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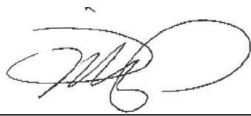
I served as Chief Examiner of the certified court interpreter test for the State of California and as a contract translator and interpreter for various federal agencies through the U.S. Department of State for more than a decade. I served as an instructor at the University of California at Berkeley and 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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I certify under penalty of perjury that the foregoing is true and correct.

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By: 
Alex N. Jo
Member, ATA

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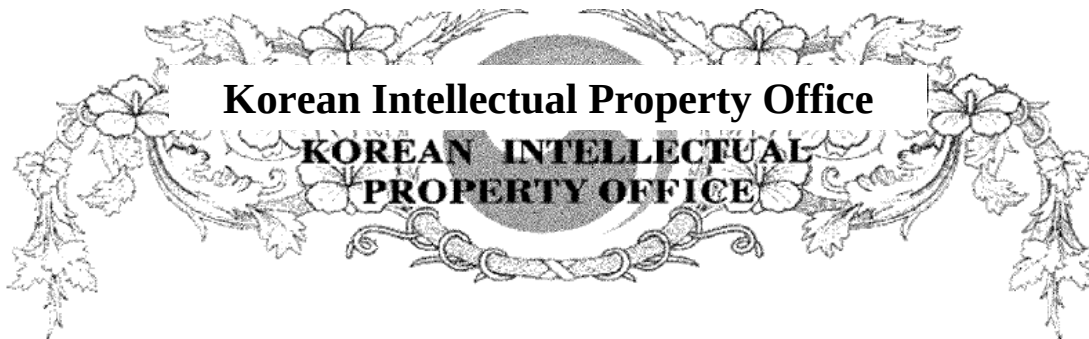
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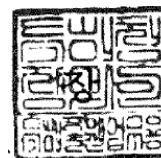
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[Title of the Invention in Korean] GROUP ACK TRANSMISSION AND PADDING METHODS
FOR WIDEBAND WIRELESS LAN MULTIPLE USER
UPLINK DATA TRANSMISSION

[Title of the Invention in English] GROUP ACK TRANSMISSION AND PADDING METHODS
FOR WIDEBAND WIRELESS LAN MULTIPLE USER
UPLINK DATA TRANSMISSION

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<i>Agent or Attorney</i>	Kook Il Lim (signature or seal)
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[Application Filing Fee]	0 page (s) 46,000 KRW
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[Priority Claim Fee]	0 case (s) 0
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[Total]	46,000 KRW
[Reason for Fee Reduction]	Small Business (70% reduction) [1]
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[Description of the Invention]

[Title of the Invention]

GROUP ACK TRANSMISSION AND PADDING METHODS FOR WIDEBAND
WIRELESS LAN MULTIPLE USER UPLINK DATA TRANSMISSION *[in Korean]* { GROUP
ACK TRANSMISSION AND PADDING METHODS FOR WIDEBAND WIRELESS LAN
MULTIPLE USER UPLINK DATA TRANSMISSION } *[in English]*

[Technical Field]

[0001] The present invention relates to apparatuses, systems and methods for wireless LANs, and more particularly, to group ack transmission and padding methods for wideband wireless LAN multiple user uplink data transmission.

[Background Technology of the Invention]

[0002] Recently, with the widespread adoption of mobile devices, wireless LAN (Wireless LAN) technology, which can provide high-speed wireless internet services to these devices, has been attracting significant attention. Wireless LAN technology enables mobile devices such as smartphones, smart pads, laptop computers, portable multimedia players, and embedded devices to connect to the internet wirelessly based on short-range wireless communication technology.

[0003] Early wireless LAN technology, through IEEE (Institute of Electrical and Electronics Engineers) 802.11, supported speeds of 1 to 2 Mbps by using the 2.4 GHz frequency with frequency hopping, spread spectrum, and infrared communication. Recently, by applying OFDM (Orthogonal Frequency Division Multiplex), it is possible to support speeds of up to 54

Mbps. Additionally, IEEE 802.11 has been commercializing or developing standards for various technologies such as QoS (Quality for Service) enhancement, access point (Access Point, AP) protocol compatibility, security enhancement, radio resource measurement, wireless access in vehicular environments, fast roaming, mesh network, interworking with external networks, and wireless network management.

[0004] Among IEEE 802.11 standards, IEEE 802.11b uses the 2.4GHz band frequency and supports a maximum communication speed of 11 Mbps. IEEE 802.11a, which was commercialized after IEEE 802.11b, uses the 5GHz band frequency instead of the 2.4GHz band, thereby reducing the effect of interference compared to the heavily congested 2.4GHz band, and improved the communication speed up to 54 Mbps by using OFDM technology. However, IEEE 802.11a has a disadvantage of a shorter communication range compared to IEEE 802.11b. IEEE 802.11g, like IEEE 802.11b, uses the 2.4GHz band frequency and supports communication speeds of up to 54 Mbps. It attracted significant attention due to its backward compatibility and also shows superiority over IEEE 802.11a in terms of communication range.

[0005] Additionally, to overcome the limitation in communication speed, which has been pointed out as a vulnerability in wireless LAN, the IEEE 802.11n standard was established. IEEE 802.11n aims to increase the speed and reliability of the network and to extend the operational range of wireless networks. More specifically, IEEE 802.11n supports High Throughput (HT) with data processing speeds exceeding 540 Mbps and is based on MIMO (Multiple Inputs and Multiple Outputs) technology, which uses multiple antennas on both the transmitting and receiving ends to

minimize transmission errors and optimize data speed. Furthermore, this standard not only uses a coding method that transmits multiple redundant copies to increase data reliability, but may also employ Orthogonal Frequency Division Multiplex (OFDM) to increase speed.

[0006] As the adoption of wireless LAN becomes more active and the applications using it become more diverse, there is a growing need for a new wireless LAN system that supports higher throughput (Very High Throughput, VHT) than the data processing speed supported by IEEE 802.11n. Among them, IEEE 802.11ac supports wide bandwidth (80 MHz to 160 MHz) in the 5 GHz frequency band. Although the IEEE 802.11ac standard is defined only for the 5 GHz band, initial 11ac chipsets will also support operation in the 2.4 GHz band for backward compatibility with existing 2.4 GHz band products. In this case, 802.11ac supports a bandwidth of up to 40 MHz in the 2.4 GHz band. Theoretically, under this standard, the wireless LAN speed for multiple terminals can reach at least 1 Gbps, and the maximum single link speed can reach at least 500 Mbps. This is achieved by expanding the wireless interface concepts adopted in 802.11n, such as wider wireless frequency bandwidth (up to 160 MHz), a greater number of MIMO spatial streams (up to 8), multi-user MIMO, and higher-density modulation (up to 256 QAM). In addition, there is IEEE 802.11ad, which uses the 60 GHz band instead of the existing 2.5 GHz/5 GHz bands to transmit data. IEEE 802.11ad is a transmission standard that provides speeds of up to 7 Gbps using beamforming technology, and is suitable for large-capacity data or high-bitrate video streaming such as uncompressed HD video. However, the 60 GHz frequency band has the disadvantage that

it cannot penetrate obstacles, making it usable only between devices in close proximity.

[0007] Wireless LAN can use a wide frequency band. To utilize a wide frequency band, it checks for available bands over a certain period of time before transmitting data and uses the frequency band in an aggregated manner based on the availability of adjacent frequency bands. For example, if the primary 20 MHz band (primary channel) is available, and the next 20 MHz is also available, but the following 20 MHz is unavailable, and the next 20 MHz is available, then a total of 40 MHz is used as the transmission band to transmit data. Since only contiguous frequency bands are used as the data transmission band, there is a problem in that some actually available frequency bands cannot be used. In addition, conventional wireless access technologies support only one-to-one communication between one transmitting terminal and one receiving terminal for each transmission attempt within the same Basic Service Set (BSS), which results in inefficiency as it fails to reflect the connection environment of terminals or the characteristics of the transmitted data.

[Specifics of the Invention]

[Problem to Be Solved by the Invention]

[0008] The present invention is intended to solve the problems of the aforementioned conventional technologies, and has the object of providing a multi-channel uplink packet transmission method, device, and system for wireless LAN.

[Means to Solve the Problem]

[0009] According to an embodiment of the present invention, an apparatus, system and method for a wireless LAN can be provided.

[Effect of the Invention]

[0010] According to an embodiment of the present invention, it is possible to reduce unnecessary channel occupancy during multi-user uplink transmission in a contention-based channel access system.

[0011] In addition, according to an embodiment of the present invention, it is possible to increase the probability of occupancy of the primary channel of an OBSS by using multiplexed group ACK.

[0012] Furthermore, according to an embodiment of the present invention, it is possible to increase the overall spectral efficiency of the network in an overcrowded OBSS environment.

[0013] In addition, it is applicable to various communication devices such as stations or access points using wireless LAN, and stations or base stations using cellular communication.

[Brief Description of the Drawings]

[0014] FIG. 1 illustrates a wireless LAN system according to an embodiment of the present invention.

FIG. 2 illustrates an independent BSS, which is a wireless LAN system according to another embodiment of the present invention.

FIG. 3 is a block diagram showing the configuration of a station according to an

embodiment of the present invention.

FIG. 4 is a block diagram showing the configuration of an AP according to an embodiment of the present invention.

FIG. 5 schematically illustrates a procedure in which a STA establishes a link with an AP in connection with an embodiment of the present invention.

FIG. 6 illustrates a passive scanning method of a STA related to an embodiment of the present invention.

FIG. 7 illustrates an active scanning method of a STA related to an embodiment of the present invention.

FIG. 8 shows an example of a basic multi-user uplink data transmission procedure.

FIG. 9 illustrates the structure of a multiplexed group ACK according to an embodiment of the present invention.

FIG. 10 illustrates a method of transmitting a multiplexed group ACK according to another embodiment of the present invention.

FIG. 11 illustrates a method of AID field padding for BA length alignment according to another embodiment of the present invention.

FIG. 12 illustrates the use of AID field padding and the use of Block ACK padding in a multi-user downlink data transmission procedure according to another embodiment of the present invention.

[Detailed Specifics for Practicing the Invention]

[0015] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings so that those skilled in the art to which the present

invention pertains can easily practice the invention. However, the present invention may be implemented in various different forms and is not limited to the embodiments described herein. Also, parts irrelevant to the description are omitted in order to clearly describe the present invention in the drawings, and throughout the specification, similar reference numerals are used for similar elements.

[0016] Throughout the specification, when a certain part is described as being "connected" to another part, it includes not only cases where they are "directly connected" but also cases where they are "electrically connected" with another element interposed therebetween. In addition, when a certain part is said to "include" a certain component, unless specifically stated otherwise, it does not exclude other components but may further include other components.

[0018] Structure of Wireless LAN System

[0019] FIG. 1 illustrates a wireless LAN system according to one embodiment of the present invention.

[0020] 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 (BSS) and independent BSS (IBSS), and FIG. 1 shows infrastructure BSS.

[0021] As illustrated in FIG. 1, infrastructure BSS (BSS1, BSS2) includes or more stations (STA-1, STA-2, STA-3, STA-4, STA-5), access point (PCP/AP-1, PCP/AP- 2) that is a station that provides a distribution service (DS), and a distribution system (DS) that connects multiple access points (PCP/AP-1, PCP/AP- 2).

[0022] A station (station, STA) is any device that includes a medium access control (MAC) and a physical layer interface to a 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). A station for wireless communication includes a processor and a transceiver, and may further include a user interface portion, a display unit, and the like, depending on the embodiment. The processor may generate frames to be transmitted over the wireless network, process frames received over the wireless network, and perform various other processing to control the station. The transceiver is functionally connected to the processor and transmits and receives frames over the wireless network for the station.

[0023] An access point (AP) is a discrete entity that provides access to a distribution system (DS) via a wireless medium for stations associated with it. In principle, communication between STAs not connected with AP in an infrastructure BSS is carried out, in principle, via an AP, but direct communication between STAs not connected with AP is also possible if a link is established. In this invention, AP is used as a concept that includes PCP (Personal BSS Coordination Point),

and broadly speaking, it can include all concepts of centralized controller, base station (BS), node-B, base transceiver system (BTS), and/or site controller, etc.

[0024] A plurality of infrastructure BSSs may be connected via a distribution system (DS). The plurality of BSSs connected via the distribution system may be referred to as an Extended Service Set (ESS). STAs included in an ESS can communicate with each other, and STA that are not connected to an AP within the same ESS can communicate seamlessly while moving from one BSS to another.

[0025] 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, parts that are the same as or correspond to those in the embodiment of FIG. 1 will not be redundantly described.

[0026] BSS-3 shown in FIG. 2 is an independent BSS and does not include an AP, so none of the stations (STA-6, STA-7) are in the state of being connected to an AP. An independent BSS is not allowed to connect to the distribution system and forms a self-contained network. In an independent BSS, each station (STA-6, STA-7) can be directly connected to each other.

[0028] Configuration of STA (Station)

[0029] FIG. 3 is a block diagram showing the configuration of a station according to an embodiment of the present invention.

[0030] As shown, the STA 100 according to an embodiment of the present invention may include a processor 110, one or more network interface cards (NIC, Network Interface Card) 120, a user interface unit 140, a display unit 150, and a memory 160.

[0031] First, the network interface card 120 is a module for performing wireless LAN access and may be embedded in or externally connected to the STA 100. According to an embodiment of the present invention, the network interface card 120 may include a plurality of network interface card modules 120_1 to 120_n that use different frequency bands. For example, the network interface card modules 120_1 to 120_n may include network interface card modules for different frequency bands such as 2.4 GHz, 5 GHz, and 60 GHz. According to an embodiment of the present invention, the STA 100 may include at least one network interface card module that uses a frequency band of 6 GHz or higher and at least one network interface card module that uses a frequency band of 6 GHz or lower. Each of the network interface card modules 120_1 to 120_n may perform wireless communication with an AP or an external STA according to the wireless LAN standard for the frequency band supported by the corresponding network interface card module 120_1 to 120_n. The network interface card 120 may operate only one of the network interface card modules 120_1 to 120_n at a time or operate multiple network interface card modules 120_1 to 120_n simultaneously depending on the performance and requirements of the STA 100.

[0032] Meanwhile, in the block diagram of FIG. 3, the plurality of network interface card modules 120_1 to 120_n of the STA 100 are illustrated as being separated from each other, and the MAC/PHY layers of each network interface card module 120_1 to 120_n operate independently. However, the present invention is not limited thereto and the plurality of network interface card modules for different frequency bands may also be integrated into a single chip and provided in the STA 100.

[0033] Next, the user interface portion 140 includes various forms of input/output means provided in the station 100. That is, the user interface portion 140 can receive user input using various input means, and the processor 110 can control the station 100 based on the received user input. Further, the user interface portion 140 may utilize various output means to perform outputs based on instructions from the processor 110.

[0034] 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 of the processor 110. In addition, the memory 160 stores control programs used in the station 100 and various data accordingly. Such control programs may include connection programs required for the station 100 to perform connections with APs or external stations.

[0035] The processor 110 of the present invention may execute various instructions or programs, and process data within the station 100. The processor 110 may also control each of the units 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 controls communication operations of the STA 100, such as the transmission/reception of sector sweep signals and the transmission/reception of corresponding feedback signals.

[0036] In addition, the processor 110 executes a program stored in the memory 160 to establish a connection with the AP, receives a communication setup message transmitted by the AP, reads information on the priority condition of the STA 100 included in the communication setup message, and requests a connection to the AP based on the information regarding the priority condition of the STA 100. A detailed description of this will be provided later.

[0037] 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 a plurality of chips, depending on the design of the device. Furthermore, in an embodiment of the present invention, some components of the station 100, such as the user interface portion 140 and the display unit 150, may be optionally equipped in the station 100.

[0039] Configuration of AP (Access Point)

[0040] FIG. 4 is a block diagram illustrating the configuration of an AP 200 according to one embodiment of the present disclosure.

[0041] As shown, an AP 200 according to an embodiment of the present invention may comprise a processor 210, a network interface card 220, and a memory 260. With respect to FIG. 4, portions of the configuration of the AP 200 that are identical or equivalent to the configuration of the station 100 of FIG. 3 will be omitted to avoid redundant description.

[0042] Referring now to FIG. 4, an AP 200 according to the present disclosure comprises a network interface card 220 for operating a BSS in at least one frequency band. As described above in the embodiment of FIG. 3, the network interface card of the AP 200 may also a plurality of network interface modules 220_1 to 220_m utilizing different frequency bands from each other. In other words, the AP 200 according to an embodiment of the present invention may comprise two or more network interface card modules in different frequency bands, such as 2.4 GHz, 5 GHz, and 60 GHz. Preferably, the AP 200 may comprise a network interface card module utilizing a frequency band above 6 GHz and a network interface card module utilizing a frequency band below 6 GHz. Each network interface card module 220_1 to 220_m can perform wireless communication with stations in accordance with the wireless LAN specifications for the frequency band supported by that network interface card module 220_1 to 220_m. The network interface card 220 may operate only one network interface card module 220_1 to 220_m at a time or may operate multiple network interface card modules 220_1 to 220_m together simultaneously, depending on the performance and requirements of the AP 200.

[0043] 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. Further, the processor 210 controls each unit of the AP 200 and may control data transmission and reception between the units.

[0044] In addition, the processor 210 may execute a program for connecting with a station stored in the memory 260 and transmit a communication setting message for one or more stations. Further, the processor 210 performs the connection setting according to the connection request of the station 100, while the communication setup message includes information about the access priority conditions of each station. A specific description of this will be stated later.

[0046] Link Establishment Procedure

[0047] FIG. 5 schematically illustrates a procedure in which a STA establishes a link with an AP according to an embodiment of the present invention.

[0048] Referring to FIG. 5, the process in which the STA 100 connects to the AP 200 according to the present invention is largely divided into three stages: scanning, authentication, and association. The scanning stage is the stage in which the STA 100 acquires access information of the BSS operated by the AP 200. Methods for performing scanning include passive scanning S101,

in which the STA acquires information by using only the beacon messages periodically transmitted by the AP, and active scanning, in which the STA transmits a probe request to the AP S103, and receives a probe response from the AP S105 to acquire access information.

[0049] The STA 100 that has successfully received wireless access information in the scanning stage transmits an authentication request S107a, and receives an authentication response S107b to perform the authentication procedure.

[0050] After successfully completing the authentication procedure at the IEEE 802.11 layer, the association steps S109a and S109b are performed, and additionally, 802.1X-based authentication S111 and IP address acquisition via DHCP S113 may be carried out. The AS 300, as an Authentication Server, handles 802.1X-based authentication with the STA 100 and may be physically integrated with the AP 200 or exist as a separate server.

[0051] FIG. 6 illustrates a passive scanning method of a STA related to an embodiment of the present invention.

[0052] Referring to FIG. 6, the first STA 110 according to the present invention receives beacon messages periodically transmitted from the first AP 210 and the second AP 220 located nearby, and acquires the wireless access information of each AP.

[0053] FIG. 7 illustrates an active scanning method of a STA related to an embodiment of the present invention.

[0054] Referring to FIG. 7, the first STA 110 according to the present invention transmits a probe request message to acquire information of APs located nearby, and receives corresponding probe response messages from the first AP 210 and the second AP 220, thereby acquiring the wireless access information of each AP.

[0056] Multi-User Uplink Transmission

[0057] FIG. 8 illustrates an example of a basic multi-user uplink data transmission procedure. In the case of multi-user uplink transmission, unlike downlink transmission, multiple terminals must transmit data simultaneously. Therefore, it is highly likely that the AP, which can communicate with all terminals within the BSS, manages the transmission procedure. Accordingly, before the actual data transmission begins, the AP needs to acquire information on whether uplink transmission data exists in the buffers of wireless terminals in the BSS and information such as TXOP. Additionally, the AP must provide terminals with information on the precise transmission timing. These procedures can be divided into a trigger process and a scheduling process for multi-user uplink data transmission. It is possible to collect scheduling-related information in advance and then perform the trigger when specific conditions are satisfied, or to perform the trigger based on a time condition and immediately carry out scheduling. The trigger and scheduling processes include an exchange of information between the AP and wireless terminals regarding channels available for transmission. Therefore, the procedure may proceed such that the AP first limits the

available channels, and then the wireless terminals provide feedback on all channels available among those. At this time, the trigger may also function as the NAV setting process for the upcoming multi-user uplink data transmission. If the trigger follows a legacy format, legacy terminals that receive the trigger frame can correctly set their NAV using the duration value included in the MAC header of the trigger frame. In the case of NAV setting using a trigger, since only the AP transmits, NAV setting for 3rd party devices near the AP can be properly established, but NAV setting may not occur for 3rd party devices near the uplink-transmitting terminals because they do not transmit the trigger. Therefore, in the present invention, to allow the AP to handle NAV setting for hidden nodes that may partially exist around the uplink terminals, it is possible to transmit the trigger frame with increased power only.

[0058] When the trigger is transmitted, multiple terminals simultaneously transmit data at the designated time through the subcarriers allocated by the AP, and after data transmission, the AP must send an ACK to all terminals that participated in the uplink data transmission, indicating whether the data was received.

[0059] In multi-user uplink data transmission, if the BSS deployment environment is congested and affected by multiple OBSS, the available channels may vary depending on the geographical location of each wireless terminal. In such cases, the number of terminals capable of transmitting on each channel may vary, resulting in different airtime usage across channels involved in actual uplink data transmission.

[0060] In the present invention, based on the principles of existing 802.11, it is assumed that all wireless terminals first receive the UL-OFDMA trigger through the primary channel and then provide feedback on available secondary channels. Therefore, wireless terminals that cannot use the primary channel cannot participate in the multi-user uplink transmission, and the primary channel will always have the highest number of wireless terminals assigned.

[0061] As illustrated in the example of FIG. 8, when airtime assigned to each channel differs, instead of transmitting ACKs per channel, the ACKs for all channels used in the multi-user uplink data transmission may be multiplexed and transmitted over the primary channel, which has the longest airtime.

[0062] By using the multiplexed group ACK, the secondary channels can be immediately released once the uplink data transmission airtime ends, allowing OBSSs that use those channels as their primary channel to access the channel at an earlier time. Therefore, an improvement in the overall spectral efficiency of the network can be expected.

[0063] FIG. 9 illustrates the structure of a multiplexed group ACK according to an embodiment of the present invention.

[0064] The multiplexed group ACK can be implemented using the structure of an existing Block ACK (BA). Depending on whether internal values of the BA control within the BA format are enabled, the BA information portion may be added with a variable size. In this case, within the Per TID info portion inside the BA information field, there exist 12 reserved bits, which can be set

to the AID values of terminals for ACK transmission. Therefore, B0 to B10, composed of 11 bits, can be set as the AID, and B11 can be used as an indication bit to specify whether the ACK is in the form of a general ACK or a BA. Accordingly, if B11 is set to ACK as shown in the example of FIG. 9, the Block ACK start sequence control and Block ACK bitmap, which would normally follow, are not needed and can thus be automatically omitted. Since the size of the BA information is variable, the AID for all terminals participating in the multi-user uplink transmission can be inserted. That is, the AID along with the associated block ACK sequence control and block ACK bitmap can be repeatedly inserted and transmitted per terminal. In cases where B11 indicates ACK, the block ACK sequence control and block ACK bitmap are omitted, and only the AID is repeated.

[0065] FIG. 10 illustrates a method of transmitting a multiplexed group ACK according to another embodiment of the present invention.

[0066] In this embodiment, it is assumed that the UL data from multiple users transmitted after the trigger ends at the same time due to scheduling and data padding. In this case, the AP may transmit ACKs not by multiplexing all ACKs on the primary channel, but by transmitting the ACKs for the transmitting terminals that sent UL data through each respective channel. Therefore, when the number of terminals assigned to each channel differs, the number of AID values in the BA information field used for the multiplexed group ACK differs accordingly, and thus the length of the multiplexed group ACK transmitted over each 20 MHz channel can be set differently.

However, in 802.11ax, it is specified that for a PPDU transmitted over a wideband of 20 MHz or more, the same L-SIG and HE-SIG A must be transmitted across all 20 MHz-wide channels used for the transmission. Therefore, it becomes necessary to adjust the length of all ACKs to match the PPDU length value included in the L-SIG, so that all ACKs have the same length.

[0067] FIG. 11 illustrates a method of AID field padding for BA length alignment according to another embodiment of the present invention.

[0068] The term “AID field padding method” used in the present invention refers to a technique in which, when the number of terminals requiring ACK in each channel differs, the Per TID info, block ACK sequence control, and block ACK bitmap, which are components of the BA information, are repeatedly inserted into the shorter ACKs until they match the length of the ACK for the channel with the longest ACK. If B11 indicates ACK, then the block ACK sequence control and block ACK bitmap are omitted, and only the Per TID info, i.e., the AID, is repeated.

[0070] When the number of UL data transmitting terminals allocated to each 20 MHz channel differs, the length of the BA information portion in the multiplexed group ACK transmitted on each channel may vary. Therefore, if the lengths of the multiplexed group ACKs need to be aligned due to constraints such as the L-SIG, the BA information length can be set based on the channel with the longest assigned BA information. In the remaining space, zero padding may be applied, or the BA information may be inserted repeatedly in the order in which it was originally

inserted. Furthermore, when the PPDU enables the ACK option instead of the BA, the ACK option must be activated for all repeated BA information as well, allowing it to be transmitted with the BA starting sequence control and BA bitmap omitted.

[0071] FIG. 12 illustrates the use of AID field padding and the use of Block ACK padding in a multi-user downlink data transmission procedure according to another embodiment of the present invention.

[0072] The padding method for length alignment of the AID field in the BA proposed by the present invention can be similarly applied in the DL-OFDMA trigger process during multi-user downlink transmission, where the AP notifies the terminals that will receive DL data on each channel. In multi-user downlink data transmission as well, a different number of terminals may be assigned as receiving terminals per channel. Therefore, in the DL-OFDMA trigger process, to align the length of the trigger when the AP notifies the AIDs of the terminals assigned to each channel, the same method as shown in FIG. 11 can be used — by inserting zero padding or repeating AIDs.

[0073] In addition, the AID field padding method proposed in the present invention can be used to align the air time for BA transmission. Since the BA is transmitted according to the number of receiving terminals per channel, as shown in this embodiment, if the fourth channel has only one receiving terminal, only one BA is transmitted and its transmission ends earlier. To align the BA transmission time, padding bits can be inserted before the FCS using the AID field padding method proposed in the present invention.

[0074] The zero padding used in the present invention is one embodiment, and padding with

1s can achieve the same effect.

[Description of Referential Numerals]

[What is claimed is]

[Claim 1]

An apparatus, system and method for wireless LANs.

[Summary]

[Abstract]

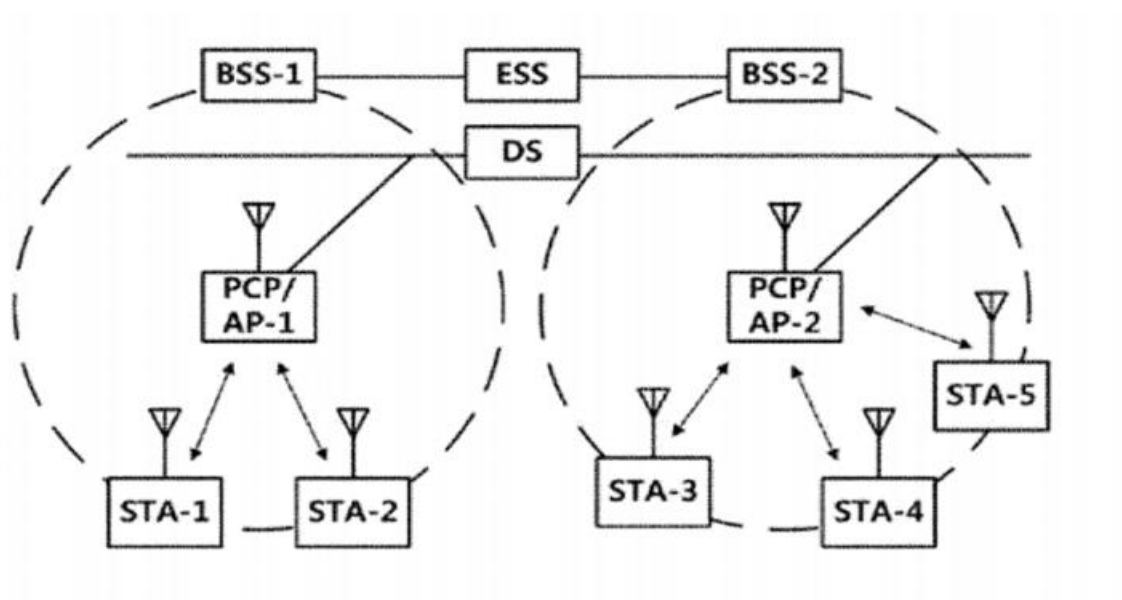
The present invention relates to apparatuses, systems and methods for wireless LANs, and according to an embodiment of the present invention, there is provided group ack transmission and padding methods for wideband wireless LAN multiple user uplink data transmission

[Representative Drawings]

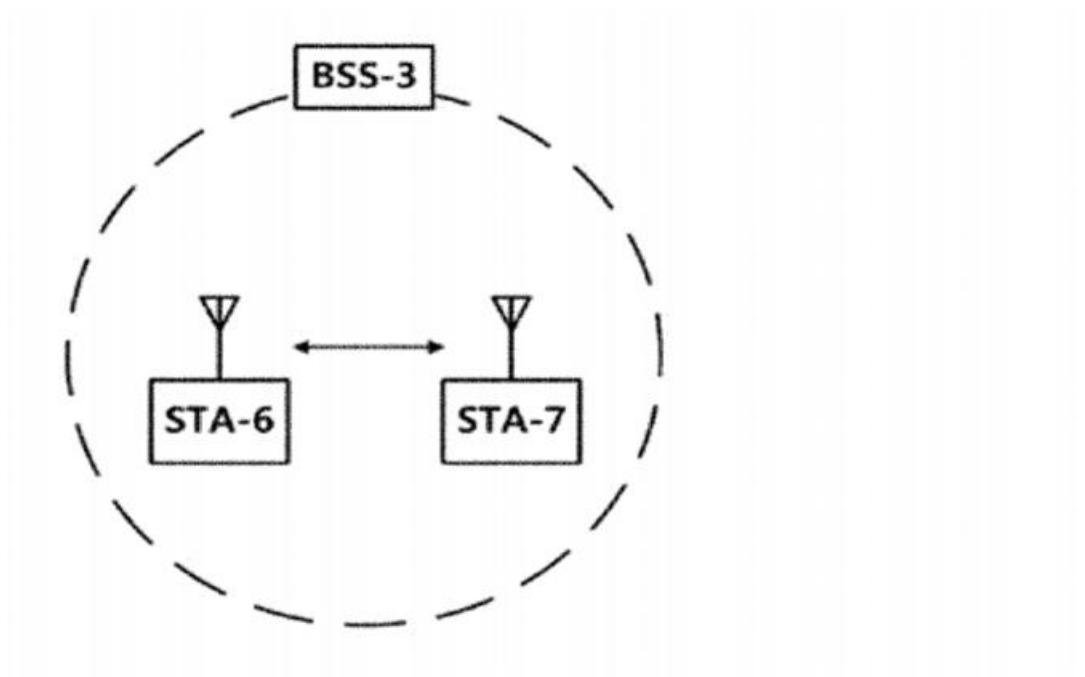
FIG. 11

[Drawings]

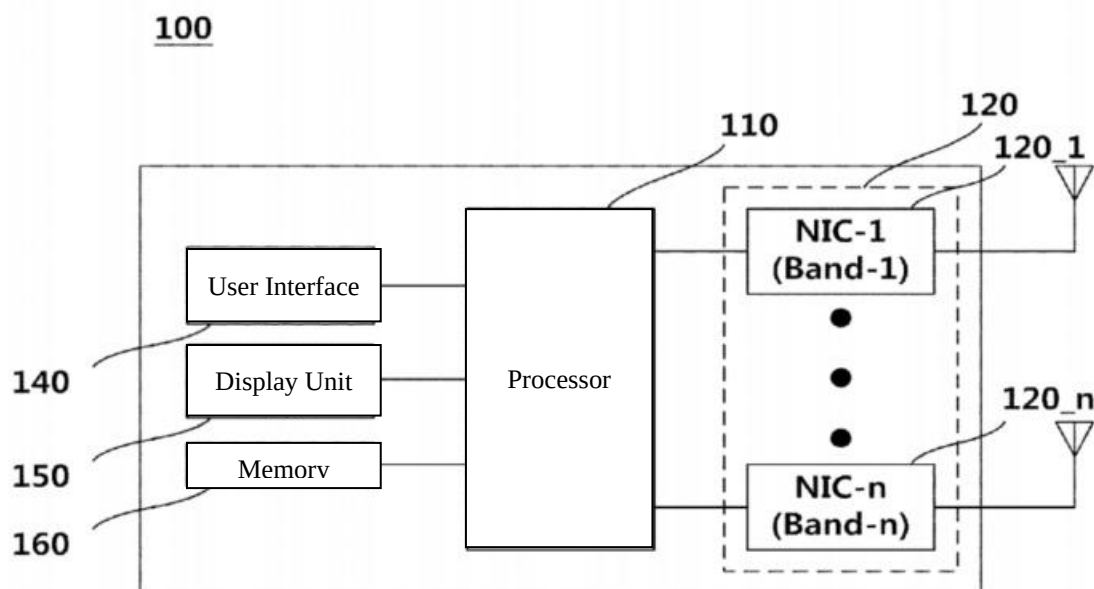
[FIG. 1]



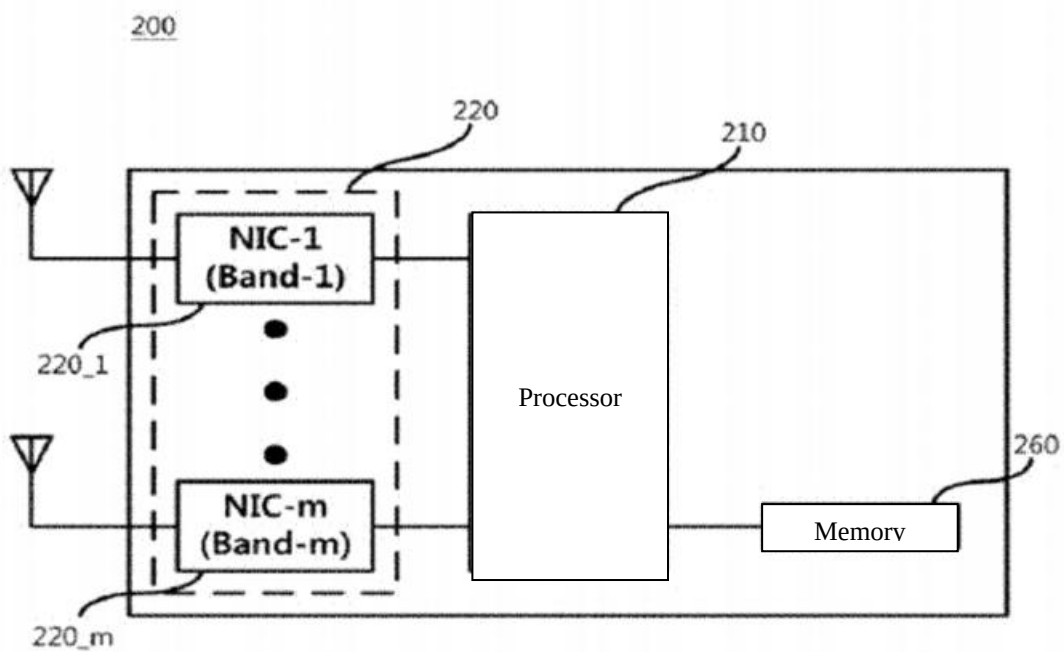
[FIG. 2]



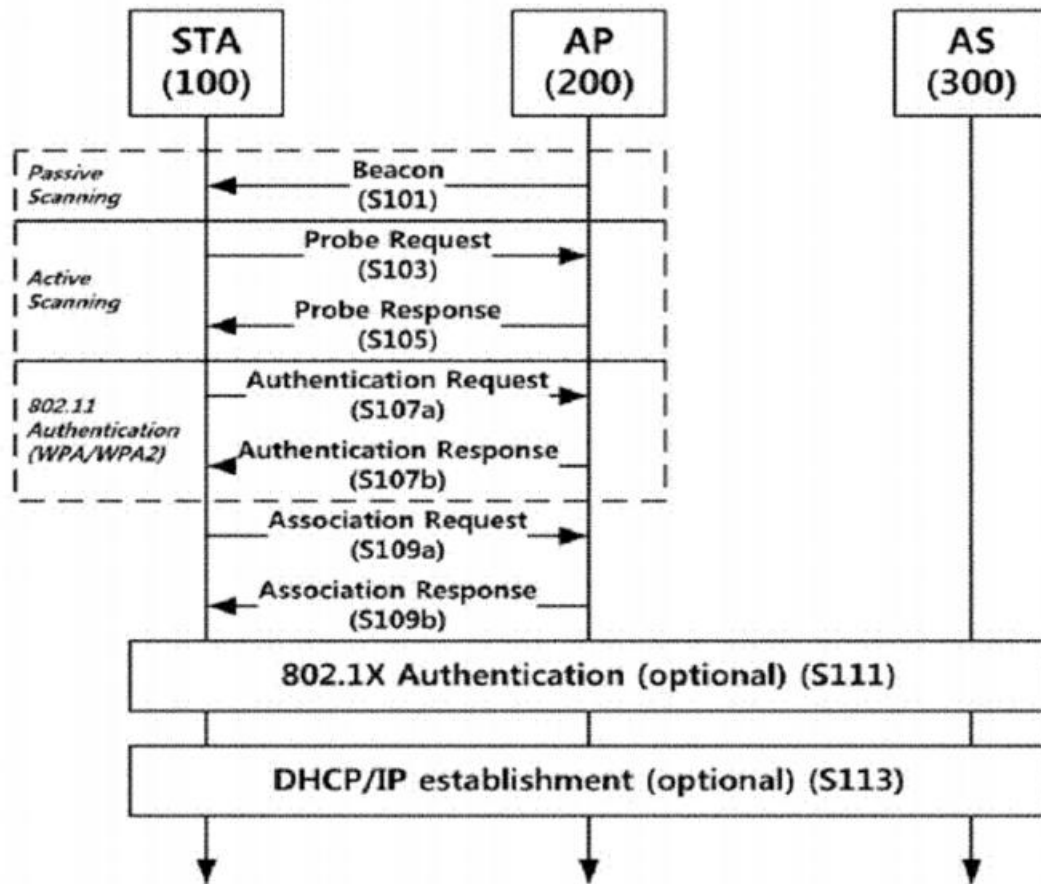
[FIG. 3]



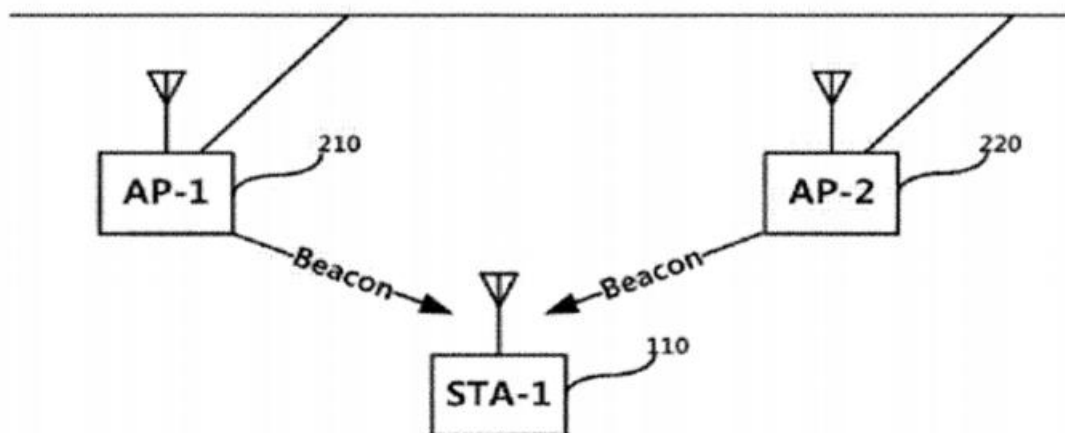
[FIG. 4]



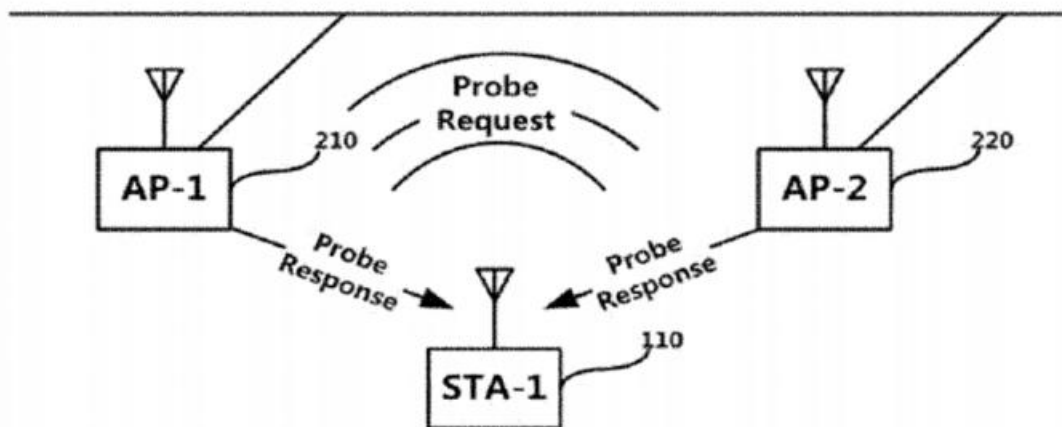
[FIG. 5]



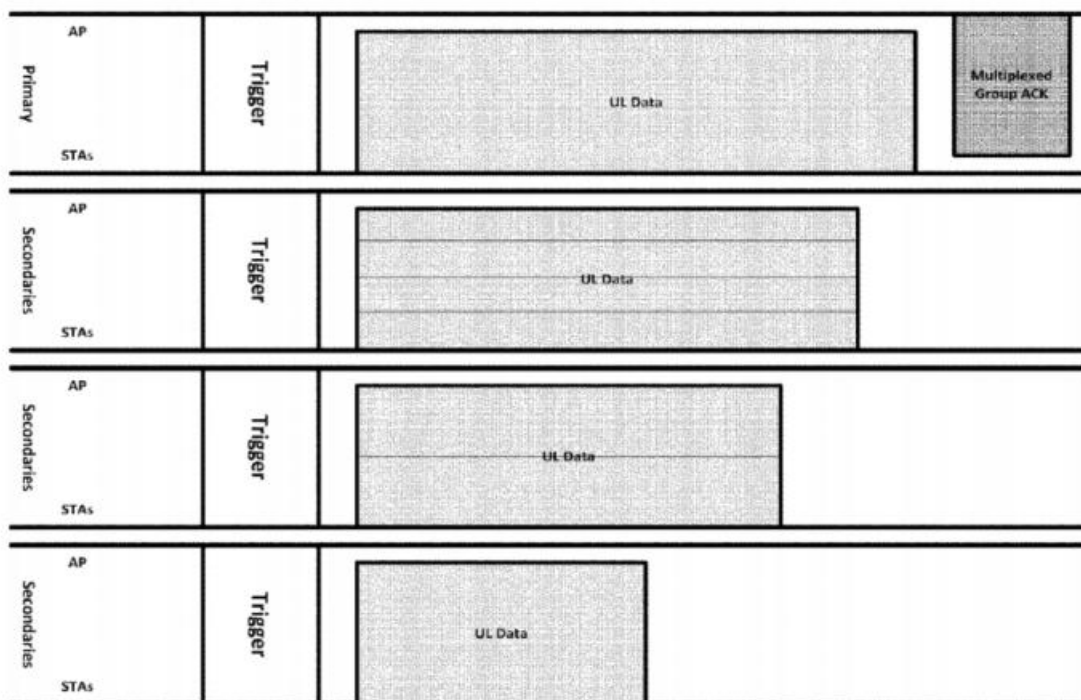
[FIG. 6]



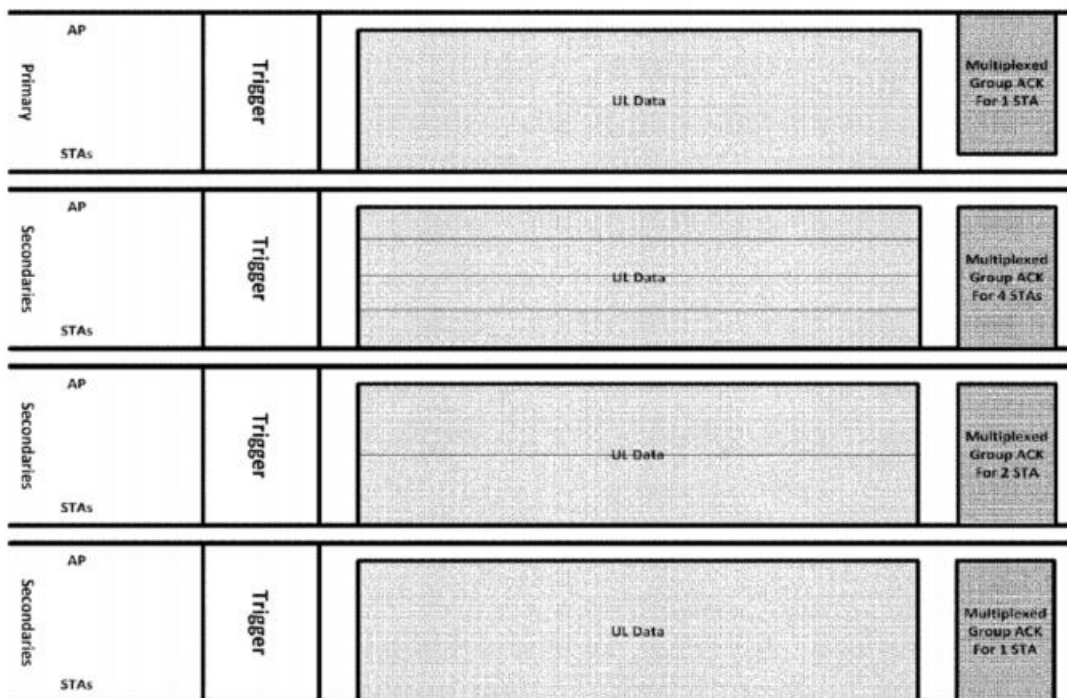
[FIG. 7]



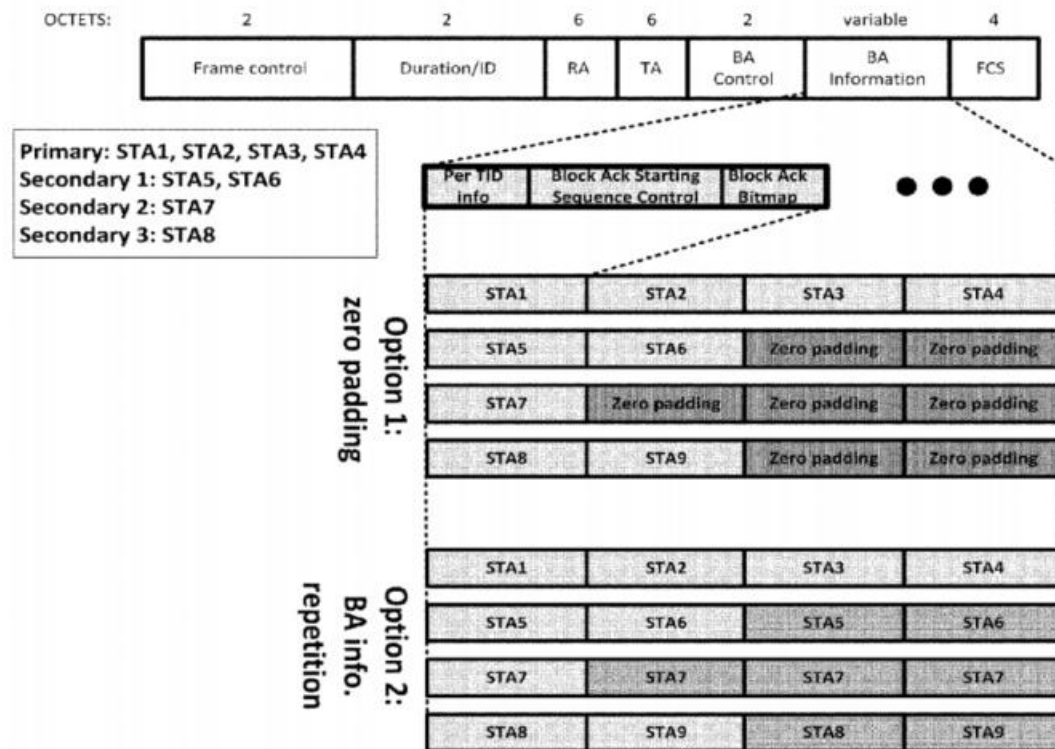
[FIG. 8]



[FIG. 10]



[FIG. 11]



[FIG. 12]

