
- [129] In this case, the amount of response information in the block response transmitted to each channel may vary. Referring to FIG. 19, the block response transmitted to the first channel includes response information of STA1, STA2, STA3, and STA4, and the block response transmitted to the second channel includes response information of STA5 and STA6. Further, the block response sent to the third channel includes the response information of STA7, and the block response sent to the fourth channel includes the response information of STA8 and STA9.
- [130] According to embodiments of the present disclosure, the transmission of the block response may end at the same time for each channel, i.e., the AP may set the length of the block response transmitted over the plurality of channels to be the same.
- [131] According to one embodiment of the present invention, as shown in FIG. 19(a), the AP can perform padding on the block response transmitted through at least one channel to match the end of the block response transmission on each channel. In other words, AP can perform padding on the block responses of the second to fourth channels based on the length of the block response of the first channel, which has the largest amount of response information. According to one embodiment, the padding of the block response can be implemented with zero padding, but the present invention is not limited to this, and the padding can also be implemented with one padding.

- [132] According to another embodiment of the present invention, as shown in FIG. 19(b), the AP can insert redundant response information into the block response transmitted through at least one channel to match the end of the block response transmission on each channel. In other words, the AP can insert redundant response information into the block responses of the second to fourth channels based on the length of the block response of the first channel, which has the largest amount of response information. At this time, the redundant response information includes at least one of the Per TID Information field, the Block Response Start Sequence Control field, and the Block Response Bitmap field for each STA.
- [133] If the indicator B11 of the reserved field indicates a block response, the block response transmitted via channels 2 to 4 may include the Per TID Information field for at least one STA, the Block Response Start Sequence Control field, and the Block Response Bitmap field in duplicate. However, if the reserved field's indicator B11 indicates a general ACK, the block response start sequence control field and block response bitmap field may be omitted from the block response information field. Therefore, the block response transmitted through channel 2 to channel 4 may include a Per TID information field for at least one STA. As mentioned above, the Per TID information field of the block response information field includes the AID information of the receiving STA.
- [134] FIG. 20 illustrates a method of frame length alignment via padding in a multi-user simultaneous transmission process according to an embodiment of the present invention.
- [135] According to embodiments of the present invention, padding may also be performed on the trigger frame that triggers a multi-user simultaneous transmission. In a multi-user upstream data transmission and a multi-user downstream data transmission, a different number of STAs may be allocated for each channel. The trigger frame may include AID information of the STAs assigned to each channel, wherein the amount of information in the trigger frame transmitted may vary for each channel.
- [136] According to one embodiment of the present invention, a preset padding may be performed before the Frame Check Sequence (FCS) field of the trigger frame. Thus, the transmission of the trigger frame may terminate at the same time on each channel over which the trigger frame is transmitted. Furthermore, by padding the trigger frame, the STAs may acquire additional processing time to participate in multi-user simultaneous transmission in response to the trigger frame. According to another embodiment of the present invention, redundant AID information may be inserted prior to the FCS field of the trigger frame.
- [137] As mentioned above, if different numbers of STAs are allocated to each channel in the multi-user simultaneous transmission process, the amount of information in the block response transmitted in response to multi-user data may vary from channel to channel. According to an embodiment of the present invention, padding may be performed on the block response of another channel based on the length of the block response of the channel to which the largest number of STAs are assigned. In this case, the padding may be performed before the FCS field of the block response.
- [138] FIG. 21 illustrates a multiplexed block response transmission method when a plurality of channels are used for multi-user uplink transmission. In the present invention, a multiplexed block response (M-BA) may refer to the multiplexed group response described above.

- [139] As described above, the AP can send a multiplexed block response to the corresponding STA on the channel over which the multi-user uplink data was transmitted. Therefore, the length of the multiplexed block response is variable depending on the number of STAs allocated to the channel and the reception status of the multi-user uplink data. Therefore, the actual length of the multiplexed block response cannot be predicted at the time the AP sends the trigger frame.
- [140] According to an embodiment of the present invention, the AP may set the TXOP value of the trigger frame by estimating the maximum time required for multi-user uplink data transmission. The maximum time may be set as the time required for the M-BA utilizing the block response option to be transmitted to all STAs on the channel to which the largest number of STAs are assigned. Therefore, when the actual multi-user uplink data transmission is completed, the actual length of the M-BA may vary from channel to channel depending on the uplink data reception results.
- [141] If M-BAs of different lengths are transmitted for each channel, other terminals may be allowed to connect after the AIFS time from the completion of transmission of the M-BA for some channels. As shown in the embodiment of FIG. 21, if the M-BA of the main channel is set to the shortest length, the other terminal may access the main channel. However, since the AP cannot switch states until it completes the transmission of the M-BA on the other channel, the transmission attempt of the other terminal may be ignored or the AP may be penalized for competing access attempts.
- [142] Thus, according to embodiments of the present disclosure, the AP may set the length of multiplexed block responses transmitted over a plurality of channels to be the same. To do so, the AP may perform padding on multiplexed block responses transmitted over at least one channel to align the end times of the multiplexed block response transmissions on each channel. According to one embodiment, the padding techniques of IEEE 802.11ac may be used for padding multiplexed block responses.
- [143] On the other hand, the transmission of the multiplexed block response may end earlier than the TXOP set in the trigger frame. According to one embodiment, the AP may return the remaining TXOP after completing transmission of the multiplexed block response. In another embodiment, the AP may perform additional actions, such as transmitting a control frame, during the remaining TXOP after completing transmission of the multiplexed block response.
- [144] As mentioned above, the invention is described using wireless LAN communication as an example, but the invention is not limited to this and can be applied equally to other communication systems such as cellular communication. In addition, the method, device, and system of the invention have been described in relation to a specific embodiment, but all or part of the components and operations of the invention can be implemented using a computer system with general-purpose hardware architecture.
- [145] Embodiments of the disclosure described above may be implemented through a variety of means. For example, embodiments of the present disclosure may be implemented by hardware, firmware, software, or a combination thereof.

- [146] For implementation by hardware, methods according to embodiments of the present disclosure may be implemented by one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, microcontrollers, microprocessors, and the like.
- [147] For implementation by firmware or software, the methods according to embodiments of the present invention may be implemented in the form of modules, procedures, or functions that perform the functions or actions described above. The software code may be stored in memory and executed by a processor. The memory may be located inside or outside the processor, and data may be transferred to and from the processor by various means already known in the art.
- [148] The foregoing description of the invention is for illustrative purposes only, and one having ordinary knowledge in the technical field to which the invention belongs will understand that it can be readily adapted to other specific forms without altering the technical idea or essential features of the invention. The embodiments described above are therefore exemplary in all respects and may not be construed as limiting. For example, each component described in a single form may be implemented in a distributed manner, and similarly, components described as distributed may be implemented in a combined form.
- [149] The scope of the present invention is indicated by the following KIPO (Korean Intellectual Property Office) claims rather than by the detailed description above, and the meaning and scope of the KIPO claims and all modifications or variations derived from the concept of equivalents thereof should be construed to be included in the scope of the invention.

Industrial Usability

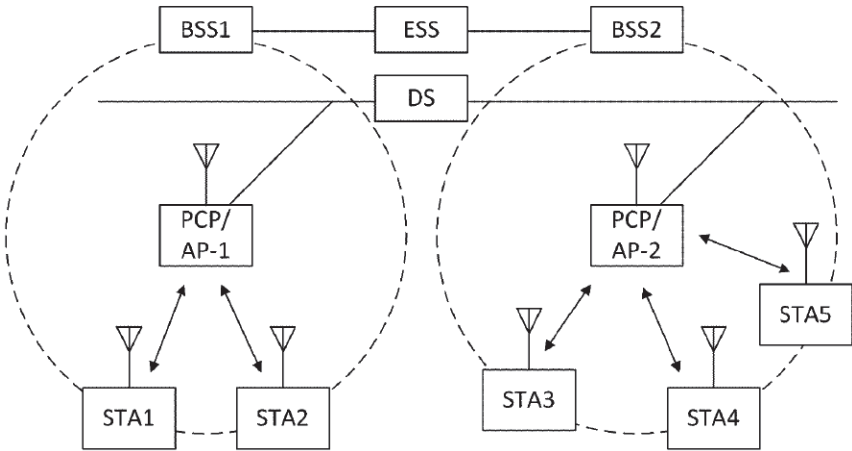
- [150] While various embodiments of the present disclosure have been described in the context of IEEE 802.11 systems, they can be applied to various other types of mobile communication devices, mobile communication systems, and the like.

Claims

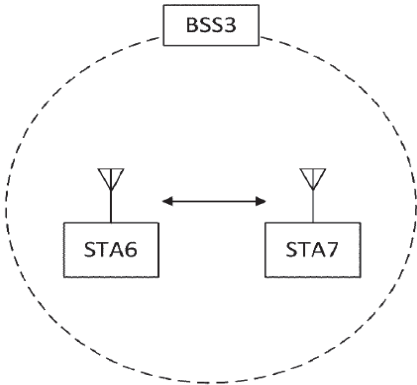
- [Claim 1] A base wireless communication terminal, comprising: a transceiver for transmitting and receiving wireless signals; and a processor for controlling operation of the base wireless communication terminal, the processor transmitting a trigger frame that triggers transmission of multi-user uplink data by a plurality of terminals, receiving the multi-user uplink data via resources allocated to the plurality of terminals, and transmitting block responses via the resources in response to the received multi-user uplink data, wherein transmission of the block responses on each of the resources terminates at the same time.
- [Claim 2] The base wireless communication terminal of claim 1, wherein the processor performs padding on the block responses transmitted over the at least one resource to coincide end times of the block response transmissions from the respective resources.
- [Claim 3] The base wireless communication terminal of claim 1, wherein the processor inserts duplicate response information into the block responses transmitted over the at least one resource to coincide with the end of transmission of the block responses from the respective resources.
- [Claim 4] The base wireless communication terminal of claim 1, wherein the predetermined padding is performed before the Frame Check Sequence (FCS) field of the trigger frame.
- [Claim 5] The base wireless communication terminal of claim 4, wherein the transmission of the trigger frame terminates at the same time on each resource to which the trigger frame is transmitted.
- [Claim 6] The base wireless communication terminal of claim 1, wherein the resource is a channel or subchannel.
- [Claim 7] The base wireless communication terminal of claim 1, wherein the transmission packet of the multi-user uplink data includes legacy preambles and non-legacy preambles, and the legacy preambles are common information in 20 MHz channel units that are received by the base wireless communication terminal.
- [Claim 8] The base wireless communication terminal of claim 7, wherein the non-legacy preamble includes HE-SIG-A and the remaining fields, wherein HE-SIG-A is received as common information in units of 20 MHz channels, and the remaining fields of the non-legacy preamble are received as individual information for each resource allocated to the terminal.

- [Claim 9] The base wireless communication terminal of claim 8, wherein the remaining fields of the above non-legacy preamble include HE-STF and HE-LTF.
- [Claim 10] The base wireless communication terminal of claim 1, wherein the multi-user uplink data transmission from each resource terminates at the same time.
- [Claim 11] A base wireless communication terminal of claim 10, wherein the padding is performed on the above-mentioned uplink data transmitted through at least one resource, and the multi-user uplink data transmission is terminated at the same time.
- [Claim 12] A wireless communication method for a base wireless communication terminal, comprising: transmitting a trigger frame to trigger transmission of multi-user uplink data by a plurality of terminals; receiving the multi-user uplink data via resources assigned to the plurality of terminals; and transmitting a block response via the resources in response to the received multi-user uplink data, wherein the transmission of the block response on each of the resources terminates at the same time.

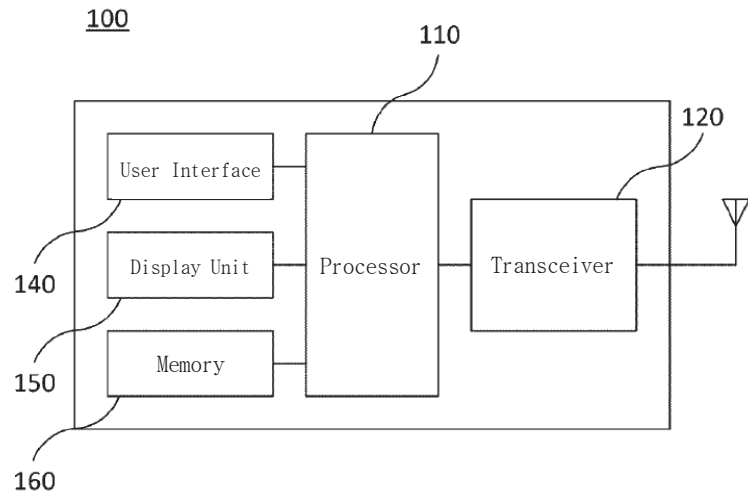
[FIG. 1]



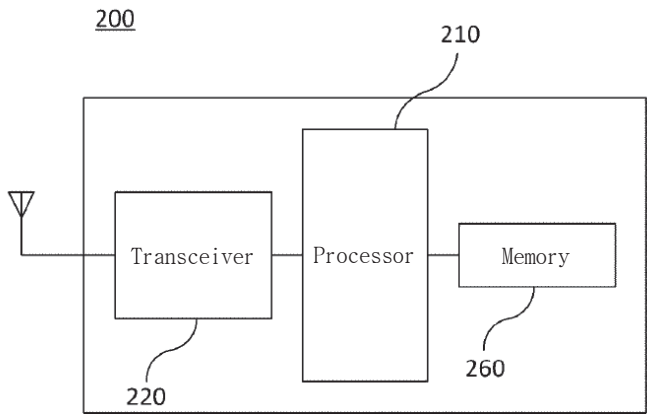
[FIG. 2]



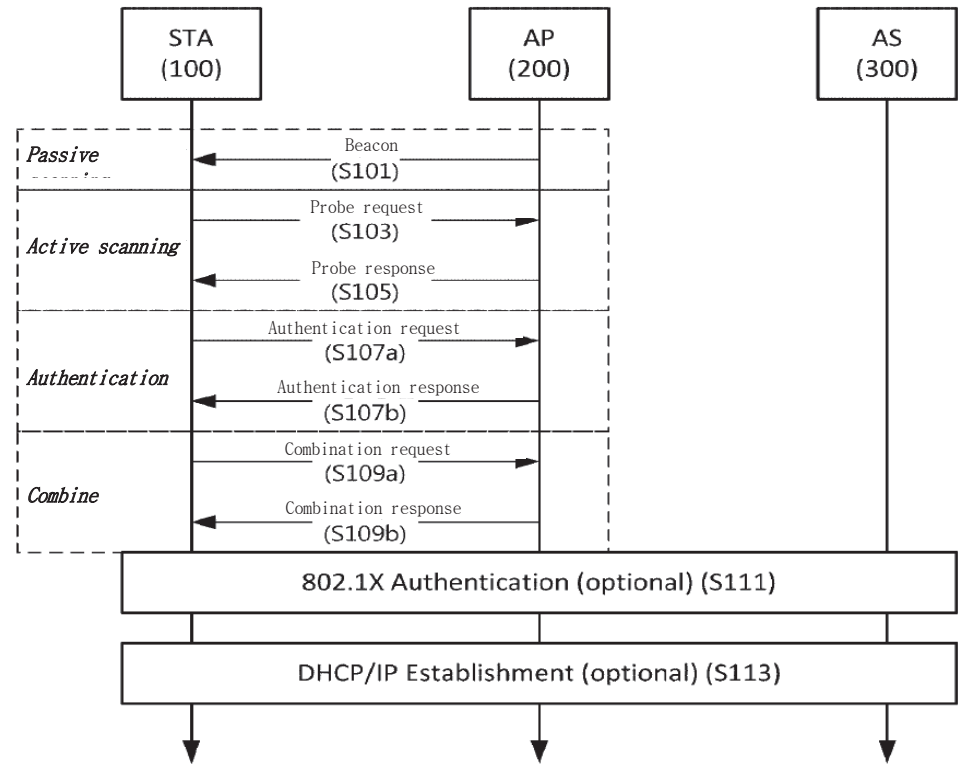
[FIG. 3]



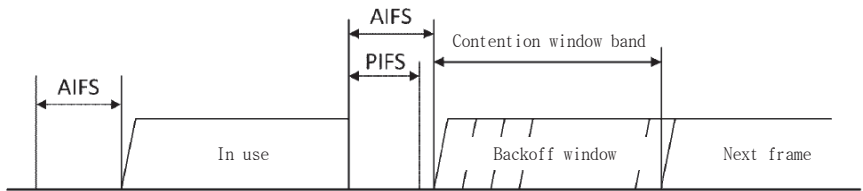
[FIG. 4]



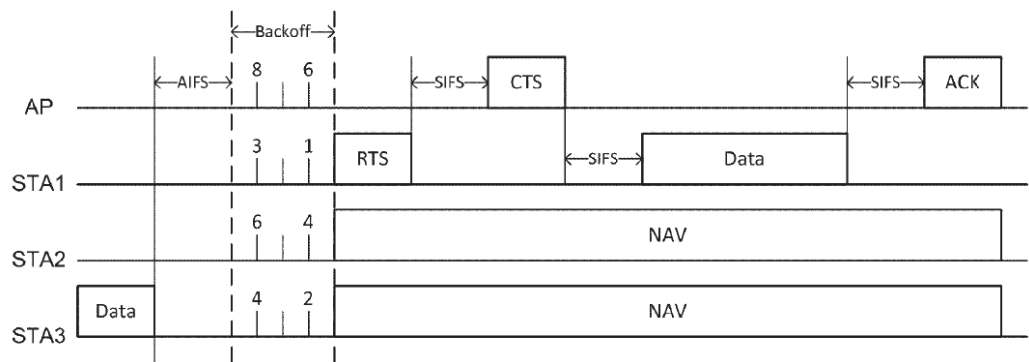
[FIG. 5]



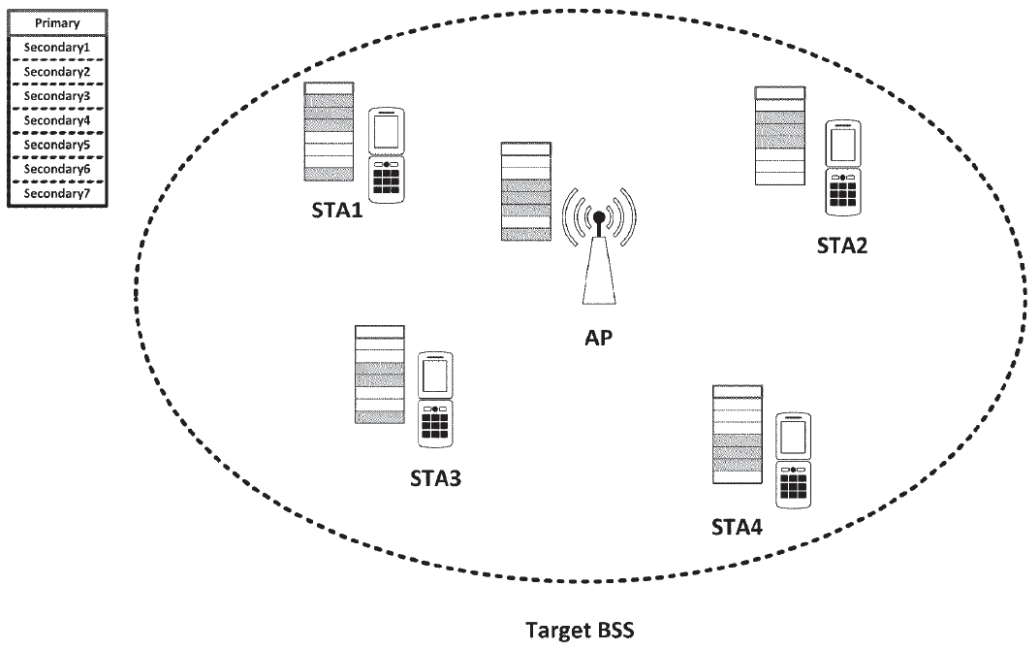
[FIG. 6]



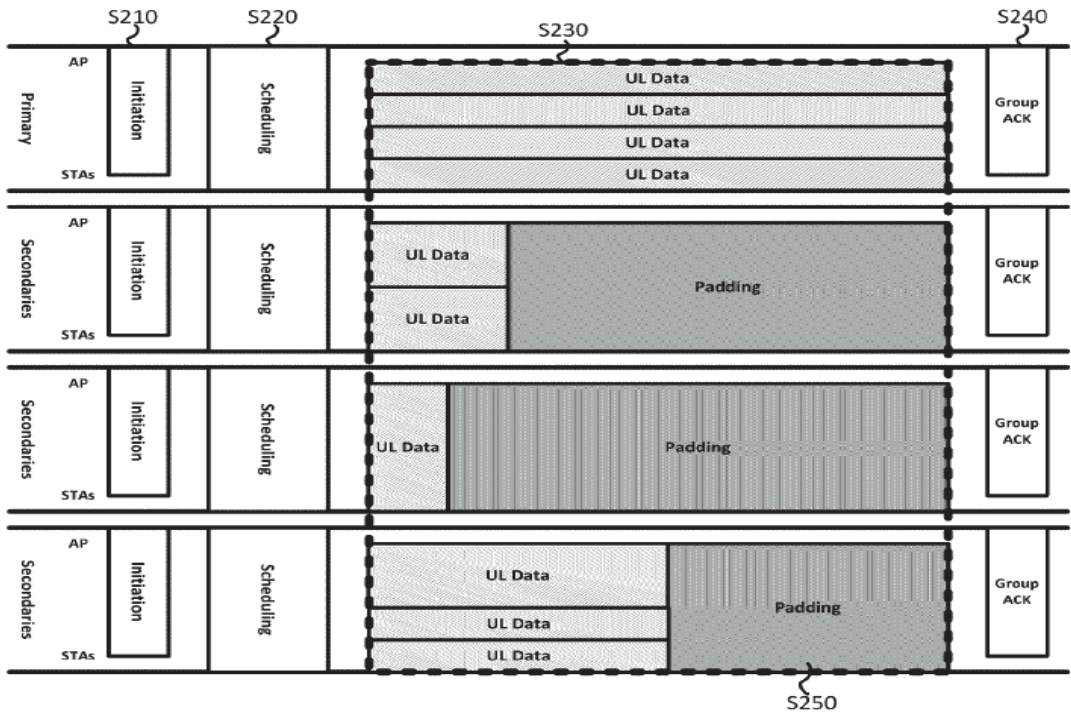
[FIG. 7]



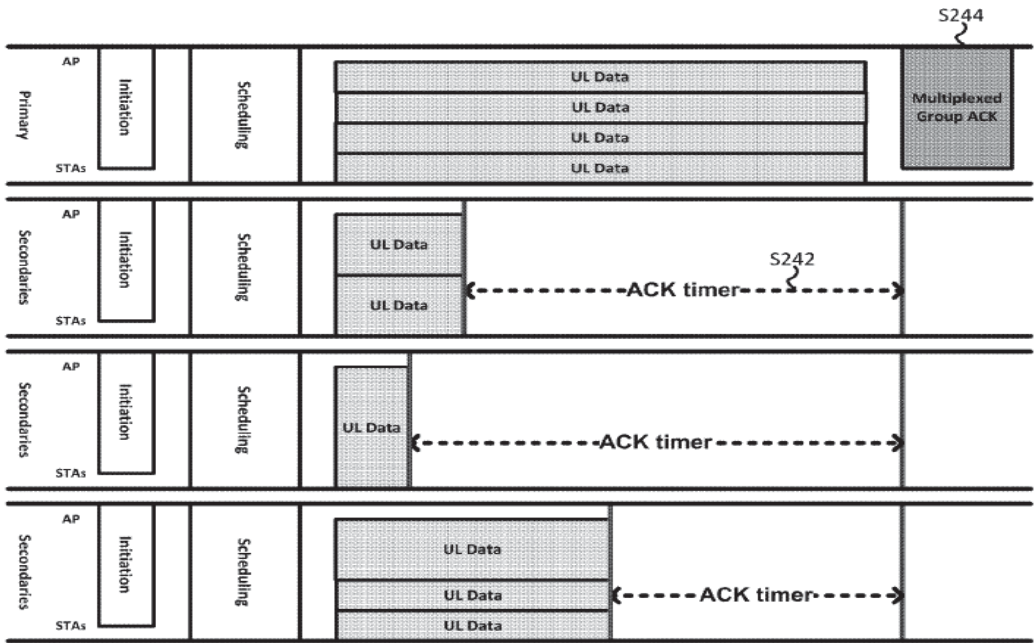
[FIG. 8]



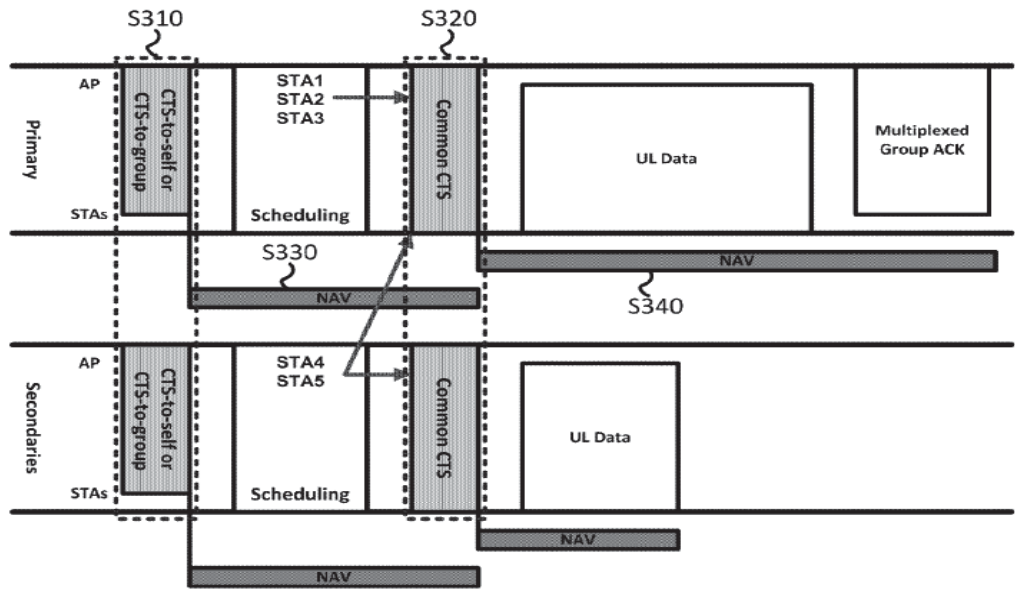
[FIG. 9]



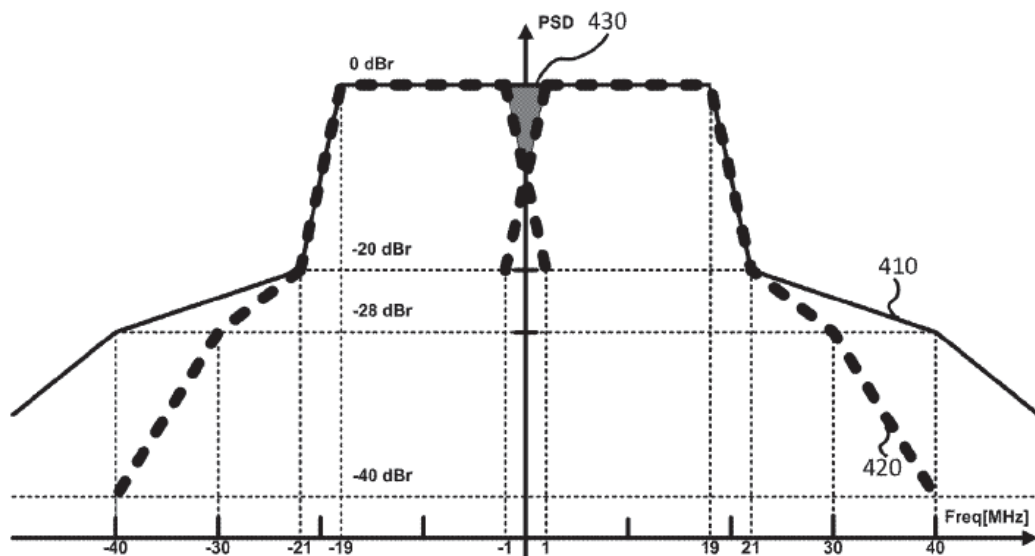
[FIG. 10]



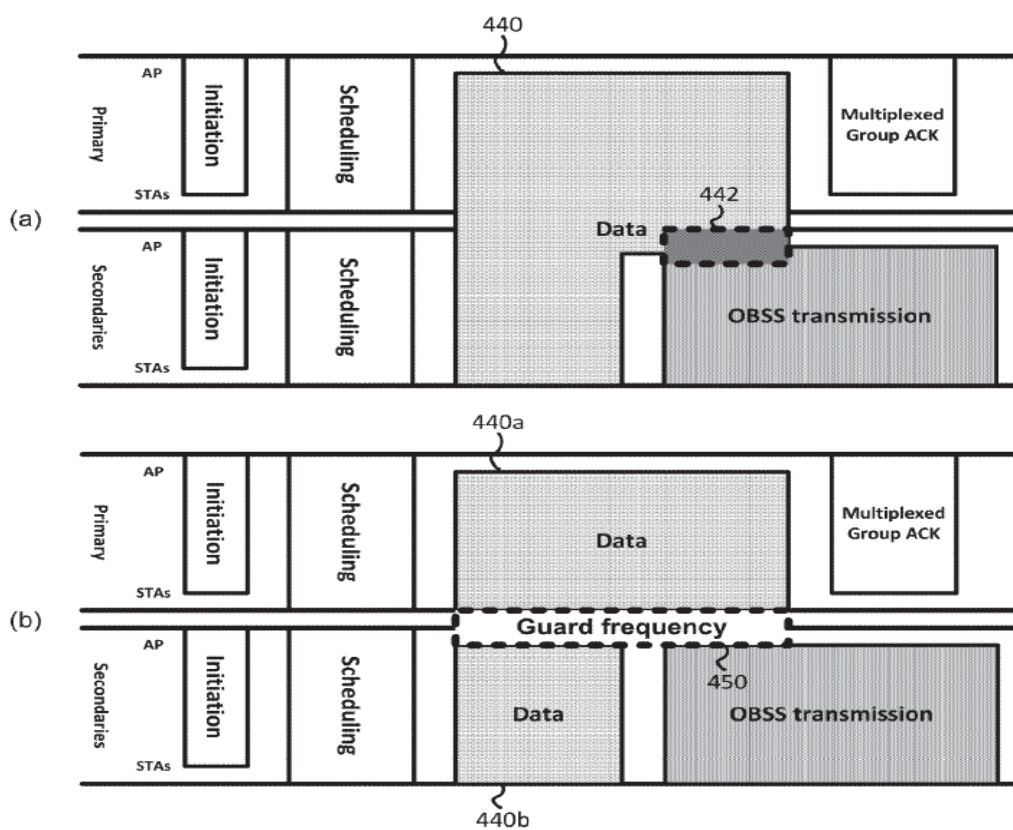
[FIG. 11]



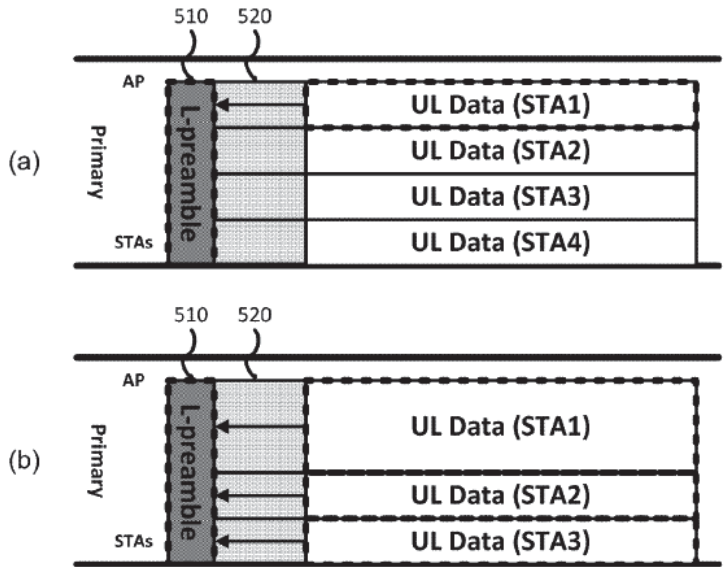
[FIG. 12]



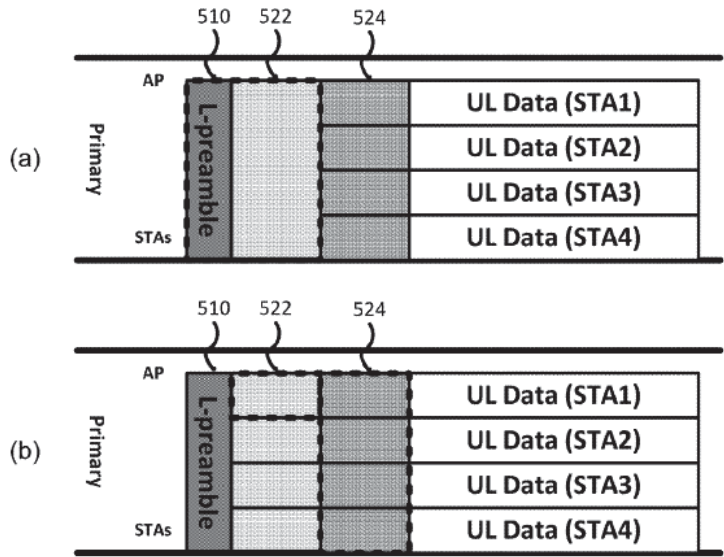
[FIG. 13]



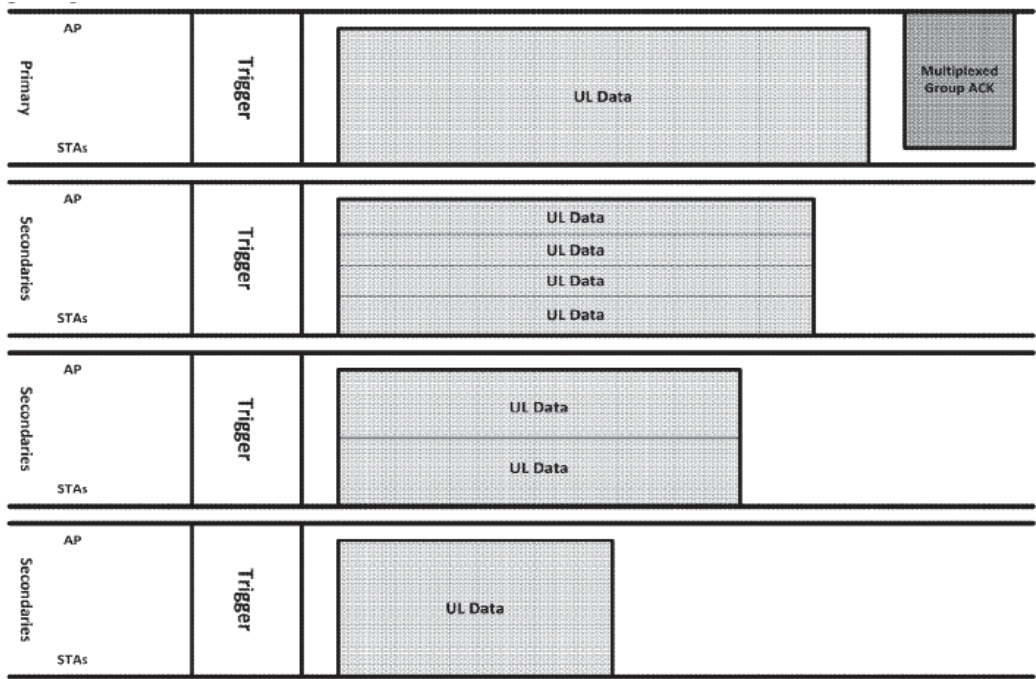
[FIG. 14]



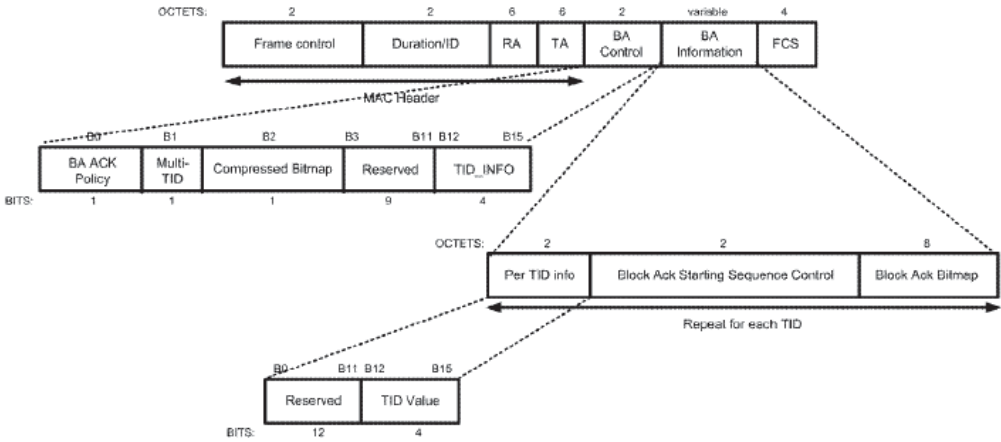
[FIG. 15]



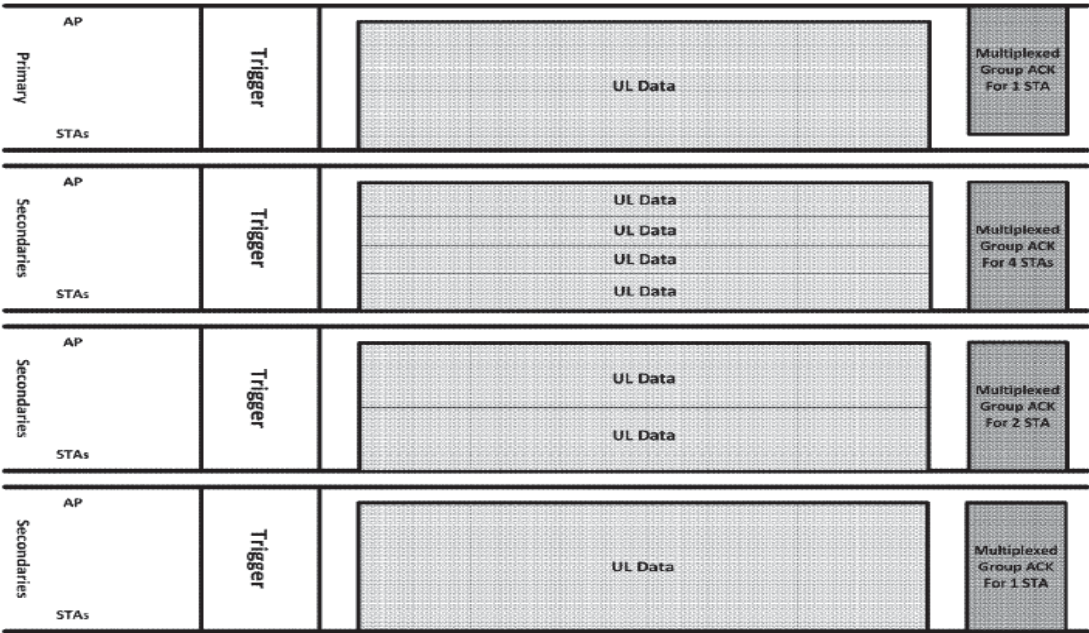
[FIG. 16]



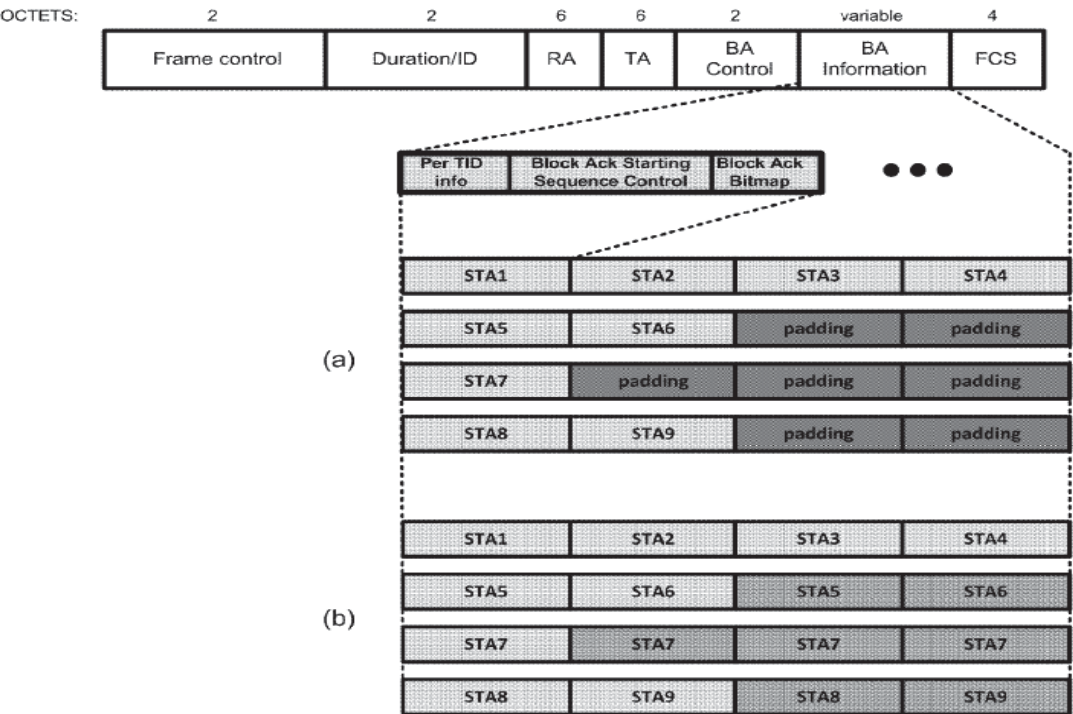
[FIG. 17]



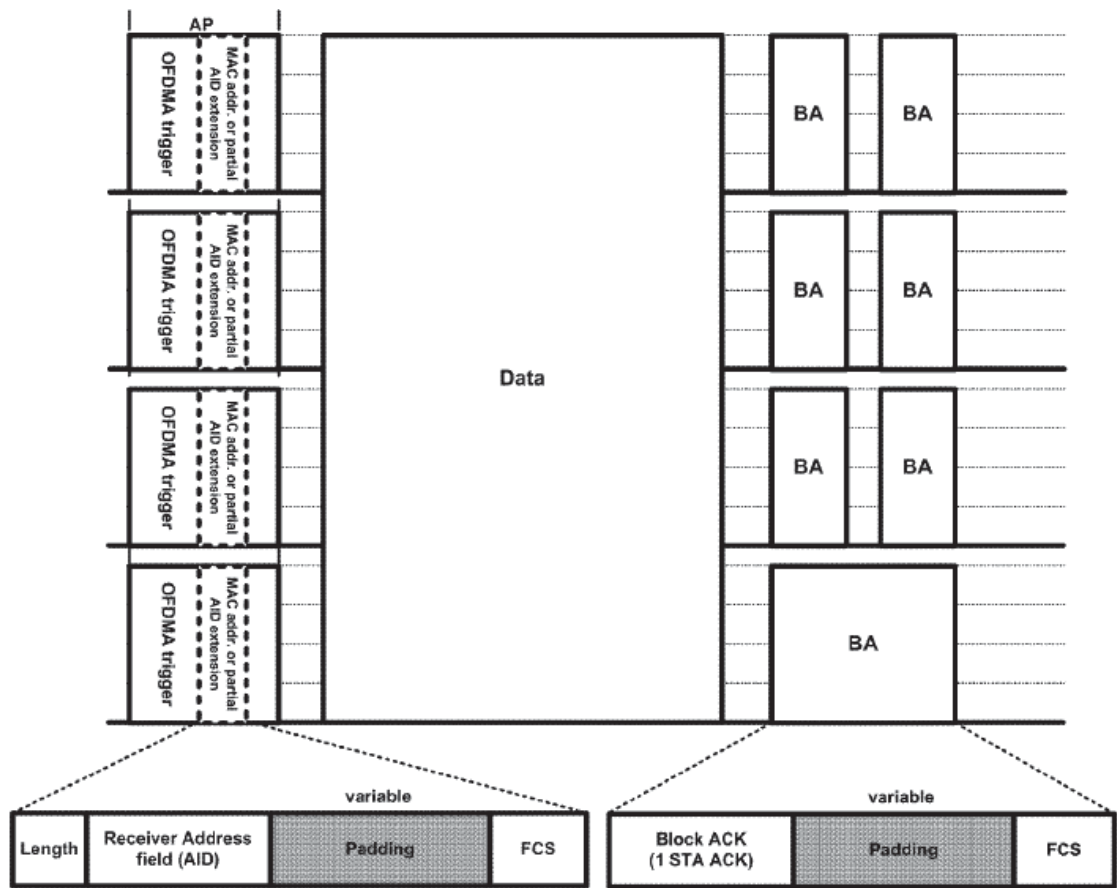
[FIG. 18]



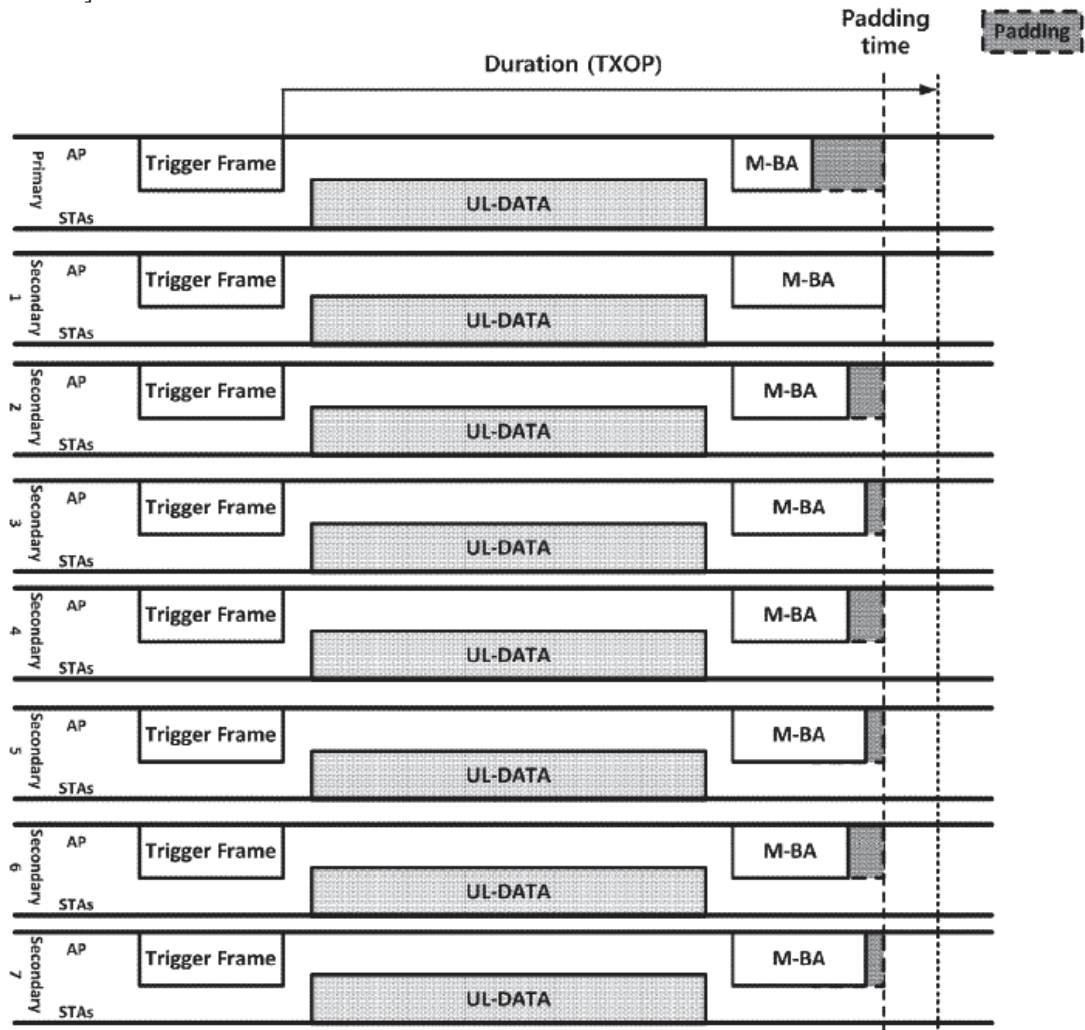
[FIG. 19]



[FIG. 20]



[FIG. 21]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2016/002199

A. CLASSIFICATION OF SUBJECT MATTER

H04W 72/12(2009.01)i, H04W 72/04(2009.01)i, H04W 74/08(2009.01)i, H04L 1/00(2006.01)i, H04L 1/16(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W 72/12; H04L 5/00; H04L 1/14; H04W 72/04; H04L 27/26; H04W 74/08; H04L 1/00; H04L 1/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models: IPC as above

Japanese Utility models and applications for Utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & Keywords: multi-user uplink data, trigger frame, block response, the same point ending, legacy preamble, HE-SIG-A

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2011-102575 A1 (LG ELECTRONICS INC.) 25 August 2011 See paragraphs [0050]-[0112]; and figures 3-11.	1-12
A	US 2013-0301569 A1 (INTERDIGITAL PATENT HOLDINGS, INC.) 14 November 2013 See paragraphs [0100]-[0107]; and figures 8, 9.	1-12
A	WO 2014-171788 A1 (LG ELECTRONICS INC.) 23 October 2014 See paragraphs [0090]-[0183]; and figures 7-13.	1-12
A	US 2013-0286959 A1 (INTERDIGITAL PATENT HOLDINGS, INC.) 31 October 2013 See paragraphs [0189]-[0276]; and figures 29, 30, 33, 34, 40-46.	1-12
A	AHN, Woo Jin et al., "UL-OFDMA Procedure in IEEE 802.11ax", IEEE 802.11-15/0091r1, 13 January 2015 See slides 3-10.	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

07 JULY 2016 (07.07.2016)

Date of mailing of the international search report

08 JULY 2016 (08.07.2016)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701,
Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/KR2016/002199

Patent document cited in search report	Publication date	Patent family member	Publication date
WO 2011-102575 A1	25/08/2011	EP 2538599 A1	26/12/2012
		KR 10-2011-0095098 A	24/08/2011
		US 2012-0314697 A1	13/12/2012
US 2013-0301569 A1	14/11/2013	CN 104321995 A	28/01/2015
		EP 2847909 A1	18/03/2015
		JP 2015-525017 A	27/08/2015
		KR 10-2015-0007334 A	20/01/2015
		TW 201407991 A	16/02/2014
		WO 2013-170136 A1	14/11/2013
WO 2014-171788 A1	23/10/2014	AU 2014-254581 A1	23/10/2014
		CA 2908045 A1	23/10/2014
		CN 105122754 A	02/12/2015
		EP 2988462 A1	24/02/2016
		KR 10-2016-0009529 A	26/01/2016
		US 2016-0050093 A1	18/02/2016
US 2013-0286959 A1	31/10/2013	CN 104321998 A	28/01/2015
		EP 2845342 A1	11/03/2015
		JP 2015-520973 A	23/07/2015
		JP 5896376 B2	06/04/2016
		KR 10-2015-0013640 A	05/02/2015
		TW 201352039 A	16/12/2013
		WO 2013-165582 A1	07/11/2013

Form PCT/ISA/210 (patent family annex) (January 2015)

international search report

International application No.

PCT/EN2016/002199

A. classification of subject matter (ipc)

H04W 72/12 (2009.01.i), H04W 72/04 (2009.01.i), H04W 74/08 (2009.01.i), H04L 1/00 (2006.01.i), H04L 1/16 (2006.01.i)

B. FIELDS SEARCHED

Minimum documentation searched (classification system and classification no. marked)
h04w 72/12; h04l 5/00; h04l 1/14; h04w 72/04; h04l 27/26; h04w 74/08; h04l 1/00; h04l 1/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Gazette of Registered Utility Models and Korean Gazette of Published Utility Model Applications: IPC listed in the "minimum documentation searched" section above

Japanese Gazette of Registered Utility Models and Japanese Gazette of Published Utility Model Applications: IPC listed in the "minimum searched" section above

Electronic database consulted during the international search (name of database, and search terms used (if applicable))

eKOMPASS (KIPO internal search system) and keywords: multi-user uplink data, trigger frame, block response, the same point ending, legacy preamble, HE-SIG-A

c. documents considered to be relevant

Cetegory ** Cetegory	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No. 1, which is also known as
A	WO 2011-102575 A1 (LG Electronics Inc.) 2011.08.25 See paragraphs[0050]-[0112]; and figures 3-11.	1-12
A	us 2013-0301569 a1 (interdigital patent holdings, inc.) 2013.11.14 See paragraphs[0100]-[0107]; and figures 8, 9.	1-12
A	WO 2014-171788 A1 (LG Electronics Inc.) 2014.10.23 See paragraphs[0090]-[0183]; and figures 7-13.	1-12
A	us 2013-0286959 a1 (interdigital patent holdings, inc.) 2013.10.31 See paragraphs[0189]-[0276]; and figures 29, 30, 33, 34, 40-46.	1-12
A	WOOJIN AHN, et al, 'UL-OFDMA procedure in IEEE 802.11ax', IEEE 802.11-15/0091r1, Jan. 13, 2015 See slides 3-10.	1-12

☐ Further documents are listed in the continuation of Box C.

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"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent that published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being conspicuous to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"
"O" document referring to an oral disclosure, use, exhibition or other means	
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Date of the actual completion of the international search
July 7, 2016 (07/07/2016)

Date of mailing of the international search report
July 8, 2016 (07/08/2016)

ISA/KR name and zip code



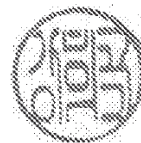
KIPO Registration Bureau, Daejeon
Government Complex Bldg. #4) 189,
Cheongsu-ro, Seo-gu, Daejeon, (zip)

Fax: +82-42-481-8578

Examiner

Hee Gok Kang [seal affixed: Hee Gok Kang] [seal affixed: Hee Gok Kang]

Tel: +82-42-481-8264



international search report
Information on patent family members

International application No.

PCT/EN2016/002199

Patent document cited in search report	Publication date	Patent family member	Publication date
W0 2011-102575 A1	08/25/2011	EP 2538599 A1 kr 10-2011-0095098 a us 2012-0314697 a1	12/26/2012 08/24/2011 12/13/2012
us 2013-0301569 a1	11/14/2013	CN 104321995 A EP 2847909 A1 JP 2015-525017 A kr 10-2015-0007334 a TW 201407991 A wo 2013-170136 a1	01/28/2015 03/18/2015 08/27/2015 01/20/2015 02/16/2014 11/14/2013
wo 2014-171788 a1	10/23/2014	au 2014-254581 a1 CA 2908045 A1 CN 105122754 A EP 2988462 A1 kr 10-2016-0009529 a us 2016-0050093 a1	10/23/2014 10/23/2014 12/02/2015 02/24/2016 01/26/2016 02/18/2016
us 2013-0286959 a1	10/31/2013	CN 104321998 A EP 2845342 A1 JP 2015-520973 A JP 5898376 B2 kr 10-2015-0013640 a TW 201352039 A wo 2013-165582 a1	01/28/2015 03/11/2015 07/23/2015 04/06/2016 02/05/2015 12/16/2013 11/07/2013