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APPLICATION NO.	ISSUE DATE	PATENT NO.
17/157,978	30-MAY-23	11664926

LADAS & PARRY E-MAIL
4525 WILSHIRE BOULEVARD SUITE 240
LOS ANGELES, CA 90010

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,978	05/30/2023	11664926	B-10005CON1 633016-0	2451

158747 7590 05/10/2023

LADAS & PARRY
E-MAIL
4525 WILSHIRE BOULEVARD
SUITE 240
LOS ANGELES, CA 90010

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 37 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

Woojin AHN, Gyeonggi-do, KOREA, REPUBLIC OF;
Juhyung Son, Gyeonggi-do, KOREA, REPUBLIC OF;
Geonjung Ko, Gyeonggi-do, KOREA, REPUBLIC OF;
Jinsam Kwak, Gyeonggi-do, KOREA, REPUBLIC OF;

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC., Gyeonggi-do, KOREA, REPUBLIC OF;
SK TELECOM CO., LTD., Seoul, KOREA, REPUBLIC OF;

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UNITED STATES PATENT AND TRADEMARK OFFICE

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Address: COMMISSIONER FOR PATENTS
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,978	01/25/2021	Woojin AHN	B-10005CON1 633016-0	2451

158747 7590 04/26/2023

LADAS & PARRY
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4525 WILSHIRE BOULEVARD
SUITE 240
LOS ANGELES, CA 90010

EXAMINER
TON, DANG T

ART UNIT	PAPER NUMBER
2476	

NOTIFICATION DATE	DELIVERY MODE
04/26/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

LA_MAIL@la.ladas.com
achinaryan@la.ladas.com
ykoo@la.ladas.com

Supplemental Notice of Allowability	**Application No.** 17/157,978	**Applicant(s)** AHN et al.	
	Examiner DANG T TON	**Art Unit** 2476	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to IDS filed on 4/18/2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are See Continuation Sheet . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/DANG T TON/
Primary Examiner, Art Unit 2476

Continuation of 3. The allowed claim(s) is/are: 17-30 (Renumbered 1-14, respectively)

April 18, 2023

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.	FILING DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	2015/0288501	Oct. 8, 2015	KWON et al.			
	2.	2016/0183274	Jun. 23, 2016	Trainin et al.			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	3.	2016-533675	Oct. 27, 2016	JP			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	4.	Notice of Allowance dated February 6, 2023 for Japanese Patent Application No. 2021-071867 and its English translation provided by Applicant's foreign counsel.
	5.	Office Action dated February 15, 2023 for U.S. Patent Application No. 17/851,035.
	6.	Notice of Allowance dated March 24, 2023 for U.S. Patent Application No. 17/157,996.
	7.	Office Action dated March 16, 2023 for European Patent Application No. 17884228.2.

EXAMINER	*DATE CONSIDERED*
/DANG T TON/	04/21/2023

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T.T/

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

158747 7590 01/19/2023
LADAS & PARRY
E-MAIL
4525 WILSHIRE BOULEVARD
SUITE 240
LOS ANGELES, CA 90010

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,978	01/25/2021	Woojin AHN	B-10005CON1 633016-0	2451

TITLE OF INVENTION: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/19/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
TON, DANG T	2476	370-329000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Ladas & Parry, LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE	(B) RESIDENCE: (CITY and STATE OR COUNTRY)
1. WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.	GYEONGGI-DO, REPUBLIC OF KOREA
2. SK TELECOM CO., LTD.	SEOUL, REPUBLIC OF KOREA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 12-0415

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Young Seok Koo 76,255/ Date April 19, 2023

Typed or printed name Young Seok Koo Registration No. 76,255

Electronic Patent Application Fee Transmittal

Application Number:	17157978
Filing Date:	25-Jan-2021
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Filer:	Young Seok Koo/Lianne Herbert
Attorney Docket Number:	B-10005CON1 633016-0

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt	
EFS ID:	47870692
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Lianne Herbert
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	19-APR-2023
Filing Date:	25-JAN-2021
Time Stamp:	17:11:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E20234IH13148542
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	633016-IssueFee-Transmittal.pdf	140121 226893f8b4d8eddd7b3fa33d548394cd143b9436	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	38209 efeb3c9801bb2313c960e6a14ea1367854283363	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	178330		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

April 18, 2023

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.	FILING DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	2015/0288501	Oct. 8, 2015	KWON et al.			
	2.	2016/0183274	Jun. 23, 2016	Trainin et al.			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	3.	2016-533675	Oct. 27, 2016	JP			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	4.	Notice of Allowance dated February 6, 2023 for Japanese Patent Application No. 2021-071867 and its English translation provided by Applicant's foreign counsel.
	5.	Office Action dated February 15, 2023 for U.S. Patent Application No. 17/851,035.
	6.	Notice of Allowance dated March 24, 2023 for U.S. Patent Application No. 17/157,996.
	7.	Office Action dated March 16, 2023 for European Patent Application No. 17884228.2.

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

Decision to Grant a Patent

Application number: Japanese Patent Application No. 2021-071867
Date of Drafting: Reiwa 5(2023) January 27
Patent examiner: NOMURA, Kiyoshi 1209 5J00
The wireless communication terminal using the transmission method of the set MPDU and the response frame to it, and it
The number of claims: 14
Applicant: Virus Institute Of Standards And Technology Incorporated (one others)
Representative: MURAYAMA, Yasuhiko (other binary name)

This application is to be granted a patent, since no reason for refusal has been found.

A Director(p.p.), an examiner, assistant examiner Manager for Determination of Classification OKAMOTO, Masaki, NOMURA, Kiyoshi, and NAKAMOTO, Junji 3138 1209, 3140
- Distinction of Patent: Division
- Reference: see below
- Application of Patent Act Article 30: not applicable
- Change of the Title of the Invention: No

- Deposit of Microorganisms

Reference information

Application number: Japanese Patent Application No. 2021-071867

- FI

H04W 28/06 110 ,H04W 28/04 ,
H04W 84/12

- Technical fields searched (IPC, DB name)

H04B 7/24- 7/26
H04W 4/00-99/00
IEEE Xplore

- Reference patent documents

JP 2013 - 536599A (JP, A)
International-Publication the 2011/159831 (WO, A1)
International-Publication the 2015/066440 (WO, A1)
International-Publication the 2016/167608 (WO, A1)
JP 2016 - 533675A (JP, A)
United States patent publication of unexamined application the 2015/0288501 (US, A1)

- Reference books and magazines

Liwen Chu (Marvell), A-MPDU 25.10.3 comment resolution, IEEE802.11-16/1185r1, and IEEE, Internet <URL: https://mentor.ieee.org/802.11/dcn/16/11-16-1185-01-00 ax-a-mpdu-25-10-3-comment-resolution.docx> and September 14, 2016 Liwen Chu (Marvell), A-MPDU Content CommentResolution, IEEE802.11-16/1186r1, IEEE, Internet <URL: https://mentor.ieee.org/802.11/dcn/16/11-16-1186-01-00 ax-a-mpdu-content-comment-resolution.docx> and September 15, 2016 George Cherian (Qualcomm) and CIDs for Section-25.4/25.4.1, and IEEE802.11-16/0024r3, IEEE, and the Internet -- < -- URL:https: //mentor.ieee.org/802.11/dcn/16/11-16-0024-03-00 ax-cids-for-section-25-4-ba-variants.docx>, August 23, 2016

特許査定

（分割）

特許出願の番号	特願２０２１－０７１８６７
起案日	令和　５年　１月２７日
特許庁審査官	野村　潔　　１２０９　５Ｊ００
発明の名称	集合ＭＰＤＵ及びそれに対する応答フレームの伝送方法及びそれを利用した無線通信端末
請求項の数	１４
特許出願人	ウィルス　インスティテュート　オブ　スタンダーズ　アンド　テクノロジー　インコーポレイティド（ほか　１名）
代理人	村山　靖彦（ほか　２名）

この出願については、拒絶の理由を発見しないから、特許査定をします。

上記はファイルに記録されている事項と相違ないことを認証する。
認証日　令和 5年 1月30日　経済産業事務官　佐藤　隆

注意：この書面を受け取った日から３０日以内に特許料の納付が必要です。

・出願種別　　分割
・参考文献　　有
・特許法第３０条適用　　無
・発明の名称の変更　　無

・菌寄託

参考情報

特許出願の番号　　特願２０２１－０７１８６７

・ＦＩ

Ｈ０４Ｗ　２８／０６　１１０　,
Ｈ０４Ｗ　２８／０４　,
Ｈ０４Ｗ　８４／１２

・調査した分野（ＩＰＣ，ＤＢ名）

Ｈ０４Ｂ　７／２４－　７／２６
Ｈ０４Ｗ　４／００－９９／００
ＩＥＥＥ　Ｘｐｌｏｒｅ

・参考特許文献

特表２０１３－５３６５９９	（ＪＰ，Ａ）
国際公開第２０１１／１５９８３１	（ＷＯ，Ａ１）
国際公開第２０１５／０６６４４０	（ＷＯ，Ａ１）
国際公開第２０１６／１６７６０８	（ＷＯ，Ａ１）
特表２０１６－５３３６７５	（ＪＰ，Ａ）
米国特許出願公開第２０１５／０２８８５０１	（ＵＳ，Ａ１）

・参考図書雑誌

Liwen Chu (Marvell), A-MPDU 25.10.3 comment resolution,　IEEE 802.11-16/1185r1　, IEEE,　インターネット＜URL:https://mentor.ieee.org/802.11/dcn/16/11-16-1185-01-00ax-a-mpdu-25-10-3-comment-resolution.docx＞, 2016年09月14日
Liwen Chu (Marvell), A-MPDU Content Comment Resolution,　IEEE 802.11-16/1186r1　, IEEE,　インターネット＜URL:https://mentor.ieee.org/802.11/dcn/16/11-16-1186-01-00ax-a-mpdu-content-comment-resolution.docx＞

, 2016年09月15日
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SYSTEMS AND METHODS FOR COMMUNICATING MULTI-DESTINATION TRAFFIC IN A WIRELESS NETWORK

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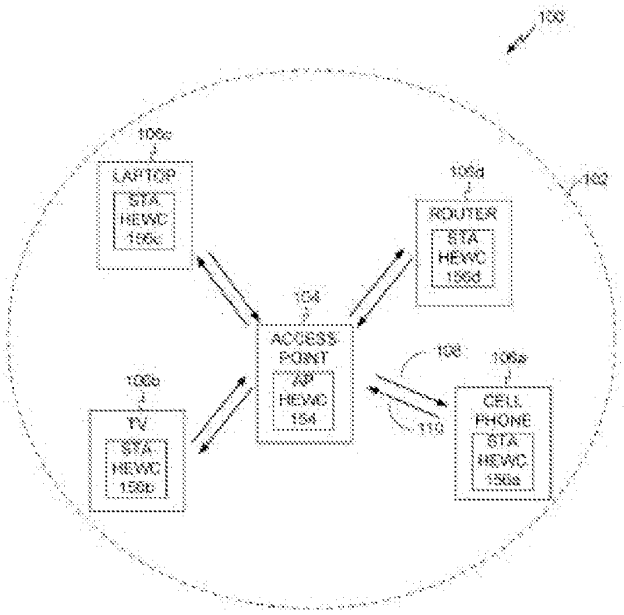
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Systems, methods, and apparatuses for communicating multi-destination traffic are provided. One aspect of this disclosure provides a method of wireless communication. The method includes generating two media access control protocol data unit (MPDU) sub-frames, the A-MPDU sub-frames each comprising a different receiver address, generating an aggregated media access control protocol data unit (A-MPDU) frame comprising the two A-MPDU sub-frames, the A-MPDU signaling two different acknowledgement policies associated with the two different receiver addresses; and transmitting the A-MPDU frame.


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CLAIMS JP2016533675A

1.

generating, by a device, an A-MPDU frame comprising two or more aggregated Media Access Control Protocol Data Unit (A-MPDU) subframes, wherein each A-MPDU subframe comprises a receiver address; further wherein said A-MPDU frame comprises at least one indication for one or more acknowledgment policies associated with said receiver address of each A-MPDU subframe; - A method of wireless communication, comprising: outputting an MPDU frame.

2.

The method of claim 1, wherein the one or more acknowledgment policies are indicated in corresponding one or more control fields of the A-MPDU subframe.

3.

At least one of said one or more acknowledgment policies indicates that a control response frame should be transmitted after receipt of said A-MPDU frame comprising said two or more A-MPDU subframes. A method according to claim 1.

4.

said at least one of said one or more acknowledgment policies further comprises transmitting said control response frame a short interframe spatial time after receipt of said A-MPDU frame comprising said two or more A-MPDU subframes; 4. The method of claim 3, which indicates that should.

5.

said at least one of said one or more acknowledgment policies is further to transmit said control response frame when said at least one of said one or more acknowledgment policies is set to a particular value 4. The method of claim 3, wherein:

6.

at least one of the two or more A-MPDU subframes further comprising a media access control protocol data unit (MPDU) delimiter field, the MPDU delimiter field being the at least one of the two or more A-MPDU subframes 2. The method of claim 1, storing a value indicative of the time delay that will elapse from one reception to transmission of said at least one acknowledgment of said two or more A-MPDU subframes.

7.

The method of claim 6, wherein the time delay indicated by the MPDU delimiter field of the at least one of the two or more A-MPDU subframes is based on a backoff value also indicated in the MPDU delimiter field.

8.

The method of claim 7, wherein the backoff value indicated in the MPDU delimiter field is based on at least one of a short interframe space time and a constant value.

9.

generating the A-MPDU frame includes requesting acknowledgment of receipt in at least one of an end of frame field and an acknowledgment policy field in at least one of the two or more A-MPDU subframes; 2. The method of claim 1, comprising generating, wherein a value in the end field of the frame or the acknowledgment policy field determines the type of the request for acknowledgment of receipt.

10.

Further comprising receiving the acknowledgment of the receipt of the at least one of the two or more A-MPDU subframes after a delay of at least a short interframe spatial time from transmission of the A-MPDU frame. The method described in .

11.

of the two or more A-MPDU subframes to indicate that the type of the request for acknowledgment of receipt for the at least one of the two or more A-MPDU subframes is an acknowledgment frame. 10. The method of claim 9, further comprising setting the value of an end field of the frame in the at least one.

12.

said two or more A-MPDU subframes to indicate said type of said request for acknowledgment of receipt for said at least one of said two or more A-MPDU subframes is a block acknowledgment frame; 10. The method of claim 9, further comprising setting the value of the end field of the frame in the at least one of .

13.

A processing system configured to generate an A-MPDU frame comprising two or more aggregated Media Access Control Protocol Data Unit (A-MPDU) subframes, wherein each A-MPDU subframe is a receiver address, and wherein said A-MPDU frame comprises at least one indication for one or more acknowledgment policies associated with said receiver address of each A-MPDU subframe for transmission. and an interface for outputting said A-MPDU frames to a.

14.

The processing system of claim 13, wherein the processing system is further configured to indicate the one or more acknowledgment policies in corresponding one or more control fields of the two or more A-MPDU subframes. Device.

15.

At least one of said one or more acknowledgment policies indicates that a control response frame should be transmitted after receipt of said A-MPDU frame comprising said two or more A-MPDU subframes. 14. The device according to claim 13.

16.

said at least one of said one or more acknowledgment policies further comprises transmitting said control response frame a short interframe spatial time after receipt of said A-MPDU frame comprising said two or more A-MPDU subframes; 16.

Apparatus according to claim 15, which indicates that should.

17.

The processing system further sets the at least one of the one or more acknowledgment policies to a particular value to indicate that the control response frame should be output for transmission. 16. Apparatus according to claim 15, wherein the apparatus is configured to:

18.

at least one of the two or more A-MPDU subframes comprises a media access control protocol data unit (MPDU) delimiter field, and the processing system receives the at least one of the two or more A-MPDU subframes. to the value stored in the MPDU Delimiter field indicating the time delay that will elapse before the at least one acknowledgment of the two or more A-MPDU subframes is output for transmission. 14. The apparatus of claim 13, configured to:

19.

The apparatus of claim 18, wherein the time delay indicated by the MPDU delimiter field of the at least one of the two or more A-MPDU subframes is based on a backoff value also indicated in the MPDU delimiter field.

20.

The apparatus of claim 19, wherein the backoff value indicated in the MPDU delimiter field is based on at least one of a short interframe space time and a constant value.

21.

The processing system is further configured to generate a request for acknowledgment of receipt in at least one of an end of frame field and an acknowledgment policy field in at least one of the two or more A-MPDU subframes. and a value in the end of frame field or the acknowledgment policy field determines the type of the request for acknowledgment of receipt.

22.

The processing system further decodes the acknowledgment of the reception of the at least one of the two or more A-MPDU subframes received after a delay of at least a short interframe spatial time from transmission of the A-MPDU frame. 22. The apparatus of claim 21, configured to.

23.

the two or more A-MPDU subframes, wherein the processing system further indicates that the type of the request for acknowledgment of receipt for the at least one of the two or more A-MPDU subframes is an acknowledgment frame; setting the value of the end of frame field in the at least one of the A-MPDU subframes to decode received acknowledgment frames for the at least one of the two or more A-MPDU subframes; 22. The apparatus of claim 21, wherein the apparatus comprises:

24.

the two or more A-MPDU subframes, wherein the processing system further indicates that the type of the request for acknowledgment of receipt for the at least one of the two or more A-MPDU subframes is a block acknowledgment frame; and decoding received block acknowledgment frames for said at least one of said two or more A-MPDU subframes. 22. The apparatus of claim 21, configured to.

25.

at least one antenna; a processing system configured to generate an A-MPDU frame comprising two or more aggregated Media Access Control Protocol Data Unit (A-MPDU) subframes; MPDU subframes comprise receiver addresses, and further wherein

said A-MPDU frames have at least one indication for one or more acknowledgment policies associated with said receiver addresses of each A-MPDU subframe. a transmitter configured to transmit said A-MPDU frames using said at least one antenna.

26.

means for generating an A-MPDU frame comprising two or more aggregated Media Access Control Protocol Data Unit (A-MPDU) subframes, wherein each A-MPDU subframe comprises a receiver address; further wherein said A-MPDU frame comprises at least one indication for one or more acknowledgment policies associated with said receiver address of each A-MPDU subframe; and means for

27.

The means for generating A-MPDU frames is configured to indicate the one or more acknowledgment policies in corresponding one or more control fields of the A-MPDU subframes. The apparatus described in .

28.

At least one of said one or more acknowledgment policies indicates that a control response frame should be transmitted after receipt of said A-MPDU frame comprising said two or more A-MPDU subframes. 27. The device according to claim 26.

29.

wherein said at least one of said one or more acknowledgment policies comprises said control response frame being transmitted a short inter-frame spatial time after receipt of said A-MPDU frame comprising said two or more A-MPDU subframes. 29. The apparatus of claim 28, further indicating that should.

30.

wherein the means for generating an A-MPDU frame further indicates that the control response frame is to be output for transmission after receipt of the A-MPDU frame, the one or more 29. The apparatus of claim 28, configured to set said at least one of acknowledgment policies to a particular value.

31.

At least one of the two or more A-MPDU subframes further comprises a Media Access Control Protocol Data Unit (MPDU) delimiter field, and the means for generating an A-MPDU frame comprises the two or more A-MPDU subframes. setting a value stored in the MPDU delimiter field that indicates a time delay that will elapse from receipt of the at least one MPDU subframe to transmission of an acknowledgment of the corresponding A-MPDU subframe; 27. Apparatus according to claim 26, comprising:

32.

The apparatus of claim 31, wherein the time delay indicated by the MPDU delimiter field of the at least one of the two or more A-MPDU subframes is based on a backoff value also indicated in the MPDU delimiter field.

33.

The apparatus of claim 32, wherein the backoff value indicated in the MPDU delimiter field is based on at least one of a short interframe space time and a constant value.

34.

The means for generating the A-MPDU frame, in at least one of the two or more A-MPDU subframes, acknowledging receipt in at least one of an end of frame field and an acknowledgment policy field. 27. The apparatus of claim 26, wherein a value in the end field of the frame or the acknowledgment policy field determines the type of the request for acknowledgment of receipt.

35.

further comprising means for decoding an acknowledgment of said at least one receipt of said two or more A-MPDU subframes received after a delay of at least a short interframe space time from transmission of said A-MPDU frame. 35. The apparatus of claim 34.

36.

the at least one of the two or more A-MPDU subframes to indicate that the type of request for acknowledgment of receipt for at least one of the two or more A-MPDU subframes is an acknowledgment frame; and means for decoding a received acknowledgment frame for said at least one of said two or more A-MPDU subframes. 35. Apparatus according to claim 34.

37.

said at least one of said two or more A-MPDU subframes to indicate that the type of request for acknowledgment of receipt for at least one of said two or more A-MPDU subframes is a block acknowledgment frame. and means for decoding a received block acknowledgment frame for said at least one of said two or more A-MPDU subframes. 35. The apparatus of claim 34, comprising:

38.

A computer program product comprising a computer readable medium encoded with instructions which, when executed, cause a device to perform a method of wireless communication, said method comprising two or more aggregated media access control protocol data units. generating an A-MPDU frame comprising (A-MPDU) subframes, wherein each A-MPDU subframe comprises a receiver address, further wherein said A-MPDU is each A-MPDU subframe; transmitting said A-MPDU frame comprising at least one indication for one or more acknowledgment policies associated with said receiver address of a frame.

39.

receiving, by a device, an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame; and decoding, by said device, two or more A-MPDU subframes of said received A-MPDU frame. decoding, by the apparatus, a receiver address corresponding to each of the two or more A-MPDU subframes; and the decoded receiver address for each of the two or more A-MPDU subframes. determining that at least one of the two or more A-MPDU subframes of the received A-MPDU frame is addressed to the device based on.

40.

the received A-MPDU frame based on at least one indication associated with the receiver address of each A-MPDU subframe in a corresponding at least one field of each of the two or more A-MPDU subframes; 40. The method of claim 39, further comprising decoding one or more acknowledgment policies corresponding to each of the two or more A-MPDU subframes of .

41.

when the at least one field of each of the two or more A-MPDU subframes is set to a particular value, generating a frame based on the particular value of the at least one field; 41. The method of claim 40, further comprising outputting the frame for transmission.

42.

decoding a value in an end field of a frame of said at least one field in said at least one of said two or more A-MPDU subframes, wherein said value in an end field of said frame 42. The method of claim 41, wherein if is 1, the frame generated and output for transmission is an acknowledgment frame.

43.

decoding a value in an end field of a frame of said at least one field in said at least one of said two or more A-MPDU subframes, wherein said value in an end field of said frame 42. The method of claim 41, wherein if is 0, the frame generated and output for transmission is a block acknowledgment frame.

44.

decoding a value in an end field of a frame in said at least one of said two or more A-MPDU subframes, said value corresponding to each of said two or more A-MPDU subframes; The two or more A-MPDU subframes, if the decoded value in the end field of the frame is 1, indicating a type of request for acknowledgment of receipt for one or more acknowledgment policies. and outputting the acknowledgment frame for transmission.

45.

decoding a value in an end field of a frame in said at least one of said two or more A-MPDU subframes; and applying said decoded value to each of said two or more A-MPDU subframes. If the decoded value in the end field of the frame is 0, the two or more A-MPDU subs indicating a request type for acknowledgment of receipt of the corresponding one or more acknowledgment policies. 41. The method of claim 40, further comprising: generating a block acknowledgment frame acknowledging receipt of said at least one of frames; and outputting said block acknowledgment frame for transmission.

46.

decoding a media access control protocol data unit (MPDU) delimiter field in said at least one of said two or more A-MPDU subframes; and transmitting said acknowledgment frame from receipt of said A-MPDU frame. determining from values stored in the MPDU delimiter fields a time delay that will elapse before outputting to the one or more corresponding to each of the two or more A-MPDU subframes; 45. The method of claim 44, further comprising outputting the acknowledgment frame for transmission after the time delay has elapsed based on an acknowledgment policy of .

47.

The method of claim 46, wherein said value stored in said MPDU delimiter field is a backoff value.

48.

The method of claim 47, wherein the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time and a constant value.

49.

generating an acknowledgment of receipt of at least one of the two or more A-MPDU subframes; based on the one or more acknowledgment policies corresponding to each of the two or more A-MPDU subframes; 41. The method of claim 40, further comprising outputting the acknowledgment of receipt for transmission after a delay of at least frame space time for a short period of time from transmission of the A-MDPU frame.

50.

receiving an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame; decoding two or more A-MPDU subframes of said received A-MPDU frame; and said two or more A-MPDU subframes. decoding receiver addresses corresponding to each of the frames; and based on the decoded receiver addresses for each of the two or more A-MPDU subframes, the two or more of the received A-MPDU frames. at least one of the A-MPDU subframes of is destined for said apparatus.

51.

said processing system further comprising: said device based on at least one indication associated with said receiver address of each A-MPDU subframe in corresponding at least one field of each of said two or more A-MPDU subframes; 51. The apparatus of claim 50, configured to decode an acknowledgment policy for each of said two or more A-MPDU sub-frames of said received

A-MPDU frame destined for .

52.

The processing system further determines a frame based on the particular value of the at least one field when the at least one field of each of the two or more A-MPDU subframes is set to a particular value. 52. The apparatus of claim 51, configured to generate and output said frame for transmission.

53.

The processing system further comprises a value in a frame tail field of the at least one field in the at least one of the two or more A-MPDU subframes of the received A-MPDU frame addressed to the device. and said processing system is further configured to generate said frame as an acknowledgment frame for transmission if said value in an end field of said frame is one. 52. The device according to 52.

54.

The processing system further comprises a value in a frame tail field of the at least one field in the at least one of the two or more A-MPDU subframes of the received A-MPDU frame addressed to the device. and the processing system is further configured to generate the frame as a block acknowledgment frame for transmission if the value in the end field of the frame is 0 53. Apparatus according to Item 52.

55.

The processing system is further configured to decode a value in an end field of a frame in the at least one of the two or more A-MPDU subframes, the value being the value of the two or more A-MPDU subframes. indicating the type of request for acknowledgment of receipt for said acknowledgment policy for each of a frame, further to generate an acknowledgment frame for transmission if said value in the tail field of said frame is 1. 52. The apparatus of claim 51, configured for:

56.

The processing system is further configured to decode a value in an end field of a frame in the at least one of the two or more A-MPDU subframes, the value being the value of the two or more A-MPDU subframes. indicating the type of request for acknowledgment of receipt for said acknowledgment policy of each frame, further generating a block acknowledgment frame for transmission if said value in the end field of said frame is 0; 52. The apparatus of claim 51, configured to:

57.

The processing system further decodes a Media Access Control Protocol Data Unit (MPDU) delimiter field in the at least one of the two or more A-MPDU subframes; from the values stored in the MPDU delimiter fields, and based on the acknowledgment policy for each of the two or more A-MPDU subframes, the time delay that will elapse before the transmission of 56. The apparatus of claim 55, configured to generate the acknowledgment frame for transmission after a delay has elapsed.

58.

The apparatus of claim 57, wherein said value stored in said MPDU delimiter field is a backoff value.

59.

The apparatus of Claim 58, wherein the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time and a constant value.

60.

The processing system further configures the device after a delay of at least a short interframe spatial time from transmission of

the A-MPDU frame based on the acknowledgment policy corresponding to each of the two or more A-MPDU subframes. 52. The claim of claim 51, configured to generate for transmission an acknowledgment of receipt of at least one of the two or more A-MPDU subframes of the received A-MPDU frame addressed to a Device.

61.

at least one antenna; a receiver configured to receive aggregated Media Access Control Protocol Data Unit (A-MPDU) frames via said antenna; and two or more of said received A-MPDU frames. and a receiver address corresponding to each of the two or more A-MPDU subframes, and the decoded receiver for each of the two or more A-MPDU subframes a processing system configured to determine, based on an address, that at least one of the two or more A-MPDU subframes of the received A-MPDU frame is intended for the wireless node. wireless node for

62.

means for receiving an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame; and means for decoding two or more A-MPDU subframes based on said received A-MPDU frame. , means for decoding a receiver address corresponding to each of the two or more A-MPDU subframes; and based on the decoded receiver address for each of the two or more A-MPDU subframes. , means for determining that at least one of the two or more A-MPDU subframes decoded from the received A-MPDU frame is intended for the apparatus.

63.

the two or more A-MPDU subframes based on at least one indication associated with the receiver address of each A-MPDU subframe in corresponding at least one field of each of the two or more A-MPDU subframes; 63. The apparatus of claim 62, further comprising - means for decoding an acknowledgment policy for each MPDU subframe.

64.

means for generating a frame based on the particular value of the at least one field when the at least one field of each of the two or more A-MPDU subframes is set to a particular value; , means for transmitting the frame.

65.

said means for decoding is further configured to decode and generate a value in an end field of a frame of said at least one field in said at least one of said two or more A-MPDU subframes; is configured to generate an acknowledgment frame, and said means for transmitting further transmits said acknowledgment frame as said frame if said value in an end field of said frame is 1 65. The apparatus of claim 64, configured to:

66.

said means for decoding is further configured to decode and generate a value in an end field of a frame of said at least one field in said at least one of said two or more A-MPDU subframes; is configured to generate an acknowledgment frame, and the means for transmitting further transmits a block acknowledgment frame as said frame if said value in an end field of said frame is 0 65. The apparatus of claim 64, configured to:

67.

means for decoding a value in an end field of a frame in said at least one of said two or more A-MPDU subframes; indicating the type of request for acknowledgment of receipt for an acknowledgment policy, acknowledging said at least one of said two or more A-MPDU subframes if said value in the end field of said frame is 1. 64. The apparatus of Claim 63, further comprising: means for generating a frame; and means for transmitting said acknowledgment frame.

68.

means for decoding a value in an end field of a frame in said at least one of said two or more A-MPDU subframes; block

acknowledgment for said at least one of said two or more A-MPDU subframes, if said value in said end field of said frame is 0, indicating the type of request for acknowledgment of receipt for an acknowledgment policy; 64. The apparatus of Claim 63, further comprising: means for generating a response frame; and means for transmitting said block acknowledgment frame.

69.

means for decoding a Media Access Control Protocol Unit (MPDU) delimiter field in said at least one of said two or more A-MPDU subframes; from receipt of said A-MPDU frame to transmission of said acknowledgment frame. means for determining, from values stored in said MPDU delimiter fields, a time delay that will elapse to, based on said acknowledgment policy for each of said two or more A-MPDU subframes, said 68. The apparatus of claim 67, further comprising means for transmitting said acknowledgment frame after a time delay has elapsed.

70.

The apparatus of claim 69, wherein said value in said MPDU delimiter field is a backoff value.

71.

The apparatus of claim 70, wherein the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time and a constant value.

72.

means for generating an acknowledgment of receipt of at least one of the two or more A-MPDU subframes; 64. The apparatus of claim 63, further comprising means for transmitting the acknowledgment of receipt after a delay of at least a short interframe spatial time from transmission of the A-MPDU frame if indicating a policy.

73.

A computer program product comprising a computer readable medium encoded with instructions which, when executed, cause a device to perform a method of wireless communication, said method comprising: an aggregated media access control protocol data unit (A-MPDU)) receiving a frame; decoding two or more A-MPDU subframes of said received A-MPDU frame; and a receiver address corresponding to each of said two or more A-MPDU subframes. and determining that at least one of the two or more A-MPDU subframes of the received A-MPDU frame is intended for the device.

74.

further comprising setting, by the apparatus, a transmitter address field of each of the two or more A-MPDU subframes to indicate a source transmitter address of each of the two or more A-MPDU subframes. A method according to claim 1.

75.

the processing system further setting a transmitter address field of each of the two or more A-MPDU subframes to indicate a source transmitter address of each of the two or more A-MPDU subframes. 14. The device of claim 13, wherein the device is configured as:

76.

further comprising means for setting a transmitter address field of each of said two or more A-MPDU subframes to indicate a source transmitter address of each of said two or more A-MPDU subframes; Item 27. Apparatus according to Item 26.

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DESCRIPTION JP2016533675A

Systems and methods for communicating multi-destination traffic in wireless networks

[0001]

This application relates generally to wireless communications, and more particularly to systems, methods, and devices for communicating multi-destination traffic.

[0002]

In many telecommunication systems, a communication network is used to exchange messages between several interacting, spatially separated devices. Networks may be classified according to geographic extent, which may be, for example, a metropolitan area, a local area, or a personal area. Such networks are called wide area networks (WAN), metropolitan area networks (MAN), local area networks (LAN), wireless local area networks (WLAN), or personal area networks (PAN), respectively. A network also describes the switching/routing technology used to interconnect the various network nodes and devices (e.g., circuit-switched vs. packet-switched), the type of physical medium utilized for transmission (e.g., wired vs. wireless). , and the set of communication protocols used (eg, Internet Protocol Suite, SONET (Synchronous Optical Networking), Ethernet, etc.).

[0003]

Wireless networks are often preferred when the network elements are mobile and thus require dynamic connectivity, or when the network architecture is formed in an ad-hoc rather than a fixed topology. .

Wireless networks utilize intangible physical media in an unguided propagation mode using electromagnetic waves in the radio, microwave, infrared, optical, etc. frequency bands. Wireless networks advantageously facilitate user mobility and rapid field deployment when compared to fixed wired networks.

[0004]

However, multiple wireless networks may exist within the same building, nearby buildings, and/or the same outdoor area.

The proliferation of multiple wireless networks can lead to interference, reduced throughput (e.g., because each wireless network operates in the same area and/or frequency band), and/or several devices communicating may interfere with Accordingly, improved systems, methods, and devices for communicating when wireless networks are dense are desired.

[0005]

The systems, methods, and devices of the invention each have several aspects, no single one of which is solely responsible for its desirable attributes.

Without limiting the scope of the invention, which is represented by the following claims, some features will now be briefly discussed.

After considering this discussion, and particularly after reading the section entitled "Description of the Invention," it is clear that features of the present invention provide improved communication between access points and stations in wireless networks. It will be appreciated how it provides advantages including

[0006]

One aspect of the present disclosure provides a method of wireless communication.

In one aspect, a method generates, by a wireless device, an aggregated MPDU (A-MPDU) frame comprising two or more Media Access Control Protocol Data Unit (MPDU) subframes; Each A-MPDU subframe comprises a receiver address, further wherein the A-MPDU frame comprises at least one for one or more acknowledgment policies associated with the receiver address of each A-MPDU subframe. and outputting, by the wireless device, the A-MPDU frame for transmission, comprising the indication.

[0007]

In some aspects, one or more acknowledgment policies are indicated in corresponding one or more control fields of the A-MPDU subframe.

In some aspects, at least one of the one or more acknowledgment policies indicates that a control response frame should be sent after receipt of the A-MPDU.

In some aspects, one or more acknowledgment policies indicate that an acknowledgment should be sent SIFS time after receipt of the A-MPDU.

[0008]

In some aspects, at least one of the one or more acknowledgment policies has a "normal acknowledgment or implicit block acknowledgment request" value indicates that a control response frame should be sent when set to a specific value such as

[0009]

In some aspects of the method, at least one of the two or more A-MPDU subframes comprises an A-MPDU delimiter field, the A-MPDU delimiter field being an acknowledgment of the corresponding A-MPDU subframe. Indicates time delay.

In some aspects, the time delay is based on a backoff value also included in the A-MPDU delimiter field.

In some aspects, the backoff value is based on at least one of a SIFS time and a constant value.

[0010]

In some aspects, the method also includes generating a request for acknowledgment of receipt in a field in at least one of the two or more A-MPDU subframes, the field being an end field of the frame, and the value of the acknowledgment policy field, the value in the field determining the type of request for acknowledgment of receipt.

In some of these aspects, the acknowledgment of receipt is received after a delay of at least SIFS time from transmission of the A-MPDU.

[0011]

In some aspects, the method also includes an A-MPDU subframe to indicate that the type of request for acknowledgment of receipt for at least one of the two or more A-MPDU subframes is an acknowledgment frame. Including setting the value of the end of frame (EOF) field in at least one of the two or more A-MPDU subframes in the MPDU frame.

In some aspects, the method also includes transmitting the A-MPDU frame to indicate that the type of request for acknowledgment of receipt for at least one of the two or more A-MPDU subframes is a block acknowledgment frame, setting the value of the end of frame (EOF) field in at least one of the two or more A-MPDU subframes in.

[0012]

Another aspect disclosed is an apparatus for wireless communication.

The apparatus comprises a processing system configured to generate an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame comprising two or more Media Access Control Protocol Data Unit (MPDU) subframes; Each A-MPDU subframe comprises a receiver address, further wherein the A-MPDU frame comprises at least one for one or more acknowledgment policies associated with the receiver address of each A-MPDU subframe, and an interface for outputting the A-MPDU frame for transmission, comprising an indication.

[0013]

In some aspects, the processing system is configured to indicate one or more acknowledgment policies in corresponding one or more control fields of A-MPDU subframes.

In some aspects, one of the one or more acknowledgment policies indicates that a control response frame should be sent after receipt of an A-MPDU frame.

In some aspects, the acknowledgment policy indicates that the acknowledgment should be sent SIFS time after receipt of the A-MPDU frame.

[0014]

In some aspects, the processing system sets at least one of the one or more acknowledgment policies to a particular value, such as a "normal acknowledgment or implicit block acknowledgment request" value, configured as

In some aspects, at least one of the two or more A-MPDU subframes comprises an A-MPDU delimiter field, and the processing system indicates a time delay for acknowledgments of the corresponding A-MPDU subframes: It is configured to set the A-MPDU delimiter field.

[0015]

In some aspects, the time delay is based on a backoff value that is also included in the A-MPDU delimiter field.

In some aspects, the backoff value is based on at least one of a SIFS time and a constant value.

In some aspects, the processing system is further configured to generate a request for acknowledgment of a received tin field in at least one of the two or more A-MPDU subframes, the field being the last field of the frame, and the value of the acknowledgment policy field, and the value in the field determines the type of request for acknowledgment of receipt.

In some aspects, the processing system is further configured to decode an acknowledgment of receipt of at least one of the two or more A-MPDU subframes received after a delay of SIFS time or more from transmission of the A-MPDU, be done.

In some aspects, the processing system further indicates that the type of request for acknowledgment of receipt for at least one of the two or more A-MPDU subframes is an acknowledgment frame. Configured to set a value of an end of frame field in at least one of the A-MPDU subframes and decode received acknowledgment frames for at least one of the two or more A-MPDU subframes.

In some aspects, the processing system further indicates that the type of request for acknowledgment of receipt for at least one of the two or more A-MPDU subframes is a block acknowledgment frame. , and is configured to decode received block acknowledgment frames for at least one of the two or more A-MPDU subframes. be.

[0016]

Another aspect disclosed is an access point.

The access point is configured to generate an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame comprising at least one antenna and two or more Media Access Control Protocol Data Unit (MPDU) subframes. a processing system, wherein each A-MPDU subframe comprises a receiver address; and further, wherein the A-MPDU frame comprises one or more acknowledgments associated with the receiver address of each A-MPDU subframe. a transmitter configured to transmit A-MPDU frames using at least one antenna comprising at least one indication for a policy.

[0017]

Another aspect disclosed is an apparatus.

An apparatus comprises means for generating an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame comprising two Media Access Control Protocol Data Unit (MPDU) subframes; A- and means for transmitting MPDU frames.

[0018]

In some aspects, the means for generating two or more Media Access Control Protocol Data Unit (MPDU) subframes is a processing system.

In some aspects, means for generating an A-MPDU frame comprising two or more aggregated Media Access Control Protocol Data Unit (A-MPDU) subframes is a processing system.

In some aspects, a means for transmitting A-MPDU frames is a transmitter.

[0019]

In some aspects, the means for generating two or more MPDU subframes indicates one or more acknowledgment policies in corresponding one or more control fields of A-MPDU subframes. configured as

In some aspects, one of the one or more acknowledgment policies indicates that a control response frame should be sent after receipt of the A-MPDU.

In some aspects, the acknowledgment policy indicates that the acknowledgment should be sent SIFS time after receipt of the A-MPDU.

In some aspects, the means for generating two or more MPDU subframes sets at least one of the one or more acknowledgment policies to a "normal acknowledgment or implicit block acknowledgment request" value is configured to be set to a specific value such as

In some aspects at least one of the two or more A-MPDU subframes comprises an A-MPDU delimiter field, and the means for generating the two or more MPDU subframes comprises: A-MPDU delimiter field is configured to indicate the time delay of the acknowledgment of the A-MPDU.

In some aspects, the time delay is based on a backoff value included in the A-MPDU delimiter field.

In some aspects, the backoff value is based on at least one of a SIFS time and a constant value.

In some aspects, the apparatus also includes means for generating an A-MPDU frame comprising two or more A-MPDU subframes in a field in at least one of the two or more A-MPDU subframes. generating a request for acknowledgment of receipt, the field having a value based on at least one of the value of an end of frame field and the value of an acknowledgment policy field, and the value in the field being a request for acknowledgment of receipt; Determine the type of request.

[0020]

In some aspects, the apparatus further acknowledges receipt of at least one of the two or more A-MPDU subframes received after a delay of at least a short interframe spatial time from transmission of the A-MPDU frame. means for decoding the

In some aspects, the apparatus also includes means for decoding a block acknowledgment frame for one of the A-MPDU subframes when an end of frame (EOF) field of the A-MPDU subframe is zero. include.

In some aspects, the apparatus also includes means for decoding an acknowledgment frame for one A-MPDU subframe when an end of frame (EOF) field of the one A-MPDU subframe is set. include.

[0021]

Another aspect disclosed is a computer program product comprising a computer-readable medium encoded with instructions that, when executed, cause a device to perform a method of wireless communication, the method comprising: [0022] generating an A-MPDU frame comprising two or more aggregated Media Access Control Protocol Data Unit (A-MPDU) subframes, wherein each A-MPDU subframe comprises a receiver address; - the MPDU comprises transmitting an A-MPDU frame comprising at least one indication for one or more acknowledgment policies associated with the receiver address of each A-MPDU subframe.

[0022]

[0023] Another aspect disclosed is a method of wireless communication.

A method includes receiving, by a wireless device, an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame; decoding, by a device, a receiver address corresponding to each of two or more A-MPDU subframes; and at least one of the two or more A-MPDU subframes of the received A-MPDU frame. determining one is addressed to the device based on the decoded receiver address for each of the two or more A-MPDU subframes.

[0023]

[0024] In some aspects, the method also includes: and decoding one or more acknowledgment policies corresponding to each of two or more A-MPDU subframes of the received A-MPDU frame based on.

In some aspects, the method also includes generating a frame based on a particular value of a field when the field of each of the two or more A-MPDU subframes is set to a particular value; and outputting for transmission.

In some aspects, the method also includes decoding a value in a frame tail field in at least one of the two or more A-MPDU subframes, wherein the value in the frame tail field is 1 If so, the frame generated and output for transmission is an acknowledgment frame.

In some aspects, the method also includes decoding a value in a frame tail field in at least one of the two or more A-MPDU subframes, wherein the value in the frame tail field is 0 If so, the frame generated and output for transmission is a block acknowledgment acknowledgment frame.

In some aspects, the method also includes decoding a value in an end field of a frame in at least one of the two or more A-MPDU subframes; Two or more A-MPDUs, if the decoded value in the end field of the frame is 1, indicating the type of request for acknowledgment of receipt for one or more acknowledgment policies corresponding to each of generating an acknowledgment frame acknowledging receipt of at least one of the subframes; and outputting the acknowledgment frame for transmission.

[0024]

[0025] In some aspects, the method also includes decoding a value in an end field of a frame in at least one of the two or more A-MPDU subframes; If the decoded value in the tail field of the frame is 0, two or more generating a block acknowledgment frame acknowledging receipt of at least one of the A-MPDU subframes; and outputting the block acknowledgment frame for transmission.

In some aspects, the method further comprises decoding a Media Access Control Protocol Data Unit (MPDU) delimiter field in at least one of the two or more A-MPDU subframes; , determining the time delay that will elapse from receipt of an A-MPDU frame to outputting an acknowledgment frame for transmission; and outputting an acknowledgment frame for transmission after the time delay has elapsed based on an acknowledgment policy.

In some aspects, the method further comprises if the value stored in the MPDU delimiter field is a backoff value, or if the backoff value stored in the MPDU delimiter field is a short interframe space time and a constant value. Including cases based on at least one.

In some aspects, a method comprises generating an acknowledgment of receipt of at least one of two or more A-MPDU subframes; decoding corresponding to each of the two or more A-MPDU subframes; and outputting an acknowledgment of receipt for transmission after a delay of at least a short period of time frame space time from transmission of the A-MPDU frame

based on one or more specified acknowledgment policies.

In some aspects, the method further comprises, by the apparatus, a transmitter address field of each of the two or more A-MPDU subframes to indicate a source transmitter address of each of the two or more A-MPDU subframes. and setting the

[0025]

[0026] Another aspect disclosed is an apparatus for wireless communication.

An apparatus includes a receiver configured to receive an aggregated Media Access Control Protocol Data Unit (MPDU) frame, and decoding two or more A-MPDU subframes of the received A-MPDU frame, each decoding receiver addresses corresponding to two or more A-MPDU subframes of the received A-MPDU frame based on the decoded receiver addresses for each of the two or more A-MPDU subframes, a processing system configured to determine that at least one of the two or more A-MPDU subframes is addressed to the device.

In some aspects of the apparatus, the processing system further generates at least one configured to decode an acknowledgment policy acknowledgment policy for each of two or more A-MPDU subframes of the received A-MPDU frame destined for the device based on the indication;

[0026]

[0027] Certain aspects of the apparatus also generate a frame and send the frame for transmission when at least one field of each of the two or more A-MPDU subframes is set to a particular value. A processing system is further configured to output.

[0027]

[0028] In some aspects, the processing system further decodes the value in the tail field of the frame in at least one of the two or more A-MPDU subframes of the received A-MPDU frame destined for the device. and the processing system is further configured to generate the frame as an acknowledgment frame for transmission based on a particular value of the field if the value in the tail field of the frame is 1 .

In some aspects, the processing system is further to decode a value in an end field of a frame in at least one of the two or more A-MPDU subframes of the received A-MPDU frame destined for the device. The processing system is further configured to generate the frame as a block acknowledgment frame for transmission if the value in the tail field of the frame is 0.

In some aspects, the processing system is further configured to decode a value in an end field of a frame of at least one field in at least one of the two or more A-MPDU subframes, the value being 2 indicates the type of request for acknowledgment of receipt for the acknowledgment policy of each of the A-MPDU subframes, and for transmission if the decoded value in the tail field of the frame is 1. configured to generate an acknowledgment frame;

In some aspects, the processing system is further configured to decode a value in an end field of a frame of at least one field in at least one of the two or more A-MPDU subframes, the value being 2 indicates the type of request for acknowledgment of receipt for the acknowledgment policy of each of the one or more A-MPDU subframes, and for transmission if the decoded value in the tail field of the frame is 0. configured to generate a block acknowledgment frame;

In some aspects, the processing system further decodes a Media Access Control Protocol Data Unit (MPDU) delimiter field in at least one of the two or more A-MPDU subframes, and from the value stored in the delimiter field: , determines the time delay that will elapse between the reception of the A-MPDU frame and the transmission of the acknowledgment frame, and based on the decoded acknowledgment policy for each of the two or more A-MPDU subframes, determine that time It is configured to generate an acknowledgment frame for transmission after the delay has elapsed.

In some aspects, the value stored in the MPDU Delimiter field is a backoff value.

In some aspects, the backoff value stored in the MPDU delimiter field is based on at least one of a short inter-frame spatial time and a constant value.

In some aspects, the processing system further determines, based on the decoded one or more acknowledgment policies corresponding to each of the two or more A-MPDU subframes, the short frame duration from transmission of the A-MPDU frame. configured to generate for transmission an acknowledgment of receipt of at least one of two or more A-MPDU subframes of the received A-MPDU frame, addressed to the device after a delay of not less than space-time. .

In some aspects, the processing system further sets the transmitter address field of each of the two or more A-MPDU subframes to indicate the source transmitter address of each of the two or more A-MPDU subframes. configured to

[0028]

[0029] Another aspect disclosed is a station for wireless communication.

The station has at least one antenna, a receiver configured to receive aggregated Media Access Control Protocol Data Unit (A-MPDU) frames via the antenna, and two received A-MPDU frames. decoding the above A-MPDU subframes, decoding a receiver address corresponding to each of the two or more A-MPDU subframes, and decoding a decoded receiver address for each of the two or more A-MPDU subframes and a processing system configured to determine that at least one of the two or more A-MPDU subframes of the received A-MPDU frame is destined for the device based on.

[0029]

[0030] Another aspect disclosed is an apparatus for wireless communication.

2. The apparatus comprises means for receiving an aggregated Media Access Control Protocol Data Unit (MPDU) frame; means for decoding two or more A-MPDU subframes of the received A-MPDU frame; means for decoding receiver addresses corresponding to each of the one or more A-MPDU subframes.

In some aspects, the apparatus also determines that one of the two A-MPDU subframes is addressed to the apparatus based on the decoded receiver address for each of the two or more A-MPDU subframes. including the means of

[0030]

[0031] Some aspects of the apparatus provide at least one indication associated with a receiver address of each A-MPDU subframe in corresponding at least one field of each of the two or more A-MPDU subframes. means for decoding an acknowledgment policy for each of the two or more A-MPDU subframes based on.

[0031]

[0032] Certain aspects of the apparatus also provide a It includes means for generating a frame and means for transmitting the frame.

In some aspects, the means for decoding is further configured to decode a value in an end field of a frame of at least one field in at least one of the two or more A-MPDU subframes; The means for doing is further configured to transmit an acknowledgment frame as the frame if the value in the end field of the frame is one.

In some aspects, the means for decoding is further configured to decode a value set in an end field of a frame of at least one field in at least one of the two or more A-MPDU subframes. , the means for transmitting is further configured to transmit the block acknowledgment frame as a frame if the value in the end field of the frame is zero.

[0032]

[0033] Some aspects of the apparatus further include means for decoding a value in an end field of a frame in at least one of the two or more A-MPDU subframes; - at least one of two or more A-MPDU subframes if the value in the end field of the frame is 1 indicating the type of request for acknowledgment of receipt for the acknowledgment policy of each MPDU subframe; means for generating an acknowledgment frame for and means for transmitting the acknowledgment frame.

In some aspects, the apparatus also includes means for decoding a value in an end field of a frame in at least one of the two or more A-MPDU subframes; For at least one of two or more A-MPDU subframes, if the value in the End of Frame field is 0, indicating the type of request for acknowledgment of receipt for each acknowledgment policy of the subframe. means for generating a block acknowledgment frame; and means for transmitting the block acknowledgment frame.

In some aspects, the apparatus also includes means for decoding a Media Access Control Protocol Unit (MPDU) delimiter field in at least one of the two or more A-MPDU subframes, and Means for determining, from the values, the time delay that will elapse between receipt of an A-MPDU frame and transmission of an acknowledgment frame, and a decoded acknowledgment

policy for each of two or more A-MPDU subframes. and means for transmitting an acknowledgment frame after the time delay has elapsed based on.

In some aspects, the value in the MPDU Delimiter field is a backoff value.

In some aspects, a backoff value stored in the MPDU delimiter field based on at least one of a short interframe space time and a constant value.

[0033]

[0034] In some aspects, the apparatus also includes means for generating an acknowledgment of receipt of at least one of the two or more A-MPDU subframes; and means for transmitting an acknowledgment of receipt after a delay of at least the short interframe spatial time from transmission of the A-MPDU frame if the acknowledgment policy for one indicates a block acknowledgment policy.

[0034]

[0035] In some aspects, the means for receiving is a receiver.

In some aspects the means for decoding two A-MPDU subframes is a processing system.

In some aspects the means for decoding two different receiver addresses is the processing system.

In some aspects, the means for determining is a processing system.

In some aspects the means for decoding an acknowledgment policy for one A-MPDU subframe is a processing system.

In some aspects, the means for transmitting the control frame when the acknowledgment policy is set to a particular value is the transmitter.

In some aspects, means for decoding an end field of a frame in an A-MPDU subframe is a processing system.

In some aspects the means for determining the time delay for transmitting the control frame is the processing system.

In some aspects, the means for receiving a request for acknowledgment for A-MPDU subframes is a receiver.

[0035]

[0036] In some aspects, the apparatus further configures the transmitter address field of each of the two or more A-MPDU subframes to indicate the source transmitter address of each of the two or more A-MPDU subframes. including means for setting the

[0036]

[0037] Another aspect disclosed is a computer program product comprising a computer-readable medium encoded with instructions that, when executed, cause a device to perform a method of wireless communication, the method comprising: receiving an access control protocol data unit (MPDU) frame; decoding two or more A-MPDU subframes of the received A-MPDU frame; and decoding the corresponding receiver address.

[0037]

[0038] Fig. 2 illustrates an exemplary wireless communication system in which aspects of this disclosure may be utilized;

[0039] Fig. 2 illustrates a wireless communication system in which multiple wireless communication networks are present;

[0040] Fig. 3 illustrates another wireless communication system in which multiple wireless communication networks are present;

[0041] FIG. 2 illustrates frequency multiplexing techniques that may be utilized within the wireless communication systems of FIGS. 1, 2A, and 2B.

[0042] FIG. 4 is a functional block diagram of an exemplary wireless device that may be utilized within the wireless communication systems of FIGS. 1, 2A, 2B, and 3;

[0043] FIG. 4 illustrates multiple messages transmitted by an access point to three stations in the wireless communication system of FIGS. 1, 2A, 2B, and 3;

[0044] FIG. 4 illustrates a single A-MPDU transmitted by an access point to three stations in the wireless communication system of FIGS. 1, 2A, 2B, and 3;

[0045] FIG. 6 illustrates an exemplary structure of a Media Access Control Protocol Data Unit (MPDU) subframe.

[0046] Fig. 4 shows an exemplary structure of a quality of service (QoS) control (qc) field;

[0047] Fig. 3 shows an exemplary structure of an Aggregated MPDU (A-MPDU) frame;

[0048] Fig. 10 shows an embodiment of the MPDU delimiter field.

[0049] Fig. 4 shows an alternative embodiment of the MPDU delimiter field;

[0050] FIG. 4 shows an A-MPDU frame that includes three A-MPDU subframes.

[0051] Fig. 3 illustrates an exemplary wireless communication between an access point and three stations;

[0052] FIG. 11 illustrates an embodiment of an A-MPDU frame including three A-MPDU subframes.

[0053] Fig. 3 shows an exemplary wireless communication between an access point and three stations;

[0054] Fig. 10 illustrates an embodiment of an A-MPDU;

[0055] Fig. 3 illustrates an exemplary wireless communication between an access point and three stations;

[0056] Fig. 11 shows an embodiment of an A-MPDU;

[0057] Fig. 3 shows an exemplary wireless communication between an access point and three stations;

[0058] A flowchart of one exemplary method of wireless communication.

[0059] FIG. 3 is a functional block diagram of an exemplary wireless device that may be utilized within a wireless communication system.

[0060] A flowchart of one exemplary method of wireless communication.

[0061] Fig. 3 is a functional block diagram of an exemplary wireless device that may be utilized within a wireless communication system.

[0062] A flowchart of one exemplary method of wireless communication.

[0063] FIG. 3 is a functional block diagram of an exemplary wireless device that may be utilized within a wireless communication system.

[0038]

[0064] Various aspects of the novel systems, apparatus, and methods are described more fully hereinafter with reference to the accompanying drawings.

The teachings of the disclosure may, however, be embodied in many different forms and should not be construed as limited to any specific structure or function presented throughout this disclosure.

Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art.

Based on the teachings herein, the scope of the present disclosure, whether implemented independently of other aspects of the invention or in combination with other aspects of the invention, is the scope of the present disclosure. It is to be understood by those skilled in the art to encompass all aspects of the novel systems, devices and methods disclosed in .

For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein.

In addition, the scope of the invention extends to devices as implemented using other structures, functions, or structures and functions in addition to, or in addition to, the various aspects of the invention described herein. or methods are intended to be

included.

It should be understood that any aspect disclosed herein may be embodied by one or more elements of a claim.

[0039]

[0065] Although particular aspects are described herein, many variations and permutations of these aspects fall within the scope of the disclosure.

Although some benefits and advantages of the preferred aspects are mentioned, the scope of the disclosure is not intended to be limited to particular benefits, uses, or objectives.

Rather, aspects of the present disclosure are intended to be broadly applicable to a variety of wireless technologies, system configurations, networks, and transmission protocols, some of which are shown by way of example in the Figures and below of preferred aspects. indicated in the description.

The detailed description and drawings are merely illustrative of the disclosure rather than limiting, the scope of the disclosure being defined by the appended claims and equivalents thereof.

[0040]

[0066] Popular wireless network technologies may include various types of wireless local area networks (WLANs).

WLANs can be used to interconnect nearby devices together utilizing widely used networking protocols.

Various aspects described herein may apply to any communication standard, such as a wireless protocol.

[0041]

[0067] In some aspects, the wireless signals are orthogonal frequency division multiplexed (OFDM), direct-sequence spread spectrum (DSSS) communications, a combination of OFDM and DSSS communications, or other schemes. can be transmitted according to the high efficiency 802.11 protocol using .

A highly efficient 802.11 protocol implementation may be used for Internet access, sensors, metering, smart grid networks, or other wireless applications.

Advantageously, aspects of some devices implementing the highly efficient 802.11 protocol using the techniques disclosed herein can be used for peer-to-peer services in the same area (e.g., Miracast, Wi-Fi Direct (Services, Social Wi-Fi, etc.), support increased minimum throughput requirements per user, support more users, improved outdoor It may include providing coverage and robustness and/or consuming less power than devices implementing other wireless protocols.

[0042]

[0068] In some implementations, a WLAN includes various devices that are components that access the wireless network.

For example, there may be two types of devices: access points ("APs") and clients (also called stations or "STAs").

In general, APs can act as hubs or base stations for WLANs, and STAs act as users of WLANs.

For example, the STA may be a laptop computer, personal digital assistant (PDA), cell phone, and the like.

In one example, a STA connects to an AP via a WiFi® (eg, IEEE 802.11 protocol) compliant wireless link to gain general connectivity to the Internet or other wide area network.

In some implementations, STAs may also be used as APs.

[0043]

[0069] Another aspect disclosed is a wireless node for wireless communication.

The wireless node includes an antenna, a processing system configured to generate a message indicating the start time of a time period during which one or more devices are permitted to communicate with the apparatus, and the start time is an

absolute time. and a transmitter configured to transmit a message generated using the reference based antenna.

[0044]

[0070] Access Points ("APs") also include NodeBs, Radio Network Controllers ("RNCs"), eNodeBs, Base Station Controllers ("BSCs"), Base Transceiver Stations ("BTSs"), Base Stations ("BSs")), transceiver function ("TF"), wireless router, wireless transceiver, or some other terminology, may be implemented as, or be known as, any of them.

[0045]

[0071] A station "STA" may be an access terminal ("AT"), subscriber station, subscriber unit, mobile station, remote station, remote terminal, user terminal, user agent, user device, user equipment, or any other The terms may comprise, be implemented as, or be known as any of them.

In some implementations, the access terminal is a mobile phone, a cordless phone, a Session Initiation Protocol (SIP) phone, a wireless local loop (WLL) station, a personal digital assistant (PDA), a handheld device with wireless connectivity capability, or a wireless It may have any other suitable processing device connected to the modem.

Accordingly, one or more aspects taught herein include telephones (e.g., mobile phones or smart phones), computers (e.g., laptops), portable communication devices, headsets, portable computing devices (e.g., handheld data terminal), entertainment device (e.g., music or video device, or satellite radio), gaming device or system, global positioning system device, or any other configured to communicate over a wireless medium. It can be incorporated into a suitable device.

[0046]

[0072] As discussed above, some of the devices described herein may implement the high efficiency 802.11 standard, for example.

Such devices, whether used as STAs, APs, or other devices, may be used for smart metering or in smart grid networks.

Such devices may provide sensor applications or may be used in home automation.

The device may alternatively or additionally be used in healthcare settings, for example for personal healthcare.

They can also be used for surveillance, to enable widespread Internet connectivity (eg, for use with hotspots), or to implement machine-to-machine communication.

Although various systems, methods, and apparatus are described herein with respect to the high efficiency 802.11 standard, for example, the disclosure is applicable to other wireless communication standards, such as 802.11ah. will be understood by those skilled in the art.

[0047]

[0073] FIG. 1 illustrates an exemplary wireless communication system 100 in which aspects of this disclosure may be utilized.

Wireless communication system 100 may operate according to a wireless standard, such as the high efficiency 802.11 standard.

Wireless communication system 100 may include AP 104 that communicates with STAs 106 (referring generally to STAs 106A-106D).

[0048]

[0074] Various processes and methods may be used for transmissions in the wireless communication system 100 between the AP 104 and the STAs 106. FIG.

For example, signals may be transmitted and received between AP 104 and STAs 106 according to OFDM/OFDMA techniques.

In this case, wireless communication system 100 may be referred to as an OFDM/OFDMA system.

Alternatively, signals may be transmitted and received between AP 104 and STAs 106 according to code division multiple access (CDMA) techniques.

In this case, wireless communication system 100 may be referred to as a CDMA system.

[0049]

[0075] A communication link that supports transmission from the AP 104 to one or more of the STAs 106 may be referred to as a downlink (DL) 108, and a communication link that supports transmission from one or more of the STAs 106 to the AP 104 is an uplink. Sometimes called a link (UL) 110 .

Alternatively, downlink 108 may be referred to as the forward link or forward channel, and uplink 110 may be referred to as the reverse link or reverse channel.

[0050]

[0076] AP 104 may act as a base station and provide wireless communication coverage in a basic service area (BSA) 102 .

An AP 104, along with the STAs 106 associated with it and using the AP 104 for communication, may be referred to as a Basic Service Set (BSS).

Note that the wireless communication system 100 may not have a central AP 104, but rather function as a peer-to-peer network between STAs 106.

Accordingly, the functions of AP 104 described herein may alternatively be performed by one or more of STAs 106 .

[0051]

[0077] In some aspects, the STAs 106 may be required to connect with the AP 104 in order to send communications to and/or receive communications from the AP 104.

In one aspect, information for connecting is included in broadcasts by the AP 104 .

To receive such broadcasts, STAs 106 can, for example, perform extensive coverage searches over coverage areas.

The search may also be performed by the STA 106, for example, by sweeping the coverage area in a lighthouse fashion.

After receiving the information to connect, STA 106 can send reference signals, such as connection probes or requests, to AP 104 .

In some aspects, the AP 104 may use backhaul services, for example, to communicate with larger networks such as the Internet or the Public Switched Telephone Network (PSTN).

[0052]

[0078] In one embodiment, the AP 104 includes an AP High Efficiency Wireless Component (HEWC) 154 .

AP HEWC 154 may perform some or all of the operations described herein that enable communication between AP 104 and STAs 106 using the high efficiency 802.11 protocol.

The functionality of AP HEWC 154 is described in more detail below with respect to FIGS. 2B, 3, 4, and 5-11.

[0053]

[0079] Alternatively or additionally, STA 106 may include STA HEWC 156.

STA HEWC 156 may perform some or all of the operations described herein to enable communication between STA 106 and AP 104 using the radio frequency 802.11 protocol.

The functionality of STA HEWC 156 is described in more detail below with respect to FIGS. 2B, 3, 4, and 5-11.

[0054]

[0080] In some situations, a BSA may be located near other BSAs.

For example, FIG. 2A shows a wireless communication system 200 in which multiple wireless communication networks exist.

As shown in FIG. 2A, BSAs 202A, 202B, and 202C may be physically located near each other.

Despite the proximity of BSAs 202A-202C, APs 204A-204C and/or STAs 206A-206H may each communicate using the same frequency band.

Thus, when a device in BSA 202C (eg, AP 204C) is transmitting data, devices external to BSA 202C (eg, APs 204A-204B or STAs 206A-206F) can sense the communication on the medium.

[0055]

[0081] In general, wireless networks using common 802.11 protocols (e.g., 802.11a, 802.11b, 802.11g, 802.11n, etc.) use Carrier Sense Multiple Access (CSMA: carrier sense multiple access) mechanism.

According to CSMA, a device senses the medium and transmits only when the medium is sensed to be idle.

Thus, if APs 204A-204C and/or STAs 206A-206H are operating according to the CSMA mechanism and devices in BSA 202C (e.g., AP 204C) are transmitting data, APs 204A-204B and/or STAs 206A outside BSA 202C ~206F may not transmit on the medium even though they are part of a different BSA.

[0056]

[0082] Figure 2A illustrates such a situation.

As shown in FIG. 2A, AP 204C is transmitting over the medium.

The transmission is sensed by STA 206G in the same BSA 202C as AP 204C and by STA 206A in a different BSA than AP 204C.

Transmissions may be directed only to STAs in STA 206G and/or BSA 202C, but STA 206A will nevertheless continue to (e.g.) may not be able to send or receive communications.

Although not shown, the same applies to STAs 206D-206F in BSA 202B and/or STA 206B in BSA 202A (e.g., other STAs can sense transmissions on the medium because transmissions by AP 204C are stronger). ~206C may apply as well.

[0057]

[0083] The use of the CSMA mechanism may then allow some APs or STAs outside the BSA to transmit data without interfering with transmissions made by APs or STAs in the BSA, thus resulting in inefficiency.

As the number of active wireless devices continues to grow, inefficiencies can begin to have a significant impact on network latency and throughput.

For example, significant network latency problems may present themselves in multi-family housing where each dwelling unit may contain an access point and associated stations.

In fact, each dwelling unit may have multiple units, as residents may own wireless routers, video game consoles with wireless media center capabilities, televisions with wireless media center capabilities, cell phones that can act like personal hotspots, etc. May include access points.

In that case, it may be essential to correct the inefficiencies of the CSMA mechanism in order to avoid latency and throughput problems and overall user dissatisfaction.

[0058]

[0084] Such latency and throughput problems may not be limited to residential areas.

For example, multiple access points may be located at airports, subway stations, and/or other densely populated public spaces.

Currently, WiFi access may be provided in these public spaces, albeit for a fee.

If the inefficiencies introduced by the CSMA mechanism are not corrected, wireless network operators may lose customers as

fees and lower quality of service may begin to outweigh the benefits.

[0059]

[0085] Accordingly, the highly efficient 802.11 protocol described herein allows devices to operate under modified mechanisms that minimize these inefficiencies and increase network throughput. can make it possible.

Such mechanisms are described below with respect to FIGS. 2B, 3 and 4. FIG.

Additional aspects of the high efficiency 802.11 protocol are described below with respect to FIGS.

[0060]

[0086] FIG. 2B shows a wireless communication system 250 in which there are multiple wireless communication networks.

Unlike wireless communication system 200 of FIG. 2A, wireless communication system 250 may operate according to the high efficiency 802.11 standard discussed herein.

Wireless communication system 250 may include AP 254A, AP 254B, and AP 254C.

AP 254A can communicate with STAs 256A-256C, AP 254B can communicate with STAs 256D-256F, and AP 254C can communicate with STAs 256G-256H.

[0061]

[0087] Various processes and methods may be used for transmissions in wireless communication system 250 between APs 254A-254C and STAs 256A-256H.

For example, signals may be transmitted and received between APs 254A-254C and STAs 256A-256H according to OFDM/OFDMA techniques or CDMA techniques.

[0062]

[0088] AP 254A may act as a base station and provide wireless communication coverage in BSA 252A.

AP 254B may act as a base station and provide wireless communication coverage in BSA 252B.

AP 254C may act as a base station and provide wireless communication coverage in BSA 252C.

Note that each BSA 252A, 252B, and/or 252C may not have a central AP 254A, 254B, or 254C, but rather may enable peer-to-peer communication between one or more of the STAs 256A-256H. sea bream.

Accordingly, the functions of APs 254A-254C described herein may alternatively be performed by one or more of STAs 256A-256H.

[0063]

[0089] In some embodiments, APs 254A-254C and/or STAs 256A-256H include high efficiency wireless components.

As described herein, the high efficiency wireless component may use the high efficiency 802.11 protocol to enable communication between the AP and the STAs.

Specifically, high-efficiency wireless components enable APs 254A-254C and/or STAs 256A-256H to minimize the inefficiencies of CSMA mechanisms (e.g., simultaneous communication over the medium in situations where no interference occurs).), which may allow a modified mechanism to be used.

High efficiency wireless components are described in more detail below with respect to FIG.

[0064]

[0090] As shown in FIG. 2B, the BSAs 252A-252C are physically located close to each other.

For example, when AP 254A and STA 256B are communicating with each other, the communication can be sensed by other devices in BSA 252B-252C.

However, that communication may only interfere with some devices, such as STA256F and/or STA256G.

Under CSMA, AP 254B is not allowed to communicate with STA 256E, even though such communication does not interfere with communication between AP 254A and STA 256B.

Accordingly, the high efficiency 802.11 protocol operates under a modified mechanism that distinguishes between devices that can and cannot communicate simultaneously.

Such classification of devices may be performed by high efficiency wireless components in APs 254A-254C and/or STAs 256A-256H.

[0065]

[0091] In some embodiments, the determination of whether a device can communicate with other devices at the same time is based on the location of the device.

For example, a STA located near the edge of a BSA may be in a state or condition that prevents the STA from communicating with other devices simultaneously.

As shown in FIG. 2B, STAs 206A, 206F, and 206G may be devices that are in a state or condition that prevents them from communicating with other devices simultaneously.

Similarly, STAs located near the center of the BSA may be in stations or conditions that allow the STA to communicate with other devices.

As shown in FIG. 2, STAs 206B, 206C, 206D, 206E, and 206H may be devices that are in a state or condition that allows them to communicate simultaneously with other devices.

Note that device classification is not persistent.

Devices may transition between states or conditions in which they can communicate at the same time and states or conditions in which they cannot communicate at the same time (e.g., when devices are in state or condition may change when connecting to an AP, disconnecting, etc.).

[0066]

[0092] Additionally, devices may be configured to operate differently based on whether they are devices that are or are not in a state or condition to communicate simultaneously with other devices.

For example, devices that are in such a state or condition that they can communicate at the same time can communicate within the same frequency band.

However, devices in conditions or conditions such that they cannot communicate simultaneously may employ some technique such as spatial multiplexing or frequency domain multiplexing to communicate over the medium.

Control of device behavior may be performed by high efficiency wireless components within APs 254A-254C and/or STAs 256A-256H.

[0067]

[0093] In one embodiment, devices that are in a state or condition such that they cannot communicate at the same time use spatial multiplexing techniques to communicate over the medium.

For example, power and/or other information may be embedded within the preamble of packets transmitted by another device.

A device that is in a state or condition such that the devices cannot communicate simultaneously can analyze the preamble when a packet is sensed on the medium and decide whether to transmit based on a set of rules.

[0068]

[0094] In another embodiment, devices that are in conditions or conditions such that they cannot communicate at the same time use frequency domain multiplexing techniques to communicate over the medium.

FIG. 3 illustrates frequency multiplexing techniques that may be utilized within wireless communication system 100 of FIG. 1 and wireless communication system 250 of FIG. 2B.

As shown in FIG. 3, within wireless communication system 300 there may be APs 304A, 304B, 304C, and 304D.

Each of APs 304A, 304B, 304C, and 304D may be associated with a different BSA and include the high efficiency wireless components described herein.

[0069]

[0095] As an example, the bandwidth of the communication medium may be 80 MHz.

Under normal 802.11 protocol, each of APs 304A, 304B, 304C, and 304D and the STAs associated with each respective AP attempt to communicate using the entire bandwidth, which is the throughput can be reduced.

However, under the high efficiency 802.11 protocol using frequency domain multiplexing, the bandwidth is divided into four 20 MHz segments 308, 310, 312, and 314 (e.g., channels) as shown in FIG. can be split.

AP 304A may be associated with segment 308, AP 304B may be associated with segment 310, AP 304C may be associated with segment 312, and AP 304D may be associated with segment 314.

[0070]

[0096] In an embodiment, when APs 304A-304D and STAs that are in a state or condition that allows them to communicate simultaneously with other devices (e.g., STAs near the center of the BSA), each AP 304A communicates with each other. ˜304D and each of these STAs may communicate using part or all of the 80 MHz medium.

However, when AP 304A-304D and STAs that are in conditions or conditions that prevent them from communicating simultaneously with other devices (e.g., STAs near the edge of the BSA) communicating with each other, AP 304A and its STAs are Communicate using segment 308, AP 304B and its STAs communicate using segment 310 at 20 MHz, AP 304C and its STAs communicate using segment 312 at 20 MHz, AP 304D and its STAs communicate using segment 312 at 20 MHz. segment 314 of the .

Because segments 308, 310, 312, and 314 are different portions of the communication medium, a first transmission using the first segment will not interfere with a second transmission using the second segment.

[0071]

[0097] Thus, APs and/or STAs that include high-efficiency wireless components can communicate simultaneously with other APs and STAs without interference, even in conditions or conditions that prevent them from communicating simultaneously with other devices. can communicate.

Accordingly, the throughput of wireless communication network 300 may be increased.

For apartment complexes or densely populated public spaces, APs and/or STAs using high-efficiency wireless components experience reduced latency and increased network throughput, even as the number of active wireless devices increases. can improve the user experience.

[0072]

[0098] FIG. 4 shows an exemplary functional block diagram of a wireless device 402 that may be utilized within the wireless communication systems 100, 250 and/or 300 of FIGS.

Wireless device 402 is one example of a device that can be configured to perform various methodologies described herein.

For example, wireless device 402 may comprise AP 104 , one of STA 106 , one of AP 254 , one of STA 256 , and/or one of AP 304 .

[0073]

[0099] Wireless device 402 may include a processor 404 that controls the operation of wireless device 402 .

Processor 404 may also be referred to as a central processing unit (CPU).

Memory 406 , which may include both read only memory (ROM) and random access memory (RAM), may provide instructions and data to processor 404 .

A portion of memory 406 may also include non-volatile random access memory (NVRAM).

Processor 404 typically performs logical and arithmetic operations based on program instructions stored within memory 406 .

The instructions in memory 406 may be executable to implement the methods described herein.

[0074]

[00100] Processor 404 may comprise or be a component of a processing system implemented by one or more processors.

The processor or processors may be general purpose microprocessors, microcontrollers, digital signal processors (DSPs), field programmable gate arrays (FPGAs), programmable logic devices (PLDs), controllers, state machines, gated logic, discrete hardware components. , a dedicated hardware finite state machine, or any other suitable entity capable of performing computations or other manipulations of information.

[0075]

[00101] The processing system may also include a machine-readable medium for storing software.

Software should be construed broadly to mean any type of instructions, whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise.

Instructions may include code (eg, in source code format, binary code format, executable code format, or any other suitable code format).

The instructions, when executed by one or more processors, cause the processing system to perform various functions described herein.

[0076]

[00102] The wireless device 402 may also include a housing 408 that may include a transmitter 410 and/or a receiver 412 to enable transmission and reception of data between the wireless device 402 and a remote location. .

Transmitter 410 and receiver 412 may be combined into transceiver 414 .

Antenna 416 may be attached to housing 408 and electrically coupled to transceiver 414 .

Wireless device 402 may also include multiple transmitters, multiple receivers, multiple transceivers, and/or multiple antennas (not shown).

[0077]

[00103] Transmitter 410 is configured to indicate to the wireless device whether it needs to wake up from hibernation and enter an active state, referred to as a "paging message," as described below. can be configured to wirelessly transmit messages that can be

For example, transmitter 410 may be configured to transmit paging messages generated by processor 404 discussed above.

When wireless device 402 is implemented or used as STA 106, processor 404 may be configured to process paging messages.

When wireless device 402 is implemented or used as AP 104, processor 404 may also be configured to generate paging messages.

[0078]

[00104] Receiver 412 may be configured to receive paging messages wirelessly.

When wireless device 402 is implemented or used as STA 106, transmitter 410 may be configured to transmit requests for data in response to paging messages.

For example, wireless device 402 may be configured to transmit a Power-Saving Poll (PS Poll) as described herein with respect to FIG.

When wireless device 402 is implemented or used as AP 104 , transmitter 410 may be further configured to transmit data to one or more STAs 106 .

When wireless device 402 is implemented or used as STA 106 , transmitter 410 may be configured to transmit acknowledgments for data received from AP 104 .

[0079]

[00105] Wireless device 402 may also include a signal detector 418, which may be used to detect and quantify the level of the signal received by transceiver 414. FIG.

Signal detector 418 may detect signals such as total energy, energy per subcarrier per symbol, power spectral density, and other signals.

Wireless device 402 may also include a digital signal processor (DSP) 420 for use in processing signals.

DSP 420 may be configured to generate packets for transmission.

In some aspects, a packet may comprise a physical layer data unit (PPDU).

[0080]

[00106] In some aspects, the wireless device 402 may further comprise a user interface 422. As shown in FIG.

User interface 422 may comprise a keypad, microphone, speaker, and/or display.

User interface 422 may include any element or component that communicates information to and/or receives input from a user of wireless device 402 .

[0081]

[00107] In some aspects, the wireless device 402 may further comprise a high efficiency wireless component 424. As shown in FIG.

High efficiency wireless component 424 may include classifier unit 428 and transmission control unit 430 .

As described herein, the high-efficiency wireless component 424 is a modification that minimizes the inefficiencies of CSMA mechanisms (eg, allows simultaneous communication over the medium in situations where no interference occurs). APs and/or STAs may be enabled to use the provided mechanisms.

[0082]

[00108] The modified mechanism may be implemented by the classifier unit 428 and the transmission control unit 430.

In some embodiments, classifier unit 428 determines which devices are in a state or condition that can communicate with other devices at the same time and which devices cannot communicate with other devices at the same time. determine whether there is

In some embodiments, transmission control unit 430 controls the operation of the device.

For example, transmission control unit 430 may allow some devices to transmit on the same medium simultaneously and other devices to transmit using spatial multiplexing or frequency domain multiplexing techniques. .

Transmission control unit 430 may control device operation based on the decisions made by classifier unit 428 .

[0083]

[00109] The various components of wireless device 402 may be coupled together by bus system 426;

Bus system 426 may include, for example, a data bus, a power bus, a control signal bus, and a status signal bus in addition to the data bus.

Those skilled in the art will appreciate that the components of wireless device 402 may be coupled together or accept or provide input to each other using some other mechanism.

[0084]

[00110] Although several separate components are shown in FIG. 4, those skilled in the art will recognize that one or more of the components may be combined or commonly implemented.

For example, processor 404 may be used to implement the functionality described above with respect to processor 404 as well as the functionality described above with respect to signal detector 418 and/or DSP 420 .

Further, each of the components shown in FIG. 4 may be implemented using multiple separate elements.

[0085]

[00111] Wireless device 402 may comprise AP 104, STA 106, AP 254, STA 256, and/or AP 304, and may be used to transmit and/or receive communications.

That is, any of AP 104, STA 106, AP 254, STA 256, or AP 304 may function as a transmitter or receiver device.

Some aspects contemplate that signal detector 418 is used by software running on memory 406 and processor 404 to detect the presence of a transmitter or receiver.

[0086]

[00112] Referring again to FIG. 1, the STA 106 may have multiple modes of operation.

For example, STA 106 may have a first mode of operation called active mode.

In active mode, the STA 106 may always be in an "active" state and actively transmit/receive data with the AP 104 .

In addition, STA 106 may have a second mode of operation called power saving mode.

In the power saving mode, the STA 106 may be in an "active" state, or a "sleep" or "sleep" state in which the STA 106 is not actively transmitting/receiving data with the AP 104 .

For example, receiver 412, and possibly DSP 420 and signal detector 418, of STA 106 may operate with reduced power consumption in the dormant state.

Additionally, in power save mode, the STA 106 determines whether it needs to "wake up" (eg, enter an active state) at certain times so that it can transmit/receive data to/from the AP 104 . An active state may occasionally be entered to listen for messages from the AP 104 (eg, paging messages) shown to the STA 106 .

[0087]

[00113] Thus, in some wireless communication systems 100, the AP 104 sends paging messages indicating whether there is data buffered at the AP 104 for the STAs 106 to multiple wireless communication systems in the same network as the AP 104 in power save mode. can be sent to the STA 106 of

STAs 106 can also use this information to determine whether they should be active or dormant.

For example, if the STA 106 determines that the STA 106 has not been paged, it may enter a dormant state.

Alternatively, if the STA 106 determines that the STA 106 can be paged, the STA 106 enters an active state for a period of time to receive the page and further determines when to become active based on the page. be able to.

Additionally, the STA 106 may remain active for a period of time after receiving the page.

In another example, the STA 106 may be configured to function in other manners consistent with this disclosure when being paged or not being paged.

[0088]

[00114] In some aspects, the paging message may include a bitmap (not shown in this figure), such as a Traffic Identification Map (TIM).

In some such aspects, a bitmap may include a number of bits.

These paging messages may be sent from AP 104 to STAs 106 in beacons or TIM frames.

Each bit in the bitmap may correspond to a particular STA 106 out of multiple STAs 106, and the value of each bit (eg, 0 or 1) is the buffed unit that the AP 104 has for that particular STA. can indicate the state (eg, dormant or active) that the corresponding STA 106 should be in order to be able to receive .

Thus, the bitmap size may be directly proportional to the number of STAs 106 in wireless communication system 100 .

Therefore, a large number of STAs 106 in wireless communication system 100 may result in a large bitmap.

[0089]

[00115] In some aspects, STAs 106 that sleep for long periods of time may not wake up to read TIM messages.

For example, STA 106 may decide to sleep through one or more TIM messages in extended sleep mode.

In this case, STA 106 may inform AP 104 that STA 106 may not read any TIM messages.

Therefore, AP 104 need not include the corresponding identifier in the TIM message.

In various embodiments, STAs 106 may use control messages or immediately during a connection that they may not wake up due to one or more TIM messages (i.e., they may enter the power saving mode described above). the AP 104).

[0090]

[00116] For STAs 106 that have notified AP 104 in this manner, AP 104 may not include an identifier in the TIM message, even if AP 104 has a BU intended for STA 106 .

STAs 106 can request their BUs by sending a PS-Poll to AP 104 at any time.

In some embodiments, the AP 104 can immediately send the buffered units BU in response to the PS poll.

In another embodiment, the AP 104 may respond to the PS Poll with an acknowledgment (ACK) and deliver the BU later.

In yet another embodiment, the AP 104 may not immediately respond to the PS Poll (either with an ACK or a BU).

AP 104 may instead reply with a cumulative ACK frame sent after a given scheduled time after the TIM message.

[0091]

[00117] In various embodiments, the STA 106 sends a BU via a PS Poll (for dynamic indications), a Connection Request sent to the AP, a Probe Request, and/or another management frame (for static indications). You can specify the waiting time for delivering the

In other embodiments, the AP 104 sends the BU via an ACK frame, a TIM element (for dynamic indications), a beacon sent to the STA 106, a connection response, a probe response, or other management frame (for static indications). You can specify the waiting time for delivering the

STA 106 can sleep for the length of the wait time.

The STA 106 may acknowledge correct receipt of the BU by sending an ACK.

STA 106 can then go back to sleep.

[0092]

[00118] FIG. 5A shows multiple wireless messages 502 sent by the AP 104 to the STAs 106 in the wireless communication system 100 of FIG.

As shown, time increases horizontally across the page on timeline 504 .

In various embodiments, the AP 104 may receive and/or store buffered units containing multiple frames 510A-510N destined for several destination STAs 106.

The AP 104 may send multiple wireless messages 502 to multiple STAs 106 when the AP 104 has buffered units to send.

[0093]

[00119] In various embodiments, the frames 510A-510B may be small or short frames 510A-510N, about 1 byte to about 100 bytes, about 10 bytes to about 50 bytes, and more specifically it may contain about 20 bytes.

Small frames are used, for example, for push notifications (e.g. emails, advertisements, etc.), short messaging applications (e.g. Facebook posts, Twitter posts, text messages, etc.), upper layer protocol overheads (e.g. transmission control protocol (TCP) acknowledgments, keep-alive messages, etc.).

Therefore, many relatively small frames can generate many wireless messages, which can lead to one or more STAs 106 competing in sending requests to the AP 104 over the medium.

[0094]

[00120] FIG. 5B shows a single A-MPDU wireless message 502 sent by the AP 104 to the STAs 106 in the wireless communication system 100 of FIG.

As shown, time increases horizontally across the page on timeline 504 .

As discussed above with respect to FIG. 5A, the AP 104 may receive and/or store buffered units containing multiple frames 510A-510N destined for several destination STAs 106. FIG.

Instead of sending multiple wireless messages 502 shown in FIG. 5A, the AP can send a single aggregated MPDU message 504 when the AP 104 has buffered units to send.

A-MPDU 504 may include multiple A-MPDU subframes 505a-c.

One or more of the multiple A-MPDU subframes 505a-c included in A-MPDU 504 may be addressed to different receivers.

[0095]

[00121] Since A-MPDU subframes 505a-c of wireless message 504 may be addressed to multiple receivers, how does each receiver acknowledge A-MPDU subframes 505a-c addressed to the receiver? The question arises as to whether

To coordinate acknowledgments from each of the receivers, one or more of the A-MPDU subframes 505a-c may include one or more fields that define an acknowledgment policy for the A-MPDU subframes.

For example, an acknowledgment policy may be, for example, whether an acknowledgment for an A-MPDU subframe should be sent by the destined receiver, the type of acknowledgment to be sent (e.g., should an acknowledgment be sent? block acknowledgment should be sent) and/or between when the A-MPDU wireless message 504 is received and when an acknowledgment for any MPDU subframe included in the message 504 is sent can indicate a delay time period of

The indicated acknowledgment policy for each A-MPDU subframe 505a-c is to reduce the probability of conflicts that occur when each of the MPDU subframes 550a-c is acknowledged. It functions to coordinate each acknowledgment.

[0096]

[00122] FIG. 6 shows an exemplary structure of a media access control protocol data unit (MPDU) frame 600. As shown in FIG.

As shown, the MPDU frame 600 includes a frame control (fc) field 610, a duration/identification (dur) field 625, a receiver address (a1) field 630, a transmitter address (a2) field 635, a destination address (a3) field 640, sequence control (sc) field 645, fourth address (a4) field 650, quality of service (QoS) control (qc) field 655, high throughput (HT) control field 660, frame body 665, and frame confirmation. It contains eleven different fields, the sequence (FCS) field 670 .

Some or all of fields 610 - 660 make up MAC header 602 .

[0097]

[00123] Each of the fields of a media access control frame may be considered a media access control parameter.

Additionally, each field may consist of one or more subfields or fields.

For example, the frame control field 610 of the medium access control header 602 may consist of multiple subfields such as protocol version, type field, subtype field, and other fields.

Each of these subfields or fields may also be considered media access control parameters.

In some embodiments, individual bits of a media access control frame may be considered media access control parameters.

[0098]

[00124] Each of the a1, a2, a3, and a4 fields 630, 635, 640, and 650 may comprise the full MAC address of the device, which is a 48-bit (6-octet) value.

In some aspects any of these fields may comprise an AID based on the short MAC header format.

FIG. 6 also shows the size in octets of each of the fields 610-670.

Frame body field 665 may contain only a portion of the fields shown in FIG. 6, comprising different types of MPDU frames of varying numbers of octets.

For example, if the MPDU frame is a control frame, the MAC header of the MPDU frame may not include QoS control field 655 or HT control field 660 .

Additionally, depending on the type, the MPDU frame 600 may contain additional fields.

However, in some cases, MPDU frame 600 may include frame control field 610 regardless of type.

[0099]

[00125] FIG. 7 shows an exemplary structure of a quality of service (QoS) control (qc) field 655. As shown in FIG.

As shown, the QoS control fields 655 include a traffic indicator (TID) field 710, an end of service period field 720, an acknowledgment policy field 730, an aggregated MSDU presence field 740, and a "colorful" field 750. contains four different fields.

In some aspects, acknowledgment policy field 730 may indicate one of four acknowledgment policies.

In some aspects, the four acknowledgment policies are "normal acknowledgment or implicit block acknowledgment request", "no acknowledgment", and "no acknowledgment or power saving multi-poll (PSMP) acknowledgment". ' and 'block acknowledgment'.

In some aspects, the acknowledgment policy (ACK policy) field 730 and traffic indicator (TID) field 710 may be located elsewhere in the MAC header.

For example, an acknowledgment policy field and/or a TID field may be located in frame control field 610 of MAC header 602 .

[0100]

[00126] The "colorful" field 750 may be a variety of different fields, depending on the embodiment of the QoS control field 655.

For example, in some aspects the "various" fields 750 may be a TXOP limit field, an access point PS buffer status field, a requested TXOP duration field, a queue size field.

[0101]

[00127] In some aspects, the acknowledgment policy field 730 indicates a particular value, such as "ordinary acknowledgment or implicit block acknowledgment request", and MPDU frame 600 is part of an A-MPDU frame. , the intended recipient of the MPDU frame sends an acknowledgment frame if MPDU 600 is sent individually, or a block acknowledgment if MPDU 600 is sent as part of an A-MPDU. frame can be sent.

Transmission of acknowledgments or block acknowledgments may begin after a short interframe space (SIFS) time period from the PPDU carrying MPDU frame 600 .

In some aspects, if the acknowledgment policy field 730 indicates "no acknowledgment," the intended recipient of the MPDU frame takes no action after receiving the MPDU subframe.

In some aspects, if the acknowledgment policy field 730 indicates "block acknowledgment," the intended recipient of the MPDU frame takes no action after receipt of the frame except to record the state.

Receivers can expect future block acknowledgment request frames to which they will respond.

[0102]

[00128] FIG. 8 shows an exemplary structure of an aggregated MPDU (A-MPDU) frame 800. As shown in FIG.

As shown, A-MPDU frame 800 includes a varying number of A-MPDU subframes, denoted as 805a, 805b, and 805n.

Each of A-MPDU subframes 805a, 805b, and 805n may, in some aspects, consist of an MPDU delimiter field 810a, an MPDU frame 600a, and zero or more pad bytes.

MPDU frame 600a may, in some aspects, substantially correspond to MPDU frame 600 shown in FIG.

[0103]

[00129] Each of the MPDU delimiter fields, eg, MPDU delimiter field 810a, includes an end of frame (EOF) field 812a, a reserved field 814a, an MPDU length field 816a, a CRC field 818a, and a delimiter signature field 820a. obtain.

[0104]

[00130] In some aspects, the end field 812 of the frame is an A-MPDU subframe if the A-MPDU subframe 805a is the only A-MPDU subframe with an MPDU length field 816a having a non-zero value. It may be set to 1 in frame 805a.

In some aspects, the end of frame field 812a is not the only A-MPDU subframe with a non-zero MPDU length field in each A-MPDU frame 800 having a non-zero MPDU length field 816a. May be set to 0 for A-MPDU subframes 805 .

[0105]

[00131] Figure 9A shows an embodiment of an MPDU delimiter field 810b.

In some aspects, MPDU delimiter field 810b may be replaced with MPDU delimiter field 810a shown in FIG.

For example, A-MPDU 900a, discussed below with respect to FIG. 9C, may utilize MPDU delimiter field 810b.

MPDU delimiter field 810b includes four fields: delay indicator field 814b, MPDU length field 816b, CRC field 818b, and delimiter signature field 820b.

In some aspects, a separate copy of the delay indicator field 814b in each of the A-MPDU subframes 905a-c discussed below with respect to FIG. If included, it may indicate a delay indicator value 814m-o.

[0106]

[00132] Figure 9B shows an embodiment of an MPDU delimiter field 810c.

In some aspects, MPDU delimiter field 810c may be replaced with MPDU delimiter field 810a shown in FIG.

For example, A-MPDU 900a may utilize MPDU delimiter field 810c.

The MPDU delimiter field 810c includes five fields: an end of frame indicator field 812c, a delay indicator field 814c, an MPDU length field 816c, a CRC field 818c, and a delimiter signature field 820c.

In some aspects, a separate copy of the delay indicator field 814c may replace the delay indicator values 814m-o shown in FIG. can show

[0107]

[00133] FIG. 9C shows an A-MPDU 900a that includes at least three A-MPDU subframes 905a-c.

The first A-MPDU subframe 905a indicates a receiver address equivalent to the station address of STA 106a.

Similarly, the second A-MPDU subframe 905b indicates a receiver address equivalent to the station address of STA 106b.

The third subframe 905c shows the receiver address equivalent to the station address of STA 106c.

In some other not shown aspects, A-MPDU 900a may include more than three A-MPDU subframes.

For example, an A-MPDU may include 4, 5, 6, 7, 8, 9, 10 or more subframes.

In some aspects, some or all of any additional subframes in A-MPDU 900a may indicate receiver addresses of any of STAs 106a-c or other stations, access points, or relays.

[0108]

[00134] As discussed above with respect to MPDU 600 and QoS Control field 655, each A-MPDU sub-frame 905a-c of A-MPDU 900a shown in FIG. 9A includes a QoS Control field, or indication of an acknowledgment policy. It may contain some other fields.

For example, each A-MPDU subframe 905a-c may follow the format of MPDU 600, including QoS control fields as shown in FIG.

[0109]

[00135] In the implementation shown, the three A-MPDU subframes 905a-c included in A-MPDU 900a are mapped to receiver address fields, such as address 1 field 630 shown in MPDU frame 600 of FIG. , contains three different receiver addresses.

The three A-MPDU subframes included in A-MPDU 900a also include three different acknowledgment policies associated with three different receiver address fields.

[0110]

[00136] The acknowledgment procedure in the illustrated aspect includes one or more fields in the MPDU delimiter and an Ack policy field included in the MPDU with which the MPDU delimiter is associated, i.e., delay indicator fields 814m-o, if any EOF field, if any, and acknowledgment policy fields 730a-c.

In some aspects, the delay indicator fields 814m-o substantially follow the format of the delay indicator field 814 shown in FIG. 9A.

In some aspects, the acknowledgment policy fields 730a-c substantially follow the format of the acknowledgment policy field 730 of FIG.

[0111]

[00137] As shown in FIG. 9C, all three of the A-MPDU subframes 905a-c include an acknowledgment policy set to "normal acknowledgment."

In some wireless standards, such as the 802.11ah standard, this may correspond to a particular value such as "normal acknowledgment or implicit block acknowledgment request".

Each of the A-MPDU subframes 905a-c has a different delay indicator value.

[0112]

[00138] Based on the values of acknowledgment policy fields 730a-c and delay indicator fields 814m-o, A-MPDU 900a indicates that STA 106a should first acknowledge correct receipt of MPDU 905a.

In some aspects, A-MPDU subframe 905a should be acknowledged SIFS time after the completion of transmission/reception of A-MPDU 900a because the delay indicator is set to a value of 0.

Note that in general, one or more MPDUs may be directed to any of the STAs 106a-c.

In such an embodiment, if a single MPDU is destined for a given receiver, the receiver responds with an ACK frame if the EOF field is set to 1, or with a BlockAck otherwise. You can decide to respond.

Generally, in some aspects the amount of delay may be determined based on equation (1).

[0113]

[00139] where K equals the length of time required for the receiver to send a control response to the transmitter.

In some aspects, the transmitting device instructs one or more receivers to follow strict rules for transmission of response frames such that the length of time K is deterministic and equal for all receivers. can be requested to

Examples of these rules may include strict MCS and bandwidth selection rules, and (e.g., A-MPDU subframes addressed to each receiver indicating that an acknowledgment should be sent to A - May request the receiver to respond with the same response frame by including it in the MPDU, and the transmitter instructs the receiver to respond with an ACK frame for the corresponding A-MPDU subframe.

A similar rule may apply for requesting only Block Ack frames in response, in which case the length of time K may be longer).

[0114]

[00140] Within a particular A-MPDU frame, each delay indicator field is a unique value, at least for any A-MPDU subframe for which the transmitter requires an acknowledgment from the receiving device. can be set.

In some aspects, if an A-MPDU subframe is addressed to a group of STAs, the transmitter sets the ACK policy to "no acknowledgment," indicating that no acknowledgment is expected.

In some aspects, the delay indicator may be a value used by another MPDU subframe.

In some aspects, the delay indicator for A-MPDU subframes that indicate an acknowledgment policy of "no acknowledgment" may be a random or uninitialized value.

[0115]

[00141] In some aspects, if the acknowledgment policy for A-MPDU subframes is set to "normal acknowledgment or implicit block acknowledgment" after the delay determined by Equation 1 has elapsed , A-MPDU subframe acknowledgment transmission may be performed.

In FIG. 9C, all three subframes 905a-c may be acknowledged in this manner.

[0116]

[00142] Because delay indicator 814n for A-MPDU subframe 905b is 0, STA 106b must acknowledge A-MPDU subframe 905b

SIFS time after transmission of A-MPDU 900a.

In some aspects, A-MPDU 900a further has acknowledgment delay indicator field 814m set to 1, so that STA 106a will receive the MPDU after SIFS+1×(SIFS+K)=2SIFS+a certain amount of time from the transmission of A-MPDU 900a. Indicates that the transmission of subframe 905a must be acknowledged.

Similarly, A-MPDU 900a has acknowledgment delay indicator value field 814o set to 2, indicating that STA 106c must acknowledge transmission of MPDU subframe 905c 3SIFS+2K after transmission of A-MPDU 900a. show.

[0117]

[00143] By including different acknowledgment policies for the two or more, in this case three, receiver addresses indicated by A-MPDU 900a, AP 104 will allow three Receipt of one acknowledgment by one of the three devices (STAs 106a-c) corresponding to one receiver address can be effectively managed.

In this embodiment, some STAs, eg, 106a and 106c, may wait a period of time before sending an acknowledgment based on the indication in the A-MPDU subframe delimiter field.

In some aspects, this reduces the probability of conflict between at least two acknowledgments for at least two A-MPDU subframes included in A-MPDU 900a at SIFS time after transmission of A-MPDU 900a.

Although three A-MPDU subframes are indicated in A-MPDU frame 900a in FIG. 9C, in some aspects two or more receiver addresses may be indicated by A-MPDU 900a.

For example, A-MPDU 900a may include A-MPDU subframes destined for two or more devices.

Such A-MPDU also includes at least two different acknowledgment policies corresponding to at least two of the receiver addresses indicated by the A-MPDU subframes included in A-MPDU 900a.

Note that in some aspects, the AP may request different acknowledgment policies based on traffic identifiers (TIDs) and/or per MPDU.

Those skilled in the art will appreciate that the acknowledgment procedures described herein are readily extendable to these embodiments.

[0118]

[00144] In addition to having multiple receiver addresses in an A-MPDU as discussed above (where one or more of the A-MPDU subframes have different receiver addresses, A - one or more of the MPDU subframes may have a different transmitter address, which means that one or more of the A-MPDU subframes are being received by the transmitter from one or more different source devices It means that there is a possibility.

For example, a transmitter of an A-MPDU containing two or more MPDUs may set the A2 field 635 (i.e., the transmitter address) in each MPDU's MAC header to different MAC addresses, which is useful for reducing overhead. can be set.

Embodiments in which the transmitter may configure different transmitter addresses are when the transmitter is an AP with multiple BSSIDs (each BSSID identifies the BSS with which the AP is associated) and when the AP is associated with an AP. and when the AP needs to send multiple MPDUs to a STA associated with any of the BSSs.

A transmitter provides a relay or mesh function and operates to forward frames that need to be exchanged between multiple STAs that may not be within their respective transmission range, thus the transmitter There may be additional embodiments that may aggregate multiple MPDUs received from different STAs into an A-MPDU and send the A-MPDU to one or more destinations, where each MPDU is , has an A2 address that indicates the source address of the MPDU (ie, the STA that generated the frame).

For example, in some embodiments, a transmitter may have one or more MPDUs with a common A1 address (receiver) and A2 address (transmitter), different A1 addresses (receivers) and a common A2 address. (transmitters), one or more MPDUs (multiple receivers-single transmitter) with a common A1 address (receivers) and a different A2 address (transmitters) (single receiver - multiple transmitters) or one or more MPDUs (multiple receivers - multiple transmitters and can be aggregated.

Such aggregation can reduce overhead and increase media efficiency.

[0119]

[00145] FIG. 9D shows exemplary wireless communication between the AP 104 and three stations STA 106a, STA 106b, and STA 106c.

Wireless communication begins with AP 104 transmitting an A-MPDU packet 900a.

In some aspects, A-MPDU 900a may be broadcast.

In some other aspects, A-MPDU 900a may be multicast to a multicast group including stations STA 106a, STA 106b, and STA 106c.

In some aspects, the format of A-MPDU 900a shown in FIG. 9D may substantially follow the format of A-MPDU 900a shown in FIG. 9C and/or A-MPDU 800 shown in FIG.

[0120]

[00146] FIG. 9D shows that STA 106b transmits an acknowledgment packet 955 SIFS time after the transmission of A-MPDU 900a is completed.

STA 106b transmits acknowledgment packet 955 at the indicated time based on acknowledgment policy 730b and acknowledgment delay indicator value 814n in A-MPDU subframe 905b, shown in FIG. 9C.

STA 106a then transmits acknowledgment packet 960 2SIFS+constant K after the transmission of A-MPDU 900a is complete.

The time at which STA 106a transmits acknowledgment 960 is based on acknowledgment policy 730a indicated by A-MPDU subframe 905a and acknowledgment delay indicator value 814m, as shown in FIG. 9C.

Although the constant K is shown to be equivalent to the time required to send the acknowledgment 955, in some other aspects the constant time K is longer than the time required to send the acknowledgment 955, may be longer.

[0121]

[00147] In some aspects, the AP instructs the receiving STA to acknowledge receipt of the MPDU only if the MPDU is a unicast transmission (i.e., the address of the receiving STA is a unicast address). can do.

However, in some embodiments where a groupcast (broadcast) frame is included in the A-MPDU, the AP sends an acknowledgment response by including an empty MPDU in the A-MPDU addressed to a single STA. One STA can be selectively requested from the group set as follows.

The empty MPDU acknowledgment policy may be set to a specific value such as "normal acknowledgment or implicit block acknowledgment request".

This procedure can be useful in allowing a transmitter to estimate whether a groupcast packet is at least partially received by one receiver.

This procedure of selecting a receiver from a group of devices to acknowledge correct receipt of an MPDU in an A-MPDU is done by the sending device to determine if the A-MPDU may have collided with other network traffic. Those skilled in the art can appreciate that by allowing identification, the reliability of multicast transmissions can be improved.

The selection of responding devices may be based on one or more criteria, which may allow maximizing the reliability of acknowledgments.

[0122]

[00148] STA 106c then transmits an acknowledgment packet 965 3 SIFS + 2 constant K after the transmission of A-MPDU 900a is complete.

The time at which STA 106c sends acknowledgment 965 is based on acknowledgment policy 730c and acknowledgment delay indicator value 814o indicated by A-MPDU subframe 905c, as shown in FIG. 9C.

Although constant K is shown in FIG. 9D as being equivalent to the time required to send acknowledgment 960, in some other

aspects constant time K is required to send acknowledgment 960. longer than the required time.

[0123]

[00149] Figure 9E shows an embodiment of an A-MPDU 900b.

A-MPDU 900b includes at least three A-MPDU subframes 905d-f.

Each of the three A-MPDU subframes 905d-f is addressed to one of the STAs 106a-c, respectively.

The format of A-MPDU 900b may substantially follow the format of A-MPDU 800.

In some aspects, MPDU delimiter field format 810b may be utilized in A-MPDU 900b instead of MPDU delimiter 810a.

In some aspects, MPDU delimiter field format 810c may be utilized in A-MPDU 900b instead of either 810a or 810b.

[0124]

[00150] Similar to the A-MPDU subframes 905a-c of FIG. 9C, the A-MPDU subframes 905d-f each provide an acknowledgment delay indicator field value 814d-f and an acknowledgment policy field 730d-f. .

As shown in FIG. 9A, the format of delay indicator fields 814d-f may substantially match delay indicator field 814b of MPDU delimiter 810b.

In some aspects, the format of delay indicator fields 814d-f may substantially match delay indicator field 814c of MPDU delimiter 810c, as shown in FIG. 9B.

The format of acknowledgment policy fields 730d-f may substantially match acknowledgment policy field 730 of FIG.

[0125]

[00151] Similar to A-MPDU 900a of FIG. 9C, the first A-MPDU subframe 905d of A-MPDU 900b has the acknowledgment policy field 730d set to the value of normal acknowledgment.

Because the delay indicator value 814d of A-MPDU subframe 905d is set to 0, STA 106a acknowledges A-MPDU subframe 905d SIFS time after transmission of A-MPDU 900b.

Each of the A-MPDU subframes 905e-f show the acknowledgment policy field 730e-f set to "no acknowledgment."

Therefore, MPDUs 905e-f are not acknowledged by STAs 106b-c, respectively.

Because the policy field 730e-f is set to "no acknowledgment," in some aspects each of the STAs 106b and 106c may not decode the value of the delay indicator fields 814e-f or does not have to work.

[0126]

[00152] FIG. 9F illustrates exemplary wireless communication between the AP 104 and three STAs 106a-c.

Wireless communication begins with AP 104 transmitting an A-MPDU packet 900b.

In some aspects, A-MPDU 900b may be broadcast.

In some other aspects, A-MPDU 900b may be multicast to a multicast group including stations STA 106a, STA 106b, and STA 106c.

In some aspects, the format of A-MPDU 900b shown in FIG. 9F may substantially match A-MPDU 800 shown in FIG.

In some aspects, A-MPDU 900b may include three A-MPDU subframes.

One aspect of A-MPDU 900b is shown above in FIG. 9E.

[0127]

[00153] STA 106a then transmits an acknowledgment packet 970 SIFS time after the transmission of A-MPDU 900b is

completed.

STA 106a transmits acknowledgment packet 970 at the indicated time based on acknowledgment policy 730d and acknowledgment delay indicator value 814d indicated by A-MPDU subframe 905d, shown in FIG. 9E.

Because delay indicator value 814d of A-MPDU subframe 905d is set to 0, STA 106a acknowledges A-MPDU subframe 905 SIFS time after transmission of A-MPDU 900b.

[0128]

[00154] Unlike FIG. 9D, where STAs 106b-c each return an acknowledgment of A-MPDUs 905b-c to AP 104, FIG. indicates no response.

As shown in FIG. 9D, STAs 106b-c do not acknowledge A-MPDUs 905e-f based on acknowledgment policy fields 730e-f being set to a value of "no acknowledgment."

[0129]

[00155] Figure 10A shows an embodiment of an A-MPDU 900c.

A-MPDU 900c includes at least three A-MPDU subframes 905g-i.

Similar to the A-MPDU subframes 905a-f of FIGS. 9E-9F, the A-MPDU subframes 905g-i each indicate an acknowledgment delay indicator field value 814g-i and an acknowledgment policy field 730g-i value. .

In some aspects, each of A-MPDU subframes 905g-i may substantially conform to the format of A-MPDU 800 of FIG.

In some aspects, MPDU delimiter field 810 b may be replaced with MPDU delimiter field 810 a of A-MPDU 800 .

In some aspects, MPDU delimiter field 810 c may be replaced with MPDU delimiter field 810 a of A-MPDU 800 .

[0130]

[00156] The first A-MPDU subframe 905g of A-MPDU 900c indicates an acknowledgment policy field 730g of block acknowledgment.

This value indicates that the receiver of A-MPDU 905g should not acknowledge A-MPDU 905g SIFS time after A-MPDU 900c was transmitted/received.

Instead, acknowledgment policy field 730g indicates to STAs 106a receiving A-MPDU 905g that they should wait for an explicit acknowledgment request before acknowledging A-MPDU 905g.

Similarly, acknowledgment policy field 730h of A-MPDU subframe 905h also indicates block acknowledgment.

Therefore, A-MPDU 905h indicates that STA 106b should wait for an explicit block acknowledgment request before acknowledging A-MPDU 905h.

Acknowledgment policy field 730i of A-MPDU subframe 905i indicates that STAs 106c receiving A-MPDU 905i should acknowledge A-MPDU 905i SIFS time after transmission of A-MPDU 900c is complete; That is because the acknowledgment delay indicator field 814i of MPDU 905i is set to 0 as discussed above.

Because both acknowledgment policy fields 730g-h are set to block acknowledgment, the value of delay indicator fields 814g-h may be ignored by STAs 106a-b in some aspects.

[0131]

[00157] FIG. 10B shows exemplary wireless communication between the AP 104 and three STAs 106a-c.

First, AP 104 transmits A-MPDU 900c.

In some aspects, A-MPDU 900c provides field values equivalent to those shown in A-MPDU 900c of FIG. 10A.

As discussed above with respect to FIG. 10A, the A-MPDU subframe 905i shown in FIG. 10A, addressed to STA 106c, indicates

an acknowledgment policy of normal acknowledgment.

Therefore, STA 106c acknowledges A-MPDU subframe 905i SIFS time after the completion of transmission of A-MPDU frame 900c because delay indicator field 814i is 0.

This is indicated via the transmission of block acknowledgment frame 1005 .

[0132]

[00158] Since each of the A-MPDU subframes 905g-h indicates an acknowledgment policy of "block acknowledgment," STAs 106a-b will not send A-MPDU subframes 905g-h without an explicit block acknowledgment request. does not acknowledge the

Accordingly, as shown in FIG. 10B, AP 104 sends block acknowledgment request 1010 to STA 106b.

In response, STA 106b sends block acknowledgment 1015 for A-MPDU 905h SIFS time after receiving block acknowledgment request 1010. FIG.

Similarly, AP 104 sends block acknowledgment request 1020 to STA 106a.

In response, STA 106a sends a block acknowledgment message 1025 for A-MPDU 905g to AP 104 SIFS time after receiving block acknowledgment request 1020 .

[0133]

[00159] FIG. 10C shows an embodiment of an A-MPDU 900d.

A-MPDU 900d includes at least three A-MPDU subframes 905j-l.

A-MPDU 900d may conform to the frame field format described above with respect to A-MPDU 800.

For example, each A-MPDU subframe may include an MPDU Delimiter field and an MPDU field (neither explicitly shown).

As shown in exemplary MPDU delimiter field 810c shown in FIG. 9B, the MPDU delimiter fields for A-MPDU subframes 905j-l include EOF field 812j-l, delay indicator field 814j-l, and MPDU length field 812j-l. fields 816j-l.

The control field of each MPDU subframe 905j-l includes an acknowledgment policy field 730j-l.

[0134]

[00160] In some aspects, the EOF field 812 of the MPDU delimiter indicates whether the A-MPDU subframe should be acknowledged using an acknowledgment frame or a block acknowledgment frame. can indicate

For example, in some aspects, if the end of frame fields 812j-l are clear (0), then the block acknowledgment should be sent in response to receiving the corresponding A-MPDU subframe.

If the EOF field 812j-l is set to (1), an acknowledgment frame should be sent in response to receipt of the corresponding A-MPDU subframe.

The block acknowledgments and normal acknowledgments for the A-MPDU subframes shown in FIG. 10C may operate similarly to the previously disclosed embodiments, eg, FIGS. 9C-10B.

For example, each A-MPDU subframe 905g-i has an acknowledgment policy in fields 730j-l that operates similarly to the previously discussed acknowledgment policy fields, such as any of the acknowledgment policy fields 730a-i. can be stipulated.

Delay indicator fields 802j-l can also operate in a manner similar to any one of delay indicator fields 802a-l or 802m-o previously discussed.

[0135]

[00161] FIG. 10D shows exemplary wireless communication between the AP 104 and three STAs 106a-c.

First, AP 104 transmits A-MPDU 900d.

In some aspects, A-MPDU 900d indicates field values indicated by A-MPDU 900d in FIG. 10C.

[0136]

[00162] Because the delay indicator field 814l of A-MPDU subframe 905i contains a delay value of 0, STA 106c acknowledges the A-MPDU (905i) destined for STA 106c SIFS time after the transmission of A-MPDU 900d. do.

Since the EOF field 812l of A-MPDU subframe 905i is clear (0), STA 106c acknowledges the A-MPDU subframe with block acknowledgment frame 1055. FIG.

[0137]

[00163] Next, based on the delay indicator value 814j, the STA 106a transmits an acknowledgment frame 1060 at a time according to equation (1) above.

The acknowledgment frame is transmitted by STA 106a because EOF field 812j is set to one.

STA 106b then transmits an acknowledgment of A-MPDU subframe 905k based on delay indicator field 814k.

The acknowledgment frame 1065 is sent instead of the block acknowledgment frame because the EOF field 812k is set.

[0138]

[00164] FIG. 11A is a flowchart of one exemplary method of wireless communication.

In some aspects, process 1100 may be performed by wireless device 202 shown above with respect to FIG.

In some aspects, process 1100 may be performed by AP 104 .

[0139]

[00165] At block 1105, an aggregated media access control protocol data unit (A-MPDU) frame is generated by the wireless device.

An A-MPDU frame includes two or more A-MPDU subframes generated at block 1105 .

Each A-MPDU subframe contains a receiver address.

The A-MPDU frame comprises at least one indication for one or more acknowledgment policies associated with each receiver address in each A-MPDU subframe.

Each of the two or more A-MPDU subframes includes a control field that indicates one or more acknowledgment policies for each corresponding A-MPDU subframe.

In some aspects, more than two A-MPDU subframes are generated at block 1105 .

In some aspects, more than two different acknowledgment policies are indicated by the A-MPDU subframes generated at block 1105 .

In some aspects, two or more of the A-MPDU subframes within an A-MPDU frame may be generated to have the same receiver address.

In some embodiments, these acknowledgment policies may be indicated by control fields, delimiter fields, or a combination of control and delimiter fields in each of the A-MPDU subframes.

[0140]

[00166] In some aspects, the control field indicating the acknowledgment policy is the acknowledgment policy control field in the QoS control field of each of the A-MPDU subframes.

In some aspects, the format of the QoS Control field in each A-MPDU subframe may substantially match the QoS Control field 855 shown in FIG.

[0141]

[00167] In some aspects, the acknowledgment policy field of the QoS control frame may be set to a specific value, such as "normal acknowledgment or implicit block acknowledgment."

In some aspects, this value corresponds to 0b00.

When set to that particular value, the acknowledgment policy specifies that the acknowledgment for the corresponding A-MPDU subframe should be sent by the receiver of the A-MPDU subframe after some time delay, show.

In some aspects, the time delay is SIFS time after transmission/reception of an A-MPDU frame containing the A-MPDU subframe.

In order to reduce contention for acknowledgments sent for A-MPDU subframes, in some aspects the acknowledgment policy for only one of the A-MPDU subframes generated is "normal acknowledgment or Set to a specific value such as "implicit block acknowledgment".

[0142]

[00168] The acknowledgment policy field 730 in some A-MPDU subframes may be set to "no acknowledgment."

If set to "no acknowledgment", the receiver should not acknowledge the corresponding A-MPDU subframe.

In some aspects, a "no acknowledgment" value corresponds to 0b10.

In some aspects, the acknowledgment policy field may be set to a value of "block acknowledgment."

In some aspects, this value corresponds to 0b11.

If set to "block acknowledgment", the acknowledgment policy field indicates that the receiver of the corresponding A-MPDU subframe may receive a request for block acknowledgment message at a later time and that the corresponding A-MPDU Indicates that none of the subframe acknowledgments should be sent SIFS after the completion of reception of the A-MPDU containing the corresponding A-MPDU subframe.

[0143]

[00169] In some aspects, the acknowledgment policy is further indicated by a delay indicator field in the control field.

In some aspects, a delay indicator field may be included in the MPDU delimiter field.

For example, the delay indicator field may be as shown by delay indicator field 814b of MPDU delimiter field 810b in FIG. 9A.

In some other aspects, the delay indicator field may be as shown by delay indicator field 814a of MPDU delimiter field 810a of FIG.

In some other aspects, the delay indicator field may be as indicated by delay indicator field 814c of MPDU delimiter field 810c in FIG. 9B.

[0144]

[00170] The delay indicator field may indicate the delay to elapse before acknowledging the corresponding A-MPDU subframe.

In some aspects, the delay indicator field may indicate a backoff counter.

In some aspects, the delay indicator may represent multiple SIFS times or one SIFS time plus a counter value.

A device that receives the corresponding A-MPDU subframe may delay sending an acknowledgment by the determined delay value.

In some aspects, if the acknowledgment policy field is set to a particular value, such as "regular acknowledgment or implicit block acknowledgment" as discussed above, the delay indicator field is set to A - indicates the delay between the reception/transmission of an MPDU subframe or A-MPDU frame and the transmission time of the frame acknowledgment.

[0145]

[00171] In some aspects, the acknowledgment policy is indicated by an end of frame (EOF) field.

For example, in some aspects the A-MPDU subfield may include an MPDU delimiter field in a format substantially according to MPDU delimiter field 810a.

In these aspects, the acknowledgment policy may be indicated by the EOF field 812a of the MPDU delimiter 810a.

In some other aspects, the acknowledgment policy may be indicated by the EOF field 812c of the MPDU delimiter field 810c.

[0146]

[00172] At block 1110, an A-MPDU frame is transmitted by the wireless device.

When performed by a wireless device that includes one or more antennas, A-MPDU frames may be transmitted using one or more antennas.

[0147]

[00173] In some aspects, the method further includes transmitting, by the wireless device, a request for an acknowledgment to a receiver address indicated by one of the A-MPDU subframes.

In some aspects, this request is a block acknowledgment request.

A request for acknowledgment may be sent if the acknowledgment policy indicated by the A-MPDU subframe indicates a block acknowledgment policy.

At block 1115, a request for acknowledgment may be sent after a delay greater than the SIFS time from sending the A-MPDU.

This delay may provide an opportunity for one A-MPDU subframe in a transmitted A-MPDU frame to be acknowledged.

A-MPDU subframes with an acknowledgment policy set to a particular value, such as "normal acknowledgment or implicit block acknowledgment" may be acknowledged during this delay.

[0148]

[00174] In some aspects, the method further comprises receiving, by the wireless device, one or more acknowledgments for one or more of the A-MPDU subframes included in the transmitted A-MPDU frame. include.

In some aspects, at block 1115, one of these acknowledgments is received SIFS time after the completion of transmission of the A-MPDU frame.

For example, an A-MPDU frame with an acknowledgment policy set to a particular value, such as "normal acknowledgment or implicit block acknowledgment", or an A-MPDU frame with an end-of-frame indication set may It can be acknowledged during the delay.

[0149]

[00175] Some aspects may further base the timing of A-MPDU subframe acknowledgments on a delay indicator field, as discussed above.

For example, in some aspects, an A-MPDU subframe with an acknowledgment policy set to a particular value (such as "normal acknowledgment or implicit block acknowledgment" in the appropriate 802.11 standard) also has a delay indicator field set to 0 or a minimum delay value such that the A-MPDU subframe is acknowledged SIFS after the transmission of the A-MPDU frame is completed in block 1115. There is a need.

[0150]

[00176] As described above, other frames may be acknowledged in response to the transmission of explicit acknowledgment requests by the wireless device, such as block acknowledgment requests.

[0151]

[00177] FIG. 11B is a functional block diagram of an exemplary wireless device 1150 that may be utilized within the wireless communication system 100. As shown in FIG.

Device 1150 comprises A-MPDU frame generation circuitry 1155 and A-MPDU transmission circuitry 1160 .

A-MPDU frame generation circuitry 1155 may be configured to perform one or more of the functions discussed above with respect to block 1105 shown in FIG. 11A.

A-MPDU frame generation circuit 1155 may correspond to one or more of processor 404 and/or DSP 420 and/or processing system.

Device 1150 further comprises A-MPDU frame transmission circuitry 1160 .

In some aspects, A-MPDU frame transmission circuitry 1160 may be configured to perform one or more of the functions discussed above with respect to block 1110 .

In some aspects, A-MPDU frame transmission circuitry 1160 may include transmitter 410 .

In some aspects, the frame transmission circuitry may be further configured to transmit a request for acknowledgment to a receiver address indicated by one of the A-MPDU subframes.

In some implementations, means for generating an aggregated Media Access Control Protocol Data Unit (A-MPDU) frame comprising two or more A-MPDU subframes and/or two or more A-MPDU Means for generating MPDU subframes may include A-MPDU generation frame circuitry 1155 .

In some implementations, means for transmitting A-MPDU frames may comprise A-MPDU transmission circuitry.

[0152]

[00178] In some aspects, the device 1150 further comprises decoding circuitry.

The decoding circuitry is configured to decode block acknowledgments for A-MPDU subframes if the end of frame (EOF) field of the A-MPDU subframes generated by A-MPDU frame generation circuitry 1155 is set to zero. can be configured.

In some aspects, decoding circuitry may correspond to one or more of processor 404 and/or DSP 420 and/or processing system.

In some aspects, the decoding circuitry further acknowledges A-MPDU subframes if an end-of-frame (EOF) field of the A-MPDU subframes generated by A-MPDU frame generation circuitry 1155 is set. can be configured to decode.

In some aspects, the device 1150 further comprises decoding circuitry.

The decoding circuitry can decode acknowledgments of receipt of at least one of two or more A-MPDU subframes received after a delay of at least the short interframe spatial time from transmission of the A-MPDU frame.

In some aspects, decoding circuitry may correspond to processor 404 or DSP 420 and/or a processing system.

In some implementations, the means for decoding the acknowledgment of receipt may include a decoding circuit.

In some aspects, the device 1150 further comprises value setting circuitry.

The setting circuit may be configured to set a value in the end field of the frame to indicate the frame to be sent after reception according to the A-MPDU subframe acknowledgment policy.

In some aspects, configuration circuitry may correspond to processor 404 or DSP 420 and/or a processing system.

In some implementations the means for setting the value of the end field of the frame comprises a setting circuit.

[0153]

[00179] FIG. 12A is a flowchart of one exemplary method of wireless communication.

In some aspects, process 1200 may be performed by wireless device 202 shown above with respect to FIG.

In some aspects, process 1200 may be performed by STA 106 .

[0154]

[00180] At block 1205, an aggregated media access control protocol data unit (A-MPDU) frame is received by the wireless device.

An A-MPDU frame includes two or more A-MPDU subframes.

In some aspects, the A-MPDU subframes substantially follow the format of one of the frames 900a-d discussed above.

[0155]

[00181] At block 1210, the A-MPDU frame is decoded by the wireless device.

In some aspects, a receiving device identifies one or more of the A-MPDU subframes included in an A-MPDU frame addressed to the device.

In some aspects, this is accomplished by comparing the receiver address specified in each of the A-MPDU subframes to the wireless device's local device address.

In some aspects, the receiver addresses specified in one or more of the A-MPDU subframes are broadcast or multicast addresses.

In this case, the receiving device can determine whether its receiver address is included in the multicast group indicated by the multicast address of the A-MPDU subframe.

[0156]

[00182] Once the receiving device identifies the A-MPDU subframes destined for the receiver, the receiving device can determine the acknowledgment policy for each of the A-MPDU subframes destined for the receiver.

In some aspects, if the acknowledgment policy field of the QoS Control field of the A-MPDU subframe is set to "no acknowledgment," then no acknowledgment for a particular A-MPDU subframe is sent by the receiving device. .

If the acknowledgment policy field is set to "block acknowledgment," then the receipt of A-MPDU subframes may be remembered, but no acknowledgment is sent by the device until a subsequent acknowledgment request is received.

In some aspects, the received acknowledgment request is a block acknowledgment request.

[0157]

[00183] If the acknowledgment policy field of the QoS Control field is set to a particular value (such as the value corresponding to "ordinary acknowledgment or implicit block acknowledgment" in the appropriate 802.11 standard): The receiving device may send an acknowledgment SIFS time after the A-MPDU frame is completely received.

In some aspects, the acknowledgment transmission time is further based on the delay indicator field.

In some aspects, the Delay Indicator field is provided in the MPDU Delimiter field of the A-MPDU subframes.

For example, in some aspects the MPDU delimiter field may substantially conform to the format of MPDU delimiter field 810b, shown in FIG. 9B.

In some aspects, the delay indicator field may indicate a backoff value.

For example, the delay indicator field may indicate a multiple of SIFS time or a multiple of SIFS time plus a constant value that the receiver should wait before acknowledging the corresponding A-MPDU subframe.

[0158]

[00184] In some aspects, determining an acknowledgment policy for an A-MPDU subframe may be based on the end field of the frame.

In some aspects, an end-of-frame field is included in the MPDU delimiter field, as shown in MPDU delimiter field 810a or 810c.

In some aspects, if the End of Frame field is set, the A-MPDU acknowledgment is sent SIFS time after receipt of the A-MPDU frame.

In some aspects, if the end field of the frame is clear (0), then no acknowledgment of any A-MPDU subframe may be sent SIFS time after receipt of the A-MPDU frame.

[0159]

[00185] Some aspects further include receiving an acknowledgment request for one or more of the A-MPDU subframes included in the A-MPDU frame.

For example, if an A-MPDU subframe indicates an acknowledgment policy of "block acknowledgment", the receiver will not acknowledge the A-MPDU subframe until an explicit acknowledgment request is received.

When requesting an acknowledgment for a received A-MPDU subframe, the acknowledgment of the A-MPDU subframe may be sent based at least on whether the A-MPDU subframe is received.

[0160]

[00186] FIG. 12B is a functional block diagram of an exemplary wireless device 1250 that may be utilized within the wireless communication system 100. As shown in FIG.

Device 1250 comprises A-MPDU frame reception circuitry 1255 and A-MPDU frame decoding circuitry 1260 .

A-MPDU frame receive circuitry 1255 may be configured to perform one or more of the functions discussed above with respect to block 1205 shown in FIG. 12A.

A-MPDU frame receive circuitry 1255 may correspond to one or more of receivers 412 .

Device 1250 further comprises A-MPDU frame decoding circuitry 1260 .

A-MPDU frame decoding circuitry 1260 may be configured to perform one or more of the functions discussed above with respect to block 1210 shown in FIG. 12A.

In some aspects, A-MPDU frame decoding circuitry 1260 may correspond to processor 404 .

In some implementations, means for receiving aggregated Media Access Control Protocol Data Unit (A-MPDU) frames may include A-MPDU receive frame circuitry 1255 .

In some implementations, means for decoding two or more A-MPDU subframes based on a received A-MPDU frame, a receiver address corresponding to each of the two or more A-MPDU subframes or at least one of the two or more A-MPDU subframes decoded from the received A-MPDU frame is decoded for each of the two or more A-MPDU subframes Means for determining destined for a device based on the address may include A-MPDU decoding circuitry 1260 .

[0161]

[00187] In some aspects, the device 1250 further comprises decoding circuitry.

The decoding circuitry may be configured to decode A-MPDU subframes based on received A-MPDU frames.

The decoding circuitry may be configured to decode A-MPDU subframes based on received A-MPDU frames.

The decoding circuitry may be configured to decode receiver addresses corresponding to each of the two or more A-MPDU subframes.

The decoding circuitry may be configured to decode MPDU delimiter fields in at least one of the two or more A-MPDU subframes.

In some aspects, decoding circuitry may correspond to processor 404, DSP 420, and/or a processing system.

In some implementations, the means for decoding the A-MPDU subframes and the means for decoding the receiver address may include decoding circuitry.

[0162]

[00188] In some aspects, the device 1250 further comprises a decision circuit.

The decision circuit determines that at least one of the two or more A-MPDU subframes decoded from the received A-MPDU frame is based on the decoded receiver address for each of the two or more A-MPDU subframes. It may be configured to determine that it is addressed to the device.

The determination circuit may also be configured to determine the time delay that will elapse between receipt of the A-MPDU frame and transmission of the acknowledgment frame from values stored in the MPDU delimiter field.

In some aspects, the decision circuit may correspond to processor 404, DSP 420, and/or a processing system.

In some implementations, the means for determining may include a determining circuit.

[0163]

[00189] In some aspects, the device 1250 further comprises an acknowledgment policy decoding circuit.

Acknowledgment policy decoding circuitry based on at least one indication associated with a receiver address of each A-MPDU subframe in corresponding one or more fields of each of the two or more A-MPDU subframes. , to decode the acknowledgment policy for each of the two or more A-MPDU subframes.

In some aspects, acknowledgment decoding circuitry may correspond to processor 404 .

In some implementations, the means for decoding the acknowledgment policy may include acknowledgment decoding circuitry.

[0164]

[00190] In some aspects, the device 1250 further comprises an end of frame field decoding circuit.

The frame trailing field decoding circuitry may be configured to decode a value in a frame trailing field in at least one of the two or more A-MPDU subframes, the value representing the two or more A-MPDU subframes. Indicates the type of request for acknowledgment of receipt for each acknowledgment policy of the MPDU subframe.

In some aspects, end of frame decoding circuitry may correspond to processor 404, DSP 420, and/or a processing system.

In some implementations, the means for decoding the end field of the frame may include a frame end field decoding circuit.

[0165]

[00191] In some aspects, the device 1250 further comprises a frame generation circuit.

The frame generation circuit can generate an acknowledgment frame or a block acknowledgment frame for at least one of the two or more A-MPDU subframes based on the value in the tail field of the frame.

In some aspects, an end-of-frame generation circuit may correspond to processor 404, DSP 420, and/or a processing system.

In some implementations, the means for generating the acknowledgment frame may include frame generation circuitry.

[0166]

[00192] FIG. 13A is a flowchart of one exemplary method of wireless communication.

In some aspects, process 1300 may be performed by wireless device 202 shown above with respect to FIG.

In some aspects, process 1300 may be performed by STA 106 .

[0167]

[00193] At block 1305, an aggregated media access control protocol data unit (A-MPDU) frame is received by the wireless device.

At block 1310, two or more A-MPDU subframes of the received A-MPDU frame are decoded by the wireless device.

In some aspects, the decoded A-MPDU subframes substantially conform to the format of one of frames 900a-d discussed above.

[0168]

[00194] At block 1315, receiver addresses corresponding to each of the two or more A-MPDU subframes are decoded by the wireless device.

In some aspects, the receiver addresses specified in one or more of the A-MPDU subframes are broadcast or multicast addresses.

In this case, the receiving device can determine whether its receiver address is included in the multicast group indicated by the multicast address of the A-MPDU subframe.

[0169]

[00195] In some aspects, the device-performing process 1300 may compare each decoded receiver address to the local address of the decoding device.

If the receiver address in one or more of the A-MPDU subframes matches the local receiver address, the receiving device can then further decode the received A-MPDU subframes.

[0170]

[00196] Once the receiving device identifies the A-MPDU subframes destined for the receiving device, the receiving device can determine the acknowledgment policy for each of the A-MPDU subframes destined for the receiver.

For example, in some aspects a receiving device may decode the acknowledgment policy indicated by the receiver A-MPDU subframe.

In some aspects, the acknowledgment policy is indicated by one or more of the acknowledgment policy field in the control field, the delay indicator field in the MPDU delimiter field, and/or the end of frame field included in the MPDU delimiter field. obtain.

[0171]

[00197] In some aspects, if the acknowledgment policy field of the QoS Control field of the A-MPDU subframe is set to a value corresponding to "no acknowledgment," any acknowledgment of a particular A-MPDU subframe No response is sent by the receiving device.

If the acknowledgment policy field is set to "block acknowledgment," then reception of A-MPDU subframes may be remembered, but no acknowledgments are sent until subsequent acknowledgment requests are received.

In some aspects, the received acknowledgment request is a block acknowledgment request.

[0172]

[00198] If the Acknowledgment Policy field of the QoS Control field is set to a particular value, then in some aspects the particular value is a "normal acknowledgment or (corresponding to the "implicit block acknowledgment" value), the receiving device may send an acknowledgment SIFS time after the completion of reception of the A-MPDU frame.

In some aspects, the acknowledgment transmission time is further based on the delay indicator field.

In some aspects, the Delay Indicator field is provided in the MPDU Delimiter field of the A-MPDU subframes.

For example, in some aspects the MPDU delimiter field may substantially conform to the format of MPDU delimiter field 810b, shown in FIG. 9B.

In some aspects, the delay indicator field may indicate a backoff value.

For example, the delay indicator field may indicate a multiple of SIFS time or a multiple of SIFS time plus a constant value that the receiver should wait before acknowledging the corresponding A-MPDU subframe.

[0173]

[00199] In some aspects, determining an acknowledgment policy for an A-MPDU subframe may be based on the end field of the frame.

In some aspects, an end-of-frame field is included in the MPDU delimiter field, as shown in MPDU delimiter field 810a or 810c.

In some aspects, if the End of Frame field is set, the A-MPDU acknowledgment is sent SIFS time after receipt of the A-MPDU frame.

In some aspects, a block acknowledgment for an A-MPDU subframe may be sent SIFS time after receipt of the A-MPDU frame if the end field of the frame is clear (0).

In some other aspects, if the end field of the frame is clear (0), no acknowledgment is sent after SIFS time from receipt of the A-MPDU frame.

[0174]

[00200] Some aspects further include receiving an acknowledgment request for one or more of the A-MPDU subframes included in the A-MPDU frame.

For example, in some aspects, if an A-MPDU subframe indicates an acknowledgment policy of "block acknowledgment," the receiver does not acknowledge the A-MPDU subframe until receipt of an explicit block acknowledgment request. .

When requesting an acknowledgment for a received A-MPDU subframe, the acknowledgment of the A-MPDU subframe may be sent based at least on whether the A-MPDU subframe is received.

[0175]

[00201] FIG. 13B is a functional block diagram of an exemplary wireless device 1350 that may be utilized within the wireless communication system 100. As shown in FIG.

Device 1350 comprises A-MPDU frame reception circuitry 1355 , A-MPDU subframe decoding circuitry 1360 and receiver address decoding circuitry 1365 .

A-MPDU frame receive circuitry 1355 may be configured to perform one or more of the functions discussed above with respect to block 1305 shown in FIG. 13A.

A-MPDU frame receive circuitry 1355 may correspond to one or more of receivers 412 .

Device 1350 further comprises A-MPDU subframe decoding circuitry 1360 .

A-MPDU subframe decoding circuitry 1360 may be configured to perform one or more of the functions discussed above with respect to block 1310 shown in FIG. 13A.

In some aspects, A-MPDU subframe decoding circuitry 1360 may be configured to decode an acknowledgment policy for one A-MPDU subframe.

In some aspects, A-MPDU subframe decoding circuitry 1360 may be further configured to decode the end field of a frame in an A-MPDU subframe.

In some aspects, A-MPDU subframe decoding circuitry 1360 may correspond to processor 404 and/or DSP 420 and/or processing system.

Device 1350 further comprises receiver address decoding circuitry 1365 .

Receiver address decoding circuitry 1365 may be configured to perform one or more of the functions discussed above with respect to block 1315 shown in FIG. 13A.

In some aspects, receiver address decoding circuitry 1365 may correspond to processor 404 and/or DSP 420 and/or processing

system.

[0176]

[00202] In some aspects, the device 1350 may further include a decision circuit.

In some aspects the determining circuit may be further configured to determine a time delay for transmitting the control frame.

The decision circuit may be configured to decide a time delay for transmitting the control frame based on the A-MPDU delimiter field of the A-MPDU subframe.

In some aspects, the decision circuit may correspond to processor 404 and/or DSP 420 and/or processing system.

[0177]

[00203] Some aspects of the device 1350 may further include transmission circuitry.

The transmitting circuitry may be configured to transmit control frames if the acknowledgment policy is set to a particular value.

In some aspects, a transmit circuit may correspond to transmitter 410 .

[0178]

[00204] In some aspects, the device 1350 may further include a receiver circuit.

The receiving circuitry may be configured to receive requests for acknowledgments for A-MPDU subframes.

In some aspects, receiving circuitry may correspond to receiver 412 .

[0179]

[00205] The term "determining" as used herein encompasses a wide variety of activities.

For example, "determining" means calculating, calculating, processing, deriving, examining, searching (e.g., searching in a table, database, or another data structure).), verifying, etc.

Also, "determining" can include receiving (eg, receiving information), accessing (eg, accessing data in memory), and the like.

Also, "determining" can include resolving, selecting, choosing, establishing and the like.

Further, "channel width" as used herein may in some aspects encompass or be referred to as bandwidth.

[0180]

[00206] As used herein, a phrase referring to "at least one of" a list of items refers to any combination of those items, including single members.

As an example, "at least one of a, b, or c" includes a, b, c, a-b, ac, b-c, and a-b-c. intended to include.

[0181]

[00207] The various operations of the methods described above may be performed by any suitable means capable of performing those operations, such as various hardware and/or software components, circuits, and/or modules. can be performed by

Generally, any operations illustrated in the figures may be performed by corresponding functional means capable of performing the operations.

[0182]

[00208] As used herein, the term interface may refer to hardware or software configured to connect two or more devices

together.

For example, an interface may be part of a processor or a bus, and may be configured to allow communication of information or data between devices.

The interface can be built into a chip or other device.

For example, in some embodiments an interface may comprise a receiver configured to receive information or communications from one device at another device.

An interface (eg, processor or bus) may receive information or data to be processed by the front-end device or another device, or may process received information.

In some embodiments, an interface may comprise a transmitter configured to transmit or communicate information or data to another device.

Thus, an interface can transmit information or data or prepare output information or data for transmission (eg, over a bus).

[0183]

[00209] The various exemplary logic blocks, modules and circuits described in connection with this disclosure are general purpose processors, digital signal processors (such as general purpose processors) designed to perform the functions described herein. DSP), application specific integrated circuits (ASICs), field programmable gate array signals (FPGAs) or other programmable logic devices (PLDs), discrete gate or transistor logic, discrete hardware components, or any combination thereof, or can be performed.

A general purpose processor may be a microprocessor, but in the alternative, the processor may be any commercially available processor, controller, microcontroller or state machine.

Also, a processor may be implemented as a combination of computing devices, such as a DSP and microprocessor combination, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration. obtain.

[0184]

[00210] In one or more aspects, the functions described may be implemented in hardware, software, firmware, or any combination thereof.

If implemented in software, the functions can be stored on or transmitted over a computer-readable medium as one or more instructions or code.

Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another.

A storage media may be any available media that can be accessed by a computer.

By way of example, and not limitation, such computer readable media may include RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any storage of instructions or data structures. Any other medium that can be used to carry or store the desired program code in form and that can be accessed by a computer.

Also, any connection is properly termed a computer-readable medium.

For example, the software may be transmitted from a website, server, or other remote source using coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave; in some cases, coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium.

As used herein, disk and disc refer to compact disc (CD), laser disc (disc), optical disc (disc), digital versatile disc (DVDs), floppy disks and Blu-ray disks, where a disk usually reproduces data magnetically and a disc reproduces the data optically with a laser.

Thus, in some aspects computer readable medium may comprise non-transitory computer readable medium (eg, tangible media).

In addition, in some aspects computer readable medium may comprise transitory computer readable medium (eg, a signal).

Combinations of the above should also be included within the scope of computer-readable media.

[0185]

[00211] Accordingly, some aspects may comprise a computer program product for performing the operations presented herein.

For example, such a computer program product may have instructions stored (and/or encoded) that are executable by one or more processors to perform the operations described herein. , may comprise a computer-readable medium.

In some aspects a computer program product may include packaging materials.

[0186]

[00212] The methods disclosed herein comprise one or more steps or actions for achieving the described method.

The method steps and/or actions may be interchanged with one another without departing from the scope of the claims.

In other words, unless a specific order of steps or activities is specified, the order and/or use of specific steps and/or activities may be modified without departing from the scope of the claims.

[0187]

[00213] Software or instructions may also be transmitted over a transmission medium.

For example, software transmitted from a website, server, or other remote source using coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave; Where applicable, coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of transmission medium.

[0188]

[00214] Furthermore, modules and/or other suitable means for performing the methods and techniques described herein may be downloaded by user terminals and/or base stations, where applicable; /or may be obtained in other ways.

Such devices may be coupled to servers, for example, to facilitate transfer of means for performing the methods described herein.

Alternatively, the various methods described herein are stored in a storage means (such as a storage means (For example, RAM, ROM, a physical storage medium such as a compact disc (CD) or floppy disk, etc.).

In addition, any other suitable technique for providing a device with the methods and techniques described herein may be utilized.

[0189]

[00215] It is to be understood that the claims are not limited to the precise configuration and components shown above.

Various modifications, changes and variations may be made in the arrangement, operation and details of the methods and apparatus described above without departing from the scope of the claims.

[0190]

[00216] While the above description is directed to aspects of the present disclosure, other and further aspects of the disclosure may be devised without departing from the basic scope of the disclosure. The scope of the disclosure is determined by the following claims.

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最終頁に続く

(54)【発明の名称】ワイヤレスネットワークにおいて多宛先トラフィックを通信するためのシステムおよび方法

(57)【要約】
多宛先トラフィックを通信するためのシステム、方法、および装置が提供される。本開示の一態様は、ワイヤレス通信の方法を提供する。方法は、２つのメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）サブフレームを生成することと、Ａ－ＭＰＤＵサブフレームは各々異なる受信機アドレスを備える、２つの集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、Ａ－ＭＰＤＵは２つの異なる受信機アドレスと関連付けられる２つの異なる肯定応答ポリシーをシグナリングする、Ａ－ＭＰＤＵフレームを送信することとを含む。

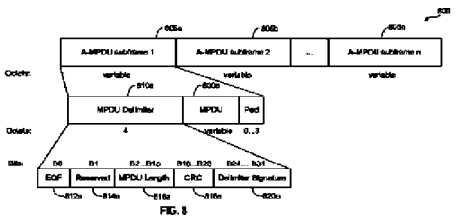


FIG. 8

【特許請求の範囲】
【請求項１】
装置によって、２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、
送信のために前記Ａ－ＭＰＤＵフレームを出力することとを備える、ワイヤレス通信の方法。
【請求項２】
前記１つまたは複数の肯定応答ポリシーが、前記Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて示される、請求項１に記載の方法。
【請求項３】
前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、請求項１に記載の方法。
【請求項４】
前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることを示す、請求項３に記載の方法。
【請求項５】
前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つが特定の値に設定される場合に前記制御応答フレームが送信されるべきであることを示す、請求項３に記載の方法。
【請求項６】
前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つがさらに、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、前記ＭＰＤＵデリミタフィールドが、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの肯定応答が送信されるまでに経過することになる時間遅延を示す値を記憶する、請求項１に記載の方法。
【請求項７】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにおいても示されるバックオフ値に基づく、請求項６に記載の方法。
【請求項８】
前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、請求項７に記載の方法。
【請求項９】
前記Ａ－ＭＰＤＵフレームを生成することが、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成することを備え、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、請求項１に記載の方法。
【請求項１０】
前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の前記肯定応答を受信することをさらに備える、請求項９に記載の方法。
【請求項１１】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つにおいて前記フレームの末尾フィールドの前記値を設定することをさらに備える、請求項９に記載の方法。

【請求項１２】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つにおいて前記フレームの末尾フィールドの前記値を設定することをさらに備える、請求項９に記載の方法。

【請求項１３】

２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、

送信のために前記Ａ－ＭＰＤＵフレームを出力するためのインターフェースとを備える、ワイヤレス通信のための装置。

【請求項１４】

前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて前記１つまたは複数の肯定応答ポリシーを示すように構成される、請求項１３に記載の装置。

【請求項１５】

前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、請求項１３に記載の装置。

【請求項１６】

前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることを示す、請求項１５に記載の装置。

【請求項１７】

前記処理システムがさらに、前記制御応答フレームが送信のために出力されるべきであることを示すように、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つを特定の値に設定するように構成される、請求項１５に記載の装置。

【請求項１８】

前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、前記処理システムが、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの肯定応答が送信のために出力されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記憶された値を設定するように構成される、請求項１３に記載の装置。

【請求項１９】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにおいても示されるバックオフ値に基づく、請求項１８に記載の装置。

【請求項２０】

前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、請求項１９に記載の装置。

【請求項２１】

前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成するように構成され、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、請求項１３に記載の装置。

【請求項２２】

前記処理システムがさらに、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の前記肯定応答を復号するように構成される、請求項２１に記載の装置。

【請求項２３】

前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの前記値を設定し、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信された肯定応答フレームを復号するように構成される、請求項２１に記載の装置。

【請求項２４】

前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの前記値を設定し、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信されたブロック肯定応答フレームを復号するように構成される、請求項２１に記載の装置。

【請求項２５】

少なくとも１つのアンテナと、

２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、

前記少なくとも１つのアンテナを使用して前記Ａ－ＭＰＤＵフレームを送信するように構成される送信機とを備える、ワイヤレス通信のためのワイヤレスノード。

【請求項２６】

２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するための手段と、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、

前記Ａ－ＭＰＤＵフレームを送信するための手段とを備える、装置。

【請求項２７】

Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて前記１つまたは複数の肯定応答ポリシーを示すように構成される、請求項２６に記載の装置。

【請求項２８】

前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、請求項２６に記載の装置。

【請求項２９】

前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つが、前記２つ以上のＡ－

ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることをさらに示す、請求項２８に記載の装置。

【請求項３０】

Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記Ａ－ＭＰＤＵフレームの受信の後に前記制御応答フレームが送信のために出力されるべきであることをさらに示すように、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つを特定の値に設定するように構成される、請求項２８に記載の装置。

【請求項３１】

前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つがさらに、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から対応するＡ－ＭＰＤＵサブフレームの肯定応答が送信されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記憶された値を設定するように構成される、請求項２６に記載の装置。

【請求項３２】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにも示されるバックオフ値に基づく、請求項３１に記載の装置。

【請求項３３】

前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、請求項３２に記載の装置。

【請求項３４】

前記Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成することを備え、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、請求項２６に記載の装置。

【請求項３５】

前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の肯定応答を復号するための手段をさらに備える、請求項３４に記載の装置。

【請求項３６】

２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの値を設定するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信された肯定応答フレームを復号するための手段とをさらに備える、請求項３４に記載の装置。

【請求項３７】

２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの値を設定するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信されたブロック肯定応答フレームを復号するための手段とをさらに備える、請求項３４に記載の装置。

【請求項３８】

実行されると、装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であって、前記方法が、

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）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、
前記Ａ－ＭＰＤＵフレームを送信することとを備える、コンピュータプログラム製品。
【請求項３９】
装置によって、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信することと、
前記装置によって、前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、
前記装置によって、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することと、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定することとを備える、ワイヤレス通信の方法。
【請求項４０】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドにおいて各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する１つまたは複数の肯定応答ポリシーを復号することをさらに備える、請求項３９に記載の方法。
【請求項４１】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成することと、前記フレームを送信のための出力することとをさらに備える、請求項４０に記載の方法。
【請求項４２】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号することをさらに備え、ここにおいて、前記フレームの末尾フィールド中の前記値が１である場合、送信のために生成され出力される前記フレームが肯定応答フレームである、請求項４１に記載の方法。
【請求項４３】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号することをさらに備え、ここにおいて、前記フレームの末尾フィールド中の前記値が０である場合、送信のために生成され出力される前記フレームがブロック肯定応答フレームである、請求項４１に記載の方法。
【請求項４４】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号することと、前記値は、前記２つ以上のＡ－ＭＤＰＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、
前記フレームの末尾フィールド中の前記復号された値が１である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信に肯定応答する肯定応答フレームを生成することと、
前記肯定応答フレームを送信のために出力することとをさらに備える、請求項４０に記載の方法。
【請求項４５】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾

フィールド中の値を復号することと、前記復号された値は、前記２つ以上のＡ－ＭＤＰＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーの受信の肯定応答に対する要求のタイプを示す、
前記フレームの末尾フィールド中の前記復号された値が０である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信に肯定応答するブロック肯定応答フレームを生成することと、
前記ブロック肯定応答フレームを送信のために出力することとをさらに備える、請求項４０に記載の方法。
【請求項４６】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号することと、
前記Ａ－ＭＰＤＵフレームの受信から前記肯定応答フレームを送信のために出力するまでに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定することと、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信のために出力することとをさらに備える、請求項４４に記載の方法。
【請求項４７】
前記ＭＰＤＵデリミタフィールドに記憶されている前記値がバックオフ値である、請求項４６に記載の方法。
【請求項４８】
前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、請求項４７に記載の方法。
【請求項４９】
前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成することと、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーに基づいて、前記Ａ－ＭＤＰＵフレームの送信から短い時間間フレーム空間時間以上の遅延の後に、受信の前記肯定応答を送信のために出力することとをさらに備える、請求項４０に記載の方法。
【請求項５０】
集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信し、
前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定する
ように構成される処理システムを備える、ワイヤレス通信のための装置。
【請求項５１】
前記処理システムがさらに、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドにおいて各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するように構成される、請求項５０に記載の装置。
【請求項５２】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィー

ルドの前記特定の値に基づいてフレームを生成し、前記フレームを送信のための出力するように構成される、請求項５１に記載の装置。

【請求項５３】

前記処理システムがさらに、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、前記処理システムがさらに、前記フレームの末尾フィールド中の前記値が１である場合、前記フレームを送信のために肯定応答フレームとして生成するように構成される、請求項５２に記載の装置。

【請求項５４】

前記処理システムがさらに、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、前記処理システムがさらに、前記フレームの末尾フィールド中の前記値が０である場合、前記フレームを送信のためにブロック肯定応答フレームとして生成するように構成される、請求項５２に記載の装置。

【請求項５５】

前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、前記値は前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、さらに、前記フレームの末尾フィールド中の前記値が１である場合、送信のために肯定応答フレームを生成するように構成される、請求項５１に記載の装置。

【請求項５６】

前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、前記値は前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、さらに、前記フレームの末尾フィールド中の前記値が０である場合、送信のためにブロック肯定応答フレームを生成するように構成される、請求項５１に記載の装置。

【請求項５７】

前記処理システムがさらに、

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号し、

前記Ａ－ＭＰＤＵフレームの受信から前記肯定応答フレームの送信までに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定し、

前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信のために生成するように構成される、請求項５５に記載の装置。

【請求項５８】

前記ＭＰＤＵデリミタフィールドに記憶されている前記値がバックオフ値である、請求項５７に記載の装置。

【請求項５９】

前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、請求項５８に記載の装置。

【請求項６０】

前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記肯定応答ポリシーに基づいて、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で前記装置に宛てられる、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を送信の

ために生成するように構成される、請求項５１に記載の装置。
【請求項６１】
少なくとも１つのアンテナと、
前記アンテナを介して集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するように構成される受信機と、
前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームと、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスとを復号し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記ワイヤレスノードに宛てられると決定する
ように構成される処理システムとを備える、ワイヤレス通信のためのワイヤレスノード。
【請求項６２】
集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するための手段と、
前記受信されたＡ－ＭＰＤＵフレームに基づいて２つ以上のＡ－ＭＰＤＵサブフレームを復号するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームから復号された前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定するための手段とを備える、ワイヤレス通信のための装置。
【請求項６３】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドの中の各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するための手段をさらに備える、請求項６２に記載の装置。
【請求項６４】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成するための手段と、前記フレームを送信するための手段とをさらに備える、請求項６３に記載の装置。
【請求項６５】
復号するための前記手段がさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、生成するための前記手段が、肯定応答フレームを生成するように構成され、送信するための前記手段がさらに、前記フレームの末尾フィールド中の前記値が１である場合、前記肯定応答フレームを前記フレームとして送信するように構成される、請求項６４に記載の装置。
【請求項６６】
復号するための前記手段がさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、生成するための前記手段が、肯定応答フレームを生成するように構成され、送信するための前記手段がさらに、前記フレームの末尾フィールド中の前記値が０である場合、ブロック肯定応答フレームを前記フレームとして送信するように構成される、請求項６４に記載の装置。
【請求項６７】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、前記値は、前記２つ以上のＡ－ＭＰＤＵサブ

フレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、
前記フレームの末尾フィールド中の前記値が１である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する肯定応答フレームを生成するための手段と、
前記肯定応答フレームを送信するための手段とをさらに備える、請求項６３に記載の装置。
【請求項６８】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、前記値は、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、
前記フレームの末尾フィールド中の前記値が０である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対するブロック肯定応答フレームを生成するための手段と、
前記ブロック肯定応答フレームを送信するための手段とをさらに備える、請求項６３に記載の装置。
【請求項６９】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルユニット（ＭＰＤＵ）デリミタフィールドを復号するための手段と、
前記Ａ－ＭＰＤＵフレームの受信から前記肯定応答フレームの送信までに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信するための手段とをさらに備える、請求項６７に記載の装置。
【請求項７０】
前記ＭＰＤＵデリミタフィールド中の前記値がバックオフ値である、請求項６９に記載の装置。
【請求項７１】
短フレーム間空間時間と定数値の少なくとも１つに基づく、前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値、請求項７０に記載の装置。
【請求項７２】
前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する前記肯定応答ポリシーがブロック肯定応答ポリシーを示す場合、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で、受信の前記肯定応答を送信するための手段とをさらに備える、請求項６３に記載の装置。
【請求項７３】
実行されると、装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であって、前記方法が、
集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信することと、
前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することと、
前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定することとを備える、コンピュータプログラム製品。

【請求項７４】
前記装置によって、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すために、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定することをさらに備える、請求項１に記載の方法。
【請求項７５】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するように構成される、請求項１３に記載の装置。
【請求項７６】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すために、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するための手段をさらに備える、請求項２６に記載の装置。
【発明の詳細な説明】
【技術分野】
【０００１】
[0001]本出願は、全般にワイヤレス通信に関し、より詳細には、多宛先トラフィックを通信するためのシステム、方法、およびデバイスに関する。
【背景技術】
【０００２】
[0002]多くの電気通信システムでは、通信ネットワークは、いくつかの対話している空間的に離れたデバイス間でメッセージを交換するために使用される。ネットワークは、たとえばメトロポリタンエリア、ローカルエリア、またはパーソナルエリアであり得る地理的範囲に従って分類され得る。そのようなネットワークは、それぞれ、ワイドエリアネットワーク（ＷＡＮ）、メトロポリタンエリアネットワーク（ＭＡＮ）、ローカルエリアネットワーク（ＬＡＮ）、ワイヤレスローカルエリアネットワーク（ＷＬＡＮ）、またはパーソナルエリアネットワーク（ＰＡＮ）と呼ばれる。ネットワークはまた、様々なネットワークノードとデバイスとを相互接続するために使用される交換／ルーティング技術（たとえば、回線交換対パケット交換）、送信に利用される物理媒体のタイプ（たとえば、有線対ワイヤレス）、および使用される通信プロトコルのセット（たとえば、インターネットプロトコルスイート、ＳＯＮＥＴ（同期光ネットワーキング）、イーサネット（登録商標）など）によって異なる。
【０００３】
[0003]ワイヤレスネットワークは、ネットワーク要素がモバイルであり、したがって動的な接続性を必要とするとき、またはネットワークアーキテクチャが固定されたトポロジでなくアドホックなトポロジで形成される場合に、好ましいことが多い。ワイヤレスネットワークは、無線、マイクロ波、赤外線、光などの周波数帯域中の電磁波を使用する非誘導伝搬モードでは、無形物理媒体を利用する。ワイヤレスネットワークは、有利には、固定された有線ネットワークと比較すると、ユーザのモビリティと迅速なフィールド展開とを容易にする。
【０００４】
[0004]しかしながら、複数のワイヤレスネットワークが、同じビル、近くのビル、および／または同じ屋外エリアの中に存在することがある。複数のワイヤレスネットワークの普及は、（たとえば、各ワイヤレスネットワークが同じエリアおよび／もしくは周波数帯において動作しているので）干渉、スループットの低下を招くことがあり、ならびに／またはいくつかのデバイスが通信するのを妨げることがある。したがって、ワイヤレスネットワークの密度が高いときに通信するための改善されたシステム、方法、およびデバイスが望まれる。
【発明の概要】
【０００５】
[0005]本発明のシステム、方法、およびデバイスは各々、いくつかの態様を有し、それ

らのうちのいずれの単一の態様も単独では本発明の望ましい属性を担わない。以下の特許請求の範囲によって表される本発明の範囲を限定することなく、ここでいくつかの特徴が簡単に論じられる。この議論を考慮した後、特に「発明を実施するための形態」と題されるセクションを読んだ後で、本発明の特徴が、ワイヤレスネットワーク中のアクセスポイントと局との間の改善された通信を含む利点をどのように提供するかが理解されるだろう。

【０００６】

[0006]本開示の一態様は、ワイヤレス通信の方法を提供する。一態様では、方法は、ワイヤレスデバイスによって、２つ以上のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）サブフレームを備える集約された（aggregated）ＭＰＤＵ（Ａ－ＭＰＤＵ）フレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、ワイヤレスデバイスによって、Ａ－ＭＰＤＵフレームを送信のために出力することとを含む。

【０００７】

[0007]いくつかの態様では、１つまたは複数の肯定応答ポリシーは、Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて示される。いくつかの態様では、１つまたは複数の肯定応答ポリシーの少なくとも１つは、Ａ－ＭＰＤＵの受信の後に制御応答フレームが送信されるべきであることを示す。いくつかの態様では、１つまたは複数の肯定応答ポリシーは、Ａ－ＭＰＤＵの受信からＳＩＦＳ時間後に肯定応答が送信されるべきであることを示す。

【０００８】

[0008]いくつか態様では、１つまたは複数の肯定応答ポリシーの少なくとも１つは、１つまたは複数の肯定応答ポリシーの少なくとも１つが、「普通の肯定応答または暗黙的なブロック肯定応答要求」値のような特定の値に設定されるときに、制御応答フレームが送信されるべきであることを示す。

【０００９】

[0009]方法のいくつかの態様では、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つはＡ－ＭＰＤＵデリミタフィールドを備え、Ａ－ＭＰＤＵデリミタフィールドは対応するＡ－ＭＰＤＵサブフレームの肯定応答の時間遅延を示す。いくつかの態様では、時間遅延は、Ａ－ＭＰＤＵデリミタフィールドにも含まれるバックオフ値に基づく。いくつかの態様では、バックオフ値はＳＩＦＳ時間と定数値の少なくとも１つに基づく。

【００１０】

[0010]いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフィールドにおける受信の肯定応答に対する要求を生成することを含み、このフィールドはフレームの末尾フィールドの値と肯定応答ポリシーフィールドの値の少なくとも１つに基づく値を備え、フィールド中の値は受信の肯定応答に対する要求のタイプを決定する。これらの態様のいくつかでは、受信の肯定応答は、Ａ－ＭＰＤＵの送信からＳＩＦＳ時間以上の遅延の後に受信される。

【００１１】

[0011]いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプが肯定応答フレームであることを示すように、Ａ－ＭＰＤＵフレーム中の２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つにおいてフレームの末尾（ＥＯＦ）フィールドの値を設定することを含む。いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプがブロック肯定応答フレームであることを示すように、Ａ－ＭＰＤＵフレーム中の２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つにおいてフレームの末尾（ＥＯＦ）フィールドの値を設定することを含む。

【００１２】

[0012]開示される別の態様は、ワイヤレス通信のための装置である。装置は、２つ以上のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）サブフレームを備える集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、Ａ－ＭＰＤＵフレームを送信のために出力するためのインターフェースとを含む。

【００１３】

[0013]いくつかの態様では、処理システムは、Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて１つまたは複数の肯定応答ポリシーを示すように構成される。いくつかの態様では、１つまたは複数の肯定応答ポリシーの１つは、Ａ－ＭＰＤＵフレームの受信の後に制御応答フレームが送信されるべきであることを示す。いくつかの態様では、肯定応答ポリシーは、Ａ－ＭＰＤＵフレームの受信からＳＩＦＳ時間後に肯定応答が送信されるべきであることを示す。

【００１４】

[0014]いくつか態様では、処理システムは、１つまたは複数の肯定応答ポリシーの少なくとも１つを、「普通の肯定応答または暗黙的なブロック肯定応答要求」値のような特定の値に設定するように構成される。いくつかの態様では、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つはＡ－ＭＰＤＵデリミタフィールドを備え、処理システムは、対応するＡ－ＭＰＤＵサブフレームの肯定応答の時間遅延を示すように、Ａ－ＭＰＤＵデリミタフィールドを設定するように構成される。

【００１５】

[0015]いくつかの態様では、時間遅延は、Ａ－ＭＰＤＵデリミタフィールドにも含まれるバックオフ値に基づく。いくつかの態様では、バックオフ値はＳＩＦＳ時間と定数値の少なくとも１つに基づく。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の受信スズフィールドの肯定応答に対する要求を生成するように構成され、このフィールドはフレームの末尾フィールドの値と肯定応答ポリシーフィールドの値の少なくとも１つに基づく値を備え、さらに、フィールド中の値は受信の肯定応答に対する要求のタイプを決定する。いくつかの態様では、処理システムはさらに、Ａ－ＭＰＤＵの送信からＳＩＦＳ時間以上の遅延の後に受信される２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を復号するように構成される。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプが肯定応答フレームであることを示すように、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つにおいてフレームの末尾フィールドの値を設定し、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信された肯定応答フレームを復号するように構成される。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプがブロック肯定応答フレームであることを示すように、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つにおいてフレームの末尾フィールドの値を設定し、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信されたブロック肯定応答フレームを復号するように構成される。

【００１６】

[0016]開示される別の態様は、アクセスポイントである。アクセスポイントは、少なくとも１つのアンテナと、２つ以上のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）サブフレームを備える集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、少なくとも１つの

アンテナを使用してＡ－ＭＰＤＵフレームを送信するように構成される送信機とを含む。

【００１７】

[0017]開示される別の態様は、装置である。装置は、２つのメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）サブフレームを備える集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを生成するための手段と、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、Ａ－ＭＰＤＵフレームを送信するための手段とを含む。

【００１８】

[0018]いくつかの態様では、２つ以上のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）サブフレームを生成するための手段は、処理システムである。いくつかの態様では、２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するための手段は、処理システムである。いくつかの態様では、Ａ－ＭＰＤＵフレームを送信するための手段は送信機である。

【００１９】

[0019]いくつかの態様では、２つ以上のＭＰＤＵサブフレームを生成するための手段は、Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて１つまたは複数の肯定応答ポリシーを示すように構成される。いくつかの態様では、１つまたは複数の肯定応答ポリシーの１つは、Ａ－ＭＰＤＵの受信の後に制御応答フレームが送信されるべきであることを示す。いくつかの態様では、肯定応答ポリシーは、Ａ－ＭＰＤＵの受信からＳＩＦＳ時間後に肯定応答が送信されるべきであることを示す。いくつかの態様では、２つ以上のＭＰＤＵサブフレームを生成するための手段は、１つまたは複数の肯定応答ポリシーの少なくとも１つを、「普通の肯定応答または暗黙的なブロック肯定応答要求」値のような特定の値に設定するように構成される。いくつかの態様では、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つはＡ－ＭＰＤＵデリミタフィールドを備え、２つ以上のＭＰＤＵサブフレームを生成するための手段は、対応するＡ－ＭＰＤＵサブフレームの肯定応答の時間遅延を示すように、Ａ－ＭＰＤＵデリミタフィールドを設定するように構成される。いくつかの態様では、時間遅延は、Ａ－ＭＰＤＵデリミタフィールドに含まれるバックオフ値に基づく。いくつかの態様では、バックオフ値はＳＩＦＳ時間と定数値の少なくとも１つに基づく。いくつかの態様では、装置が２つ以上のＡ－ＭＰＤＵサブフレームを備えるＡ－ＭＰＤＵフレームを生成するための手段も含むは、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフィールドにおける受信の肯定応答に対する要求を生成することを備え、このフィールドはフレームの末尾フィールドの値と肯定応答ポリシーフィールドの値の少なくとも１つに基づく値を備え、さらにフィールド中の値は受信の肯定応答に対する要求のタイプを決定する。

【００２０】

[0020]いくつかの態様では、装置はさらに、Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を復号するための手段を含む。いくつかの態様では、装置はまた、Ａ－ＭＰＤＵサブフレームのフレームの末尾（ＥＯＦ）フィールドが０であるときに、Ａ－ＭＰＤＵサブフレームの１つに対するブロック肯定応答フレームを復号するための手段を含む。いくつかの態様では、装置はまた、１つのＡ－ＭＰＤＵサブフレームのフレームの末尾（ＥＯＦ）フィールドが設定されるときに、１つのＡ－ＭＰＤＵサブフレームに対する肯定応答フレームを復号するための手段を含む。

【００２１】

[0021]開示される別の態様は、実行されると、装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であり、前記方法は、

[0022]２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらにＡ－ＭＰＤＵは各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、Ａ－ＭＰＤＵフレームを送信することとを備える。

【００２２】

[0023]開示される別の態様は、ワイヤレス通信の方法である。方法は、ワイヤレスデバイスによって、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信することと、ワイヤレスデバイスによって、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、装置によって、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することと、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する復号された受信機アドレスに基づいて装置に宛てられると決定することとを含む。

【００２３】

[0024]いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドにおいて各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する１つまたは複数の肯定応答ポリシーを復号することを含む。いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの各々のフィールドが特定の値に設定される場合、フィールドの特定の値に基づいてフレームを生成することと、フレームを送信のために出力することとを含む。いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号することを含み、フレームの末尾フィールド中の値が１である場合、送信のために生成され出力されるフレームは肯定応答フレームである。いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号することを含み、フレームの末尾フィールド中の値が０である場合、送信のために生成され出力されるフレームはブロック肯定応答肯定応答フレームである。いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号することと、この値は２つ以上のＡ－ＭＤＰＵサブフレームの各々に対応する１つまたは複数の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、フレームの末尾フィールド中の復号された値が１である場合、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信に肯定応答する肯定応答フレームを生成することと、肯定応答フレームを送信のために出力することとを含む。

【００２４】

[0025]いくつかの態様では、方法はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号することと、この値は２つ以上のＡ－ＭＤＰＵサブフレームの各々に対応する１つまたは複数の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、フレームの末尾フィールド中の復号された値が０である場合、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信を肯定応答するブロック肯定応答フレームを生成することと、ブロック肯定応答フレームを送信のために出力することとを含む。いくつかの態様では、方法はさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号することと、デリミタフィールドに記憶されている値から、Ａ－ＭＰＤＵフレームの受信から肯定応答フレームを送信のため出力するまでに経過することになる時間遅延を決定することと、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する復号された肯定応答ポリシーに基づいて、その時間遅延が経過した後で肯定応答フレームを送信のために出力することとを含む。いくつかの態様では、方

法はさらに、ＭＰＤＵデリミタフィールドに記憶されている値がバックオフ値である場合、または、ＭＰＤＵデリミタフィールドに記憶されているバックオフ値が短フレーム間空間時間と定数値の少なくとも１つに基づく場合を含む。いくつかの態様では、方法は、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成することを備えることと、２つ以上のＡ－ＭＤＰＵサブフレームの各々に対応する復号された１つまたは複数の肯定応答ポリシーに基づいて、Ａ－ＭＰＤＵフレームの送信から短い時間間フレーム空間時間以上の遅延の後に、受信の肯定応答を送信のために出力することとを含む。いくつかの態様では、方法はさらに、装置によって、２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すために、２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定することを備える。

【００２５】

[0026]開示される別の態様は、ワイヤレス通信のための装置である。装置は、集約されたメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）フレームを受信するように構成される受信機と、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号し、各々の２つ以上のＡ－ＭＰＤＵサブフレームに対応する受信機アドレスを復号し、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する復号された受信機アドレスに基づいて、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが装置に宛てられると決定するように構成される処理システムとを含む。装置のいくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドの中の各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる少なくとも１つの指示に基づいて装置に宛てられる、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシー肯定応答ポリシーを復号するように構成される。

【００２６】

[0027]装置のいくつかの態様はまた、２つ以上のＡ－ＭＰＤＵサブフレームの各々の少なくとも１つのフィールドが特定の値に設定される場合に、フレームを生成し、フレームを送信のために出力することようにさらに構成される、処理システムを含む。

【００２７】

[0028]いくつかの態様では、処理システムはさらに、装置に宛てられる受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、処理システムはさらに、フレームの末尾フィールド中の値が１である場合、フィールドの特定の値に基づいて、フレームを送信のために肯定応答フレームとして生成するように構成される。いくつかの態様では、処理システムはさらに、装置に宛てられる受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、処理システムはさらに、フレームの末尾フィールド中の値が０である場合、フレームを送信のためにブロック肯定応答フレームとして生成するように構成される。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、この値は２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、さらに、フレームの末尾フィールド中の復号された値が１である場合、送信のために肯定応答フレームを生成するように構成される。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、この値は２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示し、さらに、フレームの末尾フィールド中の復号された値が０である場合、送信のためにブロック肯定応答フレームを生成するように構成される。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号し、デリミ

タフィールドに記憶されている値から、Ａ－ＭＰＤＵフレームの受信から肯定応答フレームの送信までに経過することになる時間遅延を決定し、２つ以上のＡ－ＭＰＤＵサブフレームの各々の復号された肯定応答ポリシーに基づいて、その時間遅延が経過した後で肯定応答フレームを送信のために生成するように構成される。いくつかの態様では、ＭＰＤＵデリミタフィールドに記憶されている値はバックオフ値である。いくつかの態様では、ＭＰＤＵデリミタフィールドに記憶されているバックオフ値は、短フレーム間空間時間と定数値の少なくとも１つに基づく。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する復号された１つまたは複数の肯定応答ポリシーに基づいて、Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で装置に宛てられる、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を送信のために生成するように構成される。いくつかの態様では、処理システムはさらに、２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すように、２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するように構成される。

【００２８】

[0029]開示される別の態様は、ワイヤレス通信のための局である。局は、少なくとも１つのアンテナと、アンテナを介して集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するように構成される受信機と、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号し、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号し、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する復号された受信機アドレスに基づいて、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが装置に宛てられると決定するように構成される処理システムとを含む。

【００２９】

[0030]開示される別の態様は、ワイヤレス通信のための装置である。装置は、集約されたメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）フレームを受信するための手段と、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号するための手段と、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号するための手段とを含む。いくつかの態様では、装置はまた、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する復号された受信機アドレスに基づいて、２つのＡ－ＭＰＤＵサブフレームの１つが装置に宛てられると決定するための手段を含む。

【００３０】

[0031]装置のいくつかの態様は、２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドの中の各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するための手段を含む。

【００３１】

[0032]装置のいくつかの態様はまた、２つ以上のＡ－ＭＰＤＵサブフレームの各々の少なくとも１つのフィールドが特定の値に設定される場合に、少なくとも１つのフィールドの特定の値に基づいてフレームを生成するための手段と、フレームを送信するための手段とを含む。いくつかの態様では、復号するための手段はさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、送信するための手段はさらに、フレームの末尾フィールド中の値が１である場合、肯定応答フレームをフレームとして送信するように構成される。いくつかの態様では、復号するための手段はさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の少なくとも１つのフィールドのフレームの末尾フィールドにおいて設定される値を復号するように構成され、送信するための手段はさらに、フレームの末尾フィールド中の値が０である場合、ブロック肯定応答フレームをフレームとして送信するように構成される。

【００３２】

[0033]装置のいくつかの態様はさらに、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、この値は２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、フレームの末尾フィールド中の値が１である場合、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための肯定応答フレームを生成するための手段と、肯定応答フレームを送信するための手段とを含む。いくつかの態様では、装置はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、この値は２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、フレームの末尾フィールド中の値が０である場合、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのためのブロック肯定応答フレームを生成するための手段と、ブロック肯定応答フレームを送信するための手段とを含む。いくつかの態様では、装置はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のメディアアクセス制御プロトコルユニット（ＭＰＤＵ）デリミタフィールドを復号するための手段と、デリミタフィールドに記憶されている値から、Ａ－ＭＰＤＵフレームの受信から肯定応答フレームの送信までに経過することになる時間遅延を決定するための手段と、２つ以上のＡ－ＭＰＤＵサブフレームの各々の復号された肯定応答ポリシーに基づいて、その時間遅延が経過した後で肯定応答フレームを送信するための手段とを含む。いくつかの態様では、ＭＰＤＵデリミタフィールド中の値はバックオフ値である。いくつかの態様では、短フレーム間空間時間と定数値の少なくとも１つに基づく、ＭＰＤＵデリミタフィールドに記憶されているバックオフ値。

【００３３】

[0034]いくつかの態様では、装置はまた、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成するための手段と、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つに対する肯定応答ポリシーがブロック肯定応答ポリシーを示す場合、Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で、受信の肯定応答を送信するための手段とを含む。

【００３４】

[0035]いくつかの態様では、受信するための手段は受信機である。いくつかの態様では、２つのＡ－ＭＰＤＵサブフレームを復号するための手段は処理システムである。いくつかの態様では、２つの異なる受信機アドレスを復号するための手段は処理システムである。いくつかの態様では、決定するための手段は処理システムである。いくつかの態様では、１つのＡ－ＭＰＤＵサブフレームの肯定応答ポリシーを復号するための手段は処理システムである。いくつかの態様では、肯定応答ポリシーが特定の値に設定される場合に制御フレームを送信するための手段は送信機である。いくつかの態様では、Ａ－ＭＰＤＵサブフレーム中のフレームの末尾フィールドを復号するための手段は処理システムである。いくつかの態様では、制御フレームを送信するための時間遅延を決定するための手段は処理システムである。いくつかの態様では、Ａ－ＭＰＤＵサブフレームのための肯定応答に対する要求を受信するための手段は受信機である。

【００３５】

[0036]いくつかの態様では、装置はさらに、２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すように、２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するための手段を含む。

【００３６】

[0037]開示される別の態様は、実行されると装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であり、前記方法は、集約されたメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）フレームを受信することと、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することとを含む。

【図面の簡単な説明】
【００３７】
【図１】[0038]本開示の態様が利用され得る例示的なワイヤレス通信システムを示す図。
【図２Ａ】[0039]複数のワイヤレス通信ネットワークが存在するワイヤレス通信システムを示す図。
【図２Ｂ】[0040]複数のワイヤレス通信ネットワークが存在する別のワイヤレス通信システムを示す図。
【図３】[0041]図１、図２Ａ、および図２Ｂのワイヤレス通信システム内で利用され得る周波数多重化技法を示す図。
【図４】[0042]図１、図２Ａ、図２Ｂ、および図３のワイヤレス通信システム内で利用され得る例示的なワイヤレスデバイスの機能ブロック図。
【図５Ａ】[0043]図１、図２Ａ、図２Ｂ、および図３のワイヤレス通信システム中の３つの局へアクセスポイントによって送信される複数のメッセージを示す図。
【図５Ｂ】[0044]図１、図２Ａ、図２Ｂ、および図３のワイヤレス通信システム中の３つの局へアクセスポイントによって送信される単一のＡ－ＭＰＤＵを示す図。
【図６】[0045]メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）サブフレームの例示的な構造を示す図。
【図７】[0046]サービス品質（ＱｏＳ）制御（ｑｃ）フィールドの例示的な構造を示す図。
【図８】[0047]集約されたＭＰＤＵ（Ａ－ＭＰＤＵ）フレームの例示的な構造を示す図。
【図９Ａ】[0048]ＭＰＤＵデリミタフィールドのある実施形態を示す図。
【図９Ｂ】[0049]ＭＰＤＵデリミタフィールドの代替的な実施形態を示す図。
【図９Ｃ】[0050]３つのＡ－ＭＰＤＵサブフレームを含むＡ－ＭＰＤＵフレームを示す図。
【図９Ｄ】[0051]アクセスポイントと３つの局との間の例示的なワイヤレス通信を示す図。
【図９Ｅ】[0052]３つのＡ－ＭＰＤＵサブフレームを含むＡ－ＭＰＤＵフレームのある実施形態を示す図。
【図９Ｆ】[0053]アクセスポイントと３つの局との間の例示的なワイヤレス通信を示す図。
【図１０Ａ】[0054]Ａ－ＭＰＤＵのある実施形態を示す図。
【図１０Ｂ】[0055]アクセスポイントと３つの局との間の例示的なワイヤレス通信を示す図。
【図１０Ｃ】[0056]Ａ－ＭＰＤＵのある実施形態を示す図。
【図１０Ｄ】[0057]アクセスポイントと３つの局との間の例示的なワイヤレス通信を示す図。
【図１１Ａ】[0058]ワイヤレス通信の１つの例示的な方法のフローチャート。
【図１１Ｂ】[0059]ワイヤレス通信システム内で利用され得る例示的なワイヤレスデバイスの機能ブロック図。
【図１２Ａ】[0060]ワイヤレス通信の１つの例示的な方法のフローチャート。
【図１２Ｂ】[0061]ワイヤレス通信システム内で利用され得る例示的なワイヤレスデバイスの機能ブロック図。
【図１３Ａ】[0062]ワイヤレス通信の１つの例示的な方法のフローチャート。
【図１３Ｂ】[0063]ワイヤレス通信システム内で利用され得る例示的なワイヤレスデバイスの機能ブロック図。
【発明を実施するための形態】
【００３８】
[0064]添付の図面を参照して、新規のシステム、装置、および方法の様々な態様が以下でより完全に説明される。しかしながら、本開示教示は、多くの異なる形態で具現化され得るものであり、本開示全体にわたって提示される任意の特定の構造または機能に限定さ

れるものと解釈されるべきではない。むしろ、これらの態様は、本開示が徹底的で完全なものとなり、本開示の範囲を当業者に完全に伝えるように、与えられる。本明細書の教示に基づいて、本開示の範囲は、本発明の他の態様とは独立に実装されるか、本発明の他の態様と組み合わせて実装されるかにかかわらず、本明細書で開示される新規のシステム、装置、および方法のあらゆる態様を包含するものであることを、当業者は理解されたい。たとえば、本明細書に記載される任意の数の態様を使用して、装置が実装されてよく、または方法が実践されてよい。加えて、本発明の範囲は、本明細書で述べられる本発明の様々な態様に加えて、またはそれ以外の、他の構造、機能、または構造および機能を使用して実施されるような装置または方法を包含することが意図される。本明細書で開示されるいずれの態様も、請求項の１つまたは複数の要素によって具現化され得ることを理解されたい。

【００３９】

[0065]本明細書では特定の態様が説明されるが、これらの態様の多くの変形および置換が本開示の範囲内に入る。好ましい態様のいくつかの利益および利点が述べられるが、本開示の範囲は、特定の利益、使用、または目的に限定されることは意図されない。むしろ、本開示の態様は、様々なワイヤレス技術、システム構成、ネットワーク、および伝送プロトコルに広く適用可能であることが意図され、それらのいくつかが例として、図において、および好適な態様の以下の説明において示される。発明を実施するための形態および図面は、限定的なものではなく本開示を例示するものにすぎず、本開示の範囲は、添付の特許請求の範囲およびその均等物によって規定される。

【００４０】

[0066]普及しているワイヤレスネットワーク技術は、様々なタイプのワイヤレスローカルエリアネットワーク（ＷＬＡＮ）を含み得る。ＷＬＡＮは、広く使用されているネットワーキングプロトコルを利用して、近くのデバイスを一緒に相互接続するために使用され得る。本明細書で説明される様々な態様は、ワイヤレスプロトコルのような任意の通信規格に適用され得る。

【００４１】

[0067]いくつかの態様では、ワイヤレス信号は、直交周波数分割多重化（ＯＦＤＭ）、直接シーケンススペクトル拡散（ＤＳＳＳ：direct-sequence spread spectrum）通信、ＯＦＤＭ通信とＤＳＳＳ通信との組合せ、または他の方式を使用して、高効率８０２．１１プロトコルに従って送信され得る。高効率８０２．１１プロトコルの実装形態は、インターネットアクセス、センサ、計測、スマートグリッドネットワーク、または他のワイヤレス適用例のために使用され得る。有利なことに、本明細書で開示される技法を使用する高効率８０２．１１プロトコルを実装しているいくつかのデバイスの態様は、同じエリアにおけるピアツーピアサービス（たとえば、Ｍｉｒａｃａｓｔ、Ｗｉ－Ｆｉ　Ｄｉｒｅｃｔ（登録商標）　Ｓｅｒｖｉｃｅｓ、Ｓｏｃｉａｌ　Ｗｉ－Ｆｉ（登録商標）など）の増大を可能にすること、ユーザ当たりの最小スループットの要件の増大をサポートすること、より多くのユーザをサポートすること、改善された屋外カバレッジとロバスト性とをもたらすこと、および／または他のワイヤレスプロトコルを実装しているデバイスよりも少ない電力を消費することを含み得る。

【００４２】

[0068]いくつかの実施態様では、ＷＬＡＮは、ワイヤレスネットワークにアクセスするコンポーネントである様々なデバイスを含む。たとえば、２つのタイプのデバイス、すなわちアクセスポイント（「ＡＰ」）と（局または「ＳＴＡ」とも呼ばれる）クライアントとがあり得る。一般に、ＡＰはＷＬＡＮのためのハブまたは基地局として機能することができ、ＳＴＡはＷＬＡＮのユーザとして機能する。たとえば、ＳＴＡはラップトップコンピュータ、携帯情報端末（ＰＤＡ）、携帯電話などであり得る。一例では、ＳＴＡは、ＷｉＦｉ（登録商標）（たとえばＩＥＥＥ８０２．１１プロトコル）準拠ワイヤレスリンクを介してＡＰに接続して、インターネットまたは他の広域ネットワークへの一般的な接続性を得る。いくつかの実装態様では、ＳＴＡは、ＡＰとしても使用され得る。

【００４３】
[0069]開示される別の態様は、ワイヤレス通信のためのワイヤレスノードである。ワイヤレスノードは、アンテナと、１つまたは複数のデバイスが装置と通信することを許可される時間枠の開始時間を示すメッセージを生成するように構成された処理システムと、開始時間は絶対的な時間基準に基づく、アンテナを使用して生成されたメッセージを送信するように構成された送信機とを含む。
【００４４】
[0070]アクセスポイント（「ＡＰ」）はまた、ＮｏｄｅＢ、無線ネットワークコントローラ（「ＲＮＣ」）、ｅＮｏｄｅＢ、基地局コントローラ（「ＢＳＣ」）、トランシーバ基地局（「ＢＴＳ」）、基地局（「ＢＳ」）、トランシーバ機能（「ＴＦ」）、無線ルータ、無線トランシーバ、もしくは何らかの他の用語を備え、それらのいずれかとして実装され、またはそれらのいずれかとして知られ得る。
【００４５】
[0071]局「ＳＴＡ」は、アクセス端末（「ＡＴ」）、加入者局、加入者ユニット、移動局、遠隔局、遠隔端末、ユーザ端末、ユーザエージェント、ユーザデバイス、ユーザ機器、もしくは何らかの他の用語を備え、それらのいずれかとして実装され、またはそれらのいずれかとして知られ得る。いくつかの実装形態では、アクセス端末は、携帯電話、コードレス電話、セッション開始プロトコル（ＳＩＰ）電話、ワイヤレスローカルループ（ＷＬＬ）局、携帯情報端末（ＰＤＡ）、ワイヤレス接続機能を有するハンドヘルドデバイス、またはワイヤレスモデムに接続された何らかの他の適切な処理デバイスを備え得る。したがって、本明細書で教示される１つまたは複数の態様は、電話（たとえば、携帯電話もしくはスマートフォン）、コンピュータ（たとえば、ラップトップ）、ポータブル通信デバイス、ヘッドセット、ポータブルコンピューティングデバイス（たとえば、携帯データ端末）、エンターテインメントデバイス（たとえば、音楽デバイスもしくはビデオデバイス、もしくは衛星ラジオ）、ゲームデバイスもしくはゲームシステム、全地球測位システムデバイス、または、ワイヤレス媒体を介して通信するために構成された任意の他の適切なデバイスに組み込まれ得る。
【００４６】
[0072]上で論じられたように、本明細書で説明されるデバイスのいくつかは、たとえば、高効率８０２．１１規格を実装し得る。そのようなデバイスは、ＳＴＡとして使用されるか、ＡＰとして使用されるか、他のデバイスとして使用されるかにかかわらず、スマートメータリングに、またはスマートグリッドネットワークにおいて使用され得る。そのようなデバイスは、センサへの適用例を提供することができ、またはホームオートメーションにおいて使用され得る。デバイスは、代わりにまたは加えて、たとえば個人の健康管理のために健康管理の状況において使用され得る。それらはまた、（たとえばホットスポットとともに使用するための）広範囲のインターネット接続を可能にするために、または機械間通信を実装するために、監視に使用され得る。様々なシステム、方法、および装置が、たとえば、高効率８０２．１１規格に関して本明細書において説明されるが、本開示は、たとえば８０２．１１ａｈのような他のワイヤレス通信規格に適用可能であることを、当業者は理解するであろう。
【００４７】
[0073]図１は、本開示の態様が利用され得る例示的なワイヤレス通信システム１００を示す。ワイヤレス通信システム１００は、ワイヤレス規格、たとえば高効率８０２．１１規格に従って動作し得る。ワイヤレス通信システム１００は、ＳＴＡ１０６（全般にＳＴＡ１０６Ａ～１０６Ｄを指す）と通信するＡＰ１０４を含み得る。
【００４８】
[0074]ＡＰ１０４とＳＴＡ１０６との間のワイヤレス通信システム１００における送信のために、様々な処理および方法が使用され得る。たとえば、信号は、ＯＦＤＭ／ＯＦＤＭＡ技術に従って、ＡＰ１０４とＳＴＡ１０６との間で送信および受信され得る。この場合、ワイヤレス通信システム１００はＯＦＤＭ／ＯＦＤＭＡシステムと呼ばれ得る。代替

的に、信号は、符号分割多元接続（ＣＤＭＡ）技法に従って、ＡＰ１０４とＳＴＡ１０６との間で送信および受信され得る。この場合、ワイヤレス通信システム１００はＣＤＭＡシステムと呼ばれ得る。

【００４９】

[0075]ＡＰ１０４からＳＴＡ１０６の１つまたは複数への送信を支援する通信リンクはダウンリンク（ＤＬ）１０８と呼ばれることがあり、ＳＴＡ１０６の１つまたは複数からＡＰ１０４への送信を支援する通信リンクはアップリンク（ＵＬ）１１０と呼ばれることがある。代替的に、ダウンリンク１０８は順方向リンクまたは順方向チャネルと呼ばれることがあり、アップリンク１１０は逆方向リンクまたは逆方向チャネルと呼ばれることがある。

【００５０】

[0076]ＡＰ１０４は、基地局として働き、基本サービスエリア（ＢＳＡ）１０２においてワイヤレス通信カバレッジを提供することができる。ＡＰ１０４は、ＡＰ１０４と関連付けられ、通信のためにＡＰ１０４を使用するＳＴＡ１０６とともに、基本サービスセット（ＢＳＳ）と呼ばれ得る。ワイヤレス通信システム１００は、中央ＡＰ１０４を有しないことがあり、むしろＳＴＡ１０６間のピアツーピアネットワークとして機能し得ることに留意されたい。したがって、本明細書で説明されるＡＰ１０４の機能は、代替的に、ＳＴＡ１０６の１つまたは複数によって実行され得る。

【００５１】

[0077]いくつかの態様では、ＳＴＡ１０６は、ＡＰ１０４に通信を送信し、および／またはＡＰ１０４から通信を受信するために、ＡＰ１０４と接続することが必要とされ得る。一態様では、接続するための情報は、ＡＰ１０４によるブロードキャストに含まれる。そのようなブロードキャストを受信するために、ＳＴＡ１０６は、たとえば、カバレッジ領域にわたって広範なカバレッジ探索を実行することができる。探索はまた、ＳＴＡ１０６によって、たとえば、灯台方式でカバレッジ領域をスイープすることによって実行され得る。接続するための情報を受信した後、ＳＴＡ１０６は、接続調査または要求のような基準信号をＡＰ１０４に送信することができる。いくつかの態様では、ＡＰ１０４は、たとえば、インターネットまたは公衆交換電話網（ＰＳＴＮ）のようなより大きいネットワークと通信するために、バックホールサービスを使用することができる。

【００５２】

[0078]一実施形態では、ＡＰ１０４は、ＡＰ高効率ワイヤレスコンポーネント（ＨＥＷＣ）１５４を含む。ＡＰ　ＨＥＷＣ１５４は、高効率８０２．１１プロトコルを使用してＡＰ１０４とＳＴＡ１０６との間の通信を可能にする、本明細書で説明される動作の一部またはすべてを実行することができる。ＡＰ　ＨＥＷＣ１５４の機能は、図２Ｂ、図３、図４、および図５～図１１に関して以下でより詳細に説明される。

【００５３】

[0079]代替的に、または加えて、ＳＴＡ１０６は、ＳＴＡ　ＨＥＷＣ１５６を含み得る。ＳＴＡ　ＨＥＷＣ１５６は、高周波８０２．１１プロトコルを使用して、ＳＴＡ１０６とＡＰ１０４との間の通信を可能にするために、本明細書で説明される動作の一部またはすべてを実行することができる。ＳＴＡ　ＨＥＷＣ１５６の機能は、図２Ｂ、図３、図４、および図５～図１１に関して以下でより詳細に説明される。

【００５４】

[0080]ある状況では、ＢＳＡは他のＢＳＡの近くに位置し得る。たとえば、図２Ａは、複数のワイヤレス通信ネットワークが存在するワイヤレス通信システム２００を示す。図２Ａに示されるように、ＢＳＡ２０２Ａ、２０２Ｂ、および２０２Ｃは物理的に互いに近くに位置し得る。ＢＳＡ２０２Ａ～２０２Ｃが近接しているにもかかわらず、ＡＰ２０４Ａ～２０４Ｃおよび／またはＳＴＡ２０６Ａ～２０６Ｈは各々、同じ周波数帯を使用して通信し得る。したがって、ＢＳＡ２０２Ｃ中のデバイス（たとえば、ＡＰ２０４Ｃ）がデータを送信している場合、ＢＳＡ２０２Ｃの外部のデバイス（たとえば、ＡＰ２０４Ａ～２０４ＢまたはＳＴＡ２０６Ａ～２０６Ｆ）は、媒体上で通信を感知し得る。

【００５５】
[0081]一般に、通常の８０２．１１プロトコル（たとえば、８０２．１１ａ、８０２．１１ｂ、８０２．１１ｇ、８０２．１１ｎなど）を使用するワイヤレスネットワークは、媒体アクセスのための搬送波感知多元接続（ＣＳＭＡ：carrier sense multiple access）機構のもとで動作する。ＣＳＭＡによれば、デバイスは、媒体を感知し、媒体がアイドル状態であると感知されたときのみ送信する。したがって、ＡＰ２０４Ａ～２０４Ｃおよび／またはＳＴＡ２０６Ａ～２０６Ｈが、ＣＳＭＡ機構に従って動作しており、ＢＳＡ２０２Ｃ中のデバイス（たとえば、ＡＰ２０４Ｃ）がデータを送信している場合、ＢＳＡ２０２Ｃの外部のＡＰ２０４Ａ～２０４Ｂおよび／またはＳＴＡ２０６Ａ～２０６Ｆは、異なるＢＳＡの一部であるにもかかわらず、媒体上で送信しないことがある。

【００５６】
[0082]図２Ａは、そのような状況を示す。図２Ａに示されるように、ＡＰ２０４Ｃは媒体を介して送信している。送信は、ＡＰ２０４Ｃと同じＢＳＡ２０２Ｃ中のＳＴＡ２０６Ｇによって、またＡＰ２０４Ｃとは異なるＢＳＡ中のＳＴＡ２０６Ａによって感知される。送信は、ＳＴＡ　２０６Ｇおよび／またはＢＳＡ２０２Ｃ中のＳＴＡのみに宛てられ得るが、それでも、ＳＴＡ２０６Ａは、ＡＰ２０４Ｃ（および任意の他のデバイス）が媒体上で送信しなくなるまで、（たとえば、ＡＰ２０４Ａとの間で）通信を送信または受信することが可能ではないことがある。図示されないが、同じことが、（たとえば、ＡＰ２０４Ｃによる送信がより強いので、他のＳＴＡが媒体上の送信を感知することができる場合）ＢＳＡ２０２Ｂ中のＳＴＡ２０６Ｄ～２０６Ｆ、および／または、ＢＳＡ２０２Ａ中のＳＴＡ２０６Ｂ～２０６Ｃにも同様に当てはまり得る。

【００５７】
[0083]そうすると、ＣＳＭＡ機構の使用は、ＢＳＡの外にあるいくつかのＡＰまたはＳＴＡが、ＢＳＡ中のＡＰまたはＳＴＡによって行われた送信に干渉せずにデータを送信することが可能であり得るので、非効率性をもたらす。アクティブなワイヤレスデバイスの数が増加し続ける中、非効率性は、ネットワークレイテンシとスループットとに著しい影響を与え始め得る。たとえば、著しいネットワークレイテンシの問題は、各住戸がアクセスポイントと関連する局とを含み得る集合住宅において現れ得る。実際に、各住戸は、居住者がワイヤレスルータ、ワイヤレスメディアセンター機能を有するビデオゲームコンソール、ワイヤレスメディアセンター機能を有するテレビ、パーソナルホットスポットのように働き得る携帯電話などを所有し得るので、複数のアクセスポイントを含み得る。その場合、レイテンシおよびスループットの問題と全体的なユーザの不満とを回避するために、ＣＳＭＡ機構の非効率性を是正することが不可欠であり得る。

【００５８】
[0084]そのようなレイテンシおよびスループットの問題は、住宅地に限らない可能性がある。たとえば、複数のアクセスポイントが、空港、地下鉄の駅、および／または他の人口密度の高い公共空間に位置し得る。現在、これらの公共空間ではＷｉＦｉアクセスが、有料ではあるが提供されていることがある。ＣＳＭＡ機構によってもたらされる非効率性が是正されない場合、料金およびより低いサービス品質が利点を上回り始める可能性があるので、ワイヤレスネットワークの事業者は、顧客を失う可能性がある。

【００５９】
[0085]したがって、本明細書で説明される高効率８０２．１１プロトコルは、これらの非効率性を最小限にしてネットワークスループットを増大させる修正された機構のもとで、デバイスが動作することを可能にし得る。そのような機構が、図２Ｂ、図３、および図４に関して以下で説明される。高効率８０２．１１プロトコルの追加の態様が、図５～図１１に関して以下で説明される。

【００６０】
[0086]図２Ｂは、複数のワイヤレス通信ネットワークが存在する、ワイヤレス通信システム２５０を示す。図２Ａのワイヤレス通信システム２００とは異なり、ワイヤレス通信システム２５０は、本明細書で論じられる高効率８０２．１１規格に従って動作し得る。

ワイヤレス通信システム２５０は、ＡＰ２５４Ａと、ＡＰ２５４Ｂと、ＡＰ２５４Ｃとを含み得る。ＡＰ２５４Ａは、ＳＴＡ２５６Ａ～２５６Ｃと通信することができ、ＡＰ２５４Ｂは、ＳＴＡ２５６Ｄ～２５６Ｆと通信することができ、ＡＰ２５４Ｃは、ＳＴＡ２５６Ｇ～２５６Ｈと通信することができる。

【００６１】

[0087]様々なプロセスおよび方法が、ＡＰ２５４Ａ～２５４ＣとＳＴＡ２５６Ａ～２５６Ｈとの間の、ワイヤレス通信システム２５０における送信のために使用され得る。たとえば、信号は、ＯＦＤＭ／ＯＦＤＭＡ技法またはＣＤＭＡ技法に従って、ＡＰ２５４Ａ～２５４ＣとＳＴＡ２５６Ａ～２５６Ｈとの間で送信および受信され得る。

【００６２】

[0088]ＡＰ２５４Ａは、基地局として働き、ＢＳＡ２５２Ａ中でワイヤレス通信カバレッジを提供し得る。ＡＰ２５４Ｂは、基地局として働き、ＢＳＡ２５２Ｂ中でワイヤレス通信カバレッジを提供し得る。ＡＰ２５４Ｃは、基地局として働き、ＢＳＡ２５２Ｃ中でワイヤレス通信カバレッジを提供し得る。各ＢＳＡ２５２Ａ、２５２Ｂ、および／または２５２Ｃは、中央ＡＰ２５４Ａ、２５４Ｂ、または２５４Ｃを有していないことがあり、むしろ、ＳＴＡ２５６Ａ～２５６Ｈの１つまたは複数の間のピアツーピア通信を可能にし得ることに留意されたい。したがって、本明細書で説明されるＡＰ２５４Ａ～２５４Ｃの機能は、ＳＴＡ２５６Ａ～２５６Ｈの１つまたは複数によって代替的に実行され得る。

【００６３】

[0089]ある実施形態では、ＡＰ２５４Ａ～２５４Ｃおよび／またはＳＴＡ２５６Ａ～２５６Ｈは、高効率ワイヤレスコンポーネントを含む。本明細書で説明されるように、高効率ワイヤレスコンポーネントは、高効率８０２．１１プロトコルを使用して、ＡＰとＳＴＡとの間の通信を可能にし得る。具体的には、高効率ワイヤレスコンポーネントは、ＡＰ２５４Ａ～２５４Ｃおよび／またはＳＴＡ２５６Ａ～２５６Ｈが、ＣＳＭＡ機構の非効率性を最小限にする（たとえば、干渉が生じることがない状況において、媒体を通じた同時通信を可能にする）、修正された機構を使用することを可能にし得る。高効率ワイヤレスコンポーネントが、図４に関して以下でより詳細に説明される。

【００６４】

[0090]図２Ｂに示されるように、ＢＳＡ２５２Ａ～２５２Ｃは、物理的に互いの近くに配置される。たとえば、ＡＰ２５４ＡおよびＳＴＡ２５６Ｂが互いに通信しているとき、その通信は、ＢＳＡ２５２Ｂ～２５２Ｃ中の他のデバイスによって感知され得る。しかしながら、その通信は、ＳＴＡ２５６Ｆおよび／またはＳＴＡ２５６Ｇのような、いくつかのデバイスにのみ干渉し得る。ＣＳＭＡ下では、そのような通信がＡＰ２５４ＡとＳＴＡ２５６Ｂとの間の通信に干渉しなくても、ＡＰ２５４Ｂは、ＳＴＡ２５６Ｅと通信することを許されない。したがって、高効率８０２．１１プロトコルは、同時に通信することができるデバイスと同時に通信することができないデバイスとを区別する、修正された機構のもとで動作する。デバイスのそのような分類は、ＡＰ２５４Ａ～２５４Ｃおよび／またはＳＴＡ２５６Ａ～２５６Ｈ中の高効率ワイヤレスコンポーネントによって実行され得る。

【００６５】

[0091]ある実施形態では、デバイスが他のデバイスと同時に通信することができるかどうかの決定は、デバイスの位置に基づく。たとえば、ＢＳＡの端の近くに位置するＳＴＡは、ＳＴＡが他のデバイスと同時に通信することができないような状態または条件にあり得る。図２Ｂに示されるように、ＳＴＡ２０６Ａ、２０６Ｆ、および２０６Ｇは、それらが他のデバイスと同時に通信することができない状態または条件にあるデバイスであり得る。同様に、ＢＳＡの中心の近くに位置するＳＴＡは、ＳＴＡが他のデバイスと通信することができるような局または条件にあり得る。図２に示されるように、ＳＴＡ２０６Ｂ、２０６Ｃ、２０６Ｄ、２０６Ｅ、および２０６Ｈは、それらが他のデバイスと同時に通信することができる状態または条件にあるデバイスであり得る。デバイスの分類は、永続的ではないことに留意されたい。デバイスは、それらが同時に通信することができるような

状態または条件と、それらが同時に通信することができないような状態または条件との間を遷移し得る（たとえば、デバイスは、動いているとき、新しいＡＰに接続するとき、接続解除するときなどに、状態または条件を変化させ得る）。

【００６６】

[0092]さらに、デバイスは、それらが他のデバイスと同時に通信する状態または条件にあるデバイスであるか、またはそうではないデバイスであるかに基づいて、異なるように動作するように構成され得る。たとえば、同時に通信することができるような状態または条件にあるデバイスは、同じ周波数帯内で通信することができる。しかしながら、同時に通信することができないような状態または条件にあるデバイスは、媒体を通じて通信するために、空間多重化または周波数領域多重化のようないくつかの技法を利用し得る。デバイスの挙動の制御は、ＡＰ２５４Ａ～２５４Ｃおよび／またはＳＴＡ２５６Ａ～２５６Ｈの中の高効率ワイヤレスコンポーネントによって実行され得る。

【００６７】

[0093]一実施形態では、同時に通信することができないような状態または条件にあるデバイスは、媒体を通じて通信するために、空間多重化技法を使用する。たとえば、別のデバイスによって送信されるパケットのプリアンブル内に、電力および／または他の情報が埋め込まれ得る。デバイスが同時に通信することができないような状態または条件にあるデバイスは、媒体上でパケットが感知されたときにプリアンブルを分析し、規則のセットに基づいて送信すべきかどうかを決定することができる。

【００６８】

[0094]別の実施形態では、同時に通信することができないような状態または条件にあるデバイスは、媒体を通じて通信するために、周波数領域多重化技法を使用する。図３は、図１のワイヤレス通信システム１００および図２Ｂのワイヤレス通信システム２５０内で利用され得る周波数多重化技法を示す。図３に示されるように、ワイヤレス通信システム３００内に、ＡＰ３０４Ａ、３０４Ｂ、３０４Ｃ、および３０４Ｄが存在し得る。ＡＰ３０４Ａ、３０４Ｂ、３０４Ｃ、および３０４Ｄの各々は、異なるＢＳＡと関連付けられ、本明細書で説明される高効率ワイヤレスコンポーネントを含み得る。

【００６９】

[0095]例として、通信媒体の帯域幅は８０ＭＨｚであり得る。通常の８０２．１１プロトコルのもとでは、ＡＰ３０４Ａ、３０４Ｂ、３０４Ｃ、および３０４Ｄの各々ならびに各々のそれぞれのＡＰと関連付けられたＳＴＡは、帯域幅全体を使用して通信することを試み、これはスループットを低減し得る。しかしながら、周波数領域多重化を使用する高効率８０２．１１プロトコルのもとでは、図３に示されるように、帯域幅は４つの２０ＭＨｚのセグメント３０８、３１０、３１２、および３１４（たとえば、チャネル）に分割され得る。ＡＰ３０４Ａはセグメント３０８と関連付けられてよく、ＡＰ３０４Ｂはセグメント３１０と関連付けられてよく、ＡＰ３０４Ｃはセグメント３１２と関連付けられてよく、ＡＰ３０４Ｄはセグメント３１４と関連付けられてよい。

【００７０】

[0096]ある実施形態では、ＡＰ３０４Ａ～３０４Ｄと、他のデバイス（たとえば、ＢＳＡの中心の近くのＳＴＡ）と同時に通信できるような状態または条件にあるＳＴＡとが互いに通信しているとき、各ＡＰ３０４Ａ～３０４Ｄ、および、これらのＳＴＡの各々は、８０ＭＨｚの媒体の一部分または全体を使用して通信することができる。しかしながら、ＡＰ３０４Ａ～３０４Ｄと、他のデバイス（たとえば、ＢＳＡの端の近くのＳＴＡ）と同時に通信できないような状態または条件にあるＳＴＡとが互いに通信しているとき、ＡＰ３０４ＡおよびそのＳＴＡは、２０ＭＨｚのセグメント３０８を使用して通信し、ＡＰ３０４ＢおよびそのＳＴＡは、２０ＭＨｚのセグメント３１０を使用して通信し、ＡＰ３０４ＣおよびそのＳＴＡは、２０ＭＨｚのセグメント３１２を使用して通信し、ＡＰ３０４ＤおよびそのＳＴＡは、２０ＭＨｚのセグメント３１４を使用して通信する。セグメント３０８、３１０、３１２、および３１４は、通信媒体の異なる部分であるので、第１のセグメントを使用する第１の送信は、第２のセグメントを使用する第２の送信に干渉しない

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【００７１】

[0097]したがって、高効率ワイヤレスコンポーネントを含むＡＰおよび／またはＳＴＡは、他のデバイスと同時に通信できないような状態または条件にあるものであっても、干渉を伴わずに他のＡＰおよびＳＴＡと同時に通信することができる。したがって、ワイヤレス通信ネットワーク３００のスループットは増大し得る。集合住宅または人口密度の高い公共空間の場合、高効率ワイヤレスコンポーネントを使用するＡＰおよび／またはＳＴＡは、アクティブなワイヤレスデバイスの数が増加する中でも、レイテンシの低減とネットワークスループットの増大を経験し、それによってユーザ体験を改善することができる。

【００７２】

[0098]図４は、図１、図２Ｂおよび図３のワイヤレス通信システム１００、２５０および／または３００内で利用され得るワイヤレスデバイス４０２の例示的な機能ブロック図を示す。ワイヤレスデバイス４０２は、本明細書で説明される様々な方法を実施するように構成され得るデバイスの一例である。たとえば、ワイヤレスデバイス４０２は、ＡＰ１０４、ＳＴＡ１０６の１つ、ＡＰ２５４の１つ、ＳＴＡ２５６の１つ、および／またはＡＰ３０４の１つを備え得る。

【００７３】

[0099]ワイヤレスデバイス４０２は、ワイヤレスデバイス４０２の動作を制御するプロセッサ４０４を含み得る。プロセッサ４０４は、中央処理装置（ＣＰＵ）とも呼ばれ得る。読取り専用メモリ（ＲＯＭ）とランダムアクセスメモリ（ＲＡＭ）の両方を含み得るメモリ４０６は、命令とデータとをプロセッサ４０４に提供することができる。メモリ４０６の一部分は、不揮発性ランダムアクセスメモリ（ＮＶＲＡＭ）も含み得る。プロセッサ４０４は通常、メモリ４０６内に記憶されたプログラム命令に基づいて、論理演算と算術演算とを実行する。メモリ４０６中の命令は、本明細書で説明される方法を実施するように実行可能であり得る。

【００７４】

[00100]プロセッサ４０４は、１つまたは複数のプロセッサにより実装された処理システムを備え、またはそのコンポーネントであり得る。１つまたは複数のプロセッサは、汎用マイクロプロセッサ、マイクロコントローラ、デジタル信号プロセッサ（ＤＳＰ）、フィールドプログラマブルゲートアレイ（ＦＰＧＡ）、プログラマブル論理デバイス（ＰＬＤ）、コントローラ、状態機械、ゲート型論理、個別ハードウェアコンポーネント、専用のハードウェア有限状態機械、または情報の計算または他の操作を実行することができる任意の他の好適なエンティティの任意の組合せで実装され得る。

【００７５】

[00101]処理システムはまた、ソフトウェアを記憶するための機械可読媒体を含み得る。ソフトウェアは、ソフトウェア、ファームウェア、ミドルウェア、マイクロコード、ハードウェア記述言語、またはそれ以外のいずれで呼ばれるかにかかわらず、任意のタイプの命令を意味するものとして広範に解釈されるべきである。命令は、（たとえば、ソースコードフォーマット、バイナリコードフォーマット、実行可能コードフォーマット、または任意の他の好適なコードフォーマットの）コードを含み得る。命令は、１つまたは複数のプロセッサによって実行されたとき、処理システムに、本明細書で説明される様々な機能を実行させる。

【００７６】

[00102]ワイヤレスデバイス４０２はまた、ワイヤレスデバイス４０２と離れた位置との間のデータの送信および受信を可能にするための送信機４１０および／または受信機４１２を含み得る、筐体４０８を含み得る。送信機４１０と受信機４１２は送受信機４１４へと組み合わされ得る。アンテナ４１６は、筐体４０８に取り付けられ、送受信機４１４に電気的に結合され得る。ワイヤレスデバイス４０２はまた、複数の送信機、複数の受信機、複数の送受信機、および／または複数のアンテナを含み得る（図示されず）。

【００７７】
[00103]送信機４１０は、ワイヤレスデバイスが以下で説明されるように休止状態から起動し、活動状態に入る必要があるかどうかをワイヤレスデバイスに示すように構成される、「ページングメッセージ」と呼ばれ得るメッセージをワイヤレスに送信するように構成され得る。たとえば、送信機４１０は、上で論じられたプロセッサ４０４によって生成されたページングメッセージを送信するように構成され得る。ワイヤレスデバイス４０２がＳＴＡ１０６として実装または使用されるとき、プロセッサ４０４は、ページングメッセージを処理するように構成され得る。ワイヤレスデバイス４０２がＡＰ１０４として実装または使用されるとき、プロセッサ４０４はまた、ページングメッセージを生成するように構成され得る。

【００７８】
[00104]受信機４１２は、ページングメッセージをワイヤレスに受信するように構成され得る。ワイヤレスデバイス４０２がＳＴＡ１０６として実装または使用されるとき、送信機４１０は、ページングメッセージに応答して、データに対する要求を送信するように構成され得る。たとえば、ワイヤレスデバイス４０２は、図４に関して本明細書で説明されるように電力節約ポール（Power-Saving Poll）（ＰＳポール）を送信するように構成され得る。ワイヤレスデバイス４０２がＡＰ１０４として実装または使用されるとき、送信機４１０はさらに、１つまたは複数のＳＴＡ１０６にデータを送信するように構成され得る。ワイヤレスデバイス４０２がＳＴＡ１０６として実装または使用されるとき、送信機４１０は、ＡＰ１０４から受信されたデータに対する肯定応答を送信するように構成され得る。

【００７９】
[00105]ワイヤレスデバイス４０２はまた、送受信機４１４によって受信された信号のレベルを検出し定量化するために使用され得る、信号検出器４１８を含み得る。信号検出器４１８は、総エネルギー、シンボルごとのサブキャリア当たりのエネルギー、電力スペクトル密度、および他の信号のような信号を検出し得る。ワイヤレスデバイス４０２は、信号の処理に使用するためのデジタル信号プロセッサ（ＤＳＰ）４２０も含み得る。ＤＳＰ４２０は、送信のためのパケットを生成するために構成され得る。いくつかの態様では、パケットは、物理レイヤデータユニット（ＰＰＤＵ）を備え得る。

【００８０】
[00106]いくつかの態様では、ワイヤレスデバイス４０２はさらに、ユーザインターフェース４２２を備え得る。ユーザインターフェース４２２は、キーパッド、マイクロホン、スピーカー、および／またはディスプレイを備え得る。ユーザインターフェース４２２は、ワイヤレスデバイス４０２のユーザに情報を伝え、および／またはユーザからの入力を受け取る、任意の要素またはコンポーネントを含み得る。

【００８１】
[00107]いくつかの態様では、ワイヤレスデバイス４０２はさらに、高効率ワイヤレスコンポーネント４２４を備え得る。高効率ワイヤレスコンポーネント４２４は、分類器ユニット４２８と送信制御ユニット４３０とを含み得る。本明細書で説明されるように、高効率ワイヤレスコンポーネント４２４は、ＣＳＭＡ機構の非効率性を最小限にする（たとえば、干渉が生じることのない状況において媒体を通じた同時通信を可能にする）修正された機構をＡＰおよび／またはＳＴＡが使用することを可能にし得る。

【００８２】
[00108]修正された機構は、分類器ユニット４２８および送信制御ユニット４３０によって実装され得る。ある実施形態では、分類器ユニット４２８は、どのデバイスが他のデバイスと同時に通信することができるような状態または条件にあり、どのデバイスが他のデバイスと同時に通信することができないような状態または条件にあるかを決定する。ある実施形態では、送信制御ユニット４３０はデバイスの動作を制御する。たとえば、送信制御ユニット４３０は、いくつかのデバイスが同じ媒体上で同時に送信することを可能にし、他のデバイスが空間多重化技法または周波数領域多重化技法を使用して送信すること

を可能にし得る。送信制御ユニット４３０は、分類器ユニット４２８によって行われた決定に基づいてデバイスの動作を制御することができる。

【００８３】

[00109]ワイヤレスデバイス４０２の様々なコンポーネントは、バスシステム４２６によって一緒に結合され得る。バスシステム４２６は、たとえば、データバスを、さらにはデータバスに加えて、電力バスと、制御信号バスと、ステータス信号バスとを含み得る。ワイヤレスデバイス４０２のコンポーネントは、何らかの他の機構を使用して、一緒に結合されてよく、または互いに対する入力を受け入れ、もしくは提供してよいことを当業者は理解するだろう。

【００８４】

[00110]図４には、いくつかの別個のコンポーネントが示されているが、コンポーネントの１つまたは複数が組み合わされ、または共通に実装され得ることを当業者は認識するだろう。たとえば、プロセッサ４０４は、プロセッサ４０４に関して上で説明された機能を実装するためだけでなく、信号検出器４１８および／またはＤＳＰ４２０に関して上で説明された機能を実装するためにも使用され得る。さらに、図４に示されるコンポーネントの各々は、複数の別個の要素を使用して実装され得る。

【００８５】

[00111]ワイヤレスデバイス４０２は、ＡＰ１０４、ＳＴＡ１０６、ＡＰ２５４、ＳＴＡ２５６、および／またはＡＰ３０４を備えてよく、通信を送信および／または受信するために使用されてよい。すなわち、ＡＰ１０４、ＳＴＡ１０６、ＡＰ２５４、ＳＴＡ２５６、またはＡＰ３０４のいずれかが、送信機デバイスまたは受信機デバイスとして機能し得る。いくつかの態様は、信号検出器４１８が、送信機または受信機の存在を検出するために、メモリ４０６およびプロセッサ４０４上で動作しているソフトウェアによって使用されることを企図する。

【００８６】

[00112]図１を再び参照すると、ＳＴＡ１０６は、複数の動作モードを有し得る。たとえば、ＳＴＡ１０６は、アクティブモードと呼ばれる第１の動作モードを有し得る。アクティブモードでは、ＳＴＡ１０６は、常に「活動」状態にあってよく、ＡＰ１０４とデータをアクティブに送信／受信することができる。さらに、ＳＴＡ１０６は、電力節約モードと呼ばれる第２の動作モードを有し得る。電力節約モードでは、ＳＴＡ１０６は、「活動」状態、あるいは、ＳＴＡ１０６がＡＰ１０４とデータをアクティブに送信／受信しない「休眠」または「スリープ」状態であり得る。たとえば、ＳＴＡ１０６の受信機４１２、ならびに、場合によってはＤＳＰ４２０および信号検出器４１８は、休眠状態では低減された電力消費量で動作することができる。さらに、電力節約モードでは、ＳＴＡ１０６は、ＡＰ１０４とデータを送信／受信することが可能になるように、ＳＴＡ１０６が特定の時間において「起動する」（たとえば、活動状態に入る）必要があるかどうかをＳＴＡ１０６に示す、ＡＰ１０４からのメッセージ（たとえば、ページングメッセージ）を聴取するために、時として活動状態に入ることができる。

【００８７】

[00113]したがって、いくつかのワイヤレス通信システム１００の中で、ＡＰ１０４は、ＳＴＡ１０６のためにＡＰ１０４においてバッファされたデータがあるかどうか示すページングメッセージを、ＡＰ１０４と同じネットワーク中の電力節約モードにある複数のＳＴＡ１０６に送信することができる。ＳＴＡ１０６はまた、この情報を使用して、それらが活動状態である必要があるか休眠状態である必要があるかを決定することができる。たとえば、ＳＴＡ１０６がページングされていないとＳＴＡ１０６が決定した場合、それは休眠状態に入ることができる。代替的に、ＳＴＡ１０６がページングされ得るとＳＴＡ１０６が決定した場合、ＳＴＡ１０６は、ページを受信するために、ある時間の期間活動状態に入り、ページに基づいていつ活動状態になるべきかをさらに決定することができる。さらに、ＳＴＡ１０６は、ページを受信した後に、ある時間の期間活動状態にとどまることができる。別の例では、ＳＴＡ１０６は、ページングされているときまたはページン

グされていないとき、本開示と矛盾しない他の方法で機能するように構成され得る。

【００８８】

[00114]いくつかの態様では、ページングメッセージは、トラフィック識別マップ（ＴＩＭ）のようなビットマップ（この図に示されない）を含み得る。いくつかのそのような態様では、ビットマップはいくつかのビットを含み得る。これらのページングメッセージは、ＡＰ１０４からＳＴＡ１０６にビーコンまたはＴＩＭフレーム中で送られ得る。ビットマップ中の各ビットは、複数のＳＴＡ１０６のうちの特定のＳＴＡ１０６に対応してよく、各ビットの値（たとえば、０または１）は、ＡＰ１０４がその特定のＳＴＡのために有するバフされたユニットを受信することが可能となるために、対応するＳＴＡ１０６がなるべき状態（たとえば、休眠状態または活動状態）を示すことができる。したがって、ビットマップのサイズは、ワイヤレス通信システム１００中のＳＴＡ１０６の数に直接比例し得る。したがって、ワイヤレス通信システム１００中のＳＴＡ１０６の数が大きいと、ビットマップが大きくなり得る。

【００８９】

[00115]いくつかの態様では、長時間スリープするＳＴＡ１０６は、ＴＩＭメッセージを読み取るために起動しないことがある。たとえば、ＳＴＡ１０６は、拡張スリープモードでは１つまたは複数のＴＩＭメッセージを通じてスリープすることを決定することができる。この場合、ＳＴＡ１０６は、ＳＴＡ１０６がいずれのＴＩＭメッセージも読み取らないことがあることをＡＰ１０４に告知することができる。したがって、ＡＰ１０４は、ＴＩＭメッセージ中に対応する識別子を含めなくてよい。様々な実施形態では、ＳＴＡ１０６は、制御メッセージを使用して、または接続中に直ちに、それらが１つまたは複数のＴＩＭメッセージのために起動しないことがあること（すなわち、それらが上述の電力節約モードで動作していること）をＡＰ１０４に通知し得る。

【００９０】

[00116]このようにＡＰ１０４に通知したＳＴＡ１０６に対しては、ＡＰ１０４がＳＴＡ１０６を対象とするＢＵを有する場合でも、ＡＰ１０４はＴＩＭメッセージ中に識別子を含めなくてよい。ＳＴＡ１０６は、ＡＰ１０４に任意の時間にＰＳポールを送ることによってそれらのＢＵを要求することができる。ある実施形態では、ＡＰ１０４は、ＰＳポールに応答して、バッファされたユニットＢＵを直ちに送ることができる。別の実施形態では、ＡＰ１０４は、ＰＳポールに肯定応答（ＡＣＫ）で応答し、後でＢＵを配信することができる。また別の実施形態では、ＡＰ１０４は、ＰＳポールに（ＡＣＫでもＢＵでも）直ちに応答しなくてよい。ＡＰ１０４は、代わりに、ＴＩＭメッセージ後の所与のスケジューリングされた時間の後に送られる累積ＡＣＫフレームで返答することができる。

【００９１】

[00117]様々な実施形態では、ＳＴＡ１０６は、ＰＳポール（動的指示の場合）、ＡＰに送られる接続要求、プローブ要求、および／または別の管理フレーム（静的指示の場合）を介してＢＵを配信するための待ち時間を指定することができる。他の実施形態では、ＡＰ１０４は、ＡＣＫフレーム、ＴＩＭ要素（動的指示の場合）、ＳＴＡ１０６に送られるビーコン、接続応答、プローブ応答、または他の管理フレーム（静的指示の場合）を介してＢＵを配信するための待ち時間を指定することができる。ＳＴＡ１０６は待ち時間の長さの間、スリープすることができる。ＳＴＡ１０６は、ＡＣＫを送ることによってＢＵの正しい受信に肯定応答することができる。ＳＴＡ１０６は次いで、スリープに戻ることができる。

【００９２】

[00118]図５Ａは、図１のワイヤレス通信システム１００においてＡＰ１０４によってＳＴＡ１０６に送信される複数のワイヤレスメッセージ５０２を示す。示されるように、時間は、時間軸５０４上でページにわたって水平方向に増加する。様々な実施形態において、ＡＰ１０４は、いくつかの宛先ＳＴＡ１０６に宛てられる複数のフレーム５１０Ａ～５１０Ｎを含むバッファされたユニットを受信および／または記憶することができる。ＡＰ１０４が送信すべきバッファされたユニットを有する場合、ＡＰ１０４は複数のワイヤ

レスメッセージ５０２を複数のＳＴＡ１０６に送信することができる。
【００９３】
[00119]様々な実施形態において、フレーム５１０Ａ～５１０Ｂは、小さな、または短いフレーム５１０Ａ～５１０Ｎであってよく、約１バイトから約１００バイト、約１０バイトから約５０バイト、およびより具体的には約２０バイトを含み得る。小さなフレームは、たとえば、プッシュ通知（たとえば、電子メール、広告など）、ショートメッセージングアプリケーション（たとえば、Ｆａｃｅｂｏｏｋ（登録商標）投稿、Ｔｗｉｔｔｅｒ（登録商標）投稿、テキストメッセージなど）、上層プロトコルのオーバーヘッド（たとえば、送信制御プロトコル（ＴＣＰ）肯定応答、キープアライブメッセージなど）などのようなアプリケーションによって生成され得る。したがって、多数の比較的小さなフレームが多くのワイヤレスメッセージを生成する可能性があり、これは、１つまたは複数のＳＴＡ１０６が媒体上でＡＰ１０４に要求を送信する際に競合することにつながり得る。
【００９４】
[00120]図５Ｂは、図１のワイヤレス通信システム１００においてＡＰ１０４によってＳＴＡ１０６に送信される単一のＡ－ＭＰＤＵワイヤレスメッセージ５０２を示す。示されるように、時間は、時間軸５０４上でページにわたって水平方向に増加する。図５Ａに関して上で論じられたように、ＡＰ１０４は、いくつかの宛先ＳＴＡ１０６に宛てられる複数のフレーム５１０Ａ～５１０Ｎを含むバッファされたユニットを受信および／または記憶することができる。ＡＰ１０４が送信すべきバッファされたユニットを有する場合、図５Ａに示される複数のワイヤレスメッセージ５０２を送信する代わりに、ＡＰは単一の集約されたＭＰＤＵメッセージ５０４を送信することができる。Ａ－ＭＰＤＵ５０４は、複数のＡ－ＭＰＤＵサブフレーム５０５ａ～ｃを含み得る。Ａ－ＭＰＤＵ５０４に含まれる複数のＡ－ＭＰＤＵサブフレーム５０５ａ～ｃの１つまたは複数は、異なる受信機に宛てられ得る。
【００９５】
[00121]ワイヤレスメッセージ５０４のＡ－ＭＰＤＵサブフレーム５０５ａ～ｃが複数の受信機に宛てられ得るので、各受信機が受信機に宛てられたＡ－ＭＰＤＵサブフレーム５０５ａ～ｃにどのように肯定応答するかということについて、問題が生じる。受信機の各々からの肯定応答を調整するために、Ａ－ＭＰＤＵサブフレーム５０５ａ～ｃの１つまたは複数は、Ａ－ＭＰＤＵサブフレームに対する肯定応答ポリシーを定める１つまたは複数のフィールドを含み得る。たとえば、肯定応答ポリシーはたとえば、Ａ－ＭＰＤＵサブフレームに対する肯定応答が宛先指定された受信機によって送信されるべきかどうか、送信されるべき肯定応答のタイプ（たとえば、肯定応答が送信されるべきかブロック肯定応答が送信されるべきか）、および／または、Ａ－ＭＰＤＵワイヤレスメッセージ５０４が受信されるときと、メッセージ５０４に含まれる任意のＭＰＤＵサブフレームへの肯定応答が送信されるときとの間の遅延時間期間を示すことができる。各Ａ－ＭＰＤＵサブフレーム５０５ａ～ｃの示された肯定応答ポリシーは、ＭＰＤＵサブフレーム５５０ａ～ｃの各々が肯定応答される場合に発生する競合の確率を減らすために、ＭＰＤＵサブフレーム５０５ａ～ｃの各々の肯定応答を調整するように機能する。
【００９６】
[00122]図６は、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）フレーム６００の例示的な構造を示す。示されるように、ＭＰＤＵフレーム６００は、フレーム制御（ｆｃ）フィールド６１０、時間長／識別（ｄｕｒ）フィールド６２５、受信機アドレス（ａ１）フィールド６３０、送信機アドレス（ａ２）フィールド６３５、宛先アドレス（ａ３）フィールド６４０、シーケンス制御（ｓｃ）フィールド６４５、第４のアドレス（ａ４）フィールド６５０、サービス品質（ＱｏＳ）制御（ｑｃ）フィールド６５５、高スループット（ＨＴ）制御フィールド６６０、フレーム本体６６５、およびフレーム確認シーケンス（ＦＣＳ）フィールド６７０という、１１個の異なるフィールドを含む。フィールド６１０～６６０のいくつかまたはすべてが、ＭＡＣヘッダ６０２を構成する。
【００９７】

[00123]メディアアクセス制御フレームのフィールドの各々は、メディアアクセス制御パラメータと見なされ得る。加えて、各フィールドは、１つまたは複数のサブフィールドまたはフィールドからなり得る。たとえば、媒体アクセス制御ヘッダ６０２のフレーム制御フィールド６１０は、プロトコルバージョン、タイプフィールド、サブタイプフィールド、および他のフィールドのような複数のサブフィールドからなり得る。これらのサブフィールドまたはフィールドの各々も、メディアアクセス制御パラメータと見なされ得る。いくつかの実施形態では、メディアアクセス制御フレームの個々のビットが、メディアアクセス制御パラメータと見なされ得る。

【００９８】

[00124]ａ１、ａ２、ａ３、およびａ４フィールド６３０、６３５、６４０、および６５０の各々は、４８ビット（６オクテット）値である、デバイスのフルＭＡＣアドレスを備え得る。いくつかの態様では、これらのフィールドのいずれもが、短いＭＡＣヘッダフォーマットに基づくＡＩＤを備え得る。図６はさらに、フィールド６１０～６７０の各々のオクテット単位のサイズを示している。フレーム本体フィールド６６５は、異なるタイプの変化するオクテット数のＭＰＤＵフレームを備えるは、図６に示されるフィールドの一部分のみを含み得る。たとえば、ＭＰＤＵフレームが制御フレームである場合、ＭＰＤＵフレームのＭＡＣヘッダは、ＱｏＳ制御フィールド６５５またはＨＴ制御フィールド６６０を含まなくてよい。加えて、タイプによっては、ＭＰＤＵフレーム６００は追加のフィールドを含み得る。しかしながら、いくつかの場合には、タイプにかかわらず、ＭＰＤＵフレーム６００はフレーム制御フィールド６１０を含み得る。

【００９９】

[00125]図７は、サービス品質（ＱｏＳ）制御（ｑｃ）フィールド６５５の例示的な構造を示す。示されるように、ＱｏＳ制御フィールド６５５は、トラフィックインジケータ（ＴＩＤ）フィールド７１０、サービス期間の末尾フィールド７２０、肯定応答ポリシーフィールド７３０、集約されたＭＳＤＵ存在フィールド７４０、および「多彩な」フィールド７５０という、５つの異なるフィールドを含む。いくつかの態様では、肯定応答ポリシーフィールド７３０は、４つの肯定応答ポリシーの１つを示し得る。いくつかの態様では、４つの肯定応答ポリシーは、「普通の肯定応答または暗黙的なブロック肯定応答要求」と、「肯定応答なし」と、「肯定応答なしまたは電力節約マルチポール（ＰＳＭＰ）肯定応答」と、「ブロック肯定応答」とを含み得る。いくつかの態様では、肯定応答ポリシー（ＡＣＫポリシー）フィールド７３０およびトラフィックインジケータ（ＴＩＤ）フィールド７１０は、ＭＡＣヘッダ中の他の箇所に位置し得る。たとえば、肯定応答ポリシーフィールドおよび／またはＴＩＤフィールドは、ＭＡＣヘッダ６０２のフレーム制御フィールド６１０に位置し得る。

【０１００】

[00126]「多彩な」フィールド７５０は、ＱｏＳ制御フィールド６５５の実施形態に応じて、様々な異なるフィールドであってよい。たとえば、いくつかの態様では、「多彩な」フィールド７５０は、ＴＸＯＰ制限フィールド、アクセスポイントＰＳバッファ状態フィールド、要求されるＴＸＯＰ時間長フィールド、キューサイズフィールドであってよい。

【０１０１】

[00127]いくつかの態様では、肯定応答ポリシーフィールド７３０が、「普通の肯定応答または暗黙的なブロック肯定応答要求」のような特定の値を示し、ＭＰＤＵフレーム６００がＡ－ＭＰＤＵフレームの一部として含まれる場合、ＭＰＤＵフレームの宛先指定された受信者は、ＭＰＤＵ６００が個々に送信される場合は肯定応答フレームを送信し、またはＭＰＤＵ６００がＡ－ＭＰＤＵの一部として送信される場合はブロック肯定応答フレームを送信することができる。肯定応答またはブロック肯定応答の送信は、ＭＰＤＵフレーム６００を搬送するＰＰＤＵから短フレーム間空間（ＳＩＦＳ）の時間期間後に開始し得る。いくつかの態様では、肯定応答ポリシーフィールド７３０が「肯定応答なし」を示す場合、ＭＰＤＵフレームの宛先指定された受信者は、ＭＰＤＵサブフレームの受信後に

動作を行わない。いくつかの態様では、肯定応答ポリシーフィールド７３０が「ブロック肯定応答」を示す場合、ＭＰＤＵフレームの宛先指定された受信者は、状態を記録することを除き、フレームの受信後に動作を行わない。受信者は、自身が応答することになる未来のブロック肯定応答要求フレームを予期し得る。

【０１０２】

[00128]図８は、集約されたＭＰＤＵ（Ａ－ＭＰＤＵ）フレーム８００の例示的な構造を示す。示されるように、Ａ－ＭＰＤＵフレーム８００は、８０５ａ、８０５ｂ、および８０５ｎとして示される、変化する数のＡ－ＭＰＤＵサブフレームを含む。Ａ－ＭＰＤＵサブフレーム８０５ａ、８０５ｂ、および８０５ｎの各々は、いくつかの態様では、ＭＰＤＵデリミタフィールド８１０ａ、ＭＰＤＵフレーム６００ａ、および０以上のパッドバイトからなり得る。ＭＰＤＵフレーム６００ａは、いくつかの態様では、図６に示されるＭＰＤＵフレーム６００と実質的に一致し得る。

【０１０３】

[00129]ＭＰＤＵデリミタフィールドの各々、たとえばＭＰＤＵデリミタフィールド８１０ａは、フレームの末尾（ＥＯＦ）フィールド８１２ａと、予備フィールド８１４ａと、ＭＰＤＵ長さフィールド８１６ａと、ＣＲＣフィールド８１８ａと、デリミタシグネチャフィールド８２０ａとを含み得る。

【０１０４】

[00130]いくつかの態様では、フレームの末尾フィールド８１２は、Ａ－ＭＰＤＵサブフレーム８０５ａが０ではない値を有するＭＰＤＵ長さフィールド８１６ａ伴う唯一のＡ－ＭＰＤＵサブフレームである場合、Ａ－ＭＰＤＵサブフレーム８０５ａにおいて１に設定され得る。いくつかの態様では、フレームの末尾フィールド８１２ａは、０ではないＭＰＤＵ長さフィールドを有する唯一のＡ－ＭＰＤＵサブフレームではない、０ではないＭＰＤＵ長さフィールド８１６ａを有するＡ－ＭＰＤＵフレーム８００中の各Ａ－ＭＰＤＵサブフレーム８０５に対して、０に設定され得る。

【０１０５】

[00131]図９Ａは、ＭＰＤＵデリミタフィールド８１０ｂのある実施形態を示す。いくつかの態様では、ＭＰＤＵデリミタフィールド８１０ｂは、図８に示されるＭＰＤＵデリミタフィールド８１０ａと置き換えられ得る。たとえば、図９Ｃに関して以下で論じられるＡ－ＭＰＤＵ９００ａは、ＭＰＤＵデリミタフィールド８１０ｂを利用することができる。ＭＰＤＵデリミタフィールド８１０ｂは、遅延インジケータフィールド８１４ｂ、ＭＰＤＵ長さフィールド８１６ｂ、ＣＲＣフィールド８１８ｂ、およびデリミタシグネチャフィールド８２０ｂという４つのフィールドを含む。いくつかの態様では、図９Ｃに関して以下で論じられるＡ－ＭＰＤＵサブフレーム９０５ａ～ｃの各々における遅延インジケータフィールド８１４ｂの別々のコピーは、ＭＰＤＵデリミタフィールド８１０ｂがＡ－ＭＰＤＵサブフレーム９０５ａ～ｃの各々に含まれる場合、遅延インジケータ値８１４ｍ～ｏを示し得る。

【０１０６】

[00132]図９Ｂは、ＭＰＤＵデリミタフィールド８１０ｃのある実施形態を示す。いくつかの態様では、ＭＰＤＵデリミタフィールド８１０ｃは、図８に示されるＭＰＤＵデリミタフィールド８１０ａと置き換えられ得る。たとえば、Ａ－ＭＰＤＵ９００ａは、ＭＰＤＵデリミタフィールド８１０ｃを利用することができる。ＭＰＤＵデリミタフィールド８１０ｃは、フレームの末尾インジケータフィールド８１２ｃ、遅延インジケータフィールド８１４ｃ、ＭＰＤＵ長さフィールド８１６ｃ、ＣＲＣフィールド８１８ｃ、およびデリミタシグネチャフィールド８２０ｃという、５つのフィールドを含む。いくつかの態様では、遅延インジケータフィールド８１４ｃの別個のコピーは、ＭＰＤＵデリミタフィールド８１０ｃがＡ－ＭＰＤＵサブフレーム９０５ａ～ｃの各々に含まれる場合、以下の図９Ｃに示される遅延インジケータ値８１４ｍ～ｏを示し得る。

【０１０７】

[00133]図９Ｃは、少なくとも３つのＡ－ＭＰＤＵサブフレーム９０５ａ～ｃを含むＡ

－ＭＰＤＵ９００ａを示す。第１のＡ－ＭＰＤＵサブフレーム９０５ａは、ＳＴＡ１０６ａの局アドレスと等価な受信機アドレスを示す。同様に、第２のＡ－ＭＰＤＵサブフレーム９０５ｂは、ＳＴＡ１０６ｂの局アドレスと等価な受信機アドレスを示す。第３のサブフレーム９０５ｃは、ＳＴＡ１０６ｃの局アドレスと等価な受信機アドレスを示す。いくつかの他の示されていない態様では、Ａ－ＭＰＤＵ９００ａは３つよりも多くのＡ－ＭＰＤＵサブフレームを含み得る。たとえば、Ａ－ＭＰＤＵは、４個、５個、６個、７個、８個、９個、１０個以上のサブフレームを含み得る。いくつかの態様では、Ａ－ＭＰＤＵ９００ａ中の任意の追加のサブフレームのいくつかまたはすべてが、ＳＴＡ１０６ａ～ｃのいずれかまたは他の局、アクセスポイント、もしくはリレーの受信機アドレスを示し得る。

【０１０８】

[00134]ＭＰＤＵ６００およびＱｏＳ制御フィールド６５５に関して上で論じられたように、図９Ａに示されるＡ－ＭＰＤＵ９００ａの各Ａ－ＭＰＤＵサブフレーム９０５ａ～ｃは、ＱｏＳ制御フィールド、または肯定応答ポリシーの指示を含む何らかの他のフィールドを含み得る。たとえば、各Ａ－ＭＰＤＵサブフレーム９０５ａ～ｃは、図７に示されるようなＱｏＳ制御フィールドを含む、ＭＰＤＵ６００のフォーマットに従い得る。

【０１０９】

[00135]示される実装形態では、Ａ－ＭＰＤＵ９００ａに含まれる３つのＡ－ＭＰＤＵサブフレーム９０５ａ～ｃは、たとえば、図６のＭＰＤＵフレーム６００に示されるアドレス１フィールド６３０のような受信機アドレスフィールドに、３つの異なる受信機アドレスを含む。Ａ－ＭＰＤＵ９００ａに含まれる３つのＡ－ＭＰＤＵサブフレームはまた、３つの異なる受信機アドレスフィールドと関連付けられる３つの異なる肯定応答ポリシーを含む。

【０１１０】

[00136]示される態様における肯定応答の手順は、ＭＰＤＵデリミタ中の１つまたは複数のフィールド、および、ＭＰＤＵデリミタが関連付けられるＭＰＤＵに含まれるＡｃｋポリシーフィールド、すなわち、遅延インジケータフィールド８１４ｍ～ｏ、もしあればＥＯＦフィールド、および肯定応答ポリシーフィールド７３０ａ～ｃから推測される。いくつかの態様では、遅延インジケータフィールド８１４ｍ～ｏは、図９Ａに示される遅延インジケータフィールド８１４のフォーマットに実質的に従う。いくつかの態様では、肯定応答ポリシーフィールド７３０ａ～ｃは、図７の肯定応答ポリシーフィールド７３０のフォーマットに実質的に従う。

【０１１１】

[00137]図９Ｃに示されるように、Ａ－ＭＰＤＵサブフレーム９０５ａ～ｃの３つすべてが、「普通の肯定応答」に設定された肯定応答ポリシーを含む。いくつかのワイヤレス規格、たとえば８０２．１１ａｈ規格では、これは、「普通の肯定応答または暗黙的なブロック肯定応答要求」のような特定の値に対応し得る。Ａ－ＭＰＤＵサブフレーム９０５ａ～ｃの各々は、異なる遅延インジケータ値を有する。

【０１１２】

[00138]肯定応答ポリシーフィールド７３０ａ～ｃおよび遅延インジケータフィールド８１４ｍ～ｏの値に基づいて、Ａ－ＭＰＤＵ９００ａは、ＳＴＡ１０６ａがＭＰＤＵ９０５ａの正しい受信にまず肯定応答すべきであることを示す。いくつかの態様では、Ａ－ＭＰＤＵサブフレーム９０５ａは、遅延インジケータが０の値に設定されているので、Ａ－ＭＰＤＵ９００ａの送信／受信の完了からＳＩＦＳ時間後に、肯定応答されるべきである。一般に、１つまたは複数のＭＰＤＵがＳＴＡ１０６ａ～ｃのいずれかに宛てられ得ることに留意されたい。そのような実施形態では、単一のＭＰＤＵが所与の受信機に宛てられる場合、受信機は、ＥＯＦフィールドが１に設定される場合にＡＣＫフレームによって応答するか、それ以外の場合にＢｌｏｃｋＡｃｋによって応答するかを決定することができる。一般に、いくつかの態様では、遅延の量は式（１）に基づいて決定され得る。

【数１】

$$遅延 = SIFS + (遅延インジケータ * (SIFS + K)) \qquad (1)$$

【０１１３】

[00139]ここで、Ｋは受信機が送信機に制御応答を送信するために必要とされる時間の長さに等しい。いくつかの態様では、送信デバイスは、時間長Ｋが確定的でありすべての受信機に対して等しくなるように、応答フレームの送信のための厳密な規則に従うように１つまたは複数の受信機に要求し得る。これらの規則の例は、厳密なＭＣＳおよび帯域幅選択の規則を含んでよく、また、（たとえば、肯定応答が送られるべきであることを示す各受信機に宛てられるＡ－ＭＰＤＵサブフレームをＡ－ＭＰＤＵに含めることによって、同じ応答フレームによって応答することを受信機に要求することがあり、送信機は、対応するＡ－ＭＰＤＵサブフレームに対するＡＣＫフレームによって応答するように受信機に命令する。同様の規則が、ブロックＡｃｋフレームのみを応答として要求することに対して適用されることがあり、この場合、Ｋの時間長はより長くてよい）。

【０１１４】

[00140]特定のＡ－ＭＰＤＵフレーム内で、各遅延インジケータフィールドは、少なくとも、それに対する受信デバイスからの肯定応答を送信機が要求する任意のＡ－ＭＰＤＵサブフレームに対しては、固有の値に設定され得る。いくつかの態様では、Ａ－ＭＰＤＵサブフレームがＳＴＡのグループに宛てられる場合、送信機はＡＣＫポリシーを「肯定応答なし」に設定し、これは応答が予期されないことを示す。いくつかの態様では、遅延インジケータは、別のＭＰＤＵサブフレームによって使用される値であり得る。いくつかの態様では、「肯定応答なし」という肯定応答ポリシーを示すＡ－ＭＰＤＵサブフレームに対する遅延インジケータは、ランダムな値または初期化されていない値であってよい。

【０１１５】

[00141]いくつかの態様では、式１によって決定される遅延が経過した後で、Ａ－ＭＰＤＵサブフレームの肯定応答ポリシーが「普通の肯定応答または暗黙的なブロック肯定応答」に設定される場合、Ａ－ＭＰＤＵサブフレームの肯定応答の送信が実行され得る。図９Ｃにおいて、すべての３つのサブフレーム９０５ａ～ｃがこの方式で肯定応答され得る。

【０１１６】

[00142]Ａ－ＭＰＤＵサブフレーム９０５ｂに対する遅延インジケータ８１４ｎは０であるので、ＳＴＡ１０６ｂは、Ａ－ＭＰＤＵ９００ａの送信からＳＩＦＳ時間後に、Ａ－ＭＰＤＵサブフレーム９０５ｂに肯定応答しなければならない。いくつかの態様では、Ａ－ＭＰＤＵ９００ａはさらに、肯定応答遅延インジケータフィールド８１４ｍが１に設定されているので、Ａ－ＭＰＤＵ９００ａの送信から、ＳＩＦＳ＋１×（ＳＩＦＳ＋Ｋ）＝２ＳＩＦＳ＋一定の時間の後に、ＳＴＡ１０６ａがＭＰＤＵサブフレーム９０５ａの送信に肯定応答しなければならないことを示す。同様に、Ａ－ＭＰＤＵ９００ａは、肯定応答遅延インジケータ値フィールド８１４ｏが２に設定されているので、Ａ－ＭＰＤＵ９００ａの送信から３ＳＩＦＳ＋２Ｋ後に、ＳＴＡ１０６ｃがＭＰＤＵサブフレーム９０５ｃの送信に肯定応答しなければならないことを示す。

【０１１７】

[00143]Ａ－ＭＰＤＵ９００ａによって示される、２つ以上の、この場合は３つの受信機アドレスに対して異なる肯定応答ポリシーを含めることによって、ＡＰ１０４は、Ａ－ＭＰＤＵ９００ａの送信からＳＩＦＳ時間後の、３つの受信機アドレスに対応する３つのデバイス（ＳＴＡ１０６ａ～ｃ）の１つによる１つの肯定応答の受信を、効果的に管理することができる。この実施形態では、いくつかのＳＴＡ、たとえば１０６ａおよび１０６ｃは、Ａ－ＭＰＤＵサブフレームデリミタフィールド中の指示に基づいて、肯定応答を送信するまである時間期間待機することができる。いくつかの態様では、このことは、Ａ－ＭＰＤＵ９００ａの送信からＳＩＦＳ時間後における、Ａ－ＭＰＤＵ９００ａに含まれる

少なくとも２つのＡ－ＭＰＤＵサブフレームに対する少なくとも２つの肯定応答の間の競合の確率を下げる。図９Ｃでは３つのＡ－ＭＰＤＵサブフレームがＡ－ＭＰＤＵフレーム９００ａにおいて示されるが、いくつかの態様では、２つの、または４つ以上の受信機アドレスがＡ－ＭＰＤＵ９００ａによって示され得る。たとえば、Ａ－ＭＰＤＵ９００ａは、２つまたは４つ以上のデバイスに宛てられるＡ－ＭＰＤＵサブフレームを含み得る。そのようなＡ－ＭＰＤＵはまた、Ａ－ＭＰＤＵ９００ａに含まれるＡ－ＭＰＤＵサブフレームによって示される受信機アドレスの少なくとも２つに対応する、少なくとも２つの異なる肯定応答ポリシーを含む。いくつかの態様では、ＡＰは、トラフィック識別子（ＴＩＤ）に基づいて、および／またはＭＰＤＵごとに、異なる肯定応答ポリシーを要求し得ることを留意されたい。本明細書で説明される肯定応答の手順は、これらの実施形態に容易に拡張可能であることを、当業者は理解し得る。

【０１１８】

[00144]上で論じられたようにＡ－ＭＰＤＵの中に複数の受信機アドレスを有することに加えて（このとき、Ａ－ＭＰＤＵサブフレームの１つまたは複数は異なる受信機アドレスを有する、Ａ－ＭＰＤＵサブフレームの１つまたは複数は異なる送信機アドレスを有してよく、これは、Ａ－ＭＰＤＵサブフレームの１つまたは複数が１つまたは複数の異なるソースデバイスから送信機によって受信されている可能性があることを意味する。たとえば、２つ以上のＭＰＤＵを含むＡ－ＭＰＤＵの送信機は、オーバーヘッドを低減するのに有用である異なるＭＡＣアドレスへと、各ＭＰＤＵのＭＡＣヘッダ中のＡ２フィールド６３５（すなわち、送信機アドレス）を設定することができる。送信機が異なる送信機アドレスを設定することを実施し得る実施形態は、送信機が複数のＢＳＳＩＤ（各ＢＳＳＩＤはＡＰが関連付けられるＢＳＳを特定する）を有するＡＰであるときと、ＡＰが関連付けられるＢＳＳのいずれかと関連付けられるＳＴＡにＡＰが複数のＭＰＤＵを送信するを必要とするときとを含み得る。送信機が、リレー機能またはメッシュ機能を提供し、それぞれの送信範囲内にない可能性のある複数のＳＴＡの間で交換される必要のあるフレームを転送するように動作し、したがって、送信機が異なるＳＴＡから受信される複数のＭＰＤＵをＡ－ＭＰＤＵへと集約し、Ａ－ＭＰＤＵを１つまたは複数の宛先に送信し得る、追加の実施形態が存在することがあり、このとき、各ＭＰＤＵは、ＭＰＤＵのソースアドレス（すなわち、フレームを生成したＳＴＡ）を示すＡ２アドレスを有する。たとえば、いくつかの実施形態では、送信機が、共通のＡ１アドレス（受信機）とＡ２アドレス（送信機）とを有する１つまたは複数のＭＰＤＵ、異なるＡ１アドレス（受信機）と共通のＡ２アドレス（送信機）とを有する１つまたは複数のＭＰＤＵ（複数の受信機－単一の送信機）、共通のＡ１アドレス（受信機）と異なるＡ２アドレス（送信機とを有する１つまたは複数のＭＰＤＵ（単一の受信機－複数の送信機）、または、異なるＡ１アドレス（受信機）と異なるＡ２アドレス（送信機）とを有する１つまたは複数のＭＰＤＵ（複数の受信機－複数の送信機とを集約することができる。そのような集合は、オーバーヘッドを減らし、媒体の効率を上げることができる。

【０１１９】

[00145]図９Ｄは、ＡＰ１０４と３つの局ＳＴＡ１０６ａ、ＳＴＡ１０６ｂ、およびＳＴＡ１０６ｃとの間の例示的なワイヤレス通信を示す。ワイヤレス通信は、ＡＰ１０４がＡ－ＭＰＤＵパケット９００ａを送信することで開始する。いくつかの態様では、Ａ－ＭＰＤＵ９００ａはブロードキャストされ得る。いくつかの他の態様では、Ａ－ＭＰＤＵ９００ａは、局ＳＴＡ１０６ａと、ＳＴＡ１０６ｂと、ＳＴＡ１０６ｃとを含むマルチキャストグループにマルチキャストされ得る。いくつかの態様では、図９Ｄに示されるＡ－ＭＰＤＵ９００ａのフォーマットは、図９Ｃに示されるＡ－ＭＰＤＵ９００ａ、および／または図８に示されるＡ－ＭＰＤＵ８００のフォーマットに実質的に従い得る。

【０１２０】

[00146]図９Ｄは、Ａ－ＭＰＤＵ９００ａの送信が完了してからＳＩＦＳ時間後に、ＳＴＡ１０６ｂが肯定応答パケット９５５を送信することを示す。ＳＴＡ１０６ｂは、図９Ｃに示される、Ａ－ＭＰＤＵサブフレーム９０５ｂ中の肯定応答ポリシー７３０ｂおよび

肯定応答遅延インジケータ値８１４ｎに基づいて、示された時間において肯定応答パケット９５５を送信する。次に、ＳＴＡ１０６ａは、Ａ－ＭＰＤＵ９００ａの送信が完了してから２ＳＩＦＳ＋定数Ｋ後に、肯定応答パケット９６０を送信する。ＳＴＡ１０６ａが肯定応答９６０を送信する時間は、図９Ｃに示されるような、Ａ－ＭＰＤＵサブフレーム９０５ａによって示される肯定応答ポリシー７３０ａおよび肯定応答遅延インジケータ値８１４ｍに基づく。定数Ｋは、肯定応答９５５を送信するのに必要な時間と等価であるものとして示されるが、いくつかの他の態様では、定数時間Ｋは、肯定応答９５５を送信するのに必要な時間よりも長くてよい。

【０１２１】

[00147]いくつかの態様では、ＡＰは、ＭＰＤＵがユニキャスト送信である（すなわち、受信ＳＴＡのアドレスがユニキャストアドレス）である場合にのみ、ＭＰＤＵの受信に肯定応答するように受信ＳＴＡに命令することができる。しかしながら、グループキャスト（ブロードキャスト）フレームがＡ－ＭＰＤＵに含まれるいくつかの実施形態では、ＡＰは、単一のＳＴＡに宛てられるＡ－ＭＰＤＵに空のＭＰＤＵを含めることによって、肯定応答の応答を送るように設定されたグループから、１つのＳＴＡを選択的に要求することができる。空のＭＰＤＵの肯定応答ポリシーは、「普通の肯定応答または暗黙的なブロック肯定応答要求」のような特定の値に設定され得る。この手順は、グループキャストパケットが１つの受信機によって少なくとも一部受信されるかどうかを送信機が推定することを可能にするのに、有用であり得る。Ａ－ＭＰＤＵ内のＭＰＤＵの正しい受信に肯定応答するためにデバイスのグループからある受信機を選択するこの手順は、Ａ－ＭＰＤＵが他のネットワークトラフィックと競合した可能性があるかどうかを送信デバイスが特定するのを可能にすることによって、マルチキャスト送信の信頼性を向上させることができることを、当業者は理解し得る。応答デバイスの選択は、１つまたは複数の尺度に基づいてよく、このことは肯定応答の信頼性を最大にすることを可能にし得る。

【０１２２】

[00148]次に、ＳＴＡ１０６ｃは、Ａ－ＭＰＤＵ９００ａの送信が完了してから３ＳＩＦＳ＋２定数Ｋ後に、肯定応答パケット９６５を送信する。ＳＴＡ１０６ｃが肯定応答９６５を送信する時間は、図９Ｃに示されるような、Ａ－ＭＰＤＵサブフレーム９０５ｃによって示される肯定応答ポリシー７３０ｃおよび肯定応答遅延インジケータ値８１４ｏに基づく。定数Ｋは、図９Ｄでは肯定応答９６０を送信するのに必要な時間と等価であるものとして示されるが、いくつかの他の態様では、定数時間Ｋは、肯定応答９６０を送信するのに必要な時間よりも長くてよい。

【０１２３】

[00149]図９Ｅは、Ａ－ＭＰＤＵ９００ｂのある実施形態を示す。Ａ－ＭＰＤＵ９００ｂは、少なくとも３つのＡ－ＭＰＤＵサブフレーム９０５ｄ～ｆを含む。３つのＡ－ＭＰＤＵサブフレーム９０５ｄ～ｆの各々は、それぞれＳＴＡ１０６ａ～ｃの１つに宛てられる。Ａ－ＭＰＤＵ９００ｂのフォーマットは、Ａ－ＭＰＤＵ８００のフォーマットに実質的に従い得る。いくつかの態様では、ＭＰＤＵデリミタフィールドフォーマット８１０ｂが、ＭＰＤＵデリミタ８１０ａの代わりにＡ－ＭＰＤＵ９００ｂにおいて利用され得る。いくつかの態様では、ＭＰＤＵデリミタフィールドフォーマット８１０ｃが、８１０ａと８１０ｂのいずれかの代わりにＡ－ＭＰＤＵ９００ｂにおいて利用され得る。

【０１２４】

[00150]図９ＣのＡ－ＭＰＤＵサブフレーム９０５ａ～ｃと同様に、Ａ－ＭＰＤＵサブフレーム９０５ｄ～ｆは各々、肯定応答遅延インジケータフィールド値８１４ｄ～ｆと肯定応答ポリシーフィールド７３０ｄ～ｆとを提供する。図９Ａに示されるように、遅延インジケータフィールド８１４ｄ～ｆのフォーマットは、ＭＰＤＵデリミタ８１０ｂの遅延インジケータフィールド８１４ｂと実質的に一致し得る。いくつかの態様では、図９Ｂに示されるように、遅延インジケータフィールド８１４ｄ～ｆのフォーマットは、ＭＰＤＵデリミタ８１０ｃの遅延インジケータフィールド８１４ｃと実質的に一致し得る。肯定応答ポリシーフィールド７３０ｄ～ｆのフォーマットは、図７の肯定応答ポリシーフィール

ド７３０と実質的に一致し得る。

【０１２５】

[00151]図９ＣのＡ－ＭＰＤＵ９００ａと同様に、Ａ－ＭＰＤＵ９００ｂの第１のＡ－ＭＰＤＵサブフレーム９０５ｄは、普通の肯定応答という値に設定された肯定応答ポリシーフィールド７３０ｄを有する。Ａ－ＭＰＤＵサブフレーム９０５ｄの遅延インジケータ値８１４ｄは０に設定されているので、ＳＴＡ１０６ａは、Ａ－ＭＰＤＵ９００ｂの送信からＳＩＦＳ時間後に、Ａ－ＭＰＤＵサブフレーム９０５ｄに肯定応答する。Ａ－ＭＰＤＵサブフレーム９０５ｅ～ｆの各々は、「肯定応答なし」に設定された肯定応答ポリシーフィールド７３０ｅ～ｆを示す。したがって、ＭＰＤＵ９０５ｅ～ｆは、それぞれＳＴＡ１０６ｂ～ｃによって肯定応答されない。ポリシーフィールド７３０ｅ～ｆが「肯定応答なし」に設定されているので、いくつかの態様では、ＳＴＡ１０６ｂおよび１０６ｃの各々は、遅延インジケータフィールド８１４ｅ～ｆの値を復号しなくてよく、またはそれらに対して動作しなくてよい。

【０１２６】

[00152]図９Ｆは、ＡＰ１０４と３つのＳＴＡ１０６ａ～ｃとの間の例示的なワイヤレス通信を示す。ワイヤレス通信は、ＡＰ１０４がＡ－ＭＰＤＵパケット９００ｂを送信することで開始する。いくつかの態様では、Ａ－ＭＰＤＵ９００ｂはブロードキャストされ得る。いくつかの他の態様では、Ａ－ＭＰＤＵ９００ｂは、局ＳＴＡ１０６ａと、ＳＴＡ１０６ｂと、ＳＴＡ１０６ｃとを含むマルチキャストグループにマルチキャストされ得る。いくつかの態様では、図９Ｆに示されるＡ－ＭＰＤＵ９００ｂのフォーマットは、図８に示されるＡ－ＭＰＤＵ８００と実質的に一致し得る。いくつかの態様では、Ａ－ＭＰＤＵ９００ｂは３つのＡ－ＭＰＤＵサブフレームを含み得る。Ａ－ＭＰＤＵ９００ｂの一態様が、上で図９Ｅにおいて示されている。

【０１２７】

[00153]次に、ＳＴＡ１０６ａは、Ａ－ＭＰＤＵ９００ｂの送信が完了してからＳＩＦＳ時間後に、肯定応答パケット９７０を送信する。ＳＴＡ１０６ａは、図９Ｅに示される、Ａ－ＭＰＤＵサブフレーム９０５ｄによって示される肯定応答ポリシー７３０ｄおよび肯定応答遅延インジケータ値８１４ｄに基づいて、示された時間において肯定応答パケット９７０を送信する。Ａ－ＭＰＤＵサブフレーム９０５ｄの遅延インジケータ値８１４ｄは０に設定されているので、ＳＴＡ１０６ａは、Ａ－ＭＰＤＵ９００ｂの送信からＳＩＦＳ時間後に、Ａ－ＭＰＤＵサブフレーム９０５に肯定応答する。

【０１２８】

[00154]ＳＴＡ１０６ｂ～ｃが各々Ａ－ＭＰＤＵ９０５ｂ～ｃの肯定応答をＡＰ１０４に返す図９Ｄとは異なり、図９Ｆは、ＳＴＡ１０６ｂ～ｃが図９Ｅに示されるＡ－ＭＰＤＵ９００ｂのＡ－ＭＰＤＵ９０５ｅ～ｆに肯定応答しないことを示す。図９Ｄに示されるように、ＳＴＡ１０６ｂ～ｃは、肯定応答ポリシーフィールド７３０ｅ～ｆが「肯定応答なし」という値に設定されていることに基づいて、Ａ－ＭＰＤＵ９０５ｅ～ｆに肯定応答しない。

【０１２９】

[00155]図１０Ａは、Ａ－ＭＰＤＵ９００ｃのある実施形態を示す。Ａ－ＭＰＤＵ９００ｃは、少なくとも３つのＡ－ＭＰＤＵサブフレーム９０５ｇ～ｉを含む。図９Ｅ～図９ＦのＡ－ＭＰＤＵサブフレーム９０５ａ～ｆと同様に、Ａ－ＭＰＤＵサブフレーム９０５ｇ～ｉは各々、肯定応答遅延インジケータフィールド値８１４ｇ～ｉと肯定応答ポリシーフィールド７３０ｇ～ｉ値とを示す。いくつかの態様では、Ａ－ＭＰＤＵサブフレーム９０５ｇ～ｉの各々は、図８のＡ－ＭＰＤＵ８００のフォーマットと実質的に一致し得る。いくつかの態様では、ＭＰＤＵデリミタフィールド８１０ｂが、Ａ－ＭＰＤＵ８００のＭＰＤＵデリミタフィールド８１０ａと置き換えられ得る。いくつかの態様では、ＭＰＤＵデリミタフィールド８１０ｃが、Ａ－ＭＰＤＵ８００のＭＰＤＵデリミタフィールド８１０ａと置き換えられ得る。

【０１３０】

[00156]Ａ－ＭＰＤＵ９００ｃの第１のＡ－ＭＰＤＵサブフレーム９０５ｇは、ブロック肯定応答という肯定応答ポリシーフィールド７３０ｇを示す。この値は、Ａ－ＭＰＤＵ９００ｃが送信／受信されてからＳＩＦＳ時間後に、Ａ－ＭＰＤＵ９０５ｇの受信機がＡ－ＭＰＤＵ９０５ｇに肯定応答すべきではないことを示す。代わりに、肯定応答ポリシーフィールド７３０ｇは、Ａ－ＭＰＤＵ９０５ｇを受信するＳＴＡ１０６ａに対して、Ａ－ＭＰＤＵ９０５ｇに肯定応答する前に明示的な肯定応答要求を待機すべきであることを示す。同様に、Ａ－ＭＰＤＵサブフレーム９０５ｈの肯定応答ポリシーフィールド７３０ｈはまた、ブロック肯定応答を示す。したがって、Ａ－ＭＰＤＵ９０５ｈは、ＳＴＡ１０６ｂが、Ａ－ＭＰＤＵ９０５ｈに肯定応答する前に、明示的なブロック肯定応答要求を待機すべきであることを示す。Ａ－ＭＰＤＵサブフレーム９０５ｉの肯定応答ポリシーフィールド７３０ｉは、Ａ－ＭＰＤＵ９０５ｉを受信するＳＴＡ１０６ｃが、Ａ－ＭＰＤＵ９００ｃの送信が完了してからＳＩＦＳ時間後にＡ－ＭＰＤＵ９０５ｉに肯定応答すべきであることを示し、それは、ＭＰＤＵ９０５ｉの肯定応答遅延インジケータフィールド８１４ｉが上で論じられたように０に設定されているからである。肯定応答ポリシーフィールド７３０ｇ～ｈの両方がブロック肯定応答に設定されているので、遅延インジケータフィールド８１４ｇ～ｈの値は、いくつかの態様では、ＳＴＡ１０６ａ～ｂによって無視され得る。

【０１３１】

[00157]図１０Ｂは、ＡＰ１０４と３つのＳＴＡ１０６ａ～ｃとの間の例示的なワイヤレス通信を示す。まず、ＡＰ１０４がＡ－ＭＰＤＵ９００ｃを送信する。いくつかの態様では、Ａ－ＭＰＤＵ９００ｃは、図１０ＡのＡ－ＭＰＤＵ９００ｃにおいて示されるものと等価なフィールド値を提供する。図１０Ａに関して上で論じられたように、ＳＴＡ１０６ｃに宛てられる、図１０Ａに示されるＡ－ＭＰＤＵサブフレーム９０５ｉは、普通の肯定応答という肯定応答ポリシーを示す。したがって、遅延インジケータフィールド８１４ｉが０であるので、ＳＴＡ１０６ｃは、Ａ－ＭＰＤＵフレーム９００ｃの送信の完了からＳＩＦＳ時間後に、Ａ－ＭＰＤＵサブフレーム９０５ｉに肯定応答する。このことは、ブロック肯定応答フレーム１００５の送信を介して示される。

【０１３２】

[00158]Ａ－ＭＰＤＵサブフレーム９０５ｇ～ｈの各々が「ブロック肯定応答」という肯定応答ポリシーを示すので、ＳＴＡ１０６ａ～ｂは、明示的なブロック肯定応答要求がなければＡ－ＭＰＤＵサブフレーム９０５ｇ～ｈに肯定応答しない。したがって、図１０Ｂに示されるように、ＡＰ１０４は、ブロック肯定応答要求１０１０をＳＴＡ１０６ｂに送信する。それに応答して、ＳＴＡ１０６ｂは、ブロック肯定応答要求１０１０を受信してからＳＩＦＳ時間後に、Ａ－ＭＰＤＵ９０５ｈに対するブロック肯定応答１０１５を送信する。同様に、ＡＰ１０４は、ブロック肯定応答要求１０２０をＳＴＡ１０６ａに送信する。それに応答して、ＳＴＡ１０６ａは、ブロック肯定応答要求１０２０を受信してからＳＩＦＳ時間後に、Ａ－ＭＰＤＵ９０５ｇに対するブロック肯定応答メッセージ１０２５をＡＰ１０４に送信する。

【０１３３】

[00159]図１０Ｃは、Ａ－ＭＰＤＵ９００ｄのある実施形態を示す。Ａ－ＭＰＤＵ９００ｄは、少なくとも３つのＡ－ＭＰＤＵサブフレーム９０５ｊ～ｌを含む。Ａ－ＭＰＤＵ９００ｄは、Ａ－ＭＰＤＵ８００に関して上で説明されたフレームフィールドフォーマットと一致し得る。たとえば、各Ａ－ＭＰＤＵサブフレームは、ＭＰＤＵデリミタフィールドとＭＰＤＵフィールドとを含み得る（いずれも明示的には示されていない）。図９Ｂに示される例示的なＭＰＤＵデリミタフィールド８１０ｃに示されるように、Ａ－ＭＰＤＵサブフレーム９０５ｊ～ｌのＭＰＤＵデリミタフィールドは、ＥＯＦフィールド８１２ｊ～ｌと、遅延インジケータフィールド８１４ｊ～ｌと、ＭＰＤＵ長さフィールド８１６ｊ～ｌとを含み得る。各ＭＰＤＵサブフレーム９０５ｊ～ｌの制御フィールドは、肯定応答ポリシーフィールド７３０ｊ～ｌを含む。

【０１３４】

[00160]いくつかの態様では、ＭＰＤＵデリミタのＥＯＦフィールド８１２は、Ａ－ＭＰＤＵサブフレームが肯定応答フレームを使用して肯定応答されるべきかブロック肯定応答フレームを使用して肯定応答されるべきかを示し得る。たとえば、いくつかの態様では、フレームの末尾フィールド８１２ｊ～ｌがクリア（０）である場合、ブロック肯定応答は、対応するＡ－ＭＰＤＵサブフレームの受信に応答して送信されるべきである。ＥＯＦフィールド８１２ｊ～ｌが（１）に設定される場合、肯定応答フレームは、対応するＡ－ＭＰＤＵサブフレームの受信に応答して送信されるべきである。図１０Ｃに示されるＡ－ＭＰＤＵサブフレームへのブロック肯定応答および通常の肯定応答は、たとえば図９Ｃ～図１０Ｂの、前に開示された実施形態と同様に動作し得る。たとえば、各Ａ－ＭＰＤＵサブフレーム９０５ｇ～ｉは、肯定応答ポリシーフィールド７３０ａ～ｉのいずれかのような前に論じられた肯定応答ポリシーフィールドと同様に動作する肯定応答ポリシーを、フィールド７３０ｊ～ｌにおいて規定することができる。遅延インジケータフィールド８０２ｊ～ｌはまた、前に論じられた遅延インジケータフィールド８０２ａ～Ｉまたは８０２ｍ～ｏのいずれか１つと同様の方式で動作することができる。

【０１３５】

[00161]図１０Ｄは、ＡＰ１０４と３つのＳＴＡ１０６ａ～ｃとの間の例示的なワイヤレス通信を示す。まず、ＡＰ１０４がＡ－ＭＰＤＵ９００ｄを送信する。いくつかの態様では、Ａ－ＭＰＤＵ９００ｄは、図１０ＣのＡ－ＭＰＤＵ９００ｄによって示されるフィールド値を示す。

【０１３６】

[00162]Ａ－ＭＰＤＵサブフレーム９０５ｉの遅延インジケータフィールド８１４ｌは０の遅延値を含むので、ＳＴＡ１０６ｃは、Ａ－ＭＰＤＵ９００ｄの送信からＳＩＦＳ時間後に、ＳＴＡ１０６ｃに宛てられたＡ－ＭＰＤＵ（９０５ｉ）に肯定応答する。Ａ－ＭＰＤＵサブフレーム９０５ｉのＥＯＦフィールド８１２ｌはクリア（０）であるので、ＳＴＡ１０６ｃは、ブロック肯定応答フレーム１０５５によってＡ－ＭＰＤＵサブフレームに肯定応答する。

【０１３７】

[00163]次に、遅延インジケータ値８１４ｊに基づいて、ＳＴＡ１０６ａは、上の式（１）に従った時間に、肯定応答フレーム１０６０を送信する。ＥＯＦフィールド８１２ｊが１に設定されているので、肯定応答フレームはＳＴＡ１０６ａによって送信される。ＳＴＡ１０６ｂは次いで、遅延インジケータフィールド８１４ｋに基づいて、Ａ－ＭＰＤＵサブフレーム９０５ｋの肯定応答を送信する。ＥＯＦフィールド８１２ｋが設定されているので、肯定応答フレーム１０６５がブロック肯定応答フレームの代わりに送信される。

【０１３８】

[00164]図１１Ａは、ワイヤレス通信の１つの例示的な方法のフローチャートである。いくつかの態様では、プロセス１１００は、図２に関して上で示されたワイヤレスデバイス２０２によって実行され得る。いくつかの態様では、プロセス１１００はＡＰ１０４によって実行され得る。

【０１３９】

[00165]ブロック１１０５において、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームがワイヤレスデバイスによって生成される。Ａ－ＭＰＤＵフレームは、ブロック１１０５において生成された２つ以上のＡ－ＭＰＤＵサブフレームを含む。Ａ－ＭＰＤＵサブフレームの各々が受信機アドレスを含む。Ａ－ＭＰＤＵフレームは、各Ａ－ＭＰＤＵサブフレームの各受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーに対する少なくとも１つの指示を備える。２つ以上のＡ－ＭＰＤＵサブフレームの各々は制御フィールドを含み、制御フィールドは、各々の対応するＡ－ＭＰＤＵサブフレームに対する１つまたは複数の肯定応答ポリシーを示す。いくつかの態様では、２つよりも多くのＡ－ＭＰＤＵサブフレームがブロック１１０５において生成される。いくつかの態様では、２つよりも多くの異なる肯定応答ポリシーは、ブロック１１０５において生成されるＡ－ＭＰＤＵサブフレームによって示される。いくつかの態様

では、Ａ－ＭＰＤＵフレーム内のＡ－ＭＰＤＵサブフレームの２つ以上は、同じ受信機アドレスを有するように生成され得る。いくつかの実施形態では、これらの肯定応答ポリシーは、Ａ－ＭＰＤＵサブフレームの各々において、制御フィールド、デリミタフィールド、または制御フィールドとデリミタフィールドの組合せによって示され得る。

【０１４０】

[00166]いくつかの態様では、肯定応答ポリシーを示す制御フィールドは、Ａ－ＭＰＤＵサブフレームの各々のＱｏＳ制御フィールド中の肯定応答ポリシー制御フィールドである。いくつかの態様では、Ａ－ＭＰＤＵサブフレームの各々のＱｏＳ制御フィールドのフォーマットは、図７に示されるＱｏＳ制御フィールド６５５と実質的に一致し得る。

【０１４１】

[00167]いくつかの態様では、ＱｏＳ制御フレームの肯定応答ポリシーフィールドは、「普通の肯定応答または暗黙的なブロック肯定応答」のような特定の値に設定され得る。いくつかの態様では、この値は０ｂ００に対応する。その特定の値に設定される場合、肯定応答ポリシーは、対応するＡ－ＭＰＤＵサブフレームに対する肯定応答が、ある時間遅延の後でＡ－ＭＰＤＵサブフレームの受信機によって送信されるべきであることを示す。いくつかの態様では、その時間遅延は、Ａ－ＭＰＤＵサブフレームを含むＡ－ＭＰＤＵフレームの送信／受信からＳＩＦＳ時間後である。Ａ－ＭＰＤＵサブフレームに対して送信される肯定応答の競合を減らすために、いくつかの態様では、生成されるＡ－ＭＰＤＵサブフレームの１つだけの肯定応答ポリシーは、「普通の肯定応答または暗黙的なブロック肯定応答」のような特定の値に設定される。

【０１４２】

[00168]いくつかのＡ－ＭＰＤＵサブフレーム中の肯定応答ポリシーフィールド７３０は、「肯定応答なし」に設定され得る。「肯定応答なし」に設定される場合、受信機は、対応するＡ－ＭＰＤＵサブフレームに肯定応答すべきではない。いくつかの態様では、「肯定応答なし」の値は０ｂ１０に対応する。いくつかの態様では、肯定応答ポリシーフィールドは「ブロック肯定応答」という値に設定され得る。いくつかの態様では、この値は０ｂ１１に対応する。「ブロック肯定応答」に設定される場合、肯定応答ポリシーフィールドは、対応するＡ－ＭＰＤＵサブフレームの受信機が後の時間にブロック肯定応答メッセージに対する要求を受信し得ることと、対応するＡ－ＭＰＤＵサブフレームの肯定応答のいずれもが、対応するＡ－ＭＰＤＵサブフレームを含むＡ－ＭＰＤＵの受信が完了してからＳＩＦＳ時間後に送信されるべきではないこととを、示す。

【０１４３】

[00169]いくつかの態様では、肯定応答ポリシーはさらに、制御フィールド中の遅延インジケータフィールドによって示される。いくつかの態様では、遅延インジケータフィールドは、ＭＰＤＵデリミタフィールドに含まれ得る。たとえば、遅延インジケータフィールドは、図９ＡのＭＰＤＵデリミタフィールド８１０ｂの遅延インジケータフィールド８１４ｂによって示されるようなものであり得る。いくつかの他の態様では、遅延インジケータフィールドは、図８のＭＰＤＵデリミタフィールド８１０ａの遅延インジケータフィールド８１４ａによって示されるようなものであり得る。いくつかの他の態様では、遅延インジケータフィールドは、図９ＢのＭＰＤＵデリミタフィールド８１０ｃの遅延インジケータフィールド８１４ｃによって示されるようなものであり得る。

【０１４４】

[00170]遅延インジケータフィールドは、対応するＡ－ＭＰＤＵサブフレームに肯定応答する前に経過すべき遅延を示し得る。いくつかの態様では、遅延インジケータフィールドは、バックオフカウンタを示し得る。いくつかの態様では、遅延インジケータは、複数のＳＩＦＳ時間または１つのＳＩＦＳ時間とカウンタ値とを足したものを表し得る。対応するＡ－ＭＰＤＵサブフレームを受信するデバイスは、決定された遅延の値の分だけ肯定応答の送信を遅らせることができる。いくつかの態様では、肯定応答ポリシーフィールドが、上で論じられたような「普通の肯定応答または暗黙的なブロック肯定応答」のような特定の値に設定される場合、遅延インジケータフィールドは、Ａ－ＭＰＤＵサブフレーム

またはＡ－ＭＰＤＵフレームの受信／送信とフレームの肯定応答の送信時間との間の遅延を示す。

【０１４５】

[00171]いくつかの態様では、肯定応答ポリシーは、フレームの末尾（ＥＯＦ）フィールドによって示される。たとえば、いくつかの態様では、Ａ－ＭＰＤＵサブフィールドは、ＭＰＤＵデリミタフィールド８１０ａに実質的に従ったフォーマットの、ＭＰＤＵデリミタフィールドを含み得る。これらの態様では、肯定応答ポリシーは、ＭＰＤＵデリミタ８１０ａのＥＯＦフィールド８１２ａによって示され得る。いくつかの他の態様では、肯定応答ポリシーは、ＭＰＤＵデリミタフィールド８１０ｃのＥＯＦフィールド８１２ｃによって示され得る。

【０１４６】

[00172]ブロック１１１０において、Ａ－ＭＰＤＵフレームがワイヤレスデバイスによって送信される。１つまたは複数のアンテナを含むワイヤレスデバイスによって実行されるとき、Ａ－ＭＰＤＵフレームは１つまたは複数のアンテナを使用して送信され得る。

【０１４７】

[00173]いくつかの態様では、方法はさらに、ワイヤレスデバイスによって、Ａ－ＭＰＤＵサブフレームの１つによって示される受信機アドレスへ肯定応答に対する要求を送信することを含む。いくつかの態様では、この要求はブロック肯定応答要求である。Ａ－ＭＰＤＵサブフレームによって示される肯定応答ポリシーがブロック肯定応答ポリシーを示す場合、肯定応答に対する要求が送信され得る。ブロック１１１５において、肯定応答に対する要求は、Ａ－ＭＰＤＵの送信からＳＩＦＳ時間よりも長い遅延の後に送信され得る。この遅延は、送信されるＡ－ＭＰＤＵフレーム中の１つのＡ－ＭＰＤＵサブフレームが肯定応答される機会を提供することができる。「普通の肯定応答または暗黙的なブロック肯定応答」のような特定の値に設定された肯定応答ポリシーを伴うＡ－ＭＰＤＵサブフレームは、この遅延の間に肯定応答され得る。

【０１４８】

[00174]いくつかの態様では、方法はさらに、ワイヤレスデバイスによって、送信されるＡ－ＭＰＤＵフレームに含まれるＡ－ＭＰＤＵサブフレームの１つまたは複数に対する１つまたは複数の肯定応答を受信することを含む。いくつかの態様では、ブロック１１１５において、これらの肯定応答の１つは、Ａ－ＭＰＤＵフレームの送信の完了からＳＩＦＳ時間後に受信される。たとえば、「普通の肯定応答または暗黙的なブロック肯定応答」のような特定の値に設定された肯定応答ポリシーを伴うＡ－ＭＰＤＵフレーム、またはフレームの末尾指示セットを伴うＡ－ＭＰＤＵフレームが、この遅延の間に肯定応答され得る。

【０１４９】

[00175]いくつかの態様はさらに、上で論じられたように、Ａ－ＭＰＤＵサブフレーム肯定応答のタイミングは、遅延インジケータフィールドを基礎とし得る。たとえば、いくつかの態様では、（適切な８０２．１１規格の「普通の肯定応答または暗黙的なブロック肯定応答」のような）特定の値に設定された肯定応答ポリシーを伴うＡ－ＭＰＤＵサブフレームはまた、ブロック１１１５においてＡ－ＭＰＤＵフレームの送信が完了してからＳＩＦＳ時間後にそのＡ－ＭＰＤＵサブフレームが肯定応答されるように、０または最小限の遅延値に設定された遅延インジケータフィールドを有する必要がある。

【０１５０】

[00176]上で説明されたように、ブロック肯定応答要求のようなワイヤレスデバイスによる明示的な肯定応答要求の送信に応答して、他のフレームが肯定応答され得る。

【０１５１】

[00177]図１１Ｂは、ワイヤレス通信システム１００内で利用され得る例示的なワイヤレスデバイス１１５０の機能ブロック図である。デバイス１１５０は、Ａ－ＭＰＤＵフレーム生成回路１１５５とＡ－ＭＰＤＵ送信回路１１６０とを備える。Ａ－ＭＰＤＵフレーム生成回路１１５５は、図１１Ａに示されたブロック１１０５に関して上で論じられた機

能の１つまたは複数を実行するように構成され得る。Ａ－ＭＰＤＵフレーム生成回路１１５５は、プロセッサ４０４および／またはＤＳＰ４２０および／または処理システムの１つまたは複数に対応し得る。デバイス１１５０はさらに、Ａ－ＭＰＤＵフレーム送信回路１１６０を備える。いくつかの態様では、Ａ－ＭＰＤＵフレーム送信回路１１６０は、ブロック１１１０に関して上で論じられた機能の１つまたは複数を実行するように構成され得る。いくつかの態様では、Ａ－ＭＰＤＵフレーム送信回路１１６０は送信機４１０を含み得る。いくつかの態様では、フレーム送信回路はさらに、Ａ－ＭＰＤＵサブフレームの１つによって示される受信機アドレスへ肯定応答に対する要求を送信するように構成され得る。いくつかの実装形態では、２つ以上のＡ－ＭＰＤＵサブフレームを備える集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを生成するための手段、および／または、２つ以上のＡ－ＭＰＤＵサブフレームを生成するための手段は、Ａ－ＭＰＤＵ生成フレーム回路１１５５を含み得る。いくつかの実装形態では、Ａ－ＭＰＤＵフレームを送信するための手段はＡ－ＭＰＤＵ送信回路を備え得る。

【０１５２】

[00178]いくつかの態様では、デバイス１１５０はさらに復号回路を備える。復号回路は、Ａ－ＭＰＤＵフレーム生成回路１１５５によって生成されるＡ－ＭＰＤＵサブフレームのフレームの末尾（ＥＯＦ）フィールドが０に設定される場合、Ａ－ＭＰＤＵサブフレームに対するブロック肯定応答を復号するように構成され得る。いくつかの態様では、復号回路は、プロセッサ４０４および／またはＤＳＰ４２０および／または処理システムの１つまたは複数に対応し得る。いくつかの態様では、復号回路はさらに、Ａ－ＭＰＤＵフレーム生成回路１１５５によって生成されるＡ－ＭＰＤＵサブフレームのフレームの末尾（ＥＯＦ）フィールドが設定される場合、Ａ－ＭＰＤＵサブフレームに対する肯定応答を復号するように構成され得る。いくつかの態様では、デバイス１１５０はさらに復号回路を備える。復号回路は、Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を復号することができる。いくつかの態様では、復号回路は、プロセッサ４０４もしくはＤＳＰ４２０および／または処理システムに対応し得る。いくつかの実装形態では、受信の肯定応答を復号するための手段は復号回路を含み得る。いくつかの態様では、デバイス１１５０はさらに値設定回路を備える。設定回路は、Ａ－ＭＰＤＵサブフレームの肯定応答ポリシーに従って、受信後に送られるべきフレームを示すための値をフレームの末尾フィールドの中で設定するように構成され得る。いくつかの態様では、設定回路は、プロセッサ４０４もしくはＤＳＰ４２０および／または処理システムに対応し得る。いくつかの実装形態では、フレームの末尾フィールドの値を設定するための手段は、設定回路を備える。

【０１５３】

[00179]図１２Ａは、ワイヤレス通信の１つの例示的な方法のフローチャートである。いくつかの態様では、プロセス１２００は、図２に関して上で示されたワイヤレスデバイス２０２によって実行され得る。いくつかの態様では、プロセス１２００はＳＴＡ１０６によって実行され得る。

【０１５４】

[00180]ブロック１２０５において、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームがワイヤレスデバイスによって受信される。Ａ－ＭＰＤＵフレームは、２つ以上のＡ－ＭＰＤＵサブフレームを含む。いくつかの態様では、Ａ－ＭＰＤＵサブフレームは、上で論じられたフレーム９００ａ～ｄの１つのフォーマットに実質的に従う。

【０１５５】

[00181]ブロック１２１０において、Ａ－ＭＰＤＵフレームがワイヤレスデバイスによって復号される。いくつかの態様では、受信デバイスは、デバイスに宛てられるＡ－ＭＰＤＵフレームに含まれるＡ－ＭＰＤＵサブフレームの１つまたは複数を特定する。いくつかの態様では、これは、Ａ－ＭＰＤＵサブフレームの各々において指定される受信機アド

レスをワイヤレスデバイスのローカルデバイスアドレスと比較することによって達成される。いくつかの態様では、Ａ－ＭＰＤＵサブフレームの１つまたは複数において指定される受信機アドレスは、ブロードキャストアドレスまたはマルチキャストアドレスである。この場合、受信デバイスは、その受信機アドレスがＡ－ＭＰＤＵサブフレームのマルチキャストアドレスによって示されるマルチキャストグループに含まれるかどうかを決定することができる。

【０１５６】

[00182]受信デバイスが受信機に宛てられるＡ－ＭＰＤＵサブフレームを特定すると、受信デバイスは、受信機に宛てられたＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーを決定することができる。いくつかの態様では、Ａ－ＭＰＤＵサブフレームのＱｏＳ制御フィールドの肯定応答ポリシーフィールドが「肯定応答なし」に設定される場合、特定のＡ－ＭＰＤＵサブフレームのいずれの肯定応答も受信デバイスによって送信されない。肯定応答ポリシーフィールドが「ブロック肯定応答」に設定される場合、Ａ－ＭＰＤＵサブフレームの受信が記憶され得るが、後続の肯定応答要求が受信されるまで、いずれの肯定応答もデバイスによって送信されない。いくつかの態様において、受信される肯定応答要求はブロック肯定応答要求である。

【０１５７】

[00183]ＱｏＳ制御フィールドの肯定応答ポリシーフィールドが（適切な８０２．１１規格の「普通の肯定応答または暗黙的なブロック肯定応答」に対応する値のような）特定の値に設定される場合、受信デバイスは、Ａ－ＭＰＤＵフレームの受信が完了してからＳＩＦＳ時間後に肯定応答を送信することができる。いくつかの態様では、肯定応答の送信時間はさらに、遅延インジケータフィールドに基づく。いくつかの態様では、遅延インジケータフィールドは、Ａ－ＭＰＤＵサブフレームのＭＰＤＵデリミタフィールドにおいて提供される。たとえば、いくつかの態様では、ＭＰＤＵデリミタフィールドは、図９Ｂに示される、ＭＰＤＵデリミタフィールド８１０ｂのフォーマットに実質的に従い得る。いくつかの態様では、遅延インジケータフィールドは、バックオフ値を示し得る。たとえば、遅延インジケータフィールドは、対応するＡ－ＭＰＤＵサブフレームに肯定応答する前に受信機が待機すべき、ＳＩＦＳ時間の倍数またはＳＩＦＳ時間の倍数＋定数値を示し得る。

【０１５８】

[00184]いくつかの態様では、Ａ－ＭＰＤＵサブフレームの肯定応答ポリシーを決定することは、フレームの末尾フィールドに基づき得る。いくつかの態様では、ＭＰＤＵデリミタフィールド８１０ａまたは８１０ｃに示されるように、フレームの末尾フィールドがＭＰＤＵデリミタフィールドに含まれる。いくつかの態様では、フレームの末尾フィールドが設定される場合、Ａ－ＭＰＤＵの肯定応答は、Ａ－ＭＰＤＵフレームの受信からＳＩＦＳ時間後に送信される。いくつかの態様では、フレームの末尾フィールドがクリア（０）である場合、Ａ－ＭＰＤＵサブフレームのいずれの肯定応答も、Ａ－ＭＰＤＵフレームの受信からＳＩＦＳ時間後に送信されなくてよい。

【０１５９】

[00185]いくつかの態様はさらに、Ａ－ＭＰＤＵフレームに含まれるＡ－ＭＰＤＵサブフレームの１つまたは複数に対する肯定応答要求の受信を含む。たとえば、Ａ－ＭＰＤＵサブフレームが「ブロック肯定応答」という肯定応答ポリシーを示す場合、受信機は、明示的な肯定応答要求の受信までＡ－ＭＰＤＵサブフレームに肯定応答しない。受信されるＡ－ＭＰＤＵサブフレームに対する肯定応答要求とき、Ａ－ＭＰＤＵサブフレームの肯定応答は、Ａ－ＭＰＤＵサブフレームが受信されるかどうかに少なくとも基づいて送信され得る。

【０１６０】

[00186]図１２Ｂは、ワイヤレス通信システム１００内で利用され得る例示的なワイヤレスデバイス１２５０の機能ブロック図である。デバイス１２５０は、Ａ－ＭＰＤＵフレーム受信回路１２５５とＡ－ＭＰＤＵフレーム復号回路１２６０とを備える。Ａ－ＭＰＤ

Ｕフレーム受信回路１２５５は、図１２Ａに示されたブロック１２０５に関して上で論じられた機能の１つまたは複数を実行するように構成され得る。Ａ－ＭＰＤＵフレーム受信回路１２５５は、受信機４１２の１つまたは複数に対応し得る。デバイス１２５０はさらに、Ａ－ＭＰＤＵフレーム復号回路１２６０を備える。Ａ－ＭＰＤＵフレーム復号回路１２６０は、図１２Ａに示されたブロック１２１０に関して上で論じられた機能の１つまたは複数を実行するように構成され得る。いくつかの態様では、Ａ－ＭＰＤＵフレーム復号回路１２６０はプロセッサ４０４に対応し得る。いくつかの実装形態では、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するための手段は、Ａ－ＭＰＤＵ受信フレーム回路１２５５を含み得る。いくつかの実装形態では、受信されたＡ－ＭＰＤＵフレームに基づいて２つ以上のＡ－ＭＰＤＵサブフレームを復号するための手段、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号するための手段、または、受信されたＡ－ＭＰＤＵフレームから復号された２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する復号された受信機アドレスに基づいて装置に宛てられると決定するための手段は、Ａ－ＭＰＤＵ復号回路１２６０を含み得る。

【０１６１】

[00187]いくつかの態様では、デバイス１２５０はさらに復号回路を備える。復号回路は、受信されたＡ－ＭＰＤＵフレームに基づいてＡ－ＭＰＤＵサブフレームを復号するように構成され得る。復号回路は、受信されたＡ－ＭＰＤＵフレームに基づいてＡ－ＭＰＤＵサブフレームを復号するように構成され得る。復号回路は、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号するように構成され得る。復号回路は、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のＭＰＤＵデリミタフィールドを復号するように構成され得る。いくつかの態様では、復号回路は、プロセッサ４０４、ＤＳＰ４２０、および／または処理システムに対応し得る。いくつかの実装形態では、Ａ－ＭＰＤＵサブフレームを復号するための手段および受信機アドレスを復号するための手段は復号回路を含み得る。

【０１６２】

[00188]いくつかの態様では、デバイス１２５０はさらに決定回路を備える。決定回路は、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する復号された受信機アドレスに基づいて、受信されたＡ－ＭＰＤＵフレームから復号された２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが装置に宛てられると決定するように構成され得る。決定回路はまた、Ａ－ＭＰＤＵフレームの受信から肯定応答フレームの送信までに経過することになる時間遅延を、ＭＰＤＵデリミタフィールドに記憶されている値から決定するように構成され得る。いくつかの態様では、決定回路は、プロセッサ４０４、ＤＳＰ４２０、および／または処理システムに対応し得る。いくつかの実装形態では、決定するための手段が決定回路を含み得る。

【０１６３】

[00189]いくつかの態様では、デバイス１２５０はさらに肯定応答ポリシー復号回路を備える。肯定応答ポリシー復号回路は、２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する１つまたは複数のフィールドの中の各Ａ－ＭＰＤＵサブフレームの受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するように構成され得る。いくつかの態様では、肯定応答復号回路はプロセッサ４０４に対応し得る。いくつかの実装形態では、肯定応答ポリシーを復号するための手段は肯定応答復号回路を含み得る。

【０１６４】

[00190]いくつかの態様では、デバイス１２５０はさらにフレームの末尾フィールド復号回路を備える。フレームの末尾フィールド復号回路は、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成されてよく、この値は、２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す。いくつかの態様では、フレームの末

尾フィールド復号回路は、プロセッサ４０４、ＤＳＰ４２０、および／または処理システムに対応し得る。いくつかの実装形態では、フレームの末尾フィールドを復号するための手段はフレームの末尾フィールド復号回路を含み得る。

【０１６５】

[00191]いくつかの態様では、デバイス１２５０はさらにフレーム生成回路を備える。フレーム生成回路は、フレームの末尾フィールド中の値に基づいて、２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つに対する肯定応答フレームまたはブロック肯定応答フレームを生成することができる。いくつかの態様では、フレームの末尾生成回路は、プロセッサ４０４、ＤＳＰ４２０、および／または処理システムに対応し得る。いくつかの実装形態では、肯定応答フレームを生成するための手段は、フレーム生成回路を含み得る。

【０１６６】

[00192]図１３Ａは、ワイヤレス通信の１つの例示的な方法のフローチャートである。いくつかの態様では、プロセス１３００は、図２に関して上で示されたワイヤレスデバイス２０２によって実行され得る。いくつかの態様では、プロセス１３００はＳＴＡ１０６によって実行され得る。

【０１６７】

[00193]ブロック１３０５において、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームがワイヤレスデバイスによって受信される。ブロック１３１０において、受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームが、ワイヤレスデバイスによって復号される。いくつかの態様では、復号されたＡ－ＭＰＤＵサブフレームは、上で論じられたフレーム９００ａ～ｄの１つのフォーマットに実質的に従う。

【０１６８】

[00194]ブロック１３１５において、２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスが、ワイヤレスデバイスによって復号される。いくつかの態様では、Ａ－ＭＰＤＵサブフレームの１つまたは複数において指定される受信機アドレスは、ブロードキャストアドレスまたはマルチキャストアドレスである。この場合、受信デバイスは、その受信機アドレスがＡ－ＭＰＤＵサブフレームのマルチキャストアドレスによって示されるマルチキャストグループに含まれるかどうかを決定することができる。

【０１６９】

[00195]いくつかの態様では、デバイス実行プロセス１３００は、復号された受信機アドレスの各々を復号デバイスのローカルアドレスと比較することができる。Ａ－ＭＰＤＵサブフレームの１つまたは複数の中の受信機アドレスがローカル受信機アドレスと一致する場合、受信デバイスは次いで、受信されたＡ－ＭＰＤＵサブフレームをさらに復号することができる。

【０１７０】

[00196]受信デバイスが受信デバイスに宛てられるＡ－ＭＰＤＵサブフレームを特定すると、受信デバイスは、受信機に宛てられたＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーを決定することができる。たとえば、いくつかの態様では、受信デバイスは、受信機Ａ－ＭＰＤＵサブフレームによって示される肯定応答ポリシーを復号することができる。いくつかの態様では、肯定応答ポリシーは、制御フィールド中の肯定応答ポリシーフィールド、ＭＰＤＵデリミタフィールド中の遅延インジケータフィールド、および／またはＭＰＤＵデリミタフィールドに含まれるフレームの末尾フィールドの１つまたは複数によって示され得る。

【０１７１】

[00197]いくつかの態様では、Ａ－ＭＰＤＵサブフレームのＱｏＳ制御フィールドの肯定応答ポリシーフィールドが「肯定応答なし」に対応する値に設定される場合、特定のＡ－ＭＰＤＵサブフレームのいずれの肯定応答も受信デバイスによって送信されない。肯定応答ポリシーフィールドが「ブロック肯定応答」に設定される場合、Ａ－ＭＰＤＵサブフレームの受信が記憶され得るが、後続の肯定応答要求が受信されるまで、いずれの肯定応

答も送信されない。いくつかの態様において、受信される肯定応答要求はブロック肯定応答要求である。

【０１７２】

[00198]ＱｏＳ制御フィールドの肯定応答ポリシーフィールドが特定の値に設定される場合、いくつかの態様では、特定の値は、適切な８０２．１１規格によって定義されるような「普通の肯定応答または暗黙的なブロック肯定応答」の値に対応し）、受信デバイスは、Ａ－ＭＰＤＵフレームの受信が完了してからＳＩＦＳ時間後に肯定応答を送信することができる。いくつかの態様では、肯定応答の送信時間はさらに、遅延インジケータフィールドに基づく。いくつかの態様では、遅延インジケータフィールドは、Ａ－ＭＰＤＵサブフレームのＭＰＤＵデリミタフィールドにおいて提供される。たとえば、いくつかの態様では、ＭＰＤＵデリミタフィールドは、図９Ｂに示される、ＭＰＤＵデリミタフィールド８１０ｂのフォーマットに実質的に従い得る。いくつかの態様では、遅延インジケータフィールドは、バックオフ値を示し得る。たとえば、遅延インジケータフィールドは、対応するＡ－ＭＰＤＵサブフレームに肯定応答する前に受信機が待機すべき、ＳＩＦＳ時間の倍数またはＳＩＦＳ時間の倍数＋定数値を示し得る。

【０１７３】

[00199]いくつかの態様では、Ａ－ＭＰＤＵサブフレームの肯定応答ポリシーを決定することは、フレームの末尾フィールドに基づき得る。いくつかの態様では、ＭＰＤＵデリミタフィールド８１０ａまたは８１０ｃに示されるように、フレームの末尾フィールドがＭＰＤＵデリミタフィールドに含まれる。いくつかの態様では、フレームの末尾フィールドが設定される場合、Ａ－ＭＰＤＵの肯定応答は、Ａ－ＭＰＤＵフレームの受信からＳＩＦＳ時間後に送信される。いくつかの態様では、フレームの末尾フィールドがクリア（０）である場合、Ａ－ＭＰＤＵサブフレームのブロック肯定応答が、Ａ－ＭＰＤＵフレームの受信からＳＩＦＳ時間後に送信され得る。いくつかの他の態様では、フレームの末尾フィールドがクリア（０）である場合、いずれの肯定応答もＡ－ＭＰＤＵフレームの受信からＳＩＦＳ時間後に送信されない。

【０１７４】

[00200]いくつかの態様はさらに、Ａ－ＭＰＤＵフレームに含まれるＡ－ＭＰＤＵサブフレームの１つまたは複数に対する肯定応答要求の受信を含む。たとえば、いくつかの態様では、Ａ－ＭＰＤＵサブフレームが「ブロック肯定応答」という肯定応答ポリシーを示す場合、受信機は、明示的なブロック肯定応答要求の受信までＡ－ＭＰＤＵサブフレームに肯定応答しない。受信されるＡ－ＭＰＤＵサブフレームに対する肯定応答要求とき、Ａ－ＭＰＤＵサブフレームの肯定応答は、Ａ－ＭＰＤＵサブフレームが受信されるかどうかに少なくとも基づいて送信され得る。

【０１７５】

[00201]図１３Ｂは、ワイヤレス通信システム１００内で利用され得る例示的なワイヤレスデバイス１３５０の機能ブロック図である。デバイス１３５０は、Ａ－ＭＰＤＵフレーム受信回路１３５５と、Ａ－ＭＰＤＵサブフレーム復号回路１３６０と、受信機アドレス復号回路１３６５とを備える。Ａ－ＭＰＤＵフレーム受信回路１３５５は、図１３Ａに示されたブロック１３０５に関して上で論じられた機能の１つまたは複数を実行するように構成され得る。Ａ－ＭＰＤＵフレーム受信回路１３５５は、受信機４１２の１つまたは複数に対応し得る。デバイス１３５０はさらに、Ａ－ＭＰＤＵサブフレーム復号回路１３６０を備える。Ａ－ＭＰＤＵサブフレーム復号回路１３６０は、図１３Ａに示されたブロック１３１０に関して上で論じられた機能の１つまたは複数を実行するように構成され得る。いくつかの態様では、Ａ－ＭＰＤＵサブフレーム復号回路１３６０は、１つのＡ－ＭＰＤＵサブフレームの肯定応答ポリシーを復号するように構成され得る。いくつかの態様では、Ａ－ＭＰＤＵサブフレーム復号回路１３６０はさらに、Ａ－ＭＰＤＵサブフレーム中のフレームの末尾フィールドを復号するように構成され得る。いくつかの態様では、Ａ－ＭＰＤＵサブフレーム復号回路１３６０は、プロセッサ４０４、および／またはＤＳＰ４２０、および／または処理システムに対応し得る。デバイス１３５０はさらに、受信機

アドレス復号回路１３６５を備える。受信機アドレス復号回路１３６５は、図１３Ａに示されたブロック１３１５に関して上で論じられた機能の１つまたは複数を実行するように構成され得る。いくつかの態様では、受信機アドレス復号回路１３６５は、プロセッサ４０４、および／またはＤＳＰ４２０、および／または処理システムに対応し得る。

【０１７６】

[00202]いくつかの態様では、デバイス１３５０はさらに決定回路を含み得る。いくつかの態様では、決定回路はさらに、制御フレームを送信するための時間遅延を決定するように構成され得る。決定回路は、Ａ－ＭＰＤＵサブフレームの Ａ－ＭＰＤＵデリミタフィールドに基づいて、制御フレームを送信するための時間遅延を決定するように構成され得る。いくつかの態様では、決定回路は、プロセッサ４０４、および／またはＤＳＰ４２０、および／または処理システムに対応し得る。

【０１７７】

[00203]デバイス１３５０のいくつかの態様はさらに送信回路を含み得る。送信回路は、肯定応答ポリシーが特定の値に設定される場合、制御フレームを送信するように構成され得る。いくつかの態様では、送信回路は送信機４１０に対応し得る。

【０１７８】

[00204]いくつかの態様では、デバイス１３５０はさらに受信回路を含み得る。受信回路は、Ａ－ＭＰＤＵサブフレームのための肯定応答に対する要求を受信するように構成され得る。いくつかの態様では、受信回路は受信機４１２に対応し得る。

【０１７９】

[00205]本明細書で使用される「決定すること」という用語は、多種多様な活動を包含する。たとえば、「決定すること」は、計算すること、算出すること、処理すること、導出すること、調査すること、探索すること（たとえば、テーブル、データベース、または別のデータ構造の中で探索すること）、確認することなどを含み得る。また、「決定すること」は、受信すること（たとえば、情報を受信すること）、アクセスすること（たとえば、メモリ中のデータにアクセスすること）などを含み得る。また、「決定すること」は、解決すること、選択すること、選定すること、確立することなどを含み得る。さらに、本明細書で使用される「チャネル幅」は、いくつかの態様では帯域幅を包含することがあり、または帯域幅と呼ばれることもある。

【０１８０】

[00206]本明細書で使用される、項目のリスト「のうちの少なくとも１つ」に言及する句は、単一のメンバーを含む、それらの項目の任意の組合せを指す。一例として、「ａ、ｂ、またはｃのうちの少なくとも１つ」は、ａと、ｂと、ｃと、ａ－ｂと、ａ－ｃと、ｂ－ｃと、ａ－ｂ－ｃとを包含することが意図される。

【０１８１】

[00207]上で説明された方法の様々な動作は、様々なハードウェアおよび／またはソフトウェアコンポーネント、回路、ならびに／あるいはモジュールのような、それらの動作を実施することが可能な任意の好適な手段によって実行され得る。一般に、図に示される任意の動作は、その動作を実行することが可能な対応する機能的手段によって実行され得る。

【０１８２】

[00208]本明細書で使用される場合、インターフェースという用語は、２つ以上のデバイスを一緒に接続するように構成されるハードウェアまたはソフトウェアを指し得る。たとえば、インターフェースは、プロセッサまたはバスの一部であってよく、デバイス間での情報またはデータの通信を可能にするように構成されてよい。インターフェースは、チップまたは他のデバイスへと組み込まれ得る。たとえば、いくつかの実施形態では、インターフェースは、あるデバイスからの情報または通信を別のデバイスにおいて受信するように構成される受信機を備え得る。（たとえば、プロセッサまたはバスの）インターフェースは、フロントエンドデバイスまたは別のデバイスによって処理される情報またはデータを受信することができ、または受信された情報を処理することができる。いくつかの実

施形態では、インターフェースは、情報またはデータを別のデバイスに送信または通信するように構成される送信機を備え得る。したがって、インターフェースは、情報またはデータを送信することができ、または、（たとえば、バスを介した）送信のために出力する情報またはデータを準備することができる。

【０１８３】

[00209]本開示に関連して説明された様々な例示的な論理ブロック、モジュール、および回路は、本明細書で説明された機能を実行するように設計された、汎用プロセッサ、デジタル信号プロセッサ（ＤＳＰ）、特定用途向け集積回路（ＡＳＩＣ）、フィールドプログラマブルゲートアレイ信号（ＦＰＧＡ）もしくは他のプログラマブル論理デバイス（ＰＬＤ）、個別ゲートもしくはトランジスタ論理、個別ハードウェアコンポーネント、またはそれらの任意の組合せによって実装または実行され得る。汎用プロセッサはマイクロプロセッサであり得るが、代替として、プロセッサは、任意の市販のプロセッサ、コントローラ、マイクロコントローラまたは状態機械であり得る。また、プロセッサは、コンピューティングデバイスの組合せ、たとえば、ＤＳＰとマイクロプロセッサの組合せ、複数のマイクロプロセッサ、ＤＳＰコアと連携する１つまたは複数のマイクロプロセッサ、あるいは任意の他のそのような構成として実装され得る。

【０１８４】

[00210]１つまたは複数の態様では、説明された機能は、ハードウェア、ソフトウェア、ファームウェア、またはそれらの任意の組合せで実装され得る。ソフトウェアで実装される場合、機能は、１つまたは複数の命令またはコードとして、コンピュータ可読媒体上に記憶され得るか、またはコンピュータ可読媒体を介して送信され得る。コンピュータ可読媒体は、ある場所から別の場所へのコンピュータプログラムの転送を可能にする任意の媒体を含む、コンピュータ記憶媒体とコンピュータ通信媒体の両方を含む。記憶媒体は、コンピュータによってアクセスされ得る任意の利用可能な媒体であり得る。限定ではなく例として、そのようなコンピュータ可読媒体は、ＲＡＭ、ＲＯＭ、ＥＥＰＲＯＭ（登録商標）、ＣＤ－ＲＯＭもしくは他の光ディスクストレージ、磁気ディスクストレージもしくは他の磁気ストレージデバイス、または、命令もしくはデータ構造の形態の所望のプログラムコードを搬送または記憶するために使用されコンピュータによってアクセスされ得る、任意の他の媒体を備え得る。また、任意の接続が、適切にコンピュータ可読媒体と呼ばれる。たとえば、同軸ケーブル、光ファイバーケーブル、ツイストペア、デジタル加入者線（ＤＳＬ）、または赤外線、無線、およびマイクロ波などのワイヤレス技術を使用して、ソフトウェアがウェブサイト、サーバまたは他の遠隔ソースから伝送される場合、同軸ケーブル、光ファイバーケーブル、ツイストペア、ＤＳＬ、または赤外線、無線、およびマイクロ波などワイヤレス技術は、媒体の定義に含まれる。本明細書で使用されるディスク（disk）およびディスク（disc）は、コンパクトディスク（disc）（ＣＤ）、レーザーディスク（登録商標）（disc）、光ディスク（disc）、デジタル多用途ディスク（disc）（ＤＶＤ）、フロッピー（登録商標）ディスク（disk）およびＢｌｕ－ｒａｙ（登録商標）ディスク（disc）を含み、ここで、ディスク（disk）は、通常、データを磁気的に再生し、ディスク（disc）は、データをレーザーで光学的に再生する。したがって、いくつかの態様では、コンピュータ可読媒体は、非一時的コンピュータ可読媒体（たとえば有形媒体）を備え得る。さらに、いくつかの態様では、コンピュータ可読媒体は、一時的コンピュータ可読媒体（たとえば信号）を備え得る。上の組合せも、コンピュータ可読媒体の範囲の中に含まれるべきである。

【０１８５】

[00211]したがって、いくつかの態様は、本明細書で提示された動作を実行するためのコンピュータプログラム製品を備え得る。たとえば、そのようなコンピュータプログラム製品は、命令が記憶（および／または符号化）され、それらの命令が本明細書で説明された動作を実行するために１つまたは複数のプロセッサによって実行可能である、コンピュータ可読媒体を備え得る。いくつかの態様では、コンピュータプログラム製品は、パッケージング材料を含み得る。

【０１８６】
[00212]本明細書で開示されている方法は、説明されている方法を達成するための１つまたは複数のステップまたは活動を備える。本方法のステップおよび／または活動は、特許請求の範囲を逸脱することなく互いに交換され得る。言い換えれば、ステップまたは活動の特定の順序が明記されていない限り、特定のステップおよび／または活動の順序および／または使用は、特許請求の範囲を逸脱することなく修正され得る。
【０１８７】
[00213]ソフトウェアまたは命令は、伝送媒体を介して送信されることもある。たとえば、ソフトウェアが、同軸ケーブル、光ファイバーケーブル、ツイストペア、デジタル加入者線（ＤＳＬ）、または赤外線、無線、およびマイクロ波などのワイヤレス技術を使用して、ウェブサイト、サーバ、または他の遠隔ソースから送信される場合、同軸ケーブル、光ファイバーケーブル、ツイストペア、ＤＳＬ、または赤外線、無線、およびマイクロ波などのワイヤレス技術が、伝送媒体の定義に含まれる。
【０１８８】
[00214]さらに、本明細書で説明される方法および技法を実行するためのモジュールおよび／または他の適切な手段は、適用可能な場合、ユーザ端末および／または基地局によってダウンロードされ得ること、および／または他の方法で取得され得ることを理解されたい。たとえば、本明細書で説明される方法を実行するための手段の転送を容易にするために、そのようなデバイスはサーバに結合され得る。代替的に、本明細書で説明される様々な方法は、ユーザ端末および／または基地局が記憶手段をデバイスに結合するかまたは提供すると様々な方法を取得することができるように、記憶手段（たとえば、ＲＡＭ、ＲＯＭ、コンパクトディスク（ＣＤ）またはフロッピーディスクなどの物理記憶媒体など）を介して提供され得る。さらに、本明細書で説明される方法と技法とをデバイスに提供するための任意の他の適切な技法が利用され得る。
【０１８９】
[00215]特許請求の範囲は、上で示された通りの厳密な構成およびコンポーネントに限定されないことを理解されたい。上で説明された方法および装置の配置、動作および詳細には、特許請求の範囲を逸脱することなく、様々な修正、変更および変形が加えられ得る。
【０１９０】
[00216]上記の説明は、本開示の態様を対象としたものであるが、本開示の基本的な範囲を逸脱することなく、本開示の他の態様およびさらなる態様も考案されてよく、本開示の範囲は、以下の特許請求の範囲によって決定される。

【図１】

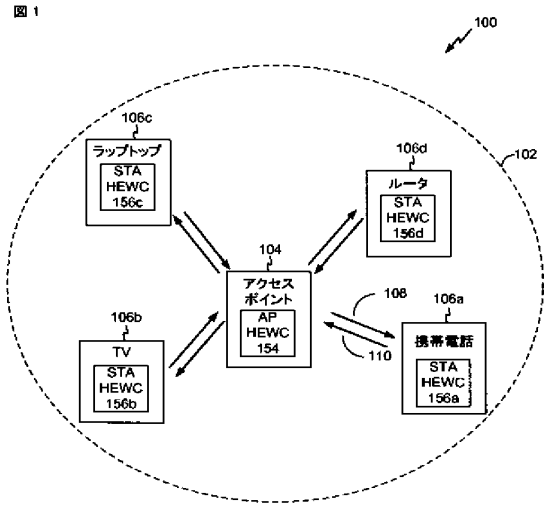


FIG. 1

【図２Ａ】

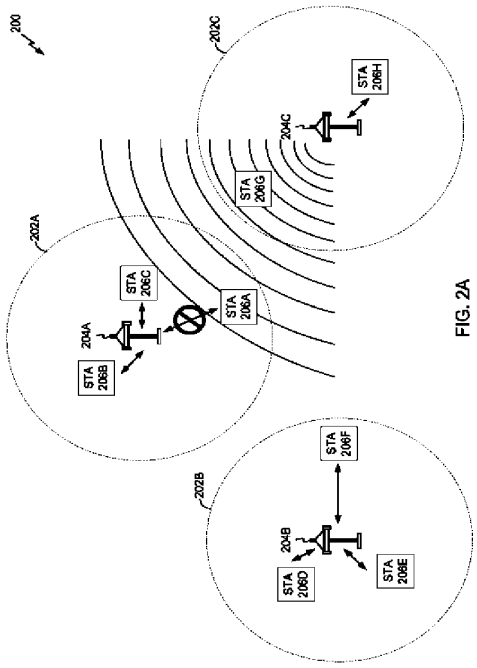


FIG. 2A

【図２Ｂ】

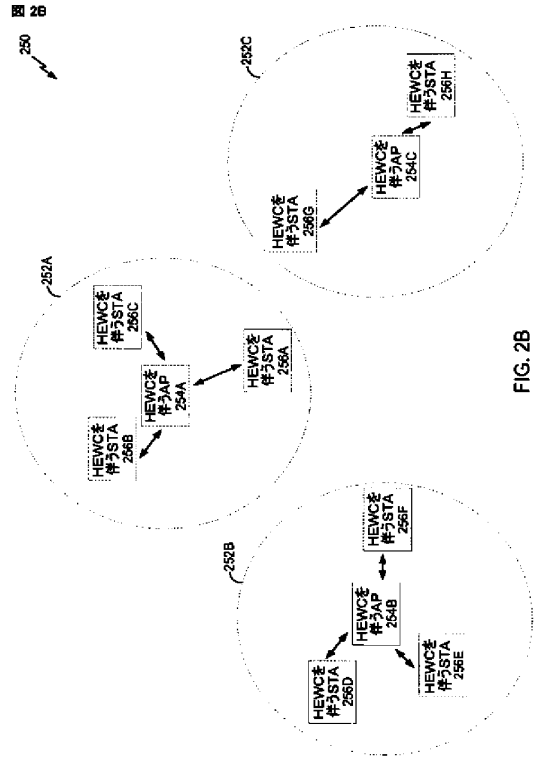


FIG. 2B

【図３】

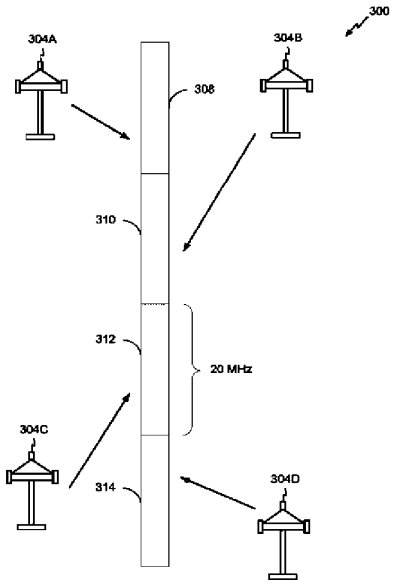


FIG. 3

【図４】

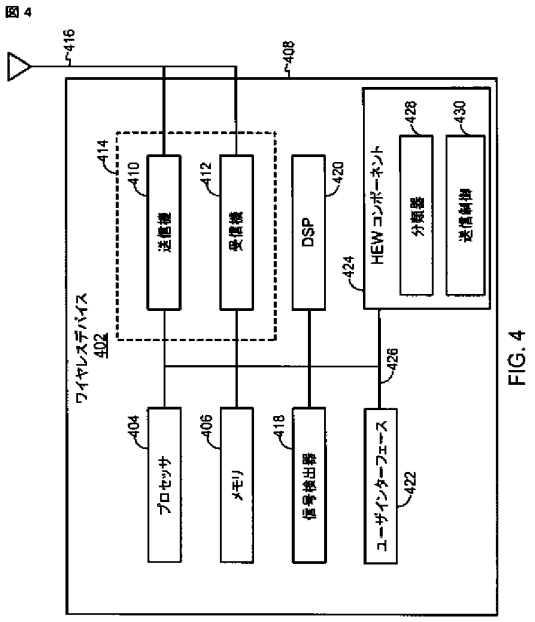


FIG. 4

【図５Ａ】

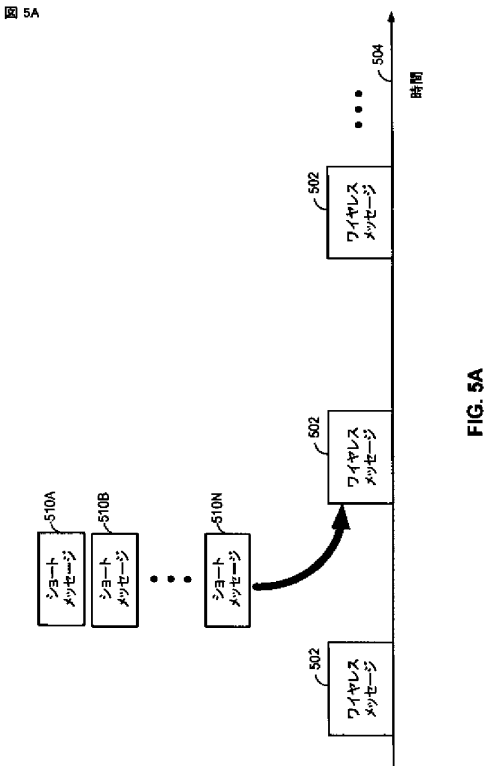


FIG. 5A

【図５Ｂ】

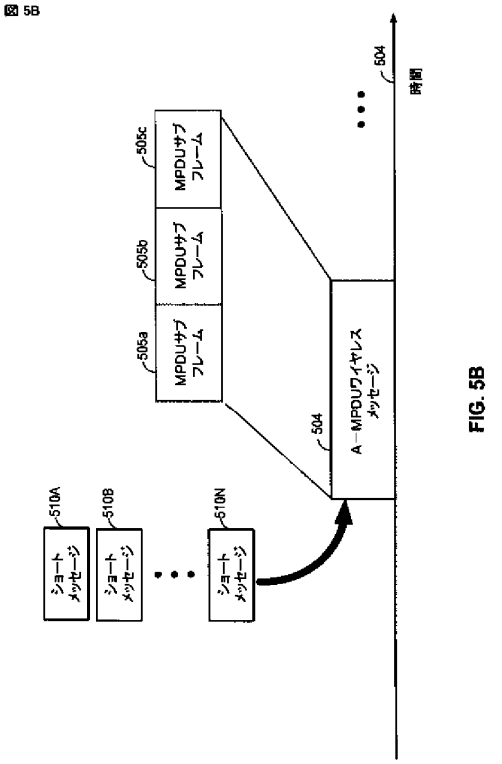


FIG. 5B

【図６】

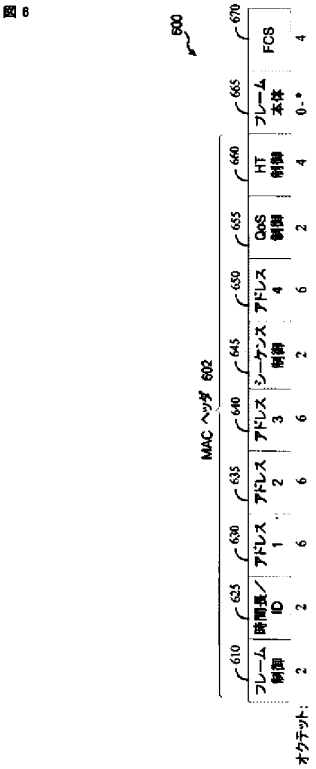


FIG. 6

【図７】

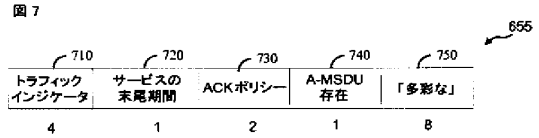


FIG. 7

【図８】

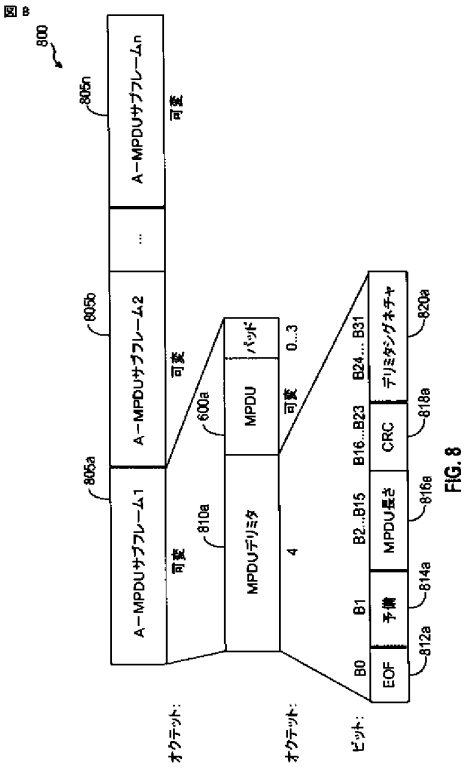


FIG. 8

【図９Ａ】

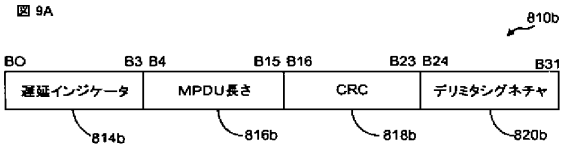


FIG. 9A

【図９Ｂ】

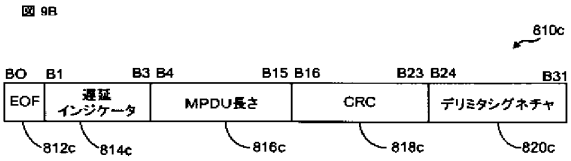


FIG. 9B

【図９Ｃ】

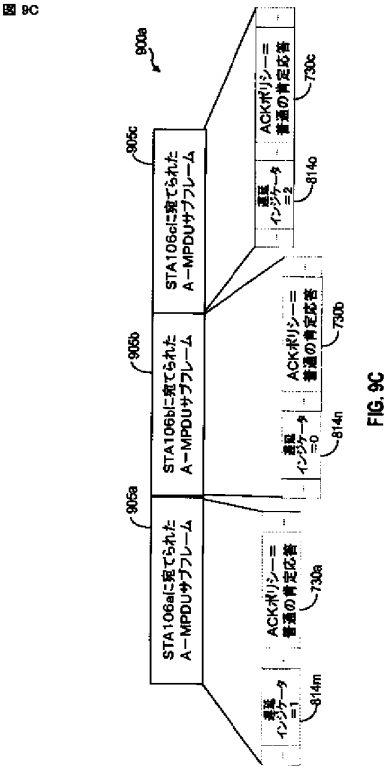


FIG. 9C

【図９Ｄ】

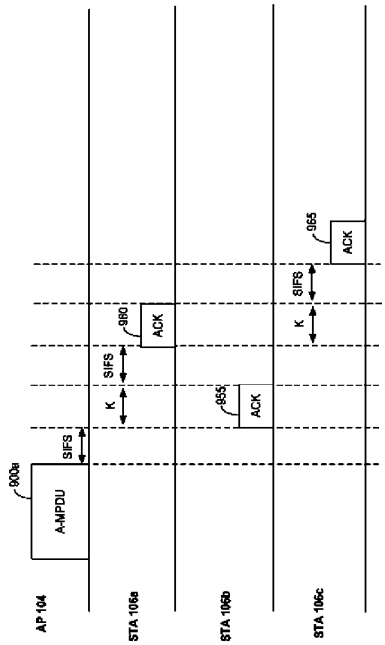


FIG. 9D

【図９Ｅ】

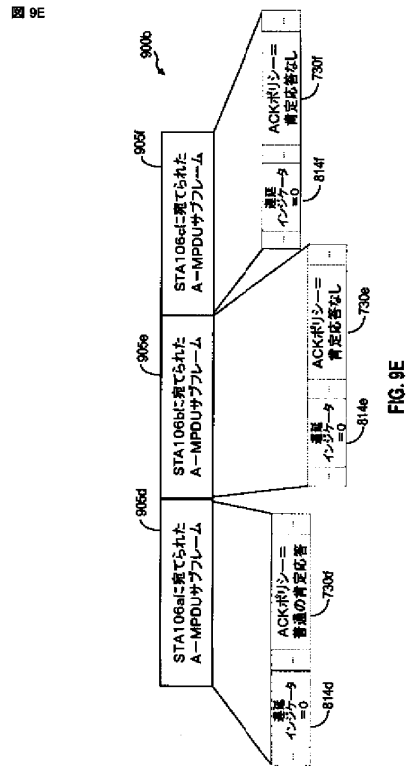


FIG. 9E

【図９Ｆ】

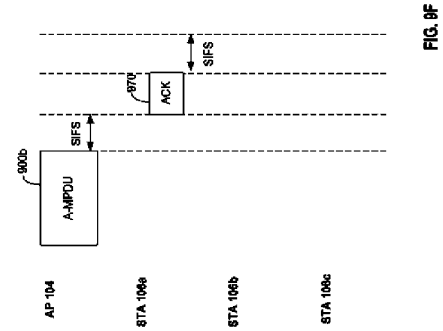


FIG. 9F

【図１０Ａ】

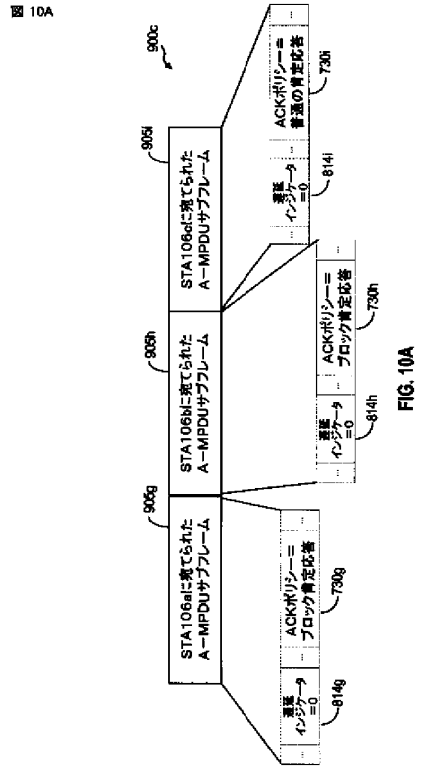


FIG. 10A

【図１０Ｂ】

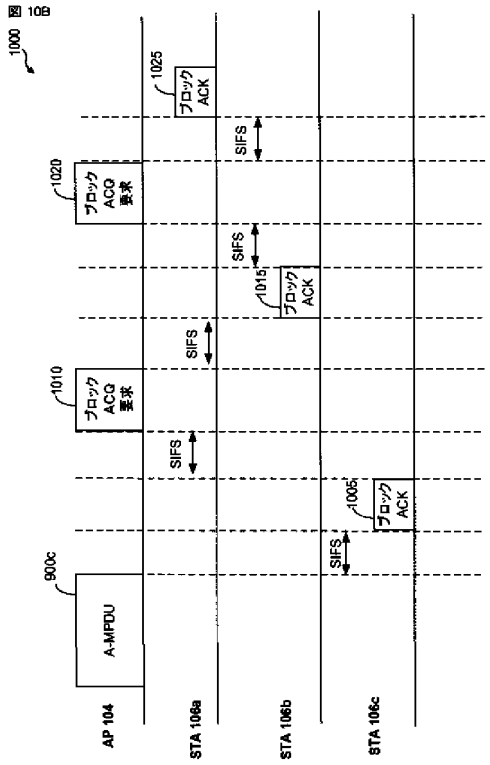


FIG. 10B

【図１０Ｃ】

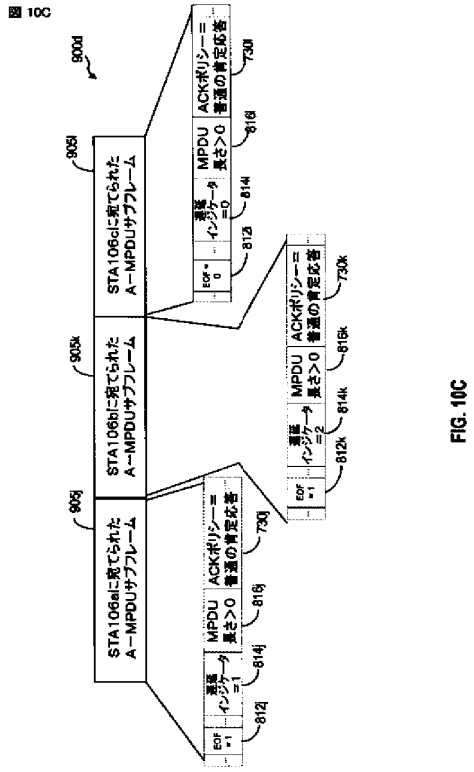


FIG. 10C

【図１０Ｄ】

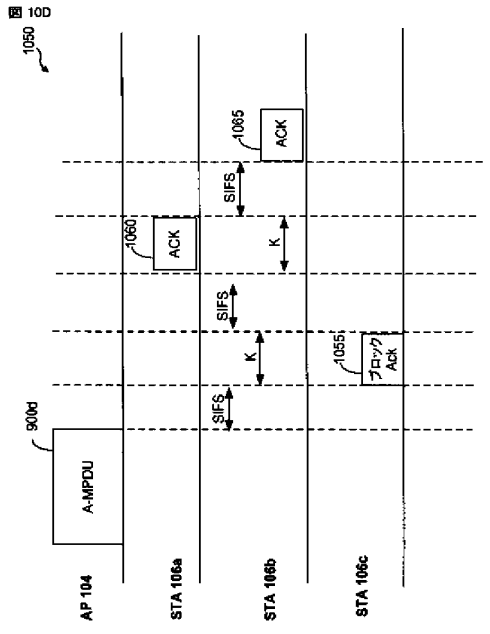


FIG. 10D

【図１１Ａ】

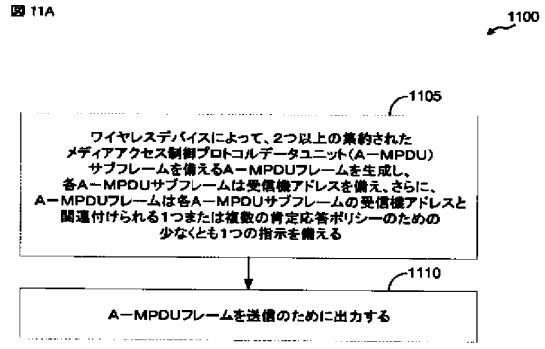


FIG. 11A

【図１１Ｂ】

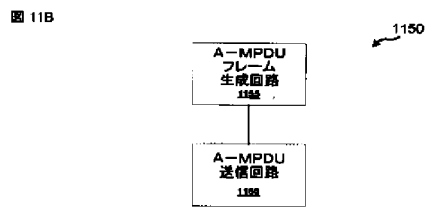


FIG. 11B

【図１２Ａ】

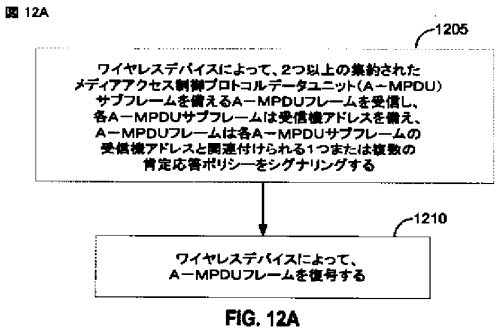


FIG. 12A

【図１２Ｂ】

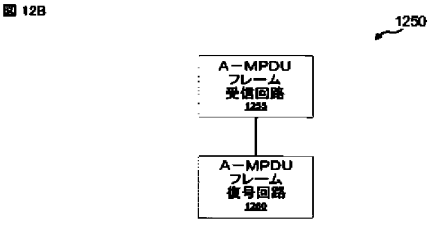


FIG. 12B

【図１３Ａ】

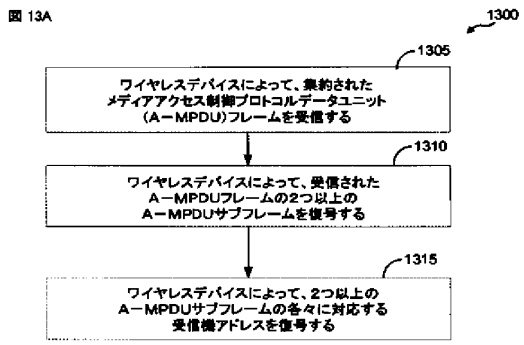


FIG. 13A

【図１３Ｂ】

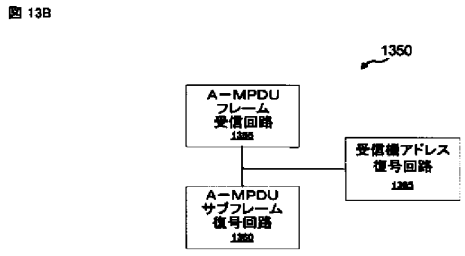


FIG. 13B

【手続補正書】
【提出日】平成28年4月15日(2016.4.15)
【手続補正１】
【補正対象書類名】特許請求の範囲
【補正対象項目名】全文
【補正方法】変更
【補正の内容】
【特許請求の範囲】
【請求項１】
装置によって、２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備え、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つがさらに、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、前記ＭＰＤＵデリミタフィールドが、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの肯定応答が送信されるまでに経過することになる時間遅延を示す値を記憶する、
送信のために前記Ａ－ＭＰＤＵフレームを出力することとを備える、ワイヤレス通信の方法。
【請求項２】
前記１つまたは複数の肯定応答ポリシーが、前記Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて示される、請求項１に記載の方法。
【請求項３】

前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、請求項１に記載の方法。

【請求項４】

前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることを示す、請求項３に記載の方法。

【請求項５】

前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つが特定の値に設定される場合に前記制御応答フレームが送信されるべきであることを示す、請求項３に記載の方法。

【請求項６】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにおいても示されるバックオフ値に基づく、請求項１に記載の方法。

【請求項７】

前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間または定数値の少なくとも１つに基づく、請求項６に記載の方法。

【請求項８】

前記Ａ－ＭＰＤＵフレームを生成することが、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成することを備え、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、請求項１に記載の方法。

【請求項９】

前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の前記肯定応答を受信することをさらに備える、請求項８に記載の方法。

【請求項１０】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つにおいて前記フレームの末尾フィールドの前記値を設定することをさらに備える、請求項８に記載の方法。

【請求項１１】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つにおいて前記フレームの末尾フィールドの前記値を設定することをさらに備える、請求項８に記載の方法。

【請求項１２】

２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備え、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、前記処理システムが、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの肯定応答が送信のために出力されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記

憶された値を設定するように構成される、
送信のために前記Ａ－ＭＰＤＵフレームを出力するためのインターフェースとを備える、ワイヤレス通信のための装置。
【請求項１３】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて前記１つまたは複数の肯定応答ポリシーを示すように構成される、請求項１２に記載の装置。
【請求項１４】
前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、請求項１２に記載の装置。
【請求項１５】
前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることを示す、請求項１４に記載の装置。
【請求項１６】
前記処理システムがさらに、前記制御応答フレームが送信のために出力されるべきであることを示すように、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つを特定の値に設定するように構成される、請求項１４に記載の装置。
【請求項１７】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにおいても示されるバックオフ値に基づく、請求項１２に記載の装置。
【請求項１８】
前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間または定数値の少なくとも１つに基づく、請求項１７に記載の装置。
【請求項１９】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成するように構成され、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、請求項１２に記載の装置。
【請求項２０】
前記処理システムがさらに、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の前記肯定応答を復号するように構成される、請求項１９に記載の装置。
【請求項２１】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの前記値を設定し、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信された肯定応答フレームを復号するように構成される、請求項１９に記載の装置。
【請求項２２】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの前記値を設定し、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信されたブロック肯定応答フレームを復

号するように構成される、請求項１９に記載の装置。
【請求項２３】
少なくとも１つのアンテナと、
２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備え、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、前記処理システムが、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの肯定応答が送信のために出力されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記憶された値を設定するように構成される、
前記少なくとも１つのアンテナを使用して前記Ａ－ＭＰＤＵフレームを送信するように構成される送信機とを備える、ワイヤレス通信のためのワイヤレスノード。
【請求項２４】
２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するための手段と、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備え、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つがさらに、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から対応するＡ－ＭＰＤＵサブフレームの肯定応答が送信されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記憶された値を設定するように構成される、
前記Ａ－ＭＰＤＵフレームを送信するための手段とを備える、装置。
【請求項２５】
Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて前記１つまたは複数の肯定応答ポリシーを示すように構成される、請求項２４に記載の装置。
【請求項２６】
前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、請求項２４に記載の装置。
【請求項２７】
前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることをさらに示す、請求項２６に記載の装置。
【請求項２８】
Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記Ａ－ＭＰＤＵフレームの受信の後に前記制御応答フレームが送信のために出力されるべきであることをさらに示すように、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つを特定の値に設定するように構成される、請求項２６に記載の装置。
【請求項２９】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにおい

ても示されるバックオフ値に基づく、請求項２４に記載の装置。
【請求項３０】
前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間または定数値の少なくとも１つに基づく、請求項２９に記載の装置。
【請求項３１】
前記Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成することを備え、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、請求項２４に記載の装置。
【請求項３２】
前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の肯定応答を復号するための手段をさらに備える、請求項３１に記載の装置。
【請求項３３】
２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの値を設定するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信された肯定応答フレームを復号するための手段とをさらに備える、請求項３１に記載の装置。
【請求項３４】
２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの値を設定するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信されたブロック肯定応答フレームを復号するための手段とをさらに備える、請求項３１に記載の装置。
【請求項３５】
実行されると、装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であって、前記方法が、
２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備え、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つがさらに、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、Ａ－ＭＰＤＵフレームを生成するための手段が、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から対応するＡ－ＭＰＤＵサブフレームの肯定応答が送信されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記憶された値を設定するように構成される、
前記Ａ－ＭＰＤＵフレームを送信することとを備える、コンピュータプログラム製品。
【請求項３６】
装置によって、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信することと、
前記装置によって、前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、
前記装置によって、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することと、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレ

スに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定することと、

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号することと、

前記Ａ－ＭＰＤＵフレームの受信から肯定応答フレームを送信のために出力するまでに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定することと、

前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信のために出力することと、

を備える、ワイヤレス通信の方法。

【請求項３７】

前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドにおいて各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する１つまたは複数の肯定応答ポリシーを復号することをさらに備える、請求項３６に記載の方法。

【請求項３８】

前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成することと、前記フレームを送信のための出力することとをさらに備える、請求項３７に記載の方法。

【請求項３９】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号することをさらに備え、ここにおいて、前記フレームの末尾フィールド中の前記値が１である場合、送信のために生成され出力される前記フレームが肯定応答フレームである、請求項３８に記載の方法。

【請求項４０】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号することをさらに備え、ここにおいて、前記フレームの末尾フィールド中の前記値が０である場合、送信のために生成され出力される前記フレームがブロック肯定応答フレームである、請求項３８に記載の方法。

【請求項４１】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号することと、前記値は、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、

前記フレームの末尾フィールド中の前記復号された値が１である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信に肯定応答する肯定応答フレームを生成することと、

前記肯定応答フレームを送信のために出力することとをさらに備える、請求項３７に記載の方法。

【請求項４２】

前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号することと、前記復号された値は、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーの受信の肯定応答に対する要求のタイプを示す、

前記フレームの末尾フィールド中の前記復号された値が０である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信に肯定応答するブロック肯定応答

フレームを生成することと、
前記ブロック肯定応答フレームを送信のために出力することとをさらに備える、請求項３７に記載の方法。
【請求項４３】
前記ＭＰＤＵデリミタフィールドに記憶されている前記値がバックオフ値である、請求項３６に記載の方法。
【請求項４４】
前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値が、短フレーム間空間時間または定数値の少なくとも１つに基づく、請求項４３に記載の方法。
【請求項４５】
前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成することと、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーに基づいて、前記Ａ－ＭＰＤＵフレームの送信から短い時間間フレーム空間時間以上の遅延の後に、受信の前記肯定応答を送信のために出力することとをさらに備える、請求項３７に記載の方法。
【請求項４６】
ワイヤレス通信のための装置であって、
集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信し、
前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号し、
前記Ａ－ＭＰＤＵフレームの受信から肯定応答フレームの送信までに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信のために生成する
ように構成される処理システムを備える、装置。
【請求項４７】
前記処理システムがさらに、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドにおいて各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するように構成される、請求項４６に記載の装置。
【請求項４８】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成し、前記フレームを送信のための出力するように構成される、請求項４７に記載の装置。
【請求項４９】
前記処理システムがさらに、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、前記処理システムがさらに、前記フレームの末尾フィールド中の前記値が１である場合、前記

フレームを送信のために肯定応答フレームとして生成するように構成される、請求項４８に記載の装置。
【請求項５０】
前記処理システムがさらに、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、前記処理システムがさらに、前記フレームの末尾フィールド中の前記値が０である場合、前記フレームを送信のためにブロック肯定応答フレームとして生成するように構成される、請求項４８に記載の装置。
【請求項５１】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、前記値は前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、さらに、前記フレームの末尾フィールド中の前記値が１である場合、送信のために肯定応答フレームを生成するように構成される、請求項４７に記載の装置。
【請求項５２】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、前記値は前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、さらに、前記フレームの末尾フィールド中の前記値が０である場合、送信のためにブロック肯定応答フレームを生成するように構成される、請求項４７に記載の装置。
【請求項５３】
前記ＭＰＤＵデリミタフィールドに記憶されている前記値がバックオフ値である、請求項４６に記載の装置。
【請求項５４】
前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値が、短フレーム間空間時間または定数値の少なくとも１つに基づく、請求項５３に記載の装置。
【請求項５５】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記肯定応答ポリシーに基づいて、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で前記装置に宛てられる、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を送信のために生成するように構成される、請求項４７に記載の装置。
【請求項５６】
ワイヤレス通信のためのワイヤレスノードであって、
少なくとも１つのアンテナと、
前記アンテナを介して集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するように構成される受信機と、
前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームと、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスとを復号し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記ワイヤレスノードに宛てられると決定し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号し、
前記Ａ－ＭＰＤＵフレームの受信から肯定応答フレームの送信までに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーに基づいて、前記

時間遅延が経過した後に前記肯定応答フレームを送信のために生成する
ように構成される処理システムとを備える、ワイヤレスノード。
【請求項５７】
ワイヤレス通信のための装置であって、
集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するための手段と、
前記受信されたＡ－ＭＰＤＵフレームに基づいて２つ以上のＡ－ＭＰＤＵサブフレームを復号するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームから復号された前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定するための手段と
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号するための手段と、
前記Ａ－ＭＰＤＵフレームの受信から肯定応答フレームの送信までに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信するための手段と
を備える、装置。
【請求項５８】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドの中の各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するための手段をさらに備える、請求項５７に記載の装置。
【請求項５９】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成するための手段と、前記フレームを送信するための手段とをさらに備える、請求項５８に記載の装置。
【請求項６０】
復号するための前記手段がさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、生成するための前記手段が、肯定応答フレームを生成するように構成され、送信するための前記手段がさらに、前記フレームの末尾フィールド中の前記値が１である場合、前記肯定応答フレームを前記フレームとして送信するように構成される、請求項５９に記載の装置。
【請求項６１】
復号するための前記手段がさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、生成するための前記手段が、肯定応答フレームを生成するように構成され、送信するための前記手段がさらに、前記フレームの末尾フィールド中の前記値が０である場合、ブロック肯定応答フレームを前記フレームとして送信するように構成される、請求項５９に記載の装置。
【請求項６２】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、前記値は、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを

示す、
前記フレームの末尾フィールド中の前記値が１である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する肯定応答フレームを生成するための手段と、
前記肯定応答フレームを送信するための手段とをさらに備える、請求項５８に記載の装置。
【請求項６３】
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、前記値は、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、
前記フレームの末尾フィールド中の前記値が０である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対するブロック肯定応答フレームを生成するための手段と、
前記ブロック肯定応答フレームを送信するための手段とをさらに備える、請求項５８に記載の装置。
【請求項６４】
前記ＭＰＤＵデリミタフィールド中の前記値がバックオフ値である、請求項５７に記載の装置。
【請求項６５】
短フレーム間空間時間または定数値の少なくとも１つに基づく、前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値、請求項６４に記載の装置。
【請求項６６】
前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する前記肯定応答ポリシーがブロック肯定応答ポリシーを示す場合、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で、受信の前記肯定応答を送信するための手段とをさらに備える、請求項５８に記載の装置。
【請求項６７】
実行されると、装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であって、前記方法が、
集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信することと、
前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することと、
前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定することと、
前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号することと、
前記Ａ－ＭＰＤＵフレームの受信から肯定応答フレームを送信のために出力するまでに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定することと、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーに基づいて、前記時間遅延が経過した後に肯定応答フレームを送信のために出力することと
を備える、コンピュータプログラム製品。
【請求項６８】
前記装置によって、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機ア

ドレスを示すために、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定することをさらに備える、請求項１に記載の方法。
【請求項６９】
前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するように構成される、請求項１２に記載の装置。
【請求項７０】
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すために、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するための手段をさらに備える、請求項２４に記載の装置。
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】０１９０
【補正方法】変更
【補正の内容】
【０１９０】
[00216]上記の説明は、本開示の態様を対象としたものであるが、本開示の基本的な範囲を逸脱することなく、本開示の他の態様およびさらなる態様も考案されてよく、本開示の範囲は、以下の特許請求の範囲によって決定される。
以下に本願の出願当初の特許請求の範囲に記載された発明を付記する。
[Ｃ１] 装置によって、２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、
送信のために前記Ａ－ＭＰＤＵフレームを出力することとを備える、ワイヤレス通信の方法。
[Ｃ２] 前記１つまたは複数の肯定応答ポリシーが、前記Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて示される、Ｃ１に記載の方法。
[Ｃ３] 前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、Ｃ１に記載の方法。
[Ｃ４] 前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることを示す、Ｃ３に記載の方法。
[Ｃ５] 前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つが特定の値に設定される場合に前記制御応答フレームが送信されるべきであることを示す、Ｃ３に記載の方法。
[Ｃ６] 前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つがさらに、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、前記ＭＰＤＵデリミタフィールドが、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの肯定応答が送信されるまでに経過することになる時間遅延を示す値を記憶する、Ｃ１に記載の方法。
[Ｃ７] 前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにおいても示されるバックオフ値に基づく、Ｃ６に記載の方法。
[Ｃ８] 前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレ

ーム間空間時間と定数値の少なくとも１つに基づく、Ｃ７に記載の方法。
［Ｃ９］　前記Ａ－ＭＰＤＵフレームを生成することが、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成することを備え、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、Ｃ１に記載の方法。
［Ｃ１０］　前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の前記肯定応答を受信することをさらに備える、Ｃ９に記載の方法。
［Ｃ１１］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つにおいて前記フレームの末尾フィールドの前記値を設定することをさらに備える、Ｃ９に記載の方法。
［Ｃ１２］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つにおいて前記フレームの末尾フィールドの前記値を設定することをさらに備える、Ｃ９に記載の方法。
［Ｃ１３］　２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、
送信のために前記Ａ－ＭＰＤＵフレームを出力するためのインターフェースとを備える、ワイヤレス通信のための装置。
［Ｃ１４］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて前記１つまたは複数の肯定応答ポリシーを示すように構成される、Ｃ１３に記載の装置。
［Ｃ１５］　前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、Ｃ１３に記載の装置。
［Ｃ１６］　前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることを示す、Ｃ１５に記載の装置。
［Ｃ１７］　前記処理システムがさらに、前記制御応答フレームが送信のために出力されるべきであることを示すように、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つを特定の値に設定するように構成される、Ｃ１５に記載の装置。
［Ｃ１８］　前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが、メディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、前記処理システムが、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの肯定応答が送信のために出力されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記憶された値を設定するように構成される、Ｃ１３に記載の装置。
［Ｃ１９］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにおいても示されるバックオフ値に基づく、Ｃ１８に記載の装置。
［Ｃ２０］　前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、Ｃ１９に記載の装置。
［Ｃ２１］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの少な

くとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成するように構成され、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、Ｃ１３に記載の装置。

［Ｃ２２］　前記処理システムがさらに、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の前記肯定応答を復号するように構成される、Ｃ２１に記載の装置。

［Ｃ２３］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの前記値を設定し、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信された肯定応答フレームを復号するように構成される、Ｃ２１に記載の装置。

［Ｃ２４］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つのための受信の肯定応答に対する前記要求の前記タイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの前記値を設定し、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信されたブロック肯定応答フレームを復号するように構成される、Ｃ２１に記載の装置。

［Ｃ２５］　少なくとも１つのアンテナと、

２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するように構成される処理システムと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、

前記少なくとも１つのアンテナを使用して前記Ａ－ＭＰＤＵフレームを送信するように構成される送信機とを備える、ワイヤレス通信のためのワイヤレスノード。

［Ｃ２６］　２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成するための手段と、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵフレームは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、

前記Ａ－ＭＰＤＵフレームを送信するための手段とを備える、装置。

［Ｃ２７］　Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記Ａ－ＭＰＤＵサブフレームの対応する１つまたは複数の制御フィールドにおいて前記１つまたは複数の肯定応答ポリシーを示すように構成される、Ｃ２６に記載の装置。

［Ｃ２８］　前記１つまたは複数の肯定応答ポリシーの少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信の後で、制御応答フレームが送信されるべきであることを示す、Ｃ２６に記載の装置。

［Ｃ２９］　前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つが、前記２つ以上のＡ－ＭＰＤＵサブフレームを備える前記Ａ－ＭＰＤＵフレームの受信から短フレーム間空間時間後に、前記制御応答フレームが送信されるべきであることをさらに示す、Ｃ２８に記載の装置。

［Ｃ３０］　Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記Ａ－ＭＰＤＵフレームの受信の後に前記制御応答フレームが送信のために出力されるべきであることをさらに示すように、前記１つまたは複数の肯定応答ポリシーの前記少なくとも１つを特定の値に設定するように構成される、Ｃ２８に記載の装置。

［Ｃ３１］　前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つがさらに、メディ

アアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを備え、Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信から対応するＡ－ＭＰＤＵサブフレームの肯定応答が送信されるまでに経過することになる時間遅延を示す、前記ＭＰＤＵデリミタフィールドに記憶された値を設定するように構成される、Ｃ２６に記載の装置。

［Ｃ３２］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの前記ＭＰＤＵデリミタフィールドによって示される前記時間遅延が、前記ＭＰＤＵデリミタフィールドにも示されるバックオフ値に基づく、Ｃ３１に記載の装置。

［Ｃ３３］　前記ＭＰＤＵデリミタフィールドにおいて示される前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、Ｃ３２に記載の装置。

［Ｃ３４］　前記Ａ－ＭＰＤＵフレームを生成するための前記手段が、前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの中の、フレームの末尾フィールドと肯定応答ポリシーフィールドの少なくとも１つにおいて、受信の肯定応答に対する要求を生成することを備え、前記フレームの末尾フィールドまたは前記肯定応答ポリシーフィールドの中の値が、受信の肯定応答に対する前記要求のタイプを決定する、Ｃ２６に記載の装置。

［Ｃ３５］　前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後に受信される、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信の肯定応答を復号するための手段をさらに備える、Ｃ３４に記載の装置。

［Ｃ３６］　２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプが肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの値を設定するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信された肯定応答フレームを復号するための手段とをさらに備える、Ｃ３４に記載の装置。

［Ｃ３７］　２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つのための受信の肯定応答に対する要求のタイプがブロック肯定応答フレームであることを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記フレームの末尾フィールドの値を設定するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する受信されたブロック肯定応答フレームを復号するための手段とをさらに備える、Ｃ３４に記載の装置。

［Ｃ３８］　実行されると、装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であって、前記方法が、

２つ以上の集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）サブフレームを備えるＡ－ＭＰＤＵフレームを生成することと、ここにおいて、各Ａ－ＭＰＤＵサブフレームは受信機アドレスを備え、さらに、ここにおいて、前記Ａ－ＭＰＤＵは各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる１つまたは複数の肯定応答ポリシーのための少なくとも１つの指示を備える、

前記Ａ－ＭＰＤＵフレームを送信することとを備える、コンピュータプログラム製品。

［Ｃ３９］　装置によって、集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信することと、

前記装置によって、前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、

前記装置によって、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することと、

前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定することとを備える、ワイヤレス通信の方法。

［Ｃ４０］　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドにおいて各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる

少なくとも１つの指示に基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する１つまたは複数の肯定応答ポリシーを復号することをさらに備える、Ｃ３９に記載の方法。

［Ｃ４１］　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成することと、前記フレームを送信のための出力することとをさらに備える、Ｃ４０に記載の方法。

［Ｃ４２］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号することをさらに備え、ここにおいて、前記フレームの末尾フィールド中の前記値が１である場合、送信のために生成され出力される前記フレームが肯定応答フレームである、Ｃ４１に記載の方法。

［Ｃ４３］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号することをさらに備え、ここにおいて、前記フレームの末尾フィールド中の前記値が０である場合、送信のために生成され出力される前記フレームがブロック肯定応答フレームである、Ｃ４１に記載の方法。

［Ｃ４４］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号することと、前記値は、前記２つ以上のＡ－ＭＤＰＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、

前記フレームの末尾フィールド中の前記復号された値が１である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信に肯定応答する肯定応答フレームを生成することと、

前記肯定応答フレームを送信のために出力することとをさらに備える、Ｃ４０に記載の方法。

［Ｃ４５］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号することと、前記復号された値は、前記２つ以上のＡ－ＭＤＰＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーの受信の肯定応答に対する要求のタイプを示す、

前記フレームの末尾フィールド中の前記復号された値が０である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの受信に肯定応答するブロック肯定応答フレームを生成することと、

前記ブロック肯定応答フレームを送信のために出力することとをさらに備える、Ｃ４０に記載の方法。

［Ｃ４６］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号することと、

前記Ａ－ＭＰＤＵフレームの受信から前記肯定応答フレームを送信のために出力するまでに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定することと、

前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信のために出力することとをさらに備える、Ｃ４４に記載の方法。

［Ｃ４７］　前記ＭＰＤＵデリミタフィールドに記憶されている前記値がバックオフ値である、Ｃ４６に記載の方法。

［Ｃ４８］　前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、Ｃ４７に記載の方法。

［Ｃ４９］　前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成することと、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記１つまたは複数の肯定応答ポリシーに基づいて、前記Ａ－ＭＤＰＵフレームの送信から短い時

間間フレーム空間時間以上の遅延の後に、受信の前記肯定応答を送信のために出力することとをさらに備える、Ｃ４０に記載の方法。
［Ｃ５０］　集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信し、
　前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号し、
　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号し、
　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定する
ように構成される処理システムを備える、ワイヤレス通信のための装置。
［Ｃ５１］　前記処理システムがさらに、
　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドにおいて各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するように構成される、Ｃ５０に記載の装置。
［Ｃ５２］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成し、前記フレームを送信のための出力するように構成される、Ｃ５１に記載の装置。
［Ｃ５３］　前記処理システムがさらに、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、前記処理システムがさらに、前記フレームの末尾フィールド中の前記値が１である場合、前記フレームを送信のために肯定応答フレームとして生成するように構成される、Ｃ５２に記載の装置。
［Ｃ５４］　前記処理システムがさらに、前記装置に宛てられる前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、前記処理システムがさらに、前記フレームの末尾フィールド中の前記値が０である場合、前記フレームを送信のためにブロック肯定応答フレームとして生成するように構成される、Ｃ５２に記載の装置。
［Ｃ５５］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、前記値は前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、さらに、前記フレームの末尾フィールド中の前記値が１である場合、送信のために肯定応答フレームを生成するように構成される、Ｃ５１に記載の装置。
［Ｃ５６］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するように構成され、前記値は前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、さらに、前記フレームの末尾フィールド中の前記値が０である場合、送信のためにブロック肯定応答フレームを生成するように構成される、Ｃ５１に記載の装置。
［Ｃ５７］　前記処理システムがさらに、
　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルデータユニット（ＭＰＤＵ）デリミタフィールドを復号し、
　前記Ａ－ＭＰＤＵフレームの受信から前記肯定応答フレームの送信までに経過すること

になる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信のために生成するように構成される、Ｃ５５に記載の装置。
［Ｃ５８］　前記ＭＰＤＵデリミタフィールドに記憶されている前記値がバックオフ値である、Ｃ５７に記載の装置。
［Ｃ５９］　前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値が、短フレーム間空間時間と定数値の少なくとも１つに基づく、Ｃ５８に記載の装置。
［Ｃ６０］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する前記肯定応答ポリシーに基づいて、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で前記装置に宛てられる、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を送信のために生成するように構成される、Ｃ５１に記載の装置。
［Ｃ６１］　少なくとも１つのアンテナと、
前記アンテナを介して集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するように構成される受信機と、
前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームと、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスとを復号し、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記ワイヤレスノードに宛てられると決定する
ように構成される処理システムとを備える、ワイヤレス通信のためのワイヤレスノード。
［Ｃ６２］　集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信するための手段と、
前記受信されたＡ－ＭＰＤＵフレームに基づいて２つ以上のＡ－ＭＰＤＵサブフレームを復号するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号するための手段と、
前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する前記復号された受信機アドレスに基づいて、前記受信されたＡ－ＭＰＤＵフレームから復号された前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定するための手段とを備える、ワイヤレス通信のための装置。
［Ｃ６３］　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の対応する少なくとも１つのフィールドの中の各Ａ－ＭＰＤＵサブフレームの前記受信機アドレスと関連付けられる少なくとも１つの指示に基づいて、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対する肯定応答ポリシーを復号するための手段をさらに備える、Ｃ６２に記載の装置。
［Ｃ６４］　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記少なくとも１つのフィールドが特定の値に設定される場合に、前記少なくとも１つのフィールドの前記特定の値に基づいてフレームを生成するための手段と、前記フレームを送信するための手段とをさらに備える、Ｃ６３に記載の装置。
［Ｃ６５］　復号するための前記手段がさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、生成するための前記手段が、肯定応答フレームを生成するように構成され、送信するための前記手段がさらに、前記フレームの末尾フィールド中の前記値が１である場合、前記肯定応答フレームを前記フレームとして送信するように構成される、Ｃ６４に記載の装置。
［Ｃ６６］　復号するための前記手段がさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中の前記少なくとも１つのフィールドのフレームの末尾フィールド中の値を復号するように構成され、生成するための前記手段が、肯定応答フレームを生

成するように構成され、送信するための前記手段がさらに、前記フレームの末尾フィールド中の前記値が０である場合、ブロック肯定応答フレームを前記フレームとして送信するように構成される、Ｃ６４に記載の装置。
［Ｃ６７］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、前記値は、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、
　前記フレームの末尾フィールド中の前記値が１である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する肯定応答フレームを生成するための手段と、
　前記肯定応答フレームを送信するための手段とをさらに備える、Ｃ６３に記載の装置。
［Ｃ６８］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のフレームの末尾フィールド中の値を復号するための手段と、前記値は、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーのための受信の肯定応答に対する要求のタイプを示す、
　前記フレームの末尾フィールド中の前記値が０である場合、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対するブロック肯定応答フレームを生成するための手段と、
　前記ブロック肯定応答フレームを送信するための手段とをさらに備える、Ｃ６３に記載の装置。
［Ｃ６９］　前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つの中のメディアアクセス制御プロトコルユニット（ＭＰＤＵ）デリミタフィールドを復号するための手段と、
　前記Ａ－ＭＰＤＵフレームの受信から前記肯定応答フレームの送信までに経過することになる時間遅延を、前記ＭＰＤＵデリミタフィールドに記憶されている値から決定するための手段と、
　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の前記肯定応答ポリシーに基づいて、前記時間遅延が経過した後に前記肯定応答フレームを送信するための手段とをさらに備える、Ｃ６７に記載の装置。
［Ｃ７０］　前記ＭＰＤＵデリミタフィールド中の前記値がバックオフ値である、Ｃ６９に記載の装置。
［Ｃ７１］　短フレーム間空間時間と定数値の少なくとも１つに基づく、前記ＭＰＤＵデリミタフィールドに記憶されている前記バックオフ値、Ｃ７０に記載の装置。
［Ｃ７２］　前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つの受信の肯定応答を生成するための手段と、前記２つ以上のＡ－ＭＰＤＵサブフレームの前記少なくとも１つに対する前記肯定応答ポリシーがブロック肯定応答ポリシーを示す場合、前記Ａ－ＭＰＤＵフレームの送信から短フレーム間空間時間以上の遅延の後で、受信の前記肯定応答を送信するための手段とをさらに備える、Ｃ６３に記載の装置。
［Ｃ７３］　実行されると、装置にワイヤレス通信の方法を実行させる命令が符号化された、コンピュータ可読媒体を備えるコンピュータプログラム製品であって、前記方法が、
　集約されたメディアアクセス制御プロトコルデータユニット（Ａ－ＭＰＤＵ）フレームを受信することと、
　前記受信されたＡ－ＭＰＤＵフレームの２つ以上のＡ－ＭＰＤＵサブフレームを復号することと、
　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々に対応する受信機アドレスを復号することと、
　前記受信されたＡ－ＭＰＤＵフレームの前記２つ以上のＡ－ＭＰＤＵサブフレームの少なくとも１つが前記装置に宛てられると決定することとを備える、コンピュータプログラム製品。
［Ｃ７４］　前記装置によって、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース

送信機アドレスを示すために、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定することをさらに備える、Ｃ１に記載の方法。

［Ｃ７５］　前記処理システムがさらに、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すように、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するように構成される、Ｃ１３に記載の装置。

［Ｃ７６］　前記２つ以上のＡ－ＭＰＤＵサブフレームの各々のソース送信機アドレスを示すために、前記２つ以上のＡ－ＭＰＤＵサブフレームの各々の送信機アドレスフィールドを設定するための手段をさらに備える、Ｃ２６に記載の装置。

【国際調査報告】

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/048920

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W28/06
ADD. H04L1/12

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 H04L

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2010/099496 A1 (QUALCOMM INC [US]; WENTINK MAARTEN MENZO [NL]) 2 September 2010 (2010-09-02)	1-5, 7-10, 13-17, 19-22, 25-30, 32-35, 38-41, 47-52, 58-64, 70-76
Y	paragraph [0064] - paragraph [0066]; figure 7	6,11,12, 18,23, 24,31, 36,37, 42-46, 53-57, 65-69

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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

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

"T" 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

"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

"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 obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 October 2014	28/10/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Orfanos, Georgios

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/048920

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012/030541 A1 (QUALCOMM INC [US]; WENTINK MAARTEN MENZO [NL]; MERLIN SIMONE [US]; ABR) 8 March 2012 (2012-03-08)	1,13,25, 26,38, 39,50, 61,62,73
Y	paragraph [0058] - paragraph [0060] paragraph [0073] - paragraph [0077]; figure 6 paragraph [0091] - paragraph [0093]	6,11,12, 18,23, 24,31, 36,37, 42-46, 53-57, 65-69
A		2-5, 7-10, 14-17, 19-22, 27-30, 32-35, 40,41, 47-49, 51,52, 58-60, 63,64, 70-72, 74-76

X	US 2013/089047 A1 (WENTINK MAARTEN MENZO [NL]) 11 April 2013 (2013-04-11)	1,13,25, 26,38, 39,50, 61,62,73
A	paragraph [0046] paragraph [0052] paragraph [0057] - paragraph [0063]; figures 5-7	2-12, 14-24, 27-37, 40-49, 51-60, 63-72, 74-76

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2014/048920

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010099496 A1	02-09-2010	CN 102318428 A	11-01-2012
		EP 2401887 A1	04-01-2012
		JP 5318974 B2	16-10-2013
		JP 2012519426 A	23-08-2012
		KR 20110120973 A	04-11-2011
		TW 201127159 A	01-08-2011
		US 2010220678 A1	02-09-2010
		WO 2010099496 A1	02-09-2010
WO 2012030541 A1	08-03-2012	CN 103081394 A	01-05-2013
		EP 2612462 A1	10-07-2013
		JP 2013542632 A	21-11-2013
		KR 20130052007 A	21-05-2013
		US 2012207087 A1	16-08-2012
		WO 2012030541 A1	08-03-2012
US 2013089047 A1	11-04-2013	US 2013089047 A1	11-04-2013
		WO 2013055943 A1	18-04-2013

Form PCT/ISA/210 (patent family annex) (April 2005)

フロントページの続き

(81)指定国 AP(BW,GH,GM,KE,LR,LS,MW,MZ,NA,RW,SD,SL,SZ,TZ,UG,ZM,ZW),EA(AM,AZ,BY,KG,KZ,RU,TJ,TM),EP(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),OA(BF,BJ,CF,CG,CI,CM,GA,GN,GQ,GW,KM,ML,MR,NE,SN,TD,TG),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,LT,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

(特許庁注：以下のものは登録商標)
１．ＭＩＲＡＣＡＳＴ

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Ｆターム(参考) 5K004 BA02
5K067 AA11 BB04 BB21 DD11 DD24 DD30 EE02 EE10 EE56 EE61
EE72 FF05 GG02 HH22 HH28 JJ12 JJ13

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/851,035	06/28/2022	Woojin AHN	B-9807CON3 633733-2	7978

158747 7590 02/15/2023

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EXAMINER	
ELPENORD, CANDAL	

ART UNIT	PAPER NUMBER
2473	

NOTIFICATION DATE	DELIVERY MODE
02/15/2023	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

LA_MAIL@la.ladas.com
achinaryan@la.ladas.com
ykoo@la.ladas.com

Office Action Summary	**Application No.** 17/851,035	**Applicant(s)** AHN et al.	
	Examiner CANDAL ELPENORD	**Art Unit** 2473	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on June 28, 2022.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 21-34 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 21-34 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on June 28, 2022 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Double Patenting

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to

file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

3. **Claims 21-34 (Instant Application 17/851,035)** are rejected on the ground of nonstatutory double patenting as being unpatentable over **claims 1-14 of U.S. Patent No. 11,405,161**, **claims 1-4 of U.S. 11,095,416**, **claims 1-15 of U.S. 10,491,355**. Although the claims at issue are not identical, they are not patentably distinct from each other because the claims of the cited patent disclose obvious versions of the instant claims as shown below.

Instant Application 17/851,035	**US 11,405,161**
21. A wireless communication terminal communicating wirelessly, the terminal comprising: a transceiver; and a processor, wherein the processor is configured to: receive trigger information from a base wireless communication terminal using the transceiver, wherein the trigger information triggers a transmission of a trigger-based physical layer protocol data unit (PPDU) by the wireless communication terminal, wherein when the trigger information is included in a trigger frame, the trigger frame comprises a signaling field, wherein the signaling field indicates whether aggregating one or more MAC Protocol Data Unit (MPDU)s requesting an immediate response to generate an Aggregate-MAC Protocol Data Unit (A-	1. A wireless communication terminal communicating wirelessly, the terminal comprising: a transceiver; and a processor, wherein the processor is configured to: receive trigger information from a base wireless communication terminal using the transceiver, wherein the trigger information triggers a transmission of a trigger-based physical layer protocol data unit (PPDU) by the wireless communication terminal, wherein when the trigger information is included in a trigger frame, the trigger frame comprises a signaling field, wherein the signaling field indicates whether aggregating one or more MAC Protocol Data Unit (MPDU)s requesting an immediate response to generate an Aggregate-MAC Protocol Data Unit (A-

MPDU) is allowed and indicates a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless communication terminal generates the A-MPDU, when the value of the signaling field is a predetermined value, generate the A-MPDU not to include one or more MPDUs requesting an immediate response, **wherein the predetermined value is 0**, when the value of the signaling field is within a predetermined range, generate the A-MPDU according to the maximum number of TIDs, and transmit the trigger-based PPDU including the A-MPDU to the base wireless communication terminal. **Difference**: Setting of the signal field to a value of zero would have been obvious.	MPDU) is allowed and indicates a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless terminal generates the A-MPDU, **when the value of the signaling field is a predetermined value,** generate the A-MPDU not to include one or more MPDUs requesting an immediate response, when the value of the signaling field is within a predetermined range, generate the A-MPDU according to the maximum number of TIDs, and transmit the trigger-based PPDU including the A-MPDU to the base wireless communication terminal.
22. The wireless communication terminal of claim 21, wherein the wireless communication is allowed to aggregate one or more MPDUs not requesting an immediate response regardless of the maximum number of TIDs.	2. The wireless communication terminal of claim 1, wherein the wireless communication is allowed to aggregate one or more MPDUs not requesting an immediate response regardless of the maximum number of TIDs.
23. The wireless communication terminal of claim 22, wherein the one or more MPDUs not requesting an immediate response comprises a Quality of Service (QoS) Null frame not requesting an ACK for the QoS Null frame.	3. The wireless communication terminal of claim 2, wherein the one or more MPDUs not requesting an immediate response comprises a Quality of Service (QoS) Null frame not requesting an ACK for the QoS Null frame.
24. The wireless communication terminal of claim 22, wherein the one or more MPDUs not requesting an immediate response comprises an Action No Ack frame not requesting an ACK for the Action No Ack frame.	4. The wireless communication terminal of claim 2, wherein the one or more MPDUs not requesting an immediate response comprises an Action No Ack frame not requesting an ACK for the Action No Ack frame.
25. The wireless communication terminal of claim 21, wherein when the value of the signaling field is within the predetermined	5. The wireless communication terminal of claim 1, wherein when the value of the signaling field is within a predetermined

range, the processor is configured to aggregate one or more action frames regardless of a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless communication terminal generates the A-MPDU.	range, the processor is configured to aggregate one or more action frames regardless of a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless terminal generates the A-MPDU.
26. The wireless communication terminal of claim 21, wherein when the trigger information is included in a MAC header, the processor is configured to generate the A-MPDU not to include one or more MPDUs requesting an immediate response.	6. The wireless communication terminal of claim 1, wherein when the trigger information is included in a MAC header, the processor is configured to generate the A-MPDU not to include one or more MPDUs requesting an immediate response.
27. The wireless communication terminal of claim 26, wherein when the trigger information is included in the MAC header, the processor is configured to aggregate any one of an ACK frame and a Block ACK (BA) frame, with one or more MPDUs not requesting an immediate response, without one or more MPDUs requesting an immediate response to generate the A-MPDU.	7. The wireless communication terminal of claim 6, wherein when the trigger information is included in the MAC header, the processor is configured to aggregate any one of an ACK frame and a Block ACK (BA) frame, with one or more MPDUs not requesting an immediate response, without one or more MPDUs requesting an immediate response to generate the A-MPDU.
28. The wireless communication terminal of claim 27, wherein the one or more MPDUs not requesting an immediate response comprises at least one of a QoS Null frame not requesting an ACK for the QoS Null frame and an Action No Ack frame not requesting an ACK for the Action No Ack frame.	8. The wireless communication terminal of claim 7, wherein the one or more MPDUs not requesting an immediate response comprises at least one of a QoS Null frame not requesting an ACK for the QoS Null frame and an Action No Ack frame not requesting an ACK for the Action No Ack frame.
29. A base wireless communication terminal communicating wirelessly, the terminal comprising: a transceiver; and a processor, wherein the processor is configured to: generate trigger information to a plurality of wireless communication terminals using the	9. A base wireless communication terminal communicating wirelessly, the terminal comprising: a transceiver; and a processor, wherein the processor is configured to: generate trigger information to a plurality of wireless communication terminals using the

transceiver, wherein the trigger information triggers a transmission of a trigger-based physical layer protocol data unit (PPDU) by the wireless communication terminal and is included in a trigger frame which include a first signaling field, wherein the first signaling field indicates whether aggregating one or more MPDUs requesting an immediate response to generate an Aggregate-MAC Protocol Data Unit (A-MPDU) is allowed and indicates a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless communication terminal generates the A-MPDU, when a wireless communication terminal corresponding to the first signaling field is not allowed to aggregate one or more MPDUs requesting an immediate response to generate the A-MPDU, **set a value of the first signaling field to a predetermined value, wherein the predetermined value is 0**, when the wireless communication terminal corresponding to the first signaling field is allowed to aggregate one or more MPDUs requesting an immediate response to generate the A-MPDU, set the value of the first signaling field according to the maximum number of TIDs, transmit the trigger frame, and receive the trigger-based PPDU including the A-MPDU from at least one of the plurality of wireless communication terminals, wherein one or more MPDUs requesting an immediate response are aggregated or not, based on the first signaling field, in the A-MPDU. **Difference**: Setting of the signal field to a value of zero would have been obvious.	transceiver, wherein the trigger information triggers a transmission of a trigger-based physical layer protocol data unit (PPDU) by the wireless communication terminal and is included in a trigger frame which include a first signaling field, wherein the first signaling field indicates whether aggregating one or more MPDUs requesting an immediate response to generate an Aggregate-MAC Protocol Data Unit (A-MPDU) is allowed and indicates a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless terminal generates the A-MPDU, when a wireless communication terminal corresponding to the first signaling field is not allowed to aggregate one or more MPDUs requesting an immediate response to generate the A-MPDU, **set a value of the first signaling field to a predetermined value,** when the wireless communication terminal corresponding to the first signaling field is allowed to aggregate one or more MPDUs requesting an immediate response to generate the A-MPDU, s**et the value of the first signaling field according to the maximum number of TIDs**, transmit the trigger frame, and receive the trigger-based PPDU including the A-MPDU from at least one of the plurality of wireless communication terminals, wherein one or more MPDUs requesting an immediate response are aggregated or not, based on the first signaling field, in the A-MPDU.
30. The base wireless communication terminal of claim 29, wherein the maximum number of TIDs indicates a maximum number of TIDs requesting an immediate response that is allowed to be aggregated in the A-MPDU.	10. The base wireless communication terminal of claim 9, wherein the maximum number of TIDs indicates a maximum number of TIDs requesting an immediate response that is allowed to be aggregated in the A-MPDU.

31. The base wireless communication terminal of claim 29, wherein one or more Quality of Service (QoS) null frames not requesting an ACK for the QoS null frames are aggregated in the A-MPDU regardless of the maximum number of TIDs.	11. The base wireless communication terminal of claim 9, wherein one or more Quality of Service (QoS) null frames not requesting an ACK for the QoS null frames are aggregated in the A-MPDU regardless of the maximum number of TIDs.
32. The base wireless communication terminal of claim 29, wherein the trigger frame comprises a second signaling field indicating whether channel sensing is required when a wireless communication terminal transmits a response to the trigger information through trigger-based Physical Layer Protocol Data Unit (PPDU), wherein the processor is configured to set the value of the first signaling field based on the value of the second signaling field.	12. The base wireless communication terminal of claim 9, wherein the trigger frame comprises a second signaling field indicating whether channel sensing is required when a wireless communication terminal transmits a response to the trigger information through trigger-based Physical Layer Protocol Data Unit (PPDU), wherein the processor is configured to set the value of the first signaling field based on the value of the second signaling field.
33. The base wireless communication terminal of claim 32, wherein when the second signaling field is set to indicate that channel sensing is not required when the wireless communication terminal transmitting the response to the trigger information transmits the trigger-based PPDU, the processor is configured to set the value of the first signaling field to the predetermined value.	13. The base wireless communication terminal of claim 12, wherein when the second signaling field is set to indicate that channel sensing is not required when the wireless communication terminal transmitting the response to the trigger information transmits the trigger-based PPDU, the processor is configured to set the value of the first signaling field to the predetermined value.
34. The base wireless communication terminal of claim 33, wherein the trigger frame comprises a third signaling field indicating information on a length of the trigger-based PPDU, wherein the processor is configured to set the value of the first signaling field based on a value of the third signaling field.	14. The base wireless communication terminal of claim 13, wherein the trigger frame comprises a third signaling field indicating information on a length of the trigger-based PPDU, wherein the processor is configured to set the value of the first signaling field based on a value of the third signaling field.

Instant Application 17/851,035	**US 11,405,161**
21. A wireless communication terminal communicating wirelessly, the terminal comprising: a transceiver; and a processor, wherein the processor is configured to: receive trigger information from a base wireless communication terminal using the transceiver, wherein the trigger information triggers a transmission of a trigger-based physical layer protocol data unit (PPDU) by the wireless communication terminal, wherein when the trigger information is included in a trigger frame, the trigger frame comprises a signaling field, wherein the signaling field indicates whether aggregating one or more MAC Protocol Data Unit (MPDU)s requesting an immediate response to generate an Aggregate-MAC Protocol Data Unit (A-MPDU) is allowed and indicates a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless communication terminal generates the A-MPDU, when the value of the signaling field is a predetermined value, generate the A-MPDU not to include one or more MPDUs requesting an immediate response, wherein the predetermined value is 0, when the value of the signaling field is within a predetermined range, generate the A-MPDU according to the maximum number of TIDs, and transmit the trigger-based PPDU including the A-MPDU to the base wireless communication terminal. **Difference**: Setting of the signal field to a value of zero would have been obvious.	1. A wireless communication terminal communicating wirelessly, the terminal comprising: a transceiver; and a processor, wherein the processor is configured to: receive trigger information from a base wireless communication terminal using the transceiver, when the trigger information is included in a MAC header, generate an Aggregate-MAC Protocol Data Unit (A-MPDU) in response to the trigger information not to include one or more MPDUs requesting an immediate response, and transmit the A-MPDU to the base wireless communication terminal, wherein when the trigger information is included in the MAC header, the trigger information does not include information on a maximum number TIDs that is allowed to be aggregated in the A-MPDU, wherein when the trigger information is included in the trigger frame, the trigger frame includes a signaling field, wherein the signaling field indicates that the wireless communication terminal is not allowed to aggregate the one or more MPDUs requesting an immediate response to generate the A-MPDU in response to the trigger information when a value of the signaling field is a predetermined value, and indicates the maximum number of TIDs when the value of the signaling field is within a predetermined range.
22. The wireless communication terminal of claim 21, wherein the wireless communication is allowed to aggregate one or more MPDUs not requesting an immediate response regardless of the maximum number of TIDs.	2. The wireless communication terminal of claim 1, wherein when the trigger information is included in the MAC header, the processor is configured to aggregate any one of an ACK frame and a Block ACK (BA) frame, with one or more MPDUs not requesting an immediate response, without the one or more MPDUs requesting an immediate response to generate the A-MPDU.

23. The wireless communication terminal of claim 22, wherein the one or more MPDUs not requesting an immediate response comprises a Quality of Service (QoS) Null frame not requesting an ACK for the QoS Null frame.	3. The wireless communication terminal of claim 2, wherein the one or more MPDUs not requesting an immediate response comprises at least one of a QoS Null frame not requesting an ACK for the QoS Null frame and an Action No Ack frame not requesting an ACK for the Action No Ack frame.

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Ghosh et al (US 2017/0257196 A1) discloses a wireless communication terminal (**fig. 1, fig. 3, see, STA 103/USER STA which receives of a trigger frame from AP 102, section 0049**) communicating wirelessly **(see**, **the AP transmits trigger frame to the STA 103, the trigger frame indicating that STA 103 is to perform uplink data transmissions, section 0049, 0059**), the terminal (**fig. 3, STA 300 that includes the transceiver circuitry 305, section 0040-0042**) comprising: a transceiver **(fig. 3, STA 300 that includes the transceiver circuitry 305, section 0040-0042**); and a processor (**fig. 3, processing circuitry 306, section 0040-0042**), wherein the processor (**fig. 3, processing circuitry 306, section 0040-0042**) is configured to: receive trigger information from a base wireless communication terminal **(fig. 3,**

AP 350 which transmits trigger frame to the STA, section 0049) using the transceiver (**fig. 3, STA 300 that includes the transceiver circuitry 305, section 0040-0042, noted: the transceiver enables to STA to receive signals from the AP, section 0040-0042**), wherein the trigger information (**see**, **the AP transmits trigger frame to the STA 103, the trigger frame indicating that STA 103 is to perform uplink data transmissions, section 0049, 0059, noted: the trigger frame ma include control information, traffic identifier (TID), common information, section 0049, 0059, 0070, 0080-0086** triggers a transmission of a trigger-based physical layer protocol data unit (PPDU) by the wireless communication terminal (**see**, **the AP transmits trigger frame to the STA 103, the trigger frame indicating that STA 103 is to perform uplink data transmissions, section 0049, 0059, noted: the trigger frame ma include control information, traffic identifier (TID), common information, section 0049, 0059, 0070, 0080-0086**), wherein when the trigger information is included in a trigger frame (**see**, **the AP transmits trigger frame to the STA 103, the trigger frame indicating that STA 103 is to perform uplink data transmissions, section 0049, 0059, noted: the trigger frame ma include control information, traffic identifier (TID), common information, section 0049, 0059, 0070, 0080-0086**), the trigger frame comprises a signaling field indicating whether the wireless communication terminal is allowed to aggregate one or more MPDUs (**see , fig. 7, traffic identifier aggregation limit parameter referencing selected TIDs from which MPPDUs that may be aggregated into A-MPDU, abstract, 0066-000678, noted: the trigger may include HE-Sig-A field**) requesting an immediate response to generate Aggregate-MAC Protocol Data Unit (A-MPDU) (**see**, **immediate acknowledgement in relation to the A-MPDU/number of aggregated TIDS which may require immediate ACK or delayed ACK, section 077, 0080-0085, 0119, fig. 6, section 0085, noted: the number of TIDs in the A-MPDU triggers the ACK response, section 0080-0081**), determine whether to aggregate one or more MPDUs requesting an immediate response to generate the A-MPDU based on the signaling field when the trigger information is included in the trigger frame (**see, the**

aggregation limit is used in relation to the number of aggregated TIDs from which A-MPDU that would be acknowledged by the AP, section 0077-0080), generate the A-MPDU according to the determination when the trigger information is included in the trigger frame **(see, the STA 103 selecting a group of aggregate TIDs from MAC PDUs to aggregate into an A-MPDU, section 0049, section 0080-0086, noted: the aggregate MPDU is based on the information included in the trigger frame, section 0049, 0077**), and transmit the trigger-based PPDU including the A-MPDU to the base wireless communication terminal (**see, the STA 103 selecting a group of aggregate TIDs from MAC PDUs to aggregate into an A-MPDU, section 0049, section 0080-0086, noted: the aggregate MPDU is based on the information included in the trigger frame, section 0049, 0077**).

Ghosh '196 fails to explicitly teach: wherein when the trigger information is included in a trigger frame, the trigger frame comprises a signaling field, wherein the signaling field indicates whether aggregating one or more MAC Protocol Data Unit (MPDU)s requesting an immediate response to generate an Aggregate-MAC Protocol Data Unit (A-MPDU) is allowed and indicates a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless communication terminal generates the A-MPDU, when the value of the signaling field is a predetermined value, generate the A-MPDU not to include one or more MPDUs requesting an immediate response, wherein the predetermined value is 0, when the value of the signaling field is within a predetermined range, generate the A-MPDU according to the maximum number of TIDs, and transmit the trigger-based PPDU including the A-MPDU to the base wireless communication terminal" as recited in **claim 21**.

Ghosh '196 fails to explicitly teach: wherein the first signaling field indicates whether aggregating one or more MPDUs requesting an immediate response to generate an Aggregate-MAC Protocol Data Unit (A-MPDU) is allowed and indicates a maximum number of TIDs that is allowed to be aggregated in the A-MPDU when the wireless communication terminal generates the A-MPDU, when a wireless communication terminal corresponding to the first signaling field is not allowed to aggregate one or more MPDUs requesting an immediate response to generate the A-MPDU, set a value of the first signaling field to a predetermined value, wherein the predetermined value is 0, when the wireless communication terminal corresponding to the first signaling field is allowed to aggregate one or more MPDUs requesting an immediate response to generate the A-MPDU, set the value of the first signaling field according to the maximum number of TIDs, transmit the trigger frame, and receive the trigger-based PPDU including the A-MPDU from at least one of the plurality of wireless communication terminals, wherein one or more MPDUs requesting an immediate response are aggregated or not, based on the first signaling field, in the A-MPDU" as recited in **claim 29**.

ASTERJADHI et al (US 2017/0310446 A1, Provisional Application No. 62/326617, filed on April. 22, 2016) discloses method and apparatus for selection of block acknowledgment Rules, the STA comprises ACK component (section 0034, 0040-0041). ASTERJADHI further discloses the maximum number of TIDs that may be aggregated in MPDU is included in High Efficiency (HE) information element (section 0043).

Trainin et al (US 2016/0183274 A1) discloses generates A-MPDU as an immediate response required by the A-MPDU (section 0048-0075).

5. **Claims 21-34** would be allowable, if a Terminal Disclaimer is filed to overcome the Double Patenting Rejection, set forth in this Office Action.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to CANDAL ELPENORD whose telephone number is (571)270-3123. The examiner can normally be reached 9 am -6 pm M-F.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kwang B Yao can be reached on 571 272-3182. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CANDAL ELPENORD/
Primary Examiner, Art Unit 2473

Notice of References Cited	Application/Control No. 17/851,035	Applicant(s)/Patent Under Reexamination AHN et al.	
	Examiner CANDAL ELPENORD	Art Unit 2473	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20160183274-A1	06-2016	Trainin; Solomon	H04W74/002	370/329
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
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	K					
	L					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
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	Q					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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NOTICE OF ALLOWANCE AND FEE(S) DUE

158747 7590 03/24/2023

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LOS ANGELES, CA 90010

EXAMINER
TON, DANG T

ART UNIT	PAPER NUMBER
2476	

DATE MAILED: 03/24/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,996	01/25/2021	Woojin AHN	B-10005CON2 633017-8	1072

TITLE OF INVENTION: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	06/26/2023

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

158747 7590 03/24/2023
LADAS & PARRY
E-MAIL
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SUITE 240
LOS ANGELES, CA 90010

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,996	01/25/2021	Woojin AHN	B-10005CON2 633017-8	1072

TITLE OF INVENTION: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	06/26/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
TON, DANG T	2476	370-329000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,996	01/25/2021	Woojin AHN	B-10005CON2 633017-8	1072

158747 7590 03/24/2023

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SUITE 240
LOS ANGELES, CA 90010

EXAMINER	
TON, DANG T	

ART UNIT	PAPER NUMBER
2476	

DATE MAILED: 03/24/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/157,996	Applicant(s) AHN et al.	
	Examiner DANG T TON	Art Unit 2476	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Amendment of 3/15/2023.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 17-32 (Renumbered 1-16, respectively) . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☑ All b) ☐ Some* c) ☐ None of the:

   1. ☑ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/DANG T TON/
Primary Examiner, Art Unit 2476

December 22, 2022

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON2 633017-8	U.S. SERIAL NO. 17/157,996
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated September 29, 2022 for Korean Patent Application No. 10-2022-7027751 and its English translation provided by Applicant's foreign counsel.

EXAMINER	*DATE CONSIDERED*
/DANG T TON/	03/16/2023

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T.T/

Europäisches Patentamt
European Patent Office
Office européen des brevets

European Patent Office
Postbus 5818
2280 HV Rijswijk
NETHERLANDS
Tel: +31 70 340 2040
Fax: +31 70 340 3016

EINGEGANGEN
17. März 2023
SCHMITT-NILSON SCHRAUD WAIBEL WOHLFROM

Questions about this communication?
Contact Customer Services at
www.epo.org/contact

Primary Examiner
Name: Cortés Gómez, Francisco
Tel: +31 70 340 - 8424

Schmitt-Nilson Schraud Waibel Wohlfrom
Patentanwälte Partnerschaft mbB
Pelkovenstraße 143
80992 München
ALLEMAGNE

Application No.	Ref.	Date
17 884 228.2 - 1215	M24157.8	16.03.2023
Applicant: Wilus Institute of Standards and Technology Inc., et al		

Communication pursuant to Article 94(3) EPC

The examination of the above-identified application has revealed that it does not meet the requirements of the European Patent Convention for the reasons enclosed herewith. If the deficiencies indicated are not rectified the application may be refused pursuant to Article 97(2) EPC.

You are invited to file your observations and in sofar as the deficiencies are such as to be rectifiable, to correct the indicated deficiencies within a period

of 4 months

from the notification of this communication, this period being computed in accordance with Rules 126(2) and 131(2) and (4) EPC. One set of amendments to the description, claims and drawings is to be filed within the said period on separate sheets (R. 50(1) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

Failure to comply with this invitation in due time will result in the application being deemed to be withdrawn (Art. 94(4) EPC).

3483281 AS 2-1606
N3 AB EPA
M24157.8 T1 15-07-2023

3483275 AS 2-0404
YC COMMENT OA 16.05.2023
M24157.8 T1 15-05-2023

Registered Letter

Cortés Gómez, Francisco
Primary Examiner
For the Examining Division

Enclosure(s): 6 page/s reasons (EPO Form 2906)

The examination is being carried out on the **following application documents**

Description, Pages

1, 2, 5-67	filed with entry into the regional phase before the EPO			
3, 4	received on	04-03-2021	with letter of	04-03-2021
4a	received on	26-11-2021	with letter of	25-11-2021

Claims, Numbers

1-12	received on	26-11-2021	with letter of	25-11-2021

Drawings, Sheets

1/13-13/13	filed with entry into the regional phase before the EPO

1 Reference is made to the following documents; the numbering will be adhered to in the rest of the procedure:

LIWEN CHU (MARVELL): "Multi-TID A-MPDU in MU Transmission ; 11-16-0069-00-00ax-multi-tid-a-mpdu-in-mu-transmission",

D1 IEEE DRAFT; 11-16-0069-00-00AX-MULTI-TID-A-MPDU-IN-MU-TRANSMISSION, IEEE-SA MENTOR, PISCATAWAY, NJ USA, vol. 802.11ax, 18 January 2016 (2016-01-18), pages 1-15, XP068104841,

ALFRED ASTERJADHI (QUALCOMM INC): "BlockAck generation and selection rules",
IEEE DRAFT; 11-16-0616-02-00AX-BLOCKACK-GENERATION-AND-SELECTION-RULES, IEEE-SA MENTOR, PISCATAWAY, NJ USA

D2 ,
vol. 802.11ax, no. 2 17 May 2016 (2016-05-17), pages 1-29, XP068119447,
Retrieved from the Internet:
URL:https://mentor.ieee.org/802.11/dcn/16/11-16-0616-02-00ax-blockack-generation-and-selection-rules.pptx
[retrieved on 2016-05-17]

D3	LAN/MAN STANDARDS COMMITTEE ? OF THE ? IEEE COMPUTER SOCIETY: "Draft Standard for Information technology- Tele- communications and information exchange between systems Local and metropolitan area networks- Specific requirements ? ? Part 11: Wireless LAN Medium Access Control ? (MAC) and Physical Layer (PHY) Specifications ? ? Amendment 6: Enhancements for High", IEEE DRAFT; DRAFT P802.11AX_D1.0, IEEE-SA, PISCATAWAY, NJ USA , vol. 802.11ax drafts, no. D1.0 1 December 2016 (2016-12-01), pages 1-453, XP068137446, Retrieved from the Internet: URL:www.ieee802.org/11/private/Draft_Standards/11ax/Draft P802.11ax_D1.0.pdf [retrieved on 2016-12-01]
D4	US 2016/360442 A1 (STACEY ROBERT [US] ET AL) 8 December 2016 (2016-12-08)
D5	US 2016/182205 A1 (ASTERJADHI ALFRED [US] ET AL) 23 June 2016 (2016-06-23)

Document D2 references explicitly document D1 as [6] in slide 13 as part of the presentation of block ack negotiation and selection mechanisms, under the header of "Passed motion", which implies that all teachings of D1 are incorporated in D2. Since document D1 is incorporated by reference in document D2, **the combination of D1+D2 is considered as one disclosure**.

2 **Amendments (Art. 123(2), 76 EPC)**

The amendments received on 26-11-2021 with letter of 25-11-2021 appear to comply with Article 123(2) EPC.

3 **Clarity and Conciseness (Art. 84 EPC)**

The examiner acknowledges that the clarity objections raised in the last communication have been successfully addressed by the applicant.

4 **Novelty and Inventive Step (Art. 52(1), 54 and 56 EPC)**

4.1 The present application does not meet the requirements of Article 52(1) EPC because the subject-matter of claim 1 is not new within the meaning of Article 54(1) and (2) EPC.

Document D1+D2 discloses:

A wireless communication terminal, (D1+D2 discloses methods and procedures for stations, STAs, and access points, APs, according to the IEEE 802.11 wireless communications standard, both types of devices corresponding to wireless communication terminals)

the terminal comprising:
a processor; and
a communication unit, (implicit in STAs and APs according to IEEE 802.11)

wherein the processor is configured to:
receive, through the communication unit, an aggregate MPDU, A-MPDU, consisting of one or more MAC protocol data units, MPDUs, (D1 slide 11 title and first bullet)

wherein the A-MPDU includes MPDU delimiter information including an end of frame, EOF, field, a length field, a cyclic redundancy check, CRC, field, and an MPDU signature field, and at least one traffic ID, TID, related to the one or more MPDUs, (D1 slide 11 figure in the bottom right corner)

and transmit, through the communication unit, a response frame of a specific format in response to the A-MPDU, (the transmission of the response frame selected according to the rules in D1 slides 11-12 is implicit; the "specific" format is one of "Ack", "BA", "not immediate BA" and M-BA)

wherein the specific format of the response frame for the A-MPDU is determined based on at least one of the number of TIDs soliciting an immediate response in MPDUs successfully received in the A-MPDU (D1 slides 11-12 where the determination among the specific formats is based on the number of TIDs soliciting immediate response, inter-alia in the 1st subbullet of the 2nd bullet of slide 11 and the first bullet of slide 12)

and the MPDU delimiter information of the A-MPDU, (D1 slide 11, 2nd, 3rd and 4th bullets referring to delimiters EOF and MPDU length)

~~characterised in that~~
the specific format of the response frame for the A-MPDU is determined to be a compressed BlockAck frame, when the MPDUs successfully received in the A-MPDU belongs to only one TID soliciting an immediate response. (D2 slide 18, where the 3rd and 4th rows of the table clearly disclose that while A-MPDUs with multiple TIDs soliciting immediate response result in sending an M-BA frame, while A-MPDUs without multiple TIDs soliciting an immediate response result in a C-BA frame. It is noted that the column "Ack Policy setting[# recipients]" indicates if immediate response is required according to the IEEE 802.11 standard, so that the value "MU Ack [>0]" corresponds to a positive number of MPDUs requering immediate reponse)

The subject-matter of claim 1 is therefore not new (Article 54(1) and (2) EPC).

4.2 The supplementary features of dependent claims 2-6 and 8-12, relate to minor implementation details which do not add anything new (Article 54(1) and (2) EPC) or of inventive significance (Article 56 EPC) to the subject-matter of the claim they refer to, especially as the advantages thus achieved can be readily contemplated in advance.

4.2.1 The following list indicates the passages where the features of dependent claims are disclosed or hinted at in documents D1, D2, D4 or D5:

claims 2, 8: D1 slide 11 second left-most bullet and sub-bullets; D4 §§39-40

claims 3, 9: D1 slide 12; D2 slides 17-20; D5 §115

claims 4, 10: D2 slides 17, 19

claims 5, 11: D2 slides 18, 20

claim 6, 12: D1 slide 11 second left-most bullet; D4 §40.

5 Further Objections

5.1 The vague and imprecise statement in the description in the paragraph extending between pages66 and 67 implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in a lack of clarity of the claims (Article 84 EPC) when the description is used to interpret the claims (see Guidelines F-IV, 4.4). This statement should therefore be amended to remove this inconsistency.

5.2 The content on the document referenced page 11 lines 12-16 of the description does not seem essential for carrying out the invention to the examiner. If the applicant disagrees, he shall expressly incorporate the required matter into the

description. The expression referring to this document being included in the detailed description of the present application, shall be removed (see Guidelines F-III, 8).

6 **Procedure**

6.1 The applicant is invited to file new claims which take account of the above comments.

6.2 When filing amended claims the applicant should at the same time **bring the description into conformity with the amended claims**. Care should be taken during revision, especially of the introductory portion and of any statements of problem or advantage, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

The applicant should adapt the description to the claims on file and delete or amend any statements or expressions which throw doubt on the scope of protection (GL F-IV, 4.3). Failure to do so could lead to the refusal of the application under Article 97(2) EPC in combination with Article 84 EPC.

The applicant should amend the description as needed to fulfil the following requirements:

– The technical field of the invention (Rule 42(1)(a), GL F-II.4.2) must correspond to the amended set of claims.
– The summary of the invention (Rule 42(1)(c) and GL F-II.4.5) must correspond to the amended set of claims. If appropriate, statements such as "The invention is set out in the appended set of claims" or "The invention is as defined in claim X" can be applied instead of repeating the claims verbatim.
– All embodiments which are not covered by the claims anymore must be deleted, unless these embodiments can reasonably be considered to be useful for highlighting specific aspects of the amended subject-matter. In such case, they must be prominently marked as not being part of the present invention (T 1808/06).
– Subject-matter in the description being excluded from patentability under Article 53 EPC needs to be excised, reworded such that it does not fall under the exceptions to patentability or prominently marked as not being according to the claimed invention.
– All technical features of the independent claims shall not be presented as optional in the description. Terms such as "for example", "may", "can", "exemplary", "optionally", "preferably" and the like should be removed when preceding a feature of an independent claim (GL F-IV, 4.9).
– Claim-like clauses must be deleted prior to grant. The term "claim-like

clauses" means clauses present in the description which use claim language such as "according to the preceding clause", "characterised in that", ... (GL F-IV, 4.4). These "claim-like clauses" also include examples, embodiments or aspects presented as claim-like clauses. A simple conversion of these clauses into separate optional features will not be admitted, either.

6.3 In order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made, irrespective of whether they concern amendments by addition, replacement or deletion, and indicate the passages of the application as filed on which these amendments are based (see Guidelines H III, 2.1).

If the applicant considers it appropriate, these indications could be submitted in handwritten form on a copy of the relevant parts of the application as filed or in documents with tracked changes.

6.4 Amendments should be made by filing replacement pages. Unnecessary recasting of the description should be avoided. An amended abstract is not required. The applicant should also take account of the requirements of Rule 50(1) EPC. According to Rule 50(1) in conjunction with Rule 49(8) EPC, amendments shall be typed or printed. Handwritten amendments may only be made in documents other than those replacing application documents (Rule 50(2) EPC); they may, for example, be used to fulfil the requirements of Rule 137(4) EPC (identifying amendments and indicating basis for them).

Electronic Patent Application Fee Transmittal

Application Number:	17157978
Filing Date:	25-Jan-2021
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Filer:	Young Seok Koo/Azatuhi Chinaryan
Attorney Docket Number:	B-10005CON1 633016-0

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	260	260
		Total in USD ($)		**260**

Electronic Acknowledgement Receipt	
EFS ID:	47862405
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo
Filer Authorized By:	
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	18-APR-2023
Filing Date:	25-JAN-2021
Time Stamp:	20:47:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$260
RAM confirmation Number	E20234HK48489000
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2023-04-18_633016_IDS.pdf	243135 613a5f46bad5bd0714747f7df3f318de6568117a	yes	4
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Other reference-Patent/Application/ Search Documents	Ref1_JP2021-071867_NOA_2-6-23.pdf	153036 9a75586a91c0df817a30d08d593c85693e85cd3d	no	6
Warnings:					
Information:					
3	Foreign Reference	Ref2_JP2016-533675A.pdf	3960026 74318b2f5269e5ce8d126db5031d8bebb2f4ba74	no	130
Warnings:					
Information:					
4	Other reference-Patent/Application/ Search Documents	Ref4_US17851035_1stOA_2-15-23.pdf	1143912 484dec2b9c72543d28475d37fd5c33cb71df32c8	no	15
Warnings:					
Information:					
5	Other reference-Patent/Application/ Search Documents	Ref6_US17157996_NOA_3-24-23.pdf	585003 b1a1ec05ef493dac04670fb25daf4eb3d587b005	no	6
Warnings:					
Information:					

6	Other reference-Patent/Application/ Search Documents	Ref7_EP178842282_2ndOA_3-16-23.pdf	441004 6c7d4af878404df4981c2dda93b5274b9b9f83fd	no	8
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	38324 67a333934a51aebe143bf4dafea20f8bfa469d11	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	6564440	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.	Examiner: Ton, Dang T
Serial No.: 17/157,978	Art Unit: 2476
Filing Date: January 25, 2021	Conf. No.: 2451
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Our Ref: B-10005CON1 633016-0
Date: April 18, 2023	Re: ***Information Disclosure Statement***

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[ ] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[ ] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

[ ] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

- [ ] accompanied by the fee set forth in § 1.17(p), or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

---

[x] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

- [x] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

[ ] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

Additional Information

[x] Translations of the foreign-language documents are also enclosed as machine-translations, human-translations, or counterpart applications as noted. Machine translations were provided by the Japanese Patent Office, ESPACENET, Google Documents, Patent Fetcher® /ESPACENET, Google Translate or Google Translator Toolkit as noted and with OCR by Adobe Acrobat 9 or ABBYY PDF Transformer 3 if needed.

[x] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and September 24, 2022 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

April 18, 2023
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
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(323) 934-2300 voice

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

158747 7590 01/19/2023

LADAS & PARRY
E-MAIL
4525 WILSHIRE BOULEVARD
SUITE 240
LOS ANGELES, CA 90010

EXAMINER
TON, DANG T

ART UNIT	PAPER NUMBER
2476	

DATE MAILED: 01/19/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,978	01/25/2021	Woojin AHN	B-10005CON1 633016-0	2451

TITLE OF INVENTION: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/19/2023

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

158747 7590 01/19/2023
LADAS & PARRY
E-MAIL
4525 WILSHIRE BOULEVARD
SUITE 240
LOS ANGELES, CA 90010

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,978	01/25/2021	Woojin AHN	B-10005CON1 633016-0	2451

TITLE OF INVENTION: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	04/19/2023

EXAMINER	ART UNIT	CLASS-SUBCLASS
TON, DANG T	2476	370-329000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,978	01/25/2021	Woojin AHN	B-10005CON1 633016-0	2451

158747 7590 01/19/2023

LADAS & PARRY
E-MAIL
4525 WILSHIRE BOULEVARD
SUITE 240
LOS ANGELES, CA 90010

EXAMINER	
TON, DANG T	

ART UNIT	PAPER NUMBER
2476	

DATE MAILED: 01/19/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	**Application No.** 17/157,978	**Applicant(s)** AHN et al.	
	Examiner DANG T TON	**Art Unit** 2476	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to Amendment of 11/25/2022.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 17-30 (Renumbered 1-14, respectively) . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☑ All b) ☐ Some* c) ☐ None of the:

   1. ☑ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/DANG T TON/
Primary Examiner, Art Unit 2476

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
	Examiner	**Art Unit**
	DANG T TON	2476

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	07/18/2022	11/28/2022							
	1	-	-							
	2	-	-							
	3	-	-							
	4	-	-							
	5	-	-							
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	11	-	-							
	12	-	-							
	13	-	-							
	14	-	-							
	15	-	-							
	16	-	-							
1	17	v	=							
2	18	v	=							
3	19	v	=							
4	20	v	=							
5	21	v	=							
6	22	v	=							
7	23	v	=							
8	24	v	=							
9	25	v	=							
10	26	v	=							
11	27	v	=							
12	28	v	=							
13	29	v	=							
14	30	v	=							

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
	Examiner	**Art Unit**
	DANG T TON	2476

CPC							
Symbol						**Type**	**Version**
H04L	/	1	/	0008		F	2013-01-01
H04L	/	1	/	1614		I	2013-01-01
H04L	/	1	/	1621		I	2013-01-01
H04W	/	72	/	0446		I	2013-01-01
H04W	/	72	/	1231		I	2013-01-01
H04W	/	80	/	02		I	2013-01-01

CPC Combination Sets								
Symbol						**Type**	**Set**	**Ranking**	**Version**
	/		/						

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	14	
/DANG T TON/ Primary Examiner, Art Unit 2476	28 November 2022	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	19

U.S. Patent and Trademark Office — Part of Paper No.: 20221128

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
	Examiner	**Art Unit**
	DANG T TON	2476

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	12	/	28

NON-CLAIMED				
H04L	/	12	/	28

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
370	329

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 14	
/DANG T TON/ Primary Examiner, Art Unit 2476 (Primary Examiner)	28 November 2022 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 19

U.S. Patent and Trademark Office — Part of Paper No.: 20221128

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
	Examiner	**Art Unit**
	DANG T TON	2476

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	3	19	12	28								
	2		11	4	20	13	29								
	3		12	5	21	14	30								
	4		13	6	22										
	5		14	7	23										
	6		15	8	24										
	7		16	9	25										
	8	1	17	10	26										
	9	2	18	11	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	14	
/DANG T TON/ Primary Examiner, Art Unit 2476	28 November 2022	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	19

U.S. Patent and Trademark Office — Part of Paper No.: 20221128

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
	Examiner	Art Unit
	DANG T TON	2476

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04L 12/28, H04L 12/50, H04L 1/0008, H04W 80/02, H04W 72/0446	07/18/2022	td

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
PE2E		07/18/2022	td
NPL		07/18/2022	td
IP.com		07/18/2022	td
Inventor searched		07/18/2022	td
CPC		07/18/2022	td
Updated		11/28/2022	td

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
370/329	07/18/2022	td

/DANG T TON/ Primary Examiner, Art Unit 2476	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
	Examiner	Art Unit
	DANG T TON	2476

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
370	329	07/18/2022	td

/DANG T TON/ Primary Examiner, Art Unit 2476	

December 22, 2022

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated September 29, 2022 for Korean Patent Application No. 10-2022-7027751 and its English translation provided by Applicant's foreign counsel.
	2.	Office Action dated December 15, 2022 for U.S. Patent Application No. 17/157,996.

EXAMINER	*DATE CONSIDERED*
/DANG T TON/	12/27/2022

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T.T/

September 23, 2022

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	1.	2016/167608	Oct. 20, 2016	WO			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	2.	Notice of Allowance dated June 29, 2022 for Chinese Patent Application No. 201780079155.0 and its English translation provided by Applicant's foreign counsel.
	3.	Office Action dated July 4, 2022 for Japanese Patent Application No. 2021-071867 and its English translation provided by Applicant's foreign counsel.
	4.	Liwen Chu: "HE Variant HT Control – A-MPDU Content", Wireless LANs, IEEE 802.11-16/1186r1, September 12, 2016, pp. 1-7.
	5.	Extended European Search Report dated July 5, 2022 for European Patent Application No. 22166225.7.
	6.	Yongho Seok et al.: "HE MU Acknowledgement Procedure", IEEE 802.11-15/1278r1, Piscataway, NJ, USA, November 10, 2015, Slides 1-13.
	7.	Notice of Allowance dated August 3, 2022 for Chinese Patent Application No. 201780041848.0 and its English translation provided by Applicant's foreign counsel.
	8.	Office Action dated August 30, 2022 for U.S. Patent Application No. 17/157,996.

EXAMINER	*DATE CONSIDERED*
/DANG T TON/	11/28/2022

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T.T/

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated September 29, 2022 for Korean Patent Application No. 10-2022-7027751 and its English translation provided by Applicant's foreign counsel.
	2.	Office Action dated December 15, 2022 for U.S. Patent Application No. 17/157,996.

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	47265500
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	22-DEC-2022
Filing Date:	25-JAN-2021
Time Stamp:	20:23:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2022-12-22_633016_IDS.pdf	240671 d9e3f4b0a8d9179bed00a5df5e52b321584ea225	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Other reference-Patent/Application/ Search Documents	Ref1_KR10-2022-7027751_1stOA_9-22-22.pdf	209381 a35bf54d0fbc213b4151cb976ccf2fcc07d879d6	no	6
Warnings:					
Information:					
3	Other reference-Patent/Application/ Search Documents	Ref2_US17157996_OA_12-15-22.pdf	536264 e67aea5a6028d70e63f95af9c317dbf3bc92acde	no	9
Warnings:					
Information:					
		Total Files Size (in bytes):	986316		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Ton, Dang T
Serial No.: 17/157,978	Art Unit: 2476
Filing Date: January 25, 2021	Conf. No.: 2451
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Our Ref: B-10005CON1 633016-0
Date: December 22, 2022	Re: ***Information Disclosure Statement***

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[ ] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[ ] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

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[x] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

- [ ] accompanied by the fee set forth in § 1.17(p), or
- [x] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

[ ] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

Additional Information

[x] Translations of the foreign-language documents are also enclosed as machine-translations, human-translations, or counterpart applications as noted. Machine translations were provided by the Japanese Patent Office, ESPACENET, Google Documents, Patent Fetcher® /ESPACENET, Google Translate or Google Translator Toolkit as noted and with OCR by Adobe Acrobat 9 or ABBYY PDF Transformer 3 if needed.

[ ] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

December 22, 2022
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor:	Woojin AHN	Examiner:	Ton, Dang T
Application No.:	17/157,978	Confirmation No.:	2451
Filing Date:	January 25, 2021	Group Art Unit:	2476
Title: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME		Attorney Docket:	B-10005CON1 633016-0
		Date:	November 25, 2022
		Re:	**Response to Non-Final Office Action of August 25, 2022**

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

RESPONSE TO OFFICE ACTION

Sir:

This paper is timely submitted in response to the non-Final Office Action mailed on August 25, 2022 for the subject application. Please amend the application as follows and consider the Remarks/Arguments set forth below.

Amendments to the Claims begin on page 2 of this paper.

Remarks/Arguments begin on page 6 of this paper.

All Amendments and Remarks/Arguments are made without prejudice or disclaimer.

AMENDMENTS TO THE CLAIMS

Please amend the claims to read as indicated in the following list of claims:

Listing of claims

1-16. (Canceled).

17. (Currently Amended) A wireless communication terminal, the terminal comprising:

a processor; and

a communication unit,

wherein the processor is configured to:

receive a PPDU(physical layer protocol data unit) including an A-MPDU (Aggregate-MAC Protocol Data Unit) in which one or more MPDUs (MAC Protocol Data Units) are aggregated,

wherein the A-MPDU includes Ack policy information related to a block Ack for the one[[s]] or more MPDUs, and one or more subframes,

wherein each of the one or more subframes includes MPDU identifier information and an MPDU of the one or more MPDUs, and

wherein the MPDU identifier information includes an end of frame (EOF) field and a length field, and

transmit a response frame in response to the PPDU,

wherein a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and

wherein the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs).

18. (Currently Amended) The wireless communication terminal of claim 17,

wherein the A-MPDU further includes the one or more TIDs ~~(traffic IDs)~~ corresponding to the one or more MPDUs.

19. (Previously Presented) The wireless communication terminal of claim 18,

wherein the type of the response frame is determined by further considering a number of TIDs indicating an immediate response among the one or more TIDs.

20. (Currently Amended) The wireless communication terminal of claim 19,

wherein the type of the response frame is [[~~an~~]] the Ack frame when the A-MPDU includes only one TID indicating the immediate response and the Ack policy information indicates a normal Ack.

21. (Currently Amended) The wireless communication terminal of claim 19,

wherein the type of the response frame is [[~~a~~]] the compressed BlockAck frame when a number of the TIDs indicating the immediate response is one or more and the one or more TIDs are the same.

22. (Previously Presented) The wireless communication terminal of claim 19,

wherein the MPDU delimiter information is first MPDU delimiter information in which a value of the EOF field is 1 and a value of the length field is non-zero, or second MPDU delimiter information in which the EOF field value is 0.

23. (Previously Presented) The wireless communication terminal of claim 22,

wherein the type of the response frame is determined by further considering whether the A-MPDU includes a subframe including the first MPDU delimiter information, and whether the A-MPDU includes at least one subframe including the second MPDU identifier information.

24. (Currently Amended) A wireless communication method of a wireless communication terminal, the method comprising:

receiving a PPDU(physical layer protocol data unit) including an A-MPDU (Aggregate-MAC Protocol Data Unit) in which one or more MPDUs (MAC Protocol Data Units) are aggregated,

wherein the A-MPDU includes Ack policy information related to a block Ack for the one[[~~s~~]] or more MPDUs, and one or more subframes,

wherein each of the one or more subframes includes MPDU identifier information and an MPDU of the one or more MPDUs, and

wherein the MPDU identifier information includes an end of frame (EOF) field and a length field; and

transmitting a response frame in response to the PPDU,

wherein a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and

wherein the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs).

25. (Currently Amended) The wireless communication method of claim 24,

wherein the A-MPDU further includes the one or more TIDs ~~(traffic IDs)~~ corresponding to the one or more MPDUs.

26. (Previously Presented) The wireless communication method of claim 25,

wherein the type of the response frame is determined by further considering a number of TIDs indicating an immediate response among the one or more TIDs.

27. (Currently Amended) The wireless communication method of claim 26,

wherein the type of the response frame is [[~~an~~]] the Ack frame when the A-MPDU includes only one TID indicating the immediate response and the Ack policy information indicates a normal Ack.

28. (Currently Amended) The wireless communication method of claim 26,

wherein the type of the response frame is [[~~a~~]] the compressed BlockAck frame when a number of the TIDs indicating the immediate response is one or more and the one or more TIDs are the same.

29. (Previously Presented) The wireless communication method of claim 24,

wherein the MPDU delimiter information is first MPDU delimiter information in which a value of the EOF field is 1 and a value of the length field is non-zero, or second MPDU delimiter information in which the EOF field value is 0.

30. (Previously Presented) The wireless communication method of claim 29,

wherein the type of the response frame is determined by further considering whether the A-MPDU includes a subframe including the first MPDU delimiter information, and whether the A-MPDU includes at least one subframe including the second MPDU identifier information.

REMARKS/ARGUMENTS

The following Remarks/Arguments are in response to the non-Final Office Action mailed on August 25, 2022 (hereinafter "Office Action") for the subject application. Pending in the application are claims 17-30.

In the Office Action, claims 17-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claims 17-32 of copending Application No. 17/157,996. Claims 17-30 stand rejected under 35 U.S.C. §103 as allegedly being obvious over "Multi-TID A-MPDU in MU Transmission", Marvel et. al., JEEE 802.11-16/0069r0, Jan. 18, 2016 (hereinafter "Marvel") in view of "Block Ack generation and May 17, 2016 selection rules", Qualcomm, IEEE 802.11-16/0616r2 (hereinafter "Qualcomm").

In this response, claims 17, 18, 20, 21, 24, 25, 27 and 29 are amended. No new matter is presented as a result of these amendments. No claim is added or canceled. Claims 1-16 were previously canceled. Accordingly, the claims pending in this application after entry of this response are claims 17-30.

For at least the following reasons, this application should be considered in condition for allowance and passed to issuance.

Double Patenting

In the Office Action, claims 17-30 stand provisionally rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claims 17-32 of copending Application No. 17/157,996 (See Office Action: item 3 at page 3). Although the Applicant respectfully questions the position taken by the Examiner, solely to expedite the prosecution of the present application and allowance of the claims, claim 17 is amended to recite "*a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and wherein the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs)*" and claim 24 is amended to recite "*a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame*

according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and wherein the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs)" (emphasis added). Accordingly, the Applicant respectfully requests reconsideration and withdrawal of the double patenting rejections of claims 17-30.

Claim Rejections – 35 U.S.C. §103

In the Office Action, claims 17-30 stand rejected under 35 U.S.C. §103 as allegedly being obvious over Marvel in view of Qualcomm (See Office Action: item 5 at page 7). These rejections are hereby traversed, and reconsideration and withdrawal are respectfully requested.

Claim 17

Claim 17 recites:

A wireless communication terminal, the terminal comprising:
a processor; and
a communication unit,
wherein the processor is configured to:
receive a PPDU(physical layer protocol data unit) including an A-MPDU (Aggregate-MAC Protocol Data Unit) in which one or more MPDUs (MAC Protocol Data Units) are aggregated,
wherein the A-MPDU includes Ack policy information related to a block Ack for the one or more MPDUs, and one or more subframes,
wherein each of the one or more subframes includes MPDU identifier information and an MPDU of the one or more MPDUs, and
wherein the MPDU identifier information includes an end of frame (EOF) field and a length field, and
transmit a response frame in response to the PPDU,
wherein a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and
wherein the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs).

Although the Applicant respectfully disagrees with the Examiner, solely to expedite prosecution of the present application and allowance of the claims, claim 17 is amended to recite "*a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and wherein the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs)*" (emphasis added).

Neither Marvel nor Qualcomm discloses, teaches or suggests that "*a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and wherein the compressed BlockAck frame is used to transmit a response to the* ***one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs)***" as recited claim 17 (emphasis added).

In the Office Action, the Examiner acknowledges that "Marvel … discloses all the subject matter of the claimed invention with the **exception** of wherein a type of the response frame is determined according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information" (Office Action: page 9; emphasis added). Therefore, Marvel fails to disclose, teach or suggest that "*a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and wherein the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to one TID, when the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs)*" as recited in claim 17.

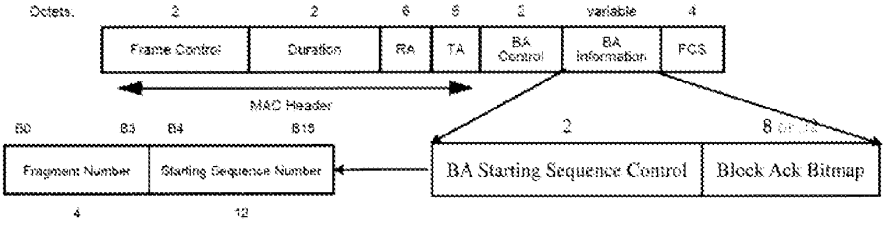
The Office Action, instead, contends that:

> Qualcomm … discloses a block Ack generation and selection rules and specifically the following technical feature (see pages 17-20 of PPT): Action Ack frames do not have an Ack Policy field to differentiate between SU and MU (preferred) I.e., by default the response to DL Multi-TID A-MPDU frames containing this MPDU is in MU mode. The number of TIDs carried in multi-TID A-MPDU cannot exceed the # of TIDs specified by RX and the format of the response frame for the A-MPDU is also determined based on the number of TIDs soliciting an immediate response in MPDU(s) successfully received in the A-MPDU (see pages 17-20 of PPT). Thus, it would have been obvious to the person of ordinary skill in the art before the effective filling date of the invention to use wherein a type of the response frame is determined according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information as taught by ("Block Ack generation and selection rules", Qualcomm, JEFF 802. 11-16/0616r2. May 17, 2016) in the communication of ("Multi-TID A-MPDU in MU Transmission", Marvel et. al., JEEE 802.11-16/0069r0, Jan. 18, 2016) for the purpose of providing acknowledge response.

(Office Action: page 10). Slides 10 and 18 of Qualcomm teach that:

May 2016 **doc.: IEEE 802.11-16/0616r2**

Compressed BlockAck frame



- **According to REVmc D5.0 and 11ax D0.1:**
  - Fragment Number is 0 in C-BlockAck frame
    - Fragment Number equal to 1 indicates re-mapping of BA Bitmap for fragmentation level 3 [3]
- **[1] proposed a variant of C-BA frame with 256-bits BA Bitmap field**
  - Reserved bit(s) in Fragment Number field of the frame indicates length of the BA Bitmap
- **We propose this mapping of the Fragment Number subfield**
  - B0 of Fragment Number is 1 to indicate that re-mapping of BA Bitmap for Fragmentation level 3 is ON [3]
  - B2 and B1 of Fragment Number indicate the length of the BA Bitmap field for C-BA frame
    - Only two values are defined in this case: 8 or 32 Bytes, as defined in [1]
  - B3 is reserved
- **Same signaling applies to M-BA frames as well, with more options for Bitmap length [2]**
  - See next slide for more details

Submission Slide 10 A. Asterjadhi, et. al

2) DL MU PPDU | SIFS | UL MU response

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ONE (AP)	(A-) MPDU	No Ack or BlockAck (ALL)	No Response	N/A
ONE	VHT Single MPDU	MU Ack** [>0]	Ack frame	UL MU PPDU*
ONE	A-MPDU	MU Ack [>0]	C-BA frame	UL MU PPDU*
ONE	Multi-TID A-MPDU***	MU Ack [>0]	M-BA frame	UL MU PPDU*

*STAs cannot solicit response from AP to an UL MU PPDU if Trigger info in DL MU PPDU was not Basic or was UL MU Response Sched.
*STAs can solicit a response from the AP to the UL MU PPDU if the Trigger carried in the DL MU PPDU was a Basic Trigger.
**MU Ack is signaled by a value of PSMP Ack value of the Ack Policy.

- **Further considerations for the soliciting DL MU PPDU:**
  - An A-MPDU under these conditions*** may contain an Action Ack frame
    - Action Ack frames do not have an Ack Policy field to differentiate between SU and MU (preferred)
      - I.e., by default the response to DL Multi-TID A-MPDU frames containing this MPDU is in MU mode
  - The # of TIDs carried in multi-TID A-MPDU cannot exceed the # of TIDs specified by RX [4]
- **Recipient can only respond to the DL MU PPDU if its allocated RU contained:**
  - Either one/more Trigger frames or one/more HE variant HT Control fields with UL MU Response Scheduling but not both

Submission Slide 18 A. Asterjadhi, et. al

However, the Applicant notes that slide 10 of Qualcomm simply discloses the **formats** of the Compressed BlockAck frame, and slide 18 of Qualcomm teaches that the C-BA frame is transmitted when the content of A-MPDU carried in the DL MU PPDU is A-MPDU. However, the Applicant cannot find in Qualcomm any disclosure, teaching or suggestion that "*the compressed BlockAck frame is used to transmit a response to the one or more MPDUs corresponding to **one TID**, when the one or more MPDUs correspond to the **one TID** among an one or more TIDs(traffic IDs)*" as recited claim 17 (emphasis added). Accordingly, Qualcomm does not cure the deficiency of Marvel with respect to the limitation of claim 17 that "*a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and wherein the compressed BlockAck frame is used to transmit a response to the **one or more MPDUs corresponding to one TID**, when **the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs)***" (emphasis added).

Hence, Marvel and Qualcomm, individually or in combination, do not disclose, teach or suggest that "*a type of the response frame is determined as one of an Ack frame, a compressed BlockAck frame, and a multi-STA BlockAck frame according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information, and wherein the compressed BlockAck frame is used to transmit a response to the* ***one or more MPDUs corresponding to one TID****, when* ***the one or more MPDUs correspond to the one TID among an one or more TIDs(traffic IDs)***" as recited in claim 17 (emphasis added).

For at least the foregoing reasons, the Applicant submits that claim 17 is not obvious over Marvel in view of Qualcomm, and requests reconsideration and withdrawal of the §103 rejection of claim 17.

Claim 24

The Applicant respectfully submits that arguments similar to the arguments set forth for claim 17 can be used, *mutatis mutandis*, to show that claim 24 is not obvious over Marvel in view of Qualcomm, and requests reconsideration and withdrawal of the §103 rejection of claim 24.

Claims 18-23 and 25-30

"If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious." *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). As discussed above, claims 17 and 24 are not obvious over Marvel in view of Qualcomm. Therefore, the Applicant respectfully submits that claims 18-23 and 25-30 are not obvious over Marvel in view of Qualcomm at least by way of their dependencies from claim 17 or 24, and requests reconsideration and withdrawal of the §103 rejections of claims 18-23 and 25-30.

CONCLUSION

It is believed that all of the grounds of rejection have been properly traversed, accommodated, or rendered moot. The Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (323) 934-2300.

The Commissioner is authorized to charge any additional fees which may be required or credit overpayment to deposit account no. 12-0415. In particular, if this response is not timely filed, then the Commissioner is authorized to treat this response as including a petition to extend the time period pursuant to 37 CFR 1.136 (a) requesting an extension of time of the number of months necessary to make this response timely filed and the petition fee due in connection therewith may be charged to deposit account no. 12-0415.

I hereby certify that this document is being transmitted electronically to the United States Patent and Trademark Office via electronic filing.

November 25, 2022
(Date of Transmission)

Young Seok Koo
(Name of Person Transmitting)

/ Young Seok Koo /
(Signature)

Respectfully submitted,

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Electronic Acknowledgement Receipt

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Application Number:	17157978
International Application Number:	
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Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Response633016_US.pdf	787043 72f5e9dea8316356fde52949b328e78aeb622cbf	yes	12

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Request for Reconsideration-After Non-Final Rejection	1	1
	Claims	2	5
	Applicant Arguments/Remarks Made in an Amendment	6	12
Warnings:			
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National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
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EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	1.	2016/167608	Oct. 20, 2016	WO			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	2.	Notice of Allowance dated June 29, 2022 for Chinese Patent Application No. 201780079155.0 and its English translation provided by Applicant's foreign counsel.
	3.	Office Action dated July 4, 2022 for Japanese Patent Application No. 2021-071867 and its English translation provided by Applicant's foreign counsel.
	4.	Liwen Chu: "HE Variant HT Control – A-MPDU Content", Wireless LANs, IEEE 802.11-16/1186r1, September 12, 2016, pp. 1-7.
	5.	Extended European Search Report dated July 5, 2022 for European Patent Application No. 22166225.7.
	6.	Yongho Seok et al.: "HE MU Acknowledgement Procedure", IEEE 802.11-15/1278r1, Piscataway, NJ, USA, November 10, 2015, Slides 1-13.
	7.	Notice of Allowance dated August 3, 2022 for Chinese Patent Application No. 201780041848.0 and its English translation provided by Applicant's foreign counsel.
	8.	Office Action dated August 30, 2022 for U.S. Patent Application No. 17/157,996.

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

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CHANNEL SOUNDING METHOD IN WIRELESS COMMUNICATION SYSTEM, AND APPARATUS THEREFOR

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Applicant(s): LG ELECTRONICS INC [KR] ± (엘지전자(주))

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Application number: WO2016KR03963 20160415 Global Dossier

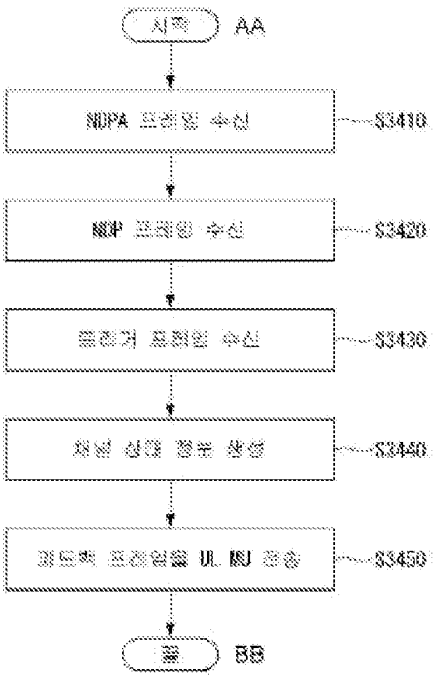
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Abstract of WO2016167608 (A1)

A sounding method of a station (STA) for transmitting feedback information on a downlink (DL) channel state in a wireless LAN (WLAN) system, according to one embodiment of the present invention, comprises the steps of: receiving an NDP announcement (NDPA) frame notifying the transmission of a null data packet (NDP); receiving the NDP frame; receiving a trigger frame including resource allocation information assigned to the STA; generating channel state information on the basis of a training field included in the NDP frame; and performing uplink (UL) multi-user (MU)

transmission of a feedback frame including the channel state information by using a frequency resource which the resource allocation information indicates.



S3410 ... Receive NDPA frame
S3420 ... Receive NDP frame
S3430 ... Receive trigger frame
S3440 ... Generate channel state information
S3450 ... Perform UL MU transmission of feedback frame
AA ... Start
BB ... End

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CLAIMS WO2016167608A1

1.

A sounding method of a station (STA) for transmitting feedback information about a downlink (DL) channel state in a wireless LAN (WLAN) system, the sounding method comprising:

receiving an NDP announcement (NDPA) frame indicating transmission of a null data packet (NDP) frame;

receiving the NDP frame;

receiving a trigger frame including resource allocation information allocated to the STA;

generating channel state information based on a training field included in the NDP frame; and

Transmitting the feedback frame including the channel state information using a frequency resource indicated by the resource allocation information uplink (UL: Uplink) multi-user (MU: Multi-User); Including, a sounding method of the STA device.

2.

The method of claim 1,

The NDPA frame, the NDP frame, and the trigger frame are received by being included in one DL PPDU or received by being included in different DL PPDUs, respectively.

3.

The method of claim 1,

When the NDPA frame, the NDP frame, and the trigger frame are respectively included in the different DL PPPDUs and received,

The different DL PPDUs are received by the STA at an SIFS (Short Interframe Space) interval.

4.

The method of claim 1,

The resource allocation information indicates the number of resource units allocated to the STA for UL MU transmission of the feedback frame.

5.

The method of claim 4,

The resource unit is a 26-tone resource unit composed of 26 sub-carriers.

6.

5. The method of claim 4,

The bit value of the resource allocation information indicates the number of resource units allocated to the STA.

7.

5. The method of claim 4,

The resource allocation information includes a plurality of bits sequentially corresponding to resource units allocated for UL MU transmission of the feedback frame,

The bit value of each of the plurality of bits is switched to a bit value different from the bit value of the previous bit as the STA to which the resource unit corresponding to each bit is allocated is changed to another STA.

8.

5. The method of claim 4,

When different indices are allocated to resource units allocated for UL MU transmission of the feedback frame, respectively,

The resource allocation information includes index information of a resource unit allocated to the STA.

9.

The method of claim 1,

The channel state information includes a feedback value generated in units of a predetermined frequency for a spatial stream,

The feedback value is a signal to noise ratio (SNR) or a beamforming feedback matrix of the preset frequency unit for the spatial stream.

10.

The method of claim 9,

The preset frequency unit is an entire transmission channel of a DL PPDU carrying the NDP frame.

11.

10. The method of claim 9,

The preset frequency unit is a 26-tone resource unit or a 20 MHz channel.

12.

The method of claim 1,

The NDPA frame includes indication information of a frequency band to be measured by the STA.

13.

The method of claim 12,

The generating of the channel state information comprises:

generating the channel state information for the frequency band indicated by the indication information.

14.

The method of claim 1,

Measuring the channel state is a step of generating the channel state information for a frequency band of a predetermined size,

The predetermined size is equal to or smaller than a size of a frequency band used for transmitting the NDP frame.

15.

The method of claim 14,

The generated channel state information is beamforming feedback matrix information for the frequency band of the predetermined size.

16.

The method of claim 1,

The training field of the NDP frame is a High Efficiency-Long Training Field (HE-LTF).

17.

In a STA (Station) device in a WLAN (Wireless LAN) system,

RF unit for transmitting and receiving radio signals; and

a processor for controlling the RF unit; including,

The processor is

Receive an NDPA (NDP announcement) frame indicating transmission of a null data packet (NDP) frame,

receiving the NDP frame;

Receiving a trigger frame including resource allocation information allocated to the STA,

generating channel state information based on the training field included in the NDP frame; and

An STA device for transmitting a feedback frame including the channel state information by using a frequency resource indicated by the resource allocation information for uplink (UL: uplink) multi-user (MU: multi-user) transmission.

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DESCRIPTION WO2016167608A1

Channel sounding method and apparatus therefor in wireless communication system The present invention relates to a wireless communication system, and more particularly, to a channel sounding method for uplink multi-user transmission of a channel state measured by an STA, and an apparatus supporting the same.

Wi-Fi is a wireless local area network (WLAN) technology that enables a device to access the Internet in a frequency band of 2.4 GHz, 5 GHz, or 60 GHz.

WLAN is based on the Institute of Electrical and Electronic Engineers (IEEE) 802.11 standard. The Wireless Next Generation Standing Committee (WNG SC) of IEEE 802.11 is an ad-hoc committee that considers a next-generation wireless local area network (WLAN) in the medium to long term.

IEEE 802.11n aims to increase the speed and reliability of the network and extend the operating distance of the wireless network. More specifically, IEEE 802.11n supports High Throughput (HT) that provides a data rate of up to 600 Mbps. It is based on Multiple Inputs and Multiple Outputs (MIMO) technology using multiple antennas.

As the spread of WLAN is activated and applications using it are diversified, the next-generation WLAN system supporting very high throughput (VHT) is the next version of the IEEE 802.11n WLAN system, and IEEE 802.11ac is newly enacted. IEEE 802.11ac supports data processing rates of 1 Gbps or more through 80 MHz bandwidth transmission and/or higher bandwidth transmission (eg, 160 MHz), and operates mainly in the 5 GHz band.

Recently, there is a need for a new WLAN system to support a higher throughput than the data processing rate supported by IEEE 802.11ac.

The scope of IEEE 802.11ax, which is mainly discussed in the next-generation WLAN task group, also called IEEE 802.11ax or High Efficiency (HEW) WLAN, is 1) 802.11 PHY (physical) layer and MAC in bands such as 2.4 GHz and 5 GHz. (medium access control) layer improvement, 2) spectrum efficiency and area throughput improvement, 3) interference source environment, dense heterogeneous network environment, and high user load. environments, such as improving performance in real indoor environments and outdoor environments.

A scenario mainly considered in IEEE 802.11ax is a dense environment with many access points (APs) and stations (STAs), and IEEE 802.11ax discusses improvement of spectrum efficiency and area throughput in this situation. . In particular, there is an interest in actual performance improvement in an indoor environment as well as an outdoor environment, which has not been considered much in the existing WLAN.

IEEE 802.11ax is interested in scenarios such as wireless office, smart home, stadium, hotspot, and building/apartment. Discussion is being conducted on system performance improvement in a dense environment with many STAs.

In the future, IEEE 802.11ax will focus on system performance improvement and outdoor environment performance improvement in an overlapping basic service set (OBSS) environment rather than single link performance improvement in one basic service set (BSS), and cellular offloading. The discussion is expected to be lively. This direction of IEEE 802.11ax means that next-generation WLAN will have a technology range similar to that of mobile communication. Considering the recent

discussion of mobile communication and WLAN technology in the small cell and direct-to-direct (D2D) communication areas, the technical and business aspects of next-generation WLAN and mobile communication based on IEEE 802.11ax Convergence is expected to become more active.

An object of the present invention is to propose a new sounding protocol applicable to a next-generation wireless communication system, and to propose a HE (High Efficiency) format of frames transmitted and received for the sounding protocol.

Another object of the present invention is to propose an efficient method for uplink multi-user transmission of channel state information measured by STAs in a next-generation wireless communication system.

The technical problems to be achieved in the present invention are not limited to the technical problems mentioned above, and other technical problems not mentioned will be clearly understood by those of ordinary skill in the art to which the present invention belongs from the description below. will be able

In order to solve the above technical problem, in a sounding method of a station (STA) for transmitting feedback information about a downlink (DL) channel state in a wireless LAN (WLAN) system, a null data packet (NDP) receiving an NDPA (NDP announcement) frame announcing transmission of the frame; receiving the NDP frame; receiving a trigger frame including resource allocation information allocated to the STA; generating channel state information based on a training field included in the NDP frame; and Uplink (UL) multi-user (MU: Multi-User) transmitting the feedback frame including the channel state information using a frequency resource indicated by the resource allocation information. may include

Also, the NDPA frame, the NDP frame, and the trigger frame may be received while being included in one DL PPDU or may be received while being included in different DL PPDUs, respectively.

In addition, when the NDPA frame, the NDP frame, and the trigger frame are respectively included in the different DL PPPDUs and received, the different DL PPDUs may be received by the STA at an SIFS (Short Interframe Space) interval.

Also, the resource allocation information may indicate the number of resource units allocated to the STA for UL MU transmission of the feedback frame.

In addition, the resource unit may be a 26-ton resource unit consisting of 26 sub-carriers.

In addition, the bit value of the resource allocation information may indicate the number of resource units allocated to the STA.

In addition, the resource allocation information includes a plurality of bits sequentially corresponding to resource units allocated for UL MU transmission of the feedback frame, and a bit value of each of the plurality of bits is a resource corresponding to each bit. As the STA to which the unit is allocated is changed to another STA, it may be switched to a bit value different from the bit value of the previous bit.

In addition, when different indexes are allocated to resource units allocated for UL MU transmission of the feedback frame, the resource allocation information may include index information of resource units allocated to the STA.

In addition, the channel state information includes a feedback value generated in units of a preset frequency for the spatial stream, and the feedback value is a signal to noise ratio (SNR) or beamforming feedback in units of the preset frequency for the spatial stream. It can be a matrix.

Also, the preset frequency unit may be an entire transmission channel of a DL PPDU carrying the NDP frame.

In addition, the preset frequency unit may be a 26-tone resource unit or a 20 MHz channel.

In addition, the NDPA frame may include indication information of a frequency band to be measured by the STA.

Also, the generating of the channel state information may include generating the channel state information for the frequency band indicated by the indication information.

In addition, the step of measuring the channel state is a step of generating the channel state information for a frequency band of a predetermined size, and the predetermined size is equal to or equal to the size of a frequency band used for transmitting the NDP frame. can be small

Also, the generated channel state information may be beamforming feedback matrix information for the frequency band of the predetermined size.

Also, the training field of the NDP frame may be a High Efficiency-Long Training Field (HE-LTF).

In addition, in a STA (Station) device in a WLAN (Wireless LAN) system according to another embodiment of the present invention, the RF unit for transmitting and receiving a wireless signal; and a processor for controlling the RF unit; , wherein the processor receives an NDPA (NDP announcement) frame indicating transmission of a null data packet (NDP) frame, receives the NDP frame, and generates a trigger frame including resource allocation information allocated to the STA. Receive, generate channel state information based on a training field included in the NDP frame, and transmit a feedback frame including the channel state information to an uplink (UL) using a frequency resource indicated by the resource allocation information.) multi-user (MU: Multi-User) can be transmitted.

In addition, other effects of the present invention will be further described in the following embodiments.

According to an embodiment of the present invention, a sounding protocol that can be efficiently applied in a next-generation WLAN system to which OFDMA technology is applied is proposed.

In addition, according to an embodiment of the present invention, since the AP transmits trigger information for UL MU feedback frame transmission of STAs, each STA is capable of UL MU transmission of the feedback frame.

In addition, according to an embodiment of the present invention, since the STAs can UL MU transmit a feedback frame for the DL channel, the AP can more quickly obtain the channel state information for the DL channel.

In addition, other effects of the present invention will be further described in the following embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS The accompanying drawings, which are included as a part of the detailed description to facilitate the understanding of the present invention, provide embodiments of the present invention, and together with the detailed description, explain the technical features of the present invention.

1 is a diagram illustrating an example of an IEEE 802.11 system to which the present invention can be applied.

2 is a diagram illustrating a structure of a layer architecture of an IEEE 802.11 system to which the present invention can be applied.

3 illustrates a non-HT format PPDU and an HT format PPDU of a wireless communication system to which the present invention can be applied.

4 illustrates a VHT format PPDU format of a wireless communication system to which the present invention can be applied.

5 illustrates a MAC frame format of an IEEE 802.11 system to which the present invention can be applied.

6 is a diagram illustrating a frame control field in a MAC frame in a wireless communication system to which the present invention can be applied.

7 is a diagram conceptually illustrating a channel sounding method in a wireless communication system to which the present invention can be applied.

8 is a diagram illustrating a VHT NDPA frame in a wireless communication system to which the present invention can be applied.

9 is a diagram illustrating an NDP PPDU in a wireless communication system to which the present invention can be applied.

10 is a diagram illustrating a VHT compressed beamforming (VHT compressed beamforming) frame format in a wireless communication system to which the present invention can be applied.

11 is a diagram illustrating a beamforming report poll frame format in a wireless communication system to which the present invention can be applied.

12 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

13 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

14 is a diagram illustrating a downlink MU-MIMO transmission process in a wireless communication system to which the present invention can be applied.

15 is a diagram illustrating an ACK frame in a wireless communication system to which the present invention can be applied.

16 is a diagram illustrating a block ACK request frame in a wireless communication system to which the present invention can be applied.

17 is a diagram illustrating a BAR information field of a block ACK request frame in a wireless communication system to which the present invention can be applied.

18 is a diagram illustrating a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

19 is a diagram illustrating a BA Information field of a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

20 is a diagram illustrating a High Efficiency (HE) format PPDU according to an embodiment of the present invention.

21 to 23 are diagrams illustrating HE format PPDUs according to an embodiment of the present invention.

24 is a diagram illustrating an uplink multi-user transmission procedure according to an embodiment of the present invention.

25 to 27 are diagrams illustrating resource allocation units in an OFDMA multi-user transmission scheme according to an embodiment of the present invention.

28 is a diagram illustrating a sounding protocol according to an embodiment of the present invention.

29 is a diagram illustrating a sounding protocol according to the first embodiment of the present invention.

30 is a diagram illustrating a sounding protocol according to the second and third embodiments of the present invention.

31 is a diagram illustrating information respectively included in an NDPA frame, an NDP frame, and a trigger frame according to an embodiment of the present invention.

32 illustrates a DL PPDU format transmitted and received in a sounding protocol according to a third embodiment of the present invention.

33 is a diagram illustrating a specific embodiment of the DL PPDU format of FIG. 32(a).

34 is a flowchart illustrating a sounding method of an STA device according to an embodiment of the present invention.

35 is a block diagram of each STA device according to an embodiment of the present invention.

The terms used in the present specification have been selected as currently widely used general terms as possible while considering the functions in the present specification, but these may vary depending on the intention, custom, or emergence of new technologies of those of ordinary skill in the art. In addition, in certain cases, there are also terms arbitrarily selected by the applicant, and in this case, the meaning will be described in the description of the corresponding embodiment. Therefore, it is intended to clarify that the terms used in the present specification should be interpreted based on the actual meaning and the overall content of the present specification, rather than the simple name of the term.

Moreover, the embodiment will be described in detail with reference to the accompanying drawings and the contents described in the accompanying drawings, but it is not limited or limited by the embodiments.

Hereinafter, preferred embodiments of the present invention will be described in more detail with reference to the accompanying drawings.

The following technologies are code division multiple access (CDMA), frequency division multiple access (FDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), single carrier frequency division multiple access (SC-FDMA), NOMA (non-orthogonal multiple access) may be used in various wireless access systems. CDMA may be implemented with a radio technology such as universal terrestrial radio access (UTRA) or CDMA2000. TDMA may be implemented with a radio technology such as global system for mobile communications (GSM)/general packet radio service (GPRS)/enhanced data rates for GSM evolution (EDGE). OFDMA may be implemented with a wireless technology such as Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802-20, and evolved UTRA (E-UTRA). UTRA is part of the universal mobile telecommunications system (UMTS). 33rd generation partnership project (GPP) long term evolution (LTE) is a part of evolved UMTS (E-UMTS) using E-UTRA, and employs OFDMA in downlink and SC-FDMA in uplink. LTE-A (advanced) is an evolution of 3GPP LTE.

Embodiments of the present invention may be supported by standard documents disclosed in at least one of wireless access systems IEEE 802, 3GPP and 3GPP2. That is, steps or parts not described in order to clearly reveal the technical spirit of the present invention among the embodiments of the present invention may be supported by the above documents. In addition, all terms disclosed in this document may be described by the standard document.

For clarity of explanation, the IEEE 802.11 system is mainly described, but the technical features of the present invention are not limited thereto.

system general

1 is a diagram illustrating an example of an IEEE 802.11 system to which the present invention can be applied.

The IEEE 802.11 structure may be composed of a plurality of components, and a wireless communication system supporting station (STA) mobility that is transparent to an upper layer may be provided by their interaction. .

A basic service set (BSS) may correspond to a basic building block in an IEEE 802.11 system.

In FIG. 1 , there are three BSSs (BSS 1 to BSS 3), and two STAs are included as members of each BSS (STA 1 and STA 2 are included in BSS 1, STA 3 and STA 4 are BSS 2 , and STA 5 and STA 6 are included in BSS 3) as an example.

The ellipse indicating the BSS in FIG. 1 may also be understood as indicating a coverage area in which STAs included in the corresponding BSS maintain communication. This area may be referred to as a basic service area (BSA). When the STA moves out of the BSA, it cannot communicate directly with other STAs within the BSA.

In the IEEE 802.11 system, the most basic type of BSS is an Independent BSS (IBSS). For example, the IBSS may have a minimal form consisting of only two STAs. In addition, BSS 3 of FIG. 1 having the simplest form and omitting other components may correspond to a representative example of IBSS. This configuration is possible when the STAs can communicate directly. In addition, this type of LAN is not configured in advance, but may be configured when a LAN is required, and may be referred to as an ad-hoc network.

The membership of the STA in the BSS may be dynamically changed by turning the STA on or off, the STA entering or leaving the BSS area, and the like. To become a member of the BSS, the STA may join the BSS using a synchronization process. In order to access all services of the BSS infrastructure, the STA must be associated with the BSS. This association may be dynamically established and may include the use of a Distribution System Service (DSS).

802.11 The direct STA-to-STA distance in the system may be limited by physical layer (PHY: physical) performance. In some cases, this distance limit may be sufficient, but in some cases, communication between STAs at a greater distance may be required. A distribution system (DS) may be configured to support extended coverage.

DS means a structure in which BSSs are interconnected. Specifically, instead of the BSS independently existing as shown in FIG. 1 , the BSS may exist as a component of an extended form of a network composed of a plurality of BSSs.

DS is a logical concept and can be specified by the characteristics of a distribution system medium (DSM). In this regard, the IEEE 802.11 standard logically divides a wireless medium (WM: Wireless Medium) and a Distribution System Medium (DSM). Each logical medium serves a different purpose and is used by different components. The definition of the IEEE 802.11 standard does not limit these media to the same nor to different. In this way, in that the plurality of media are logically different, the flexibility of the structure (DS structure or other network structure) of the IEEE 802.11 system can be explained. That is, the IEEE 802.11 system structure may be implemented in various ways, and the corresponding system structure may be independently specified by the physical characteristics of each implementation.

A DS can support a mobile device by providing seamless integration of a plurality of BSSs and providing logical services necessary to handle addresses to destinations.

The AP means an entity that enables access to the DS through the WM for associated STAs and has STA functionality. Data movement between the BSS and DS may be performed through the AP. For example, STA 2 and STA 3 shown in FIG. 1 provide a function to allow associated STAs (STA 1 and STA 4) to access the DS while having STA functionality. In addition, since all APs basically correspond to STAs, all APs are addressable entities. The address used by the AP for communication on the WM and the address used by the AP for communication on the DSM are not necessarily the same.

Data transmitted from one of the STAs associated with the AP to the STA address of the AP is always received on an uncontrolled port and may be processed by the IEEE 802.1X port access entity. In addition, when the control port is authenticated, transmission data (or frame) may be transmitted to the DS.

A wireless network of arbitrary size and complexity may be composed of DS and BSS. In the IEEE 802.11 system, this type of network is called an Extended Service Set (ESS) network. The ESS may correspond to a set of BSSs connected to one DS. However, the ESS does not include the DS. The ESS network is characterized by being seen as an IBSS network in the Logical Link Control (LLC) layer. STAs included in the ESS can communicate with each other, and mobile STAs can move from one

BSS to another (within the same ESS) transparently to the LLC.

In the IEEE 802.11 system, nothing is assumed about the relative physical positions of the BSSs in FIG. 1 , and all of the following forms are possible.

Specifically, BSSs may partially overlap, which is a commonly used form to provide continuous coverage. In addition, the BSSs may not be physically connected, and there is no logical limit to the distance between the BSSs. In addition, the BSSs may be physically located at the same location, which may be used to provide redundancy. Also, one (or one or more) IBSS or ESS networks may physically exist in the same space as one or more ESS networks. This is when an ad-hoc network operates at a location where the ESS network exists, or when IEEE 802.11 networks that are physically overlapped by different organizations are configured, or when two or more different access and security policies are required at the same location. It may correspond to the type of ESS network in cases, etc.

In a WLAN system, an STA is a device that operates according to medium access control (MAC)/PHY regulations of IEEE 802.11. As long as the function of the STA is not separately distinguished from the AP, the STA may include an AP STA and a non-AP STA (non-AP STA). However, when communication is performed between the STA and the AP, the STA may be understood as a non-AP STA. In the example of FIG. 1 , STA 1 , STA 4 , STA 5 , and STA 6 correspond to non-AP STAs, and STA 2 and STA 3 correspond to AP STAs.

A non-AP STA corresponds to a device that a user generally handles directly, such as a laptop computer or a mobile phone. In the following description, a non-AP STA is a wireless device, a terminal, a user equipment (UE), a mobile station (MS), a mobile terminal, and a wireless terminal.), a wireless transmit/receive unit (WTRU), a network interface device, a machine-type communication (MTC) device, a machine-to-machine (M2M) device, and the like.

In addition, the AP is a base station (BS) in another wireless communication field, a Node-B (Node-B), an evolved Node-B (eNB), a Base Transceiver System (BTS) , a concept corresponding to a femto base station (Femto BS) and the like.

Hereinafter, in the present specification, downlink (DL: downlink) means communication from an AP to a non-AP STA, and uplink (UL: uplink) means communication from a non-AP STA to an AP. In the downlink, a transmitter may be a part of an AP, and a receiver may be a part of a non-AP STA. In the uplink, the transmitter may be a part of a non-AP STA, and the receiver may be a part of the AP.

2 is a diagram illustrating a structure of a layer architecture of an IEEE 802.11 system to which the present invention can be applied.

Referring to FIG. 2 , the layer architecture of the IEEE 802.11 system may include a MAC sublayer (MAC sublayer) and a PHY sublayer (PHY sublayer).

The PHY sublayer may be divided into a Physical Layer Convergence Procedure (PLCP) entity and a Physical Medium Dependent (PMD) entity.

In this case, the PLCP entity serves to connect the MAC sublayer and the data frame, and the PMD entity serves to wirelessly transmit/receive data to and from two or more STAs.

Both the MAC sublayer and the PHY sublayer may include a management entity, and may be referred to as a MAC sublayer management entity (MLME) and a PHY sublayer management entity (PLME), respectively. have. These management entities provide a layer management service interface through the operation of layer management functions. The MLME may be connected to the PLME to perform a management operation of the MAC sublayer, and similarly, the PLME may also be connected to the MLME to perform a management operation of the PHY sublayer.

In order to provide accurate MAC operation, a Station Management Entity (SME) may exist in each STA. As a management entity independent of each layer, the SME collects layer-based state information from the MLME and PLME or sets the values of specific parameters of each layer. SMEs may perform these functions on behalf of general system management entities and may implement standard management protocols.

MLME, PLME, and SME may interact in various ways based on primitives. Specifically, the XX-GET.request primitive is used to request the value of the management information base attribute (MIB attribute: Management Information Base attribute), and the XX-GET.confirm primitive returns the corresponding MIB attribute value if the status is 'SUCCESS'. It returns, and in other cases, an error is displayed in the status field and returned. The XX-SET.request primitive is used to request that a specified MIB attribute be set to a given value. If the MIB attribute implies a specific action, this request requests the execution of that specific action. And, if the status of the XX-SET.confirm primitive is 'SUCCESS', this means that the specified MIB attribute is set

to the requested value. Otherwise, the status field indicates an error condition. If this MIB attribute means a specific operation, this primitive can confirm that the corresponding operation is performed.

The operation in each sublayer is briefly described as follows.

The MAC sublayer includes a MAC header and a frame check sequence (FCS) in a MAC service data unit (MSDU) or a fragment of an MSDU received from an upper layer (eg, LLC layer). Sequence) to create one or more MAC Protocol Data Units (MPDUs). The generated MPDU is delivered to the PHY sublayer.

When an aggregated MSDU (A-MSDU) scheme is used, a plurality of MSDUs may be aggregated into a single aggregated MSDU (A-MSDU). The MSDU merging operation may be performed in a MAC upper layer. The A-MSDU is delivered to the PHY sublayer as a single MPDU (if not fragmented).

The PHY sublayer generates a Physical Protocol Data Unit (PPDU) by adding additional fields including information required by the physical layer transceiver to the Physical Service Data Unit (PSDU) received from the MAC sublayer. . The PPDU is transmitted over a wireless medium.

Since the PSDU is received by the PHY sublayer from the MAC sublayer and the MPDU is transmitted by the MAC sublayer to the PHY sublayer, the PSDU is substantially the same as the MPDU.

When an aggregated MPDU (A-MPDU) scheme is used, a plurality of MPDUs (in this case, each MPDU may carry an A-MSDU).) may be merged into a single A-MPDU. The MPDU aggregation operation may be performed in the MAC lower layer. In the A-MPDU, various types of MPDUs (eg, QoS data, ACK (Acknowledge), block ACK (BlockAck), etc.) may be merged. The PHY sublayer receives the A-MPDU as a single PSDU from the MAC sublayer. That is, the PSDU consists of a plurality of MPDUs. Accordingly, the A-MPDU is transmitted over the wireless medium within a single PPDU.

PPDU

(Physical Protocol Data Unit) format

A PPDU (Physical Protocol Data Unit) refers to a data block generated in a physical layer. Hereinafter, the PPDU format will be described based on the IEEE 802.11 WLAN system to which the present invention can be applied.

3 illustrates a non-HT format PPDU and an HT format PPDU of a wireless communication system to which the present invention can be applied.

3A illustrates a non-HT format PPDU for supporting the IEEE 802.11a/g system. The non-HT PPDU may also be referred to as a legacy PPDU.

Referring to (a) of Figure 3, the non-HT format PPDU is L-STF (Legacy (or Non-HT) Short Training field), L-LTF (Legacy (or Non-HT) Long Training field) and It is configured including a legacy format preamble and a data field consisting of a L-SIG (Legacy (or Non-HT) SIGNAL) field.

The L-STF may include a short training orthogonal frequency division multiplexing symbol (OFDM). L-STF can be used for frame timing acquisition, automatic gain control (AGC), diversity detection, coarse frequency/time synchronization .

The L-LTF may include a long training orthogonal frequency division multiplexing symbol (OFDM). The L-LTF may be used for fine frequency/time synchronization and channel estimation.

The L-SIG field may be used to transmit control information for demodulation and decoding of the data field.

The L-SIG field consists of a 4-bit Rate field, a 1-bit Reserved bit, a 12-bit Length field, a 1-bit parity bit, and a 6-bit Signal Tail field. can be

The rate field includes data rate information, and the length field indicates the number of octets of the PSDU.

3B illustrates an HT-mixed format PPDU (HT-mixed format PPDU) for supporting both the IEEE 802.11n system and the IEEE 802.11a/g system.

Referring to Figure 3 (b), the HT mixed format PPDU is a legacy format preamble consisting of L-STF, L-LTF and L-SIG fields, HT-SIG (HT-Signal) field, HT-STF (HT Short) Training field), HT-LTF (HT Long Training field) is configured including the HT format preamble and data field.

Since the L-STF, L-LTF, and L-SIG fields mean legacy fields for backward compatibility, the L-STF to L-SIG fields are identical to the non-HT format. The L-STA may interpret the data field through the L-LTF, L-LTF, and L-SIG fields even when receiving the

HT mixed PPDU. However, the L-LTF may further include information for channel estimation to be performed by the HT-STA to receive the HT mixed PPDU and demodulate the L-SIG field and the HT-SIG field.

The HT-STA can know that it is an HT-mixed format PPDU by using the HT-SIG field following the legacy field, and can decode the data field based on this.

The HT-LTF field may be used for channel estimation for demodulation of the data field. Since IEEE 802.11n supports Single-User Multi-Input and Multi-Output (SU-MIMO), a plurality of HT-LTF fields may be configured for channel estimation for each data field transmitted through a plurality of spatial streams.

The HT-LTF field includes data HT-LTF (data HT-LTF) used for channel estimation for a spatial stream and extension HT-LTF (extension HT-LTF) additionally used for full channel sounding. can be composed of Accordingly, the plurality of HT-LTFs may be equal to or greater than the number of transmitted spatial streams.

In the HT-mixed format PPDU, the L-STF, L-LTF and L-SIG fields are first transmitted so that the L-STA can also receive and acquire data. Thereafter, the HT-SIG field is transmitted for demodulation and decoding of data transmitted for the HT-STA.

The HT-SIG field is transmitted without beamforming so that the L-STA and HT-STA can receive the corresponding PPDU to acquire data, and the HT-STF, HT-LTF and data fields transmitted thereafter are precoded Wireless signal transmission is performed through Here, the HT-STF field is transmitted so that the STA receiving the precoding can take into account the variable power due to the precoding, and thereafter, a plurality of HT-LTFs and data fields are transmitted.

Table 1 below is a table illustrating the HT-SIG field.

3 (c) illustrates an HT-greenfield format PPDU (HT-greenfield format PPDU) for supporting only the IEEE 802.11n system.

Referring to FIG. 3C , the HT-GF format PPDU includes HT-GF-STF, HT-LTF1, HT-SIG fields, a plurality of HT-LTF2 fields, and data fields.

HT-GF-STF is used for frame timing acquisition and AGC.

HT-LTF1 is used for channel estimation.

The HT-SIG field is used for demodulation and decoding of the data field.

HT-LTF2 is used for channel estimation for demodulation of the data field.

Similarly, since the HT-STA uses SU-MIMO, channel estimation is required for each data field transmitted in a plurality of spatial streams, and thus HT-LTF2 may be configured in plurality.

The plurality of HT-LTF2s may consist of a plurality of Data HT-LTFs and a plurality of extended HT-LTFs similarly to the HT-LTF field of the HT mixed PPDU.

In (a) to (c) of Figure 3, the data field is a payload, a service field (SERVICE field), a scrambled PSDU (scrambled PSDU) field, tail bits (Tail bits), padding bits (padding bits) may include. All bits in the data field are scrambled.

3(d) shows a service field included in a data field. The service field has 16 bits. Each bit is assigned from 0 to 15, and is transmitted sequentially from bit 0. 0Bits 1 to 6 are set to 0, and are used to synchronize a descrambler in the receiving end.

The IEEE 802.11ac WLAN system supports transmission of a downlink Multi User Multiple Input Multiple Output (MU-MIMO) scheme in which a plurality of STAs simultaneously access the channel in order to efficiently use a radio channel. According to the MU-MIMO transmission method, the AP may simultaneously transmit a packet to one or more MIMO paired STAs.

DL MU transmission (downlink multi-user transmission) refers to a technology in which an AP transmits a PPDU to a plurality of non-AP STAs through the same time resource through one or more antennas.

Hereinafter, the MU PPDU means a PPDU that transmits one or more PSDUs for one or more STAs using MU-MIMO technology or OFDMA technology. And, the SU PPDU means a PPDU having a format that can carry only one PSDU or does not have a PSDU.

For MU-MIMO transmission, the size of the control information transmitted to the STA may be relatively large compared to the size of the 802.11n control information. As an example of control information additionally required for MU-MIMO support, information indicating the number of spatial streams received by each STA, modulation and coding related information of data transmitted to each STA, etc. can be

Accordingly, when MU-MIMO transmission is performed to simultaneously provide a data service to a plurality of STAs, the size of transmitted control information may increase according to the number of receiving STAs.

In order to efficiently transmit the increased size of control information, a plurality of control information required for MU-MIMO transmission is individually requested from common control information commonly required for all STAs and a specific STA. Dedicated control information to be transmitted may be divided into two types of information.

4 illustrates a VHT format PPDU format of a wireless communication system to which the present invention can be applied.

Figure 4 (a) illustrates a VHT format PPDU (VHT format PPDU) for supporting the IEEE 802.11ac system.

Referring to Figure 4 (a), the VHT format PPDU is a legacy format preamble consisting of L-STF, L-LTF and L-SIG fields, VHT-SIG-A (VHT-Signal-A) field, VHT-STF (VHT Short Training field), VHT-LTF (VHT Long Training field), VHT-SIG-B (VHT-Signal-B) field is configured including a VHT format preamble and data field.

Since L-STF, L-LTF, and L-SIG mean legacy fields for backward compatibility, the L-STF to L-SIG fields are the same as the non-HT format.

However, the L-LTF may further include information for channel estimation to be performed in order to demodulate the L-SIG field and the VHT-SIG-A field.

The L-STF, L-LTF, L-SIG field, and VHT-SIG-A field may be repeatedly transmitted in units of 20 MHz channels. For example, when a PPDU is transmitted through four 20 MHz channels (ie, 80 MHz bandwidth), the L-STF, L-LTF, L-SIG field and VHT-SIG-A field are transmitted repeatedly in every 20 MHz channel. can be

The VHT-STA can know that it is a VHT format PPDU by using the VHT-SIG-A field following the legacy field, and can decode the data field based on this.

In the VHT format PPDU, the L-STF, L-LTF and L-SIG fields are transmitted first so that the L-STA can also receive and acquire data. Thereafter, the VHT-SIG-A field is transmitted for demodulation and decoding of data transmitted for the VHT-STA.

The VHT-SIG-A field is a field for transmitting control information common to the AP and MIMO paired VHT STAs, and includes control information for interpreting the received VHT format PPDU.

The VHT-SIG-A field may include a VHT-SIG-A1 field and a VHT-SIG-A2 field.

The VHT-SIG-A1 field is used for channel bandwidth (BW: bandwidth) information, whether or not to apply Space Time Block Coding (STBC), group identification information for indicating a group of STAs grouped in MU-MIMO (Contains information about Group ID: Group Identifier), Number of space-time streams (NSTS)/Partial Association Identifier (AID) and Transmit power save forbidden information. can do. Here, the group ID means an identifier allocated to a transmission target STA group to support MU-MIMO transmission, and may indicate whether the currently used MIMO transmission method is MU-MIMO or SU-MIMO.

Table 2 is a table illustrating the VHT-SIG-A1 field.

The VHT-SIG-A2 field includes information on whether to use a short guard interval (GI), Forward Error Correction (FEC) information, information on Modulation and Coding Scheme (MCS) for a single user, and multiple Information on the type of channel coding for the user, beamforming related information, redundancy bits for CRC (Cyclic Redundancy Checking) and tail bits of a convolutional decoder. can

Table 3 is a table illustrating the VHT-SIG-A2 field.

VHT-STF is used to improve the performance of AGC estimation in MIMO transmission.

The VHT-LTF is used by the VHT-STA to estimate the MIMO channel.

Since the VHT WLAN system supports MU-MIMO, the VHT-LTF may be configured as much as the number of spatial streams through which the PPDU is transmitted.

Additionally, when full channel sounding is supported, the number of VHT-LTFs may be increased.

The VHT-SIG-B field includes dedicated control information required for a plurality of MU-MIMO paired VHT-STAs to receive a PPDU and acquire data. Therefore, only when the PPDU currently received in the common control information included in the VHT-SIG-A field indicates MU-MIMO transmission, the VHT-STA decodes the VHT-SIG-B field. can be designed to On the other hand, when the common control information indicates that the currently received PPDU is for a single VHT-STA (including SU-

MIMO), the STA may be designed not to decode the VHT-SIG-B field.

The VHT-SIG-B field includes a VHT-SIG-B length field, a VHT-MCS field, a reserved field, and a tail field.

The VHT-SIG-B length field indicates the length of the A-MPDU (before end-of-frame (EOF) padding). The VHT-MCS field includes information on modulation, encoding, and rate-matching of each VHT-STA.

The size of the VHT-SIG-B field may vary according to a type of MIMO transmission (MU-MIMO or SU-MIMO) and a channel bandwidth used for PPDU transmission.

Figure 4 (b) illustrates the VHT-SIG-B field according to the PPDU transmission bandwidth.

Referring to FIG. 4(b), in 40 MHz transmission, the VHT-SIG-B bit is repeated twice. 80For MHz transmission, the VHT-SIG-B bit is repeated 4 times, and a pad bit set to zero is attached.

160 For MHz transmission and 80+80 MHz, the VHT-SIG-B bit is repeated 4 times as in 80 MHz transmission first, and a pad bit set to 0 is attached. Then, all 117 bits are repeated again.

In order to transmit a PPDU of the same size to STAs paired with an AP in a system supporting MU-MIMO, information indicating the bit size of a data field constituting the PPDU and/or indicating a bit stream size constituting a specific field information may be included in the VHT-SIG-A field.

However, the L-SIG field may be used to effectively use the PPDU format. In order to transmit a PPDU of the same size to all STAs, a length field and a rate field included in the L-SIG field and transmitted may be used to provide necessary information. In this case, since MAC Protocol Data Unit (MPDU) and/or Aggregate MAC Protocol Data Unit (A-MPDU) are set based on bytes (or octets) of the MAC layer, additional padding in the physical layer is may be requested

In FIG. 4 , the data field is a payload and may include a SERVICE field, a scrambled PSDU (PSDU), tail bits, and padding bits.

Since various PPDU formats are mixed and used as described above, the STA must be able to distinguish the received PPDU formats.

Here, the meaning of distinguishing the PPDU (or the meaning of distinguishing the PPDU format) may have various meanings. For example, the meaning of classifying the PPDU may include the meaning of determining whether the received PPDU is a PPDU that can be decoded (or interpreted) by the STA. In addition, classifying the PPDU may mean determining whether the received PPDU is a PPDU that can be supported by the STA. Also, the meaning of distinguishing the PPDU may be interpreted as the meaning of distinguishing what kind of information is transmitted through the received PPDU.

This will be described in more detail with reference to the drawings below.

MAC frame format

5 illustrates a MAC frame format of an IEEE 802.11 system to which the present invention can be applied.

Referring to FIG. 5 , a MAC frame (ie, MPDU) includes a MAC header, a frame body, and a frame check sequence (FCS).

MAC Header is a Frame Control field, Duration/ID field, Address 1 field, Address 2 field, Address 3 field, Sequence control (Sequence) field. Control) field, an address 4 field, a QoS control field, and an HT control field are defined as an area.

The Frame Control field includes information about the corresponding MAC frame characteristics.

A more detailed description of the Frame Control field will be described later.

The Duration/ID field may be implemented to have different values according to the type and subtype of the corresponding MAC frame.

If the type and subtype of the corresponding MAC frame is a PS-Poll frame for power save (PS) operation, the Duration/ID field is an association identifier (AID) of the STA that transmitted the frame. may be set to include In other cases, the Duration/ID field may be set to have a specific duration value according to the type and subtype of the corresponding MAC frame. In addition, when the frame is an MPDU included in an aggregate-MPDU (A-MPDU) format, all Duration/ID fields included in the MAC header may be set to have the same value.

The Address 1 field to the Address 4 field include a BSSID, a source address (SA), a destination address (DA), a transmission address (TA) indicating a transmission STA address, and a reception address indicating the reception STA address (RA: Receiving Address).

Meanwhile, the address field implemented as the TA field may be set to a bandwidth signaling TA (TA) value. In this case, the TA field may indicate that the corresponding MAC frame contains additional information in the scrambling sequence. The bandwidth signaling TA may be expressed as the MAC address of the STA transmitting the corresponding MAC frame, but individual/group bits included in the MAC address may be set to a specific value (eg, '1'). can

The Sequence Control field is set to include a sequence number and a fragment number. The sequence number may indicate a sequence number assigned to the corresponding MAC frame. The fragment number may indicate the number of each fragment of the corresponding MAC frame.

The QoS Control field includes information related to QoS. The QoS Control field may be included when a QoS data frame is indicated in the Subtype subfield.

The HT Control field includes control information related to HT and/or VHT transmission/reception techniques. The HT Control field is included in the Control Wrapper frame. In addition, the Order subfield is present in a QoS data frame and a management frame having a value of 1.

The frame body is defined as a MAC payload, and data to be transmitted from an upper layer is located, and has a variable size. For example, the maximum MPDU size may be 11454 octets, and the maximum PPDU size may be 5.484 ms.

The FCS is defined as a MAC footer and is used for error detection of a MAC frame.

The first three fields (Frame Control field, Duration/ID field, and Address 1 field) and the last field (FCS field) constitute the minimum frame format and are present in all frames. Other fields may exist only in a specific frame type.

6 is a diagram illustrating a frame control field in a MAC frame in a wireless communication system to which the present invention can be applied.

Referring to FIG. 6 , the Frame Control field includes a protocol version subfield, a type subfield, a subtype subfield, a To DS subfield, a From DS subfield, and more fragments. It consists of a subfield, a Retry subfield, a Power Management subfield, a More Data subfield, a Protected Frame subfield, and an Order subfield.

The Protocol Version subfield may indicate the version of the WLAN protocol applied to the corresponding MAC frame.

The Type subfield and the Subtype subfield may be set to indicate information identifying the function of the corresponding MAC frame.

The MAC frame type may include three types of frames: a management frame, a control frame, and a data frame.

In addition, each frame type may be divided into subtypes again.

For example, control frames include a request to send (RTS) frame, a clear-to-send (CTS) frame, an acknowledgment (ACK) frame, a PS-Poll frame, a contention free (CF)-End frame, and a CF. -End+CF-ACK frame, Block ACK request (BAR: Block Acknowledgment request) frame, Block ACK (BA: Block Acknowledgment) frame, Control Wrapper (Control+HTcontrol) frame, VHT null data packet notification (NDPA) : Null Data Packet Announcement) and a beamforming report poll (Beamforming Report Poll) frame may be included.

Management frames include a Beacon frame, an Announcement Traffic Indication Message (ATIM) frame, a Disassociation frame, an Association Request/Response frame, and a Reassociation Request/response (Reassociation Request/Response) frame. Response) Frame, Probe Request/Response Frame, Authentication Frame, Deauthentication Frame, Action Frame, Action No ACK Frame, Timing Advertisement It may include a frame.

The To DS subfield and From DS subfield may include information necessary to interpret the Address 1 field to the Address 4 field included in the corresponding MAC frame header.

In the case of the Control frame, both the To DS subfield and the From DS subfield are set to '0'. In the case of a management frame, the To DS subfield and From DS subfield are set to '1' and '0' in order if the corresponding frame is a QoS Management frame (QMF), and in order if the corresponding frame is not QMF. Both can be set to '0' or '0'.

The More Fragments subfield may indicate whether a fragment to be transmitted following the corresponding MAC frame exists. If another fragment of the current MSDU or MMPDU exists, it may be set to '1', otherwise it may be set to '0'.

The Retry subfield may indicate whether the corresponding MAC frame is in accordance with retransmission of the previous MAC frame. In case of retransmission of the previous MAC frame, it may be set to '1', otherwise it may be set to '0'.

The Power Management subfield may indicate the power management mode of the STA. If the value of the Power Management subfield is '1', it may indicate that the STA switches to the power save mode.

The More Data subfield may indicate whether a MAC frame to be additionally transmitted exists. If there is a MAC frame to be additionally transmitted, it may be set to '1', otherwise it may be set to '0'.

The Protected Frame subfield may indicate whether the Frame Body field is encrypted. When the Frame Body field includes information processed by an encrypted encapsulation algorithm, it may be set to '1', otherwise it may be set to '0'.

Information included in each of the fields described above may follow the definition of the IEEE 802.11 system. In addition, each of the fields described above corresponds to an example of fields that may be included in the MAC frame, but is not limited thereto. That is, each field described above may be replaced with another field or additional fields may be further included, and all fields may not necessarily be included.

Channel State Information feedback (feedback) method

SU-MIMO technology, in which a beamformer allocates all antennas to one beamformee and communicates, increases channel capacity through diversity gain using space-time and stream multiplexing. .

The SU-MIMO technology can contribute to improving the performance of the physical layer by extending the spatial freedom by increasing the number of antennas compared to when the MIMO technology is not applied.

In addition, the MU-MIMO technology, in which the Beamformer allocates antennas to a plurality of Beamformees, through a link layer protocol for multiple access of a plurality of Beamformees connected to the Beamformer, increases the transmission rate per Beamformee or increases the reliability of the MIMO antenna by increasing the reliability of the channel. performance can be improved.

In the MIMO environment, how accurately the Beamformer knows the channel information can have a great effect on the performance, so a feedback procedure for acquiring the channel information is required.

Two types of feedback procedures for acquiring channel information may be supported. One is a method using a control frame, and the other is a method using a channel sounding procedure that does not include a data field. Sounding means using a corresponding training field to measure a channel for purposes other than data demodulation of a PPDU including a preamble training field.

Hereinafter, a channel information feedback method using a control frame and a channel information feedback method using a null data packet (NDP) will be described in more detail.

1)

Feedback method using control frame

In the MIMO environment, the Beamformer may instruct feedback of the channel state information through the HT control field included in the MAC header, or the Beamformee may report the channel state information through the HT control field included in the MAC frame header (see FIG. 8). .

The HT control field may be included in a control wrapper frame or a QoS data frame or management frame in which the Order subfield of the MAC header is set to 1.

2)

Feedback method using channel sounding

7 is a diagram conceptually illustrating a channel sounding method in a wireless communication system to which the present invention can be applied.

7 illustrates a method of feeding back channel state information between a Beamformer (eg, AP) and a Beamformee (eg, a non-AP STA) based on a sounding protocol.

A sounding protocol may refer to a procedure for receiving feedback information on channel state information.

The channel state information sounding method between Beamformer and Beamformee based on the sounding protocol may be performed in the following steps.

(1) The Beamformer transmits a VHT Null Data Packet Announcement (VHT NDPA) frame notifying transmission of sounding for feedback of Beamformee.

The VHT NDPA frame means a control frame used to inform that channel sounding is started and that a null data packet (NDP) will be transmitted. In other words, by transmitting the VHT NDPA frame before transmitting the NDP, the Beamformee can prepare to feed back the channel state information before receiving the NDP frame.

The VHT NDPA frame may include AID (association identifier) information of Beamformee to transmit NDP, feedback type information, and the like. A more detailed description of the VHT NDPA frame will be described later.

The VHT NDPA frame may be transmitted in different transmission methods when data is transmitted using MU-MIMO and when data is transmitted using SU-MIMO. For example, when channel sounding for MU-MIMO is performed, a VHT NDPA frame is transmitted in a broadcast method, but when channel sounding for SU-MIMO is performed, a VHT NDPA frame is sent to one target STA. can be transmitted in a unicast manner.

(2) After transmitting the VHT NDPA frame, the Beamformer transmits the NDP after the SIFS time. The NDP has a VHT PPDU structure excluding the data field.

Beamformees that have received the VHT NDPA frame may check the value of the AID12 subfield included in the STA information field, and determine whether they are a sounding target STA.

In addition, Beamformees may know the feedback order through the order of the STA Info field included in the NDPA. 11 exemplifies a case in which the feedback order proceeds in the order of Beamformee 1, Beamformee 2, and Beamformee 3.

(3)

Beamformee 1 acquires downlink channel state information based on a training field included in the NDP, and generates feedback information to be transmitted to the Beamformer.

After receiving the NDP frame, Beamformee 1 transmits a VHT Compressed Beamforming frame including feedback information to the Beamformer after SIFS.

The VHT Compressed Beamforming frame may include information about an SNR value for a space-time stream, a compressed beamforming feedback matrix for a subcarrier, and the like.

A more detailed description of the VHT Compressed Beamforming frame will be described later.

(4)

After receiving the VHT Compressed Beamforming frame from Beamformee 1, the Beamformer transmits a Beamforming Report Poll frame to Beamformee 2 to obtain channel information from Beamformee 2 after SIFS.

The Beamforming Report Poll frame is a frame that performs the same role as the NDP frame, and Beamformee 2 may measure a channel state based on the transmitted Beamforming Report Poll frame.

A more detailed description of the beamforming report poll frame frame will be described later.

(5)

After receiving the Beamforming Report Poll frame, Beamformee 2 transmits a VHT Compressed Beamforming frame including feedback information to the Beamformer after SIFS.

(6)

After receiving the VHT Compressed Beamforming frame from Beamformee 2, the Beamformer transmits a Beamforming Report Poll frame to Beamformee 3 to obtain channel information from Beamformee 3 after SIFS.

(7)

After receiving the Beamforming Report Poll frame, Beamformee 3 transmits a VHT Compressed Beamforming frame including

feedback information to the Beamformer after SIFS.

Hereinafter, a frame used in the above-described channel sounding procedure will be described.

8 is a diagram illustrating a VHT NDPA frame in a wireless communication system to which the present invention can be applied.

Referring to Figure 8, the VHT NDPA frame frame control (Frame Control) field, duration (Duration) field, RA (Receiving Address) field, TA (Transmitting Address) field, sounding dialog token (Sounding Dialog Token) field, It may consist of an STA information 1 (STA Info 1) field, an STA information n (STA Info n) field, and an FCS.

The RA field value indicates a receiver address or an STA address for receiving the VHT NDPA frame.

When the VHT NDPA frame includes one STA Info field, the RA field value has the address of the STA identified by the AID in the STA Info field.

For example, when transmitting a VHT NDPA frame to one target STA for SU-MIMO channel sounding, the AP transmits the VHT NDPA frame to the target STA by unicast.

On the other hand, when the VHT NDPA frame includes one or more STA Info fields, the RA field value has a broadcast address.

For example, when transmitting a VHT NDPA frame to at least one target STA for MU-MIMO channel sounding, the AP broadcasts the VHT NDPA frame.

The TA field value indicates a transmitter address for transmitting the VHT NDPA frame, an address of a transmitting STA, or a bandwidth for signaling the TA.

The Sounding Dialog Token field may be referred to as a sounding sequence field.

The Sounding Dialog Token Number subfield in the Sounding Dialog Token field contains a value selected by the Beamformer to identify the VHT NDPA frame.

The VHT NDPA frame includes at least one STA Info field.

That is, the VHT NDPA frame includes an STA Info field including information on a sounding target STA.

One STA Info field may be included for each sounding target STA.

Each STA Info field may include an AID12 subfield, a Feedback Type subfield, and an Nc Index subfield.

Table 4 shows subfields of the STA Info field included in the VHT NDPA frame.

Information included in each of the fields described above may follow the definition of the IEEE 802.11 system.

In addition, each of the fields described above corresponds to an example of fields that may be included in the MAC frame, and may be replaced with other fields or additional fields may be further included.

9 is a diagram illustrating an NDP PPDU in a wireless communication system to which the present invention can be applied.

Referring to FIG. 9 , the NDP may have a format in which a data field is omitted from the VHT PPDU format shown in FIG. 4 above.

The NDP may be precoded based on a specific precoding matrix and transmitted to a sounding target STA.

In the L-SIG field of the NDP, the length field indicating the PSDU length included in the data field is set to '0'.

In the VHT-SIG-A field of NDP, the Group ID field indicating whether the transmission scheme used for NDP transmission is MU-MIMO or SU-MIMO is set to a value indicating SU-MIMO transmission.

The data bits of the VHT-SIG-B field of the NDP are set in a fixed bit pattern for each bandwidth.

When the sounding target STA receives the NDP, it estimates a channel based on the VHT-LTF field of the NDP and obtains channel state information.

10 is a diagram illustrating a VHT compressed beamforming (VHT compressed beamforming) frame format in a wireless communication system to which the present invention can be applied.

Referring to FIG. 10 , the VHT compressed beamforming frame is a VHT action frame for supporting the VHT function, and

includes an Action field in the Frame Body.

The Action field is included in the Frame Body of the MAC frame to provide a mechanism for specifying extended management operations.

The Action field includes a Category field, a VHT Action field, a VHT MIMO Control field, a VHT Compressed Beamforming Report field, and a MU Exclusive Beamforming report. Report) field.

The Category field is set to a value indicating a VHT category (ie, VHT Action frame), and the VHT Action field is set to a value indicating a VHT Compressed Beamforming frame.

The VHT MIMO Control field is used to feed back control information related to beamforming feedback. The VHT MIMO Control field may always exist in the VHT Compressed Beamforming frame.

The VHT Compressed Beamforming Report field is used to feed back information on a beamforming metric including SNR information for a space-time stream used to transmit data.

The MU Exclusive Beamforming Report field is used to feed back SNR information on a spatial stream when MU-MIMO transmission is performed.

The existence and content of the VHT Compressed Beamforming Report field and the MU Exclusive Beamforming Report field are a feedback type subfield of the VHT MIMO Control field, a Remaining Feedback Segments subfield, and a first feedback segment (First). Feedback Segment) may be determined according to the value of the subfield.

Hereinafter, the VHT MIMO Control field, the VHT Compressed Beamforming Report field, and the MU Exclusive Beamforming Report field will be described in more detail.

1) The VHT MIMO Control field includes an Nc Index subfield, an Nr Index subfield, a Channel Width subfield, a Grouping subfield, a Codebook Information subfield, and a feedback type. (Feedback Type) subfield, Remaining Feedback Segments subfield, First Feedback Segment subfield, reserved subfield, and Sounding Dialog Token Number subfield is composed

Table 5 shows subfields of the VHT MIMO Control field.

When the VHT Compressed Beamforming frame does not convey all or part of the VHT Compressed Beamforming Report field, Nc Index subfield, Channel Width subfield, Grouping subfield, Codebook Information subfield, Feedback Type subfield, and Sounding Dialog Token Number subfield is set as a reserved field, the First Feedback Segment subfield is set to '0', and the Remaining Feedback Segments subfield is set to '7'.

The Sounding Dialog Token Number subfield may be referred to as a Sounding Sequence Number subfield.

2) The VHT compressed beamforming report field indicates the compressed beamforming feedback matrix 'V' used by the transmitting Beamformer to determine the steering matrix 'Q' in the form of an angle. used to transmit

Table 6 shows subfields of the VHT compressed beamforming report field.

Referring to Table 6, the VHT compressed beamforming report field may include an average SNR for each space-time stream and a compressed beamforming feedback matrix 'V' for each subcarrier.

The compressed beamforming feedback matrix is a matrix including information on channel conditions and is used to calculate a channel matrix (ie, a steering matrix 'Q') in a transmission method using MIMO.

scidx( ) means a subcarrier through which the Compressed Beamforming Feedback Matrix subfield is transmitted.

Na is fixed by the value of Nr × Nc (eg, when Nr × Nc = 2 × 1, ?11, ?21, ...).

Ns means the number of subcarriers through which the compressed beamforming feedback matrix is transmitted to the beamformer. Beamformee can reduce the number of Ns through which the compressed beamforming feedback matrix is transmitted by using a grouping method. For example, the number of fed back compressed beamforming feedback matrices may be reduced by grouping a plurality of subcarriers into one group and transmitting the compressed beamforming feedback matrix for each corresponding group. Ns may be calculated from the Channel Width subfield and the Grouping subfield included in the VHT MIMO Control field.

Table 7 illustrates an Average SNR of Space-Time (SNR) Stream subfield of a space-time stream.

Referring to Table 7, the average SNR for each spatiotemporal stream is calculated by calculating the average SNR value for all

subcarriers included in the channel and mapping the value to the range of -128 to +128.

3)

The MU Exclusive Beamforming Report field is used to deliver explicit feedback information expressed in the form of delta () SNR. Information in the VHT Compressed Beamforming Report field and the MU Exclusive Beamforming Report field may be used by the MU Beamformer to determine a steering matrix 'Q'.

Table 8 shows subfields of the MU Exclusive Beamforming Report field included in the VHT compressed beamforming frame.

Referring to Table 8, the MU Exclusive Beamforming Report field may include SNR per spatiotemporal stream for each subcarrier.

Each Delta SNR subfield has a value in increments of 1dB between -8dB and 7dB.

scidx() means subcarrier(s) on which the Delta SNR subfield is transmitted, and Ns means the number of subcarriers on which the Delta SNR subfield is transmitted to the Beamformer.

11 is a diagram illustrating a beamforming report poll frame format in a wireless communication system to which the present invention can be applied.

Referring to FIG. 11 , the Beamforming Report Poll frame includes a Frame Control field, a Duration field, a Receiving Address (RA) field, a Transmitting Address (TA) field, and a Feedback Segment Retransmission Bitmap.) field and FCS.

The RA field value indicates the address of the intended recipient.

The TA field value indicates the address of the STA transmitting the Beamforming Report Poll frame or the bandwidth signaling the TA.

The Feedback Segment Retransmission Bitmap field indicates a feedback segment requested in a VHT Compressed Beamforming report.

If the bit at position n in the Feedback Segment Retransmission Bitmap field value is '1' (n=0 for LSB, n=7 for MSB), the corresponding n in the Remaining Feedback Segments subfield in the VHT MIMO Control field of the VHT compressed beamforming frame is A feedback segment is requested.

On the other hand, if the bit at position n is '0', the feedback segment corresponding to n in the Remaining Feedback Segments subfield in the VHT MIMO Control field is not requested.

Downlink MU-

MIMO

Frame (DL MU-

MIMO

Frame)

12 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

Referring to FIG. 12 , the PPDU is configured to include a preamble and a data field.

The data field may include a service field, a scrambled PSDU field, tail bits, and padding bits.

The AP may transmit a data frame in an aggregated MPDU (A-MPDU) format by aggregating the MPDUs.

In this case, the scrambled PSDU (scrambled PSDU) field may consist of an A-MPDU.

The A-MPDU consists of a sequence of one or more A-MPDU subframes.

In the case of VHT PPDU, since the length of each A-MPDU subframe is a multiple of 4 octets, the A-MPDU is 0 after the last A-MPDU subframe in order to fit the A-MPDU to the last octet of the PSDU. It may include an end-of-frame (EOF) pad of to 3 octets.

The A-MPDU subframe consists of an MPDU delimiter, and optionally the MPDU may be included after the MPDU delimiter.

In addition, except for the last A-MPDU subframe in one A-MPDU, a pad octet is attached after the MPDU to make the length of each A-MPDU subframe a multiple of 4 octets.

The MPDU Delimiter consists of a Reserved field, an MPDU Length field, a cyclic redundancy check (CRC) field, and a delimiter signature field.

In the case of the VHT PPDU, the MPDU Delimiter may further include an end-of-frame (EOF) field.

If the MPDU Length field is 0 and an A-MPDU subframe used for padding, or an A-MPDU subframe in which the corresponding MPDU is loaded when the A-MPDU consists of only one MPDU, the EOF field is set to '1'. do.

Otherwise, it is set to '0'.

The MPDU Length field includes information on the length of the MPDU.

If there is no MPDU in the corresponding A-MPDU subframe, it is set to '0'.

The A-MPDU subframe in which the MPDU Length field has a value of '0' is used when padding the A-MPDU to fit the A-MPDU to the available octets in the VHT PPDU.

The CRC field includes CRC information for error checking, and the Delimiter Signature field includes pattern information used to search for the MPDU delimiter.

And, the MPDU is composed of a MAC header (MAC Header), a frame body (Frame Body), and a frame check sequence (FCS).

13 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

13 shows that the number of STAs receiving the corresponding PPDU is 3 and the number of spatial streams allocated to each STA is 1, but the number of STAs paired to the AP and the number of spatial streams allocated to each STA is not limited thereto.

13, the MU PPDU includes an L-TFs field (L-STF field and L-LTF field), L-SIG field, VHT-SIG-A field, and VHT-TFs field (VHT-STF field and VHT-LTF field). field), a VHT-SIG-B field, a Service field, one or more PSDUs, a padding field, and a Tail bit.

Since the L-TFs field, the L-SIG field, the VHT-SIG-A field, the VHT-TFs field, and the VHT-SIG-B field are the same as in the example of FIG. 4 above, a detailed description thereof will be omitted.

Information for indicating the PPDU duration may be included in the L-SIG field.

Within the PPDU, the PPDU duration indicated by the L-SIG field includes a symbol to which the VHT-SIG-A field is assigned, a symbol to which the VHT-TFs field is assigned, a field to which the VHT-SIG-B field is assigned, and the Service field. It includes bits constituting the bits, bits constituting the PSDU, bits constituting the padding field, and bits constituting the Tail field.

The STA receiving the PPDU may obtain information on the duration of the PPDU through information indicating the duration of the PPDU included in the L-SIG field.

As described above, group ID information and information on the number of spatiotemporal streams per user are transmitted through VHT-SIG-A, and a coding method and MCS information are transmitted through VHT-SIG-B.

Therefore, Beamformees can check VHT-SIG-A and VHT-SIG-B and know whether it is the MU MIMO frame to which they belong.

Therefore, a STA that is not a member of the corresponding Group ID or a member of the corresponding Group ID or an STA whose number of allocated streams is '0' reduces power consumption by setting to stop reception of the physical layer from after the VHT-SIG-A field to the end of the PPDU. can do.

By receiving the Group ID Management frame transmitted by the Beamformer in advance, the Group ID can know which MU group the Beamformee belongs to, which user it belongs to, that is, through which stream it receives the PPDU.

802.11

All MPDUs transmitted in the VHT MU PPDU based on ac are included in the A-MPDU.

In the data field of FIG. 13, each VHT A-MPDU may be transmitted in different streams.

In FIG. 13 , since the size of data transmitted to each STA may be different, each A-MPDU may have a different bit size.

In this case, null padding may be performed so that a time at which transmission of a plurality of data frames transmitted by the Beamformer ends is the same as a time at which transmission of a maximum interval transmission data frame ends.

The maximum period transmission data frame may be a frame in which valid downlink data is transmitted for the longest period by the Beamformer.

The valid downlink data may be downlink data that is not null padded.

For example, valid downlink data may be transmitted while being included in the A-MPDU.

Null padding may be performed on the remaining data frames except for the maximum interval transmission data frame among the plurality of data frames.

For null padding, the Beamformer may encode and fill one or more A-MPDU subframes located temporally lower in a plurality of A-MPDU subframes in the A-MPDU frame only with the MPDU delimiter field.

An A-MPDU subframe having an MPDU length of 0 may be referred to as a null subframe.

As described above, in the null subframe, the EOF field of the MPDU Delimiter is set to '1'.

Accordingly, when the MAC layer of the receiving STA detects the EOF field set to 1, it is possible to reduce power consumption by setting the physical layer to stop reception.

block

ACK

(Block

Ack

) procedure

14 is a diagram illustrating a downlink MU-MIMO transmission process in a wireless communication system to which the present invention can be applied.

802.11

In ac, MU-MIMO is defined in the downlink from the AP to the client (ie, non-AP STA).

In this case, a multi-user frame is simultaneously transmitted to multiple receivers, but acknowledgment must be individually transmitted in the uplink.

802.11Since all MPDUs transmitted in the VHT MU PPDU based on ac are included in the A-MPDU, the response to the A-MPDU in the VHT MU PPDU rather than the immediate response to the VHT MU PPDU is a block ACK request (BAR: It is sent in response to the Block Ack Request) frame.

First, the AP transmits a VHT MU PPDU (ie, preamble and data) to all receivers (ie, STA 1 , STA 2 , STA 3).

The VHT MU PPDU includes a VHT A-MPDU transmitted to each STA.

Upon receiving the VHT MU PPDU from the AP, STA 1 transmits a Block Acknowledgment (BA) frame to the AP after SIFS.

A more detailed description of the BA frame will be described later.

After receiving the BA from STA 1, the AP transmits a block acknowledgment request (BAR) frame to the next STA 2 after SIFS, and STA 2 transmits a BA frame to the AP after SIFS.

After receiving the BA frame from STA 2, the AP transmits a BAR frame to STA 3 after SIFS, and STA 3 transmits a BA frame to the AP after SIFS.

When this process is performed for all STAs, the AP transmits the next MU PPDU to all STAs.

ACK

(Acknowledgment)/block

ACK

(Block

ACK

) frame

In general, an ACK frame is used as a response to an MPDU, and a block ACK frame is used as a response to an A-MPDU.

15 is a diagram illustrating an ACK frame in a wireless communication system to which the present invention can be applied.

Referring to FIG. 15 , the ACK frame includes a frame control field, a duration field, an RA field, and an FCS.

The RA field is the second address (Address 2) field of a data frame, a management frame, a block ACK request frame, a block ACK (Block Ack) frame, or a PS-Poll frame received immediately before is set to the value of

When the ACK frame is transmitted by a non-QoS (non-QoS) STA, the More Fragments subfield in the Frame Control field of the immediately received Data frame and the Management frame is If '0', the duration value is set to '0'.

In the ACK frame that is not transmitted by the non-QoS (non-QoS) STA, the duration value is the immediately received data (Data) frame, the management frame, the block ACK request (Block Ack Request) frame, the block It is set to a value (ms) obtained by subtracting the time required for ACK frame transmission and the SIFS period from the Duration/ID field of the ACK (Block Ack) frame or the PS-Poll frame.

If the calculated duration value is not an integer value, it is rounded up.

Hereinafter, a block ACK (request) frame will be described.

16 is a diagram illustrating a block ACK request frame in a wireless communication system to which the present invention can be applied.

Referring to Figure 16, the block ACK request (BAR) frame is a frame control (Frame Control) field, duration / identifier (Duration / ID) field, receiving address (RA) field, transmission address (TA) field, BAR control (It consists of a BAR control field, a BAR information field, and a frame check sequence (FCS).

The RA field may be set to the address of the STA that receives the BAR frame.

The TA field may be set to the address of the STA transmitting the BAR frame.

The BAR control field includes a BAR Ack Policy subfield, a Multi-TID subfield, a Compressed Bitmap subfield, a Reserved subfield, and a TID information (TID_Info) subfield. includes

Table 9 is a table illustrating the BAR control field.

The BAR Information field includes different information according to the type of the BAR frame.

This will be described with reference to FIG. 17 .

17 is a diagram illustrating a BAR information field of a block ACK request frame in a wireless communication system to which the present invention can be applied.

Figure 17 (a) illustrates the BAR Information field of the Basic BAR frame and the Compressed BAR frame, and Figure 17 (b) illustrates the BAR Information field of the Multi-TID BAR frame.

Referring to FIG. 17(a), in the case of a Basic BAR frame and a Compressed BAR frame, the BAR Information field includes a Block Ack Starting Sequence Control subfield.

In addition, the Block Ack Starting Sequence Control subfield includes a fragment number subfield and a starting sequence number subfield.

The Fragment Number subfield is set to 0.

In the case of a Basic BAR frame, the Starting Sequence Number subfield contains the sequence number of the first MSDU in which the corresponding BAR frame is transmitted.

In the case of a Compressed BAR frame, the Starting Sequence Control subfield includes the sequence number of the first MSDU or A-MSDU for transmitting the corresponding BAR frame.

Referring to FIG. 17(b), in the case of a Multi-TID BAR frame, the BAR Information field includes a per TID Info subfield and a Block Ack Starting Sequence Control subfield including one or more TIDs. It is composed by repetition.

The Per TID Info subfield includes a Reserved subfield and a TID Value subfield.

The TID Value subfield contains a TID value.

The Block Ack Starting Sequence Control subfield includes the Fragment Number and Starting Sequence Number subfields as described above.

The Fragment Number subfield is set to 0.

The Starting Sequence Control subfield contains the sequence number of the first MSDU or A-MSDU for which the corresponding BAR frame is to be transmitted.

18 is a diagram illustrating a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

Referring to FIG. 18 , the block ACK (BA) frame includes a frame control field, a duration/identifier (Duration/ID) field, a receiving address (RA) field, a transmission address (TA) field, and a BA control (BA) field. control) field, a BA Information field, and a frame check sequence (FCS).

The RA field may be set to the address of the STA that requested the block ACK.

The TA field may be set to the address of the STA transmitting the BA frame.

The BA control field is a BA Ack Policy subfield, a Multi-TID subfield, a Compressed Bitmap subfield, a Reserved subfield, and a TID information (TID_Info) subfield. includes

Table 10 is a table illustrating the BA control field.

The BA Information field includes different information according to the type of the BA frame.

This will be described with reference to FIG. 19 .

19 is a diagram illustrating a BA Information field of a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

19(a) illustrates the BA Information field of the Basic BA frame, FIG. 19(b) illustrates the BA Information field of the Compressed BA frame, and FIG. 19(c) illustrates the BA Information field of the Multi-TID BA frame. exemplify

Referring to FIG. 19(a), in the case of a Basic BA frame, the BA Information field includes a Block Ack Starting Sequence Control subfield and a Block Ack Bitmap subfield.

The Block Ack Starting Sequence Control subfield includes a Fragment Number subfield and a Starting Sequence Number subfield as described above.

The Fragment Number subfield is set to 0.

The Starting Sequence Number subfield contains the sequence number of the first MSDU for which the corresponding BA frame is transmitted, and is set to the same value as the previously received Basic BAR frame.

The Block Ack Bitmap subfield has a length of 128 octets and is used to indicate the reception status of up to 64 MSDUs.

In the Block Ack Bitmap subfield, a value of '1' indicates that the MPDU corresponding to the corresponding bit position has been successfully received, and a value of '0' indicates that the MPDU corresponding to the corresponding bit position has not been successfully received.

Referring to FIG. 19B , in the case of a compressed BA frame, the BA Information field includes a Block Ack Starting Sequence Control subfield and a Block Ack Bitmap subfield.

The Block Ack Starting Sequence Control subfield includes a Fragment Number subfield and a Starting Sequence Number subfield as described above.

The Fragment Number subfield is set to 0.

The Starting Sequence Number subfield contains the sequence number of the first MSDU or A-MSDU for the corresponding BA

frame to be transmitted, and is set to the same value as the Basic BAR frame received immediately before.

The Block Ack Bitmap subfield has a length of 8 octets and is used to indicate the reception status of up to 64 MSDUs and A-MSDUs.

In the Block Ack Bitmap subfield, a value of '1' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received, and a value of '0' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received. indicates that it has not been received.

Referring to FIG. 19(c) , in the case of a Multi-TID BA frame, the BA Information field includes a per TID Info subfield, a Block Ack Starting Sequence Control subfield, and a block ACK bit. A map (Block Ack Bitmap) subfield is repeatedly configured for each of one or more TIDs, and is configured in an increasing order of TIDs.

The Per TID Info subfield includes a Reserved subfield and a TID Value subfield.

The TID Value subfield contains a TID value.

The Block Ack Starting Sequence Control subfield includes the Fragment Number and Starting Sequence Number subfields as described above.

The Fragment Number subfield is set to 0.

The Starting Sequence Control subfield includes the sequence number of the first MSDU or A-MSDU for which the corresponding BA frame is to be transmitted.

The Block Ack Bitmap subfield consists of a length of 8 octets.

In the Block Ack Bitmap subfield, a value of '1' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received, and a value of '0' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received. indicates that it has not been received.

Uplink multi-user transmission method

A new frame for the next-generation WLAN system, the 802.11ax system, in a situation where there is a lot of interest from vendors in various fields for next-generation WiFi and the demand for high throughput and quality of experience (QoE) performance improvement after 802.11ac is increasing. There is an active discussion of format and numerology.

IEEE 802.11ax is one of the recently proposed WLAN systems as a next-generation WLAN system to support a higher data rate and handle a higher user load, so-called High Efficiency WLAN (HEW). It is called Efficiency WLAN).

The IEEE 802.11ax WLAN system may operate in the 2.4 GHz frequency band and the 5 GHz frequency band in the same way as the existing WLAN system.

It can also operate in a higher 60 GHz frequency band.

In the IEEE 802.11ax system, for average throughput enhancement and outdoor robust transmission against inter-symbol interference in an outdoor environment, the existing IEEE 802.11 OFDM system (IEEE 802.11a, 802.11n) , 802.11ac, etc.) can use an FFT size four times larger at each bandwidth.

This will be described with reference to the drawings below.

Hereinafter, in the description of the HE format PPDU in the present invention, the description of the non-HT format PPDU, the HT-mixed format PPDU, the HT-greenfield format PPDU and / or the VHT format PPDU described above is HE format even if there is no separate mention. It may be incorporated into the description of the PPDU.

20 is a diagram illustrating a High Efficiency (HE) format PPDU according to an embodiment of the present invention.

20(a) illustrates a schematic structure of a HE format PPDU, and FIGS. 20(b) to (d) illustrate a more specific structure of an HE format PPDU.

Referring to FIG. 20(a), the HE format PPDU for HEW may be largely composed of a legacy part (L-part: legacy-part), an HE part (HE-part), and a data field (HE-data).

The L-part consists of an L-STF field, an L-LTF field, and an L-SIG field in the same way as in the form maintained in the existing WLAN system.

The L-STF field, the L-LTF field, and the L-SIG field may be referred to as a legacy preamble.

The HE-part is a part newly defined for the 802.11ax standard, and may include a HE-STF field, a HE-SIG field, and a HE-LTF field.

Although the order of the HE-STF field, the HE-SIG field, and the HE-LTF field is exemplified in FIG. 25(a), it may be configured in a different order.

Also, HE-LTF may be omitted.

The HE-STF field and the HE-LTF field as well as the HE-SIG field may be collectively referred to as a HE-preamble.

In addition, L-part and HE-part (or HE-preamble) may be collectively referred to as a physical preamble (PHY (physical) preamble).

The HE-SIG may include information (eg, OFDMA, UL MU MIMO, enhanced MCS, etc.) for decoding the HE-data field.

The L-part and the HE-part may have different Fast Fourier Transform (FFT) sizes (ie, subcarrier spacing), and may use different cyclic prefixes (CPs).

802.11

In the ax system, it is possible to use an FFT size that is 4 times larger (4×) compared to the legacy WLAN system.

That is, the L-part may be configured in a 1× symbol structure, and the HE-part (particularly, HE-preamble and HE-data) may be configured in a 4× symbol structure.

Here, FFTs of 1×, 2×, and 4× sizes refer to sizes relative to legacy WLAN systems (eg, IEEE 802.11a, 802.11n, 802.11ac, etc.).

For example, if the FFT size used for the L-part is 64, 128, 256, and 512 at 20 MHz, 40 MHz, 80 MHz, and 160 MHz, respectively, the FFT size used for the HE-part is 256 at 20 MHz, 40 MHz, 80 MHz and 160 MHz, respectively. , 512, 1024, 2048.

As described above, when the FFT size is larger than that of the legacy WLAN system, the subcarrier frequency spacing is reduced, so the number of subcarriers per unit frequency is increased, but the OFDM symbol length is increased.

That is, the use of a larger FFT size means that the subcarrier spacing becomes narrow, and similarly, the IDFT (Inverse Discrete Fourier Transform)/DFT (Discrete Fourier Transform) period increases.

Here, the IDFT/DFT period may mean a symbol length excluding the guard period (GI) in the OFDM symbol.

Therefore, if an FFT size 4 times larger than that of the L-part is used for the HE-part (in particular, HE-preamble and HE-data), the subcarrier spacing of the HE-part is 1/4 of the subcarrier spacing of the L-part. is doubled, and the IDFT/DFT period of the HE-part is 4 times the IDFT/DFT period of the L-part.

For example, if the subcarrier spacing of the L-part is 312.5kHz (=20MHz/64, 40MHZ/128, 80MHz/256 and/or 160MHz/512), the subcarrier spacing of the HE-part is 78.125kHz (=20MHz/256) , 40 MHz/512, 80 MHz/1024 and/or 160 MHz/2048).

In addition, if the IDFT/DFT period of the L-part is 3.2 μs (=1/312.5 kHz), the IDFT/DFT period of the HE-part may be 12.8 μs (=1/78.125 kHz).

Here, since one of 0.8 μs, 1.6 μs, and 3.2 μs can be used for the GI, the OFDM symbol length (or symbol interval) of the HE-part including the GI is 13.6 μs, 14.4 μs, or 16 depending on the GI. It may be μs.

Referring to FIG. 20B , the HE-SIG field may be divided into a HE-SIG-A field and a HE-SIG-B field.

For example, the HE-part of the HE format PPDU includes a HE-SIG-A field having a length of 12.8 μs, a HE-STF field of 1 OFDM symbol, one or more HE-LTF fields, and a HE-SIG-B field of 1 OFDM symbol. may include

In addition, from the HE-STF field except for the HE-SIG-A field in the HE-part, an FFT having a size 4 times larger than that of the existing PPDU may be applied.

That is, FFTs of sizes 256, 512, 1024 and 2048 may be applied from the HE-STF field of the HE format PPDU of 20 MHz, 40 MHz, 80 MHz, and 160 MHz, respectively.

However, when the HE-SIG is divided into the HE-SIG-A field and the HE-SIG-B field and transmitted as shown in FIG. 20(b), the positions of the HE-SIG-A field and the HE-SIG-B field are shown in FIG. 25(b).

For example, the HE-SIG-B field may be transmitted after the HE-SIG-A field, and the HE-STF field and the HE-LTF field may be transmitted after the HE-SIG-B field.

In this case as well, an FFT having a size 4 times larger than that of the existing PPDU may be applied from the HE-STF field.

Referring to FIG. 20(c) , the HE-SIG field may not be divided into a HE-SIG-A field and a HE-SIG-B field.

For example, the HE-part of the HE format PPDU may include a HE-STF field of 1 OFDM symbol, a HE-SIG field of 1 OFDM symbol, and one or more HE-LTF fields.

Similarly to the above, an FFT having a size 4 times larger than that of the existing PPDU may be applied to the HE-part.

That is, FFTs of sizes 256, 512, 1024 and 2048 may be applied from the HE-STF field of the HE format PPDU of 20 MHz, 40 MHz, 80 MHz, and 160 MHz, respectively.

Referring to FIG. 20(d) , the HE-SIG field is not divided into a HE-SIG-A field and a HE-SIG-B field, and the HE-LTF field may be omitted.

For example, the HE-part of the HE format PPDU may include a HE-STF field of 1 OFDM symbol and a HE-SIG field of 1 OFDM symbol.

Similarly to the above, an FFT having a size 4 times larger than that of the existing PPDU may be applied to the HE-part.

That is, FFTs of sizes 256, 512, 1024 and 2048 may be applied from the HE-STF field of the HE format PPDU of 20 MHz, 40 MHz, 80 MHz, and 160 MHz, respectively.

The HE format PPDU for the WLAN system according to the present invention may be transmitted through at least one 20 MHz channel.

For example, the HE format PPDU may be transmitted in a frequency band of 40 MHz, 80 MHz, or 160 MHz through a total of four 20 MHz channels.

This will be described in more detail with reference to the drawings below.

21 is a diagram illustrating an HE format PPDU according to an embodiment of the present invention.

21 illustrates a PPDU format when 80 MHz is allocated to one STA (or when OFDMA resource units are allocated to a plurality of STAs within 80 MHz) or when different streams of 80 MHz are allocated to a plurality of STAs, respectively.

Referring to FIG. 21 , L-STF, L-LTF, and L-SIG may be transmitted in OFDM symbols generated based on 64 FFT points (or 64 subcarriers) in each 20 MHz channel.

Also, the HE-SIG B field may be located after the HE-SIG A field.

In this case, the size of the FFT per unit frequency may become larger after the HE-STF (or HE-SIG B).

For example, from HE-STF (or HE-SIG B), 256 FFTs may be used in a 20 MHz channel, 512 FFTs may be used in a 40 MHz channel, and 1024 FFTs may be used in an 80 MHz channel.

The HE-SIG A field may include common control information commonly transmitted to STAs receiving the PPDU.

The HE-SIG A field may be transmitted in 1 to 3 OFDM symbols.

The HE-SIG A field is copied in units of 20 MHz and includes the same information.

In addition, the HE-SIG-A field informs the overall bandwidth information of the system.

Table 11 is a table illustrating information included in the HE-SIG A field.

Information included in each field illustrated in Table 11 may follow the definition of the IEEE 802.11 system.

In addition, each of the fields described above corresponds to an example of fields that may be included in the PPDU, but is not limited thereto.

That is, each field described above may be replaced with another field or additional fields may be further included, and all fields may not necessarily be included.

Another embodiment of information included in the HE-SIG A field will be described below with reference to FIG. 34 .

HE-STF is used to improve the performance of AGC estimation in MIMO transmission.

The HE-SIG B field may include user-specific information required for each STA to receive its own data (eg, PSDU).

The HE-SIG B field may be transmitted in one or two OFDM symbols.

For example, the HE-SIG B field may include information about a modulation and coding scheme (MCS) of the corresponding PSDU and the length of the corresponding PSDU.

The L-STF, L-LTF, L-SIG and HE-SIG A fields may be repeatedly transmitted in units of 20 MHz channels.

For example, when a PPDU is transmitted through four 20 MHz channels (ie, an 80 MHz band), the L-STF, L-LTF, L-SIG, and HE-SIG A fields may be repeatedly transmitted in every 20 MHz channel. .

If the FFT size increases, the legacy STA supporting the existing IEEE 802.11a/g/n/ac may not be able to decode the corresponding HE PPDU.

In order for the legacy STA and the HE STA to coexist, the L-STF, L-LTF, and L-SIG fields are transmitted through 64 FFT on a 20 MHz channel so that the legacy STA can receive them.

For example, the L-SIG field occupies one OFDM symbol, one OFDM symbol time may be 4 μs, and the GI may be 0.8 μs.

The FFT size for each frequency unit may be increased from HE-STF (or HE-SIG A).

For example, 256 FFTs may be used in a 20 MHz channel, 512 FFTs may be used in a 40 MHz channel, and 1024 FFTs may be used in an 80 MHz channel.

As the size of the FFT increases, the spacing between OFDM subcarriers decreases, so that the number of OFDM subcarriers per unit frequency increases, but the OFDM symbol time increases.

In order to improve system efficiency, the length of the GI after the HE-STF may be set to be the same as the length of the GI of the HE-SIG A.

The HE-SIG A field may include information required for the HE STA to decode the HE PPDU.

However, the HE-SIG A field may be transmitted through 64 FFT on a 20 MHz channel so that both the legacy STA and the HE STA can receive it.

This is because the HE STA can receive not only the HE format PPDU but also the existing HT/VHT format PPDU, and the legacy STA and the HE STA must distinguish between the HT/VHT format PPDU and the HE format PPDU.

22 is a diagram illustrating an HE format PPDU according to an embodiment of the present invention.

In FIG. 22 , it is assumed that 20 MHz channels are allocated to different STAs (eg, STA 1 , STA 2 , STA 3 , and STA 4).

Referring to FIG. 22 , the FFT size per unit frequency may be increased from HE-STF (or HE-SIG-B).

For example, from HE-STF (or HE-SIG-B), 256 FFTs may be used in a 20 MHz channel, 512 FFTs may be used in a 40 MHz channel, and 1024 FFTs may be used in an 80 MHz channel.

Since the information transmitted in each field included in the PPDU is the same as the example of FIG. 26 above, the following description will be omitted.

The HE-SIG-B field may include information specific to each STA, but may be encoded over the entire band (ie, indicated in the HE-SIG-A field).

That is, the HE-SIG-B field includes information on all STAs and is received by all STAs.

The HE-SIG-B field may inform frequency bandwidth information allocated to each STA and/or stream information in a corresponding frequency band.

For example, in FIG. 27 , in HE-SIG-B, 20 MHz to STA 1, 20 MHz to STA 2, 20 MHz to STA 3, and 20 MHz to STA 4 may be allocated.

In addition, STA 1 and STA 2 may allocate 40 MHz, and STA 3 and STA 4 may allocate the next 40 MHz.

In this case, STA 1 and STA 2 may allocate different streams, and STA 3 and STA 4 may allocate different streams.

In addition, by defining the HE-SIG-C field, the HE-SIG-C field may be added to the example of FIG. 27 .

In this case, in the HE-SIG-B field, information on all STAs is transmitted over the entire band, and control information specific to each STA may be transmitted in units of 20 MHz through the HE-SIG-C field.

In addition, unlike the examples of FIGS. 21 and 22 , the HE-SIG-B field may not be transmitted over the entire band, but may be transmitted in units of 20 MHz in the same manner as the HE-SIG-A field.

This will be described with reference to the drawings below.

23 is a diagram illustrating an HE format PPDU according to an embodiment of the present invention.

In FIG. 23 , it is assumed that 20 MHz channels are allocated to different STAs (eg, STA 1 , STA 2 , STA 3 , and STA 4).

Referring to FIG. 23 , the HE-SIG-B field is not transmitted over the entire band, but is transmitted in units of 20 MHz like the HE-SIG-A field.

However, in this case, HE-SIG-B is encoded and transmitted in units of 20 MHz differently from the HE-SIG-A field, but may not be copied and transmitted in units of 20 MHz.

In this case, the FFT size per unit frequency may be larger from HE-STF (or HE-SIG-B).

For example, from HE-STF (or HE-SIG-B), 256 FFTs may be used in a 20 MHz channel, 512 FFTs may be used in a 40 MHz channel, and 1024 FFTs may be used in an 80 MHz channel.

Since the information transmitted in each field included in the PPDU is the same as the example of FIG. 26 above, the following description will be omitted.

The HE-SIG-A field is transmitted by being duplicated in units of 20 MHz.

The HE-SIG-B field may inform frequency bandwidth information allocated to each STA and/or stream information in a corresponding frequency band.

Since the HE-SIG-B field includes information on each STA, information on each STA may be included for each HE-SIG-B field in units of 20 MHz.

In this case, the example of FIG. 23 exemplifies a case in which 20 MHz is allocated to each STA. For example, when 40 MHz is allocated to an STA, the HE-SIG-B field may be copied and transmitted in units of 20 MHz.

In a situation in which different bandwidths are supported for each BSS, when a partial bandwidth with a low interference level from an adjacent BSS is allocated to an STA, it may be preferable not to transmit the HE-SIG-B field over the entire band as described above. .

Hereinafter, for convenience of description, the HE format PPDU of FIG. 28 will be described.

21 to 23 , the data field is a payload and may include a SERVICE field, a scrambled PSDU, tail bits, and padding bits.

Meanwhile, the HE format PPDU as shown in FIGS. 21 to 23 may be distinguished through a Repeated L-SIG (RL-SIG) field, which is a repeated symbol of the L-SIG field.

The RL-SIG field is inserted before the HE SIG-A field, and each STA may use the RL-SIG field to distinguish the received PPDU format as the HE format PPDU.

Hereinafter, a multi-user uplink transmission method in a WLAN system will be described.

A method in which an AP operating in a WLAN system transmits data to a plurality of STAs on the same time resource may be referred to as DL MU transmission (downlink multi-user transmission).

Conversely, a method in which a plurality of STAs operating in a WLAN system transmit data to an AP on the same time resource may be referred to as UL MU transmission (uplink multi-user transmission).

Such DL MU transmission or UL MU transmission may be multiplexed on a frequency domain or a spatial domain.

When multiplexing in the frequency domain, different frequency resources (eg, subcarriers or tones) are allocated as downlink or uplink resources for each of a plurality of STAs based on orthogonal frequency division multiplexing (OFDMA). can

A transmission scheme through different frequency resources in the same time resource may be referred to as 'DL/UL MU

OFDMA transmission'.

In the case of multiplexing in the spatial domain, different spatial streams may be allocated as downlink or uplink resources to each of a plurality of STAs.

A transmission equation through different spatial streams in the same time resource may be referred to as 'DL/UL MU MIMO' transmission.

The current WLAN system cannot support UL MU transmission due to the following limitations.

Synchronization of the transmission timing of uplink data transmitted from a plurality of STAs is not supported in the current WLAN system.

For example, assuming that a plurality of STAs transmit uplink data through the same time resource in the existing WLAN system, in the current WLAN system, each of the plurality of STAs can know the transmission timing of uplink data of another STA. none.

Accordingly, it is difficult for the AP to receive uplink data from each of the plurality of STAs on the same time resource.

Also, in the current WLAN system, overlap between frequency resources used for transmitting uplink data by a plurality of STAs may occur.

For example, when an oscillator of each of a plurality of STAs is different, a frequency offset may appear differently.

If each of a plurality of STAs having different frequency offsets simultaneously performs uplink transmission through different frequency resources, some of the frequency domains used by each of the plurality of STAs may overlap.

In addition, power control for each of the plurality of STAs is not performed in the existing WLAN system.

Depending on the distance between each of the plurality of STAs and the channel environment and the channel environment, the AP may receive signals of different powers from each of the plurality of STAs.

In this case, a signal arriving with weak power may be relatively difficult to be detected by the AP compared to a signal arriving with strong power.

Accordingly, the present invention proposes a UL MU transmission method in a WLAN system.

24 is a diagram illustrating an uplink multi-user transmission procedure according to an embodiment of the present invention.

24, the AP instructs STAs participating in UL MU transmission to prepare for UL MU transmission, receives UL MU data frames from the corresponding STAs, and responds to the UL MU data frame with an ACK frame (BA (Block Ack) frame) is transmitted.

First, the AP instructs STAs to transmit UL MU data to prepare for UL MU transmission by transmitting a UL MU trigger frame (UL MU Trigger frame, 2410).

Here, the UL MU scheduling frame may be referred to as a 'UL MU scheduling frame'.

Here, the UL MU trigger frame 2410 may include control information such as STA identifier (ID)/address information, resource allocation information to be used by each STA, duration information, and the like.

The STA ID/address information means information on an identifier or address for specifying each STA that transmits uplink data.

The resource allocation information is an uplink transmission resource allocated to each STA (e.g., frequency/subcarrier information allocated to each STA in the case of UL MU OFDMA transmission, and a stream index allocated to each STA in the case of UL MU MIMO transmission). means information about

Duration information means information for determining a time resource for transmission of an uplink data frame transmitted by each of a plurality of STAs.

For example, the duration information includes information (eg, bits or symbols) about the duration information or uplink frame length of TXOP (Transmit Opportunity) allocated for uplink transmission of each STA. can

In addition, the UL MU trigger frame 2410 may further include control information such as MCS information and coding information to be used when transmitting the UL MU data frame for each STA.

The above control information is the HE-part (eg, HE-SIG A field or HE-SIG B field) of the PPDU carrying the UL MU trigger

frame 2410 or the control field of the UL MU trigger frame 2410 (eg, For example, it may be transmitted in the Frame Control field of the MAC frame, etc.).

A PPDU carrying the UL MU trigger frame 2410 has a structure starting with an L-part (eg, an L-STF field, an L-LTF field, an L-SIG field, etc.).

Accordingly, legacy STAs may perform Network Allocation Vector (NAV) setting through L-SIG protection from the L-SIG field.

For example, legacy STAs may calculate a period for NAV setting (hereinafter, 'L-SIG guard period') based on data length and data rate information in the L-SIG.

In addition, the legacy STAs may determine that there is no data to be transmitted to them during the calculated L-SIG guard period.

For example, the L-SIG guard period may be determined as the sum of the MAC duration field value of the UL MU trigger frame 2410 and the remaining period after the L-SIG field of the PPDU carrying the UL MU trigger frame 2410 .

Accordingly, the L-SIG guard period may be set to a value up to the period in which the ACK frame 2430 (or BA frame) transmitted to each STA is transmitted according to the MAC duration value of the UL MU trigger frame 2410 .

Hereinafter, a method of allocating resources for UL MU transmission to each STA will be described in more detail.

For convenience of explanation, fields including control information are divided and described, but the present invention is not limited thereto.

The first field may indicate UL MU OFDMA transmission and UL MU MIMO transmission separately.

For example, '0' may indicate UL MU OFDMA transmission, and '1' may indicate UL MU MIMO transmission.

The size of the first field may consist of 1 bit.

The second field (eg, STA ID/address field) informs STA IDs or STA addresses to participate in UL MU transmission.

The size of the second field may consist of the number of bits for informing the STA ID × the number of STAs participating in the UL MU.

For example, when the second field consists of 12 bits, the ID/address of each STA may be indicated by 4 bits.

The third field (eg, resource allocation field) indicates a resource region allocated to each STA for UL MU transmission.

In this case, the resource region allocated to each STA may be sequentially indicated to each STA according to the order of the previous second field.

If the first field value is '0', frequency information (eg, frequency index, subcarrier index, etc.) for UL MU transmission is indicated in the order of the STA ID/address included in the second field, When the 1 field value is '1', MIMO information (eg, stream index, etc.) for UL MU transmission is indicated in the order of the STA IDs/addresses included in the second field.

In this case, since several indexes (ie, frequency/subcarrier index or stream index) may be informed to one STA, the size of the third field is a plurality of bits (or may be configured in a bitmap format) × It may be configured with the number of STAs to participate in UL MU transmission.

For example, it is assumed that the second field is set in the order of 'STA 1' and 'STA 2', and the third field is set in the order of '2' and '2'.

In this case, when the first field is '0', frequency resources may be allocated to STA 1 from an upper (or lower) frequency domain, and subsequent frequency resources may be sequentially allocated to STA 2 .

For example, when OFDMA in units of 20 MHz is supported in an 80 MHz band, STA 1 may use an upper (or lower) 40 MHz band, and STA 2 may use the next 40 MHz band.

On the other hand, when the first field is '1', a higher (or lower) stream may be allocated to STA 1 and a next stream may be sequentially allocated to STA 2 .

In this case, the beamforming method according to each stream may be specified in advance, or more specific information on the beamforming method according to the stream may be included in the third field or the fourth field.

Each STA transmits UL MU data frames (UL MU Data frames, 2421, 2422, 2423) to the AP based on the UL MU trigger frame

2410 transmitted by the AP.

Here, after receiving the UL MU trigger frame 2410 from the AP, each STA may transmit the UL MU data frames 2421 , 2422 , and 2423 to the AP after SIFS.

Each STA may determine a specific frequency resource for UL MU OFDMA transmission or a spatial stream for UL MU MIMO transmission based on resource allocation information of the UL MU trigger frame 2410 .

Specifically, in the case of UL MU OFDMA transmission, each STA may transmit an uplink data frame on the same time resource through different frequency resources.

Here, each of STA 1 to STA 3 may be allocated different frequency resources for uplink data frame transmission based on STA ID/address information and resource allocation information included in the UL MU trigger frame 2410 .

For example, STA ID/address information may sequentially indicate STAs 1 to 3, and resource allocation information may sequentially indicate frequency resource 1, frequency resource 2, and frequency resource 3.

In this case, STAs 1 to 3 sequentially indicated based on STA ID/address information may be allocated frequency resource 1, frequency resource 2, and frequency resource 3 sequentially indicated based on resource allocation information.

That is, STA 1 may transmit uplink data frames 2421 , 2422 , and 2423 to the AP through frequency resource 1 , STA 2 frequency resource 2 , and STA 3 frequency resource 3 .

In addition, in the case of UL MU MIMO transmission, each STA may transmit an uplink data frame on the same time resource through at least one different stream among a plurality of spatial streams.

Here, each of STAs 1 to 3 may be allocated a spatial stream for uplink data frame transmission based on STA ID/address information and resource allocation information included in the UL MU trigger frame 2410 .

For example, STA ID/address information may sequentially indicate STAs 1 to 3, and resource allocation information may sequentially indicate spatial stream 1, spatial stream 2, and spatial stream 3.

In this case, STAs 1 to 3 sequentially indicated based on STA ID/address information may be allocated spatial stream 1, spatial stream 2, and spatial stream 3 sequentially indicated based on resource allocation information, respectively.

That is, STA 1 may transmit uplink data frames 2421 , 2422 , and 2423 to the AP through spatial stream 1 , STA 2 spatial stream 2 , and STA 3 spatial stream 3 .

The PPDU carrying the uplink data frames 2421, 2422, and 2423 can be configured with a new structure without the L-part.

In addition, in the case of UL MU MIMO transmission or UL MU OFDMA transmission in the form of a subband of less than 20 MHz, the L-part of the PPDU carrying the uplink data frames 2421, 2422, 2423 is in the SFN form (that is, all STAs have the same L-part configuration and content can be transmitted simultaneously).

On the other hand, in the case of UL MU OFDMA transmission in the form of a subband of 20 MHz or higher, the L-part of the PPDU carrying the uplink data frames 2421, 2422, 2423 is the L-part in the band to which each STA is allocated in units of 20 MHz. can be transmitted.

If the uplink data frame can be sufficiently configured with the information of the UL MU trigger frame 2410, the HE-SIG field in the PPDU that delivers the uplink data frames 2421, 2422, 2423 (that is, in the method of configuring the data frame) area for transmitting control information) may not be required.

For example, the HE-SIG-A field and/or the HE-SIG-B may not be transmitted.

In addition, the HE-SIG-A field and the HE-SIG-C field may be transmitted, and the HE-SIG-B field may not be transmitted.

The AP may transmit an ACK frame (ACK frame, 2430) (or BA frame) in response to the uplink data frames 2421 , 2422 , and 2423 received from each STA.

Here, the AP may receive uplink data frames 2421 , 2422 , and 2423 from each STA and transmit an ACK frame 2430 to each STA after SIFS.

If the same structure of the existing ACK frame is used, the RA field having a size of 6 octets may include the AIDs (or partial AIDs) of STAs participating in UL MU transmission.

Alternatively, if an ACK frame having a new structure is configured, it can be configured in a form for DL SU transmission or DL

MU transmission.

The AP may transmit only the ACK frame 2430 for the successfully received UL MU data frame to the corresponding STA.

In addition, the AP may inform whether reception was successful through ACK frame 2430 as ACK or NACK.

If the ACK frame 2430 includes NACK information, the reason for the NACK or information for a subsequent procedure (eg, UL MU scheduling information, etc.) may also be included.

Alternatively, the PPDU carrying the ACK frame 2430 may be configured in a new structure without an L-part.

The ACK frame 2430 may include STA ID or address information, but if the order of the STAs indicated in the UL MU trigger frame 2410 is equally applied, STA ID or address information may be omitted.

In addition, by extending the TXOP (ie, L-SIG guard period) of the ACK frame 2430, a frame for the next UL MU scheduling or a control frame including correction information for the next UL MU transmission is included in the TXOP. may be

Meanwhile, for UL MU transmission, an adjustment process such as synchronization between STAs may be added.

25 to 27 are diagrams illustrating resource allocation units in an OFDMA multi-user transmission scheme according to an embodiment of the present invention.

When the DL/UL OFDMA transmission scheme is used, a plurality of resource units may be defined in units of n tones (or subcarriers) within the PPDU bandwidth.

The resource unit means an allocation unit of frequency resources for DL/UL OFDMA transmission.

One or more resource units may be allocated as DL/UL frequency resources to one STA, and different resource units may be allocated to a plurality of STAs, respectively.

25 illustrates a case in which the PPDU bandwidth is 20 MHz.

20

Seven DC tones may be located in the center frequency region of the MHz PPDU bandwidth.

In addition, 6 left guard tones and 5 right guard tones may be located on both sides of the 20 MHz PPDU bandwidth, respectively.

According to the resource unit configuration method as shown in FIG. 25(a), one resource unit may be configured with 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 25(b), one resource unit may consist of 52 tones or 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 25(c), one resource unit may consist of 106 tones or 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 25(d), one resource unit may be configured with 242 tones.

26 A resource unit configured with tones may include 2 pilot tones, a resource unit configured with 52 tones may include 4 pilot tones, and a resource unit configured with 106 tones may include 4 pilot tones.

When a resource unit is configured as shown in FIG. 25(a), up to 9 STAs may be supported for DL/UL OFDMA transmission in a 20 MHz band.

In addition, when a resource unit is configured as shown in FIG. 25(b), up to 5 STAs may be supported for DL/UL OFDMA transmission in a 20 MHz band.

In addition, when a resource unit is configured as shown in FIG. 25C , up to three STAs may be supported for DL/UL OFDMA transmission in a 20 MHz band.

In addition, when a resource unit is configured as shown in 25(d), a 20 MHz band may be allocated to one STA.

Based on the number of STAs participating in DL/UL OFDMA transmission and/or the amount of data transmitted or received by the STA, any one resource unit configuration method in FIGS. 25(a) to 25(d) is applied or Alternatively, the resource unit

configuration method in which FIGS. 25 (a) to 25 (d) are combined may be applied.

26 illustrates a case in which the PPDU bandwidth is 40 MHz.

40

Five DC tones may be located in the center frequency region of the MHz PPDU bandwidth.

In addition, 12 left guard tones and 11 right guard tones may be located on both sides of the 40 MHz PPDU bandwidth, respectively.

According to the resource unit configuration method as shown in FIG. 26(a), one resource unit may consist of 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 26(b), one resource unit may consist of 52 tones or 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 26(c), one resource unit may consist of 106 tones or may consist of 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 26(d), one resource unit may consist of 242 tones.

In addition, according to the resource unit configuration method as shown in FIG. 26(e), one resource unit may consist of 484 tones.

26 A resource unit configured with tones may include 2 pilot tones, a resource unit configured with 52 tones may include 4 pilot tones, a resource unit configured with 106 tones may include 4 pilot tones, A resource unit configured with 242 tones may include 8 pilot tones, and a resource unit configured with 484 tones may include 16 pilot tones.

When a resource unit is configured as shown in FIG. 26(a), up to 18 STAs may be supported for DL/UL OFDMA transmission in a 40 MHz band.

In addition, when a resource unit is configured as shown in FIG. 26(b), up to 10 STAs may be supported for DL/UL OFDMA transmission in a 40 MHz band.

In addition, when a resource unit is configured as shown in FIG. 26(c), up to 6 STAs may be supported for DL/UL OFDMA transmission in a 40 MHz band.

In addition, when the resource unit is configured as shown in 26(d), up to two STAs may be supported for DL/UL OFDMA transmission in a 40 MHz band.

In addition, when a resource unit is configured as shown in 26(e), the resource unit may be allocated to one STA for SU DL/UL transmission in a 40 MHz band.

Based on the number of STAs participating in DL/UL OFDMA transmission and/or the amount of data transmitted or received by the STA, any one resource unit configuration method in FIGS. 26(a) to 26(e) is applied or Alternatively, a resource unit configuration method in which FIGS. 26(a) to 26(e) are combined may be applied.

27 exemplifies a case in which the PPDU bandwidth is 80 MHz.

80

Seven DC tones may be located in the center frequency region of the MHz PPDU bandwidth.

However, when the 80 MHz PPDU bandwidth is allocated to one STA (ie, when a resource unit composed of 996 tones is allocated to one STA), 5 DC tones may be located in the center frequency region.

In addition, 12 left guard tones and 11 right guard tones may be located on both sides of the 80 MHz PPDU bandwidth, respectively.

According to the resource unit configuration method as shown in FIG. 27(a), one resource unit may be configured with 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 27(b), one resource unit may consist of 52 tones or 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 27(c), one resource unit may consist of 106

tones or 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 27(d), one resource unit may consist of 242 tones or 26 tones.

According to the resource unit configuration method as shown in FIG. 27(e), one resource unit may consist of 484 tones or 26 tones.

According to the resource unit configuration method as shown in FIG. 27(f), one resource unit may consist of 996 tones.

26 A resource unit configured with tones may include 2 pilot tones, a resource unit configured with 52 tones may include 4 pilot tones, a resource unit configured with 106 tones may include 4 pilot tones, A resource unit configured with 242 tones may include 8 pilot tones, a resource unit configured with 484 tones may include 16 pilot tones, and a resource unit configured with 996 tones may include 16 pilot tones. .

When a resource unit is configured as shown in FIG. 27(a), up to 37 STAs may be supported for DL/UL OFDMA transmission in an 80 MHz band.

In addition, when a resource unit is configured as shown in FIG. 27(b), up to 21 STAs may be supported for DL/UL OFDMA transmission in an 80 MHz band.

In addition, when a resource unit is configured as shown in FIG. 27(c), up to 13 STAs may be supported for DL/UL OFDMA transmission in an 80 MHz band.

In addition, when the resource unit is configured as shown in 27(d), up to 5 STAs may be supported for DL/UL OFDMA transmission in an 80 MHz band.

In addition, when a resource unit is configured as shown in 27(e), up to three STAs may be supported for DL/UL OFDMA transmission in an 80 MHz band.

In addition, when a resource unit is configured as shown in 27(f), the corresponding resource unit may be allocated to one STA for SU DL/UL transmission in an 80 MHz band.

Based on the number of STAs participating in DL/UL OFDMA transmission and/or the amount of data transmitted or received by the STA, any one resource unit configuration method in FIGS. 27(a) to 27(f) is applied or Alternatively, a resource unit configuration method in which FIGS. 27(a) to 27(f) are combined may be applied.

In addition, although not shown in the drawings, a method of configuring a resource unit when the PPDU bandwidth is 160 MHz may also be proposed.

In this case, the bandwidth of the 160 MHz PPDU may have a structure in which the 80 MHz PPDU bandwidth described above with reference to FIG. 32 is repeated twice.

Only some resource units may be used for DL/UL OFDMA transmission among all the resource units determined according to the above-described resource unit configuration method.

For example, when a resource unit is configured within 20 MHz as shown in FIG. 30(a), one resource unit is allocated to less than nine STAs, respectively, and the remaining resource units may not be allocated to any STA.

In the case of DL OFDMA transmission, the data field of the PPDU is multiplexed and transmitted in the frequency domain in units of resource units allocated to each STA.

On the other hand, in the case of UL OFDMA transmission, the data field of the PPDU may be configured in units of resource units allocated to each STA for each STA and transmitted to the AP at the same time.

As each STA transmits the PPDU at the same time, the receiving end, the AP, may recognize that the data field of the PPDU transmitted from each STA is multiplexed and transmitted in the frequency domain.

In addition, when DL/UL OFDMA transmission and DL/UL MU-MIMO transmission are simultaneously supported, one resource unit may consist of a plurality of streams in a spatial domain.

In addition, one or more streams may be allocated as DL/UL spatial resources to one STA, and different streams may be allocated to a plurality of STAs, respectively.

For example, in FIG. 25(c) , a resource unit configured with 106 tones may be configured with a plurality of streams in a spatial

domain to simultaneously support DL/UL OFDMA and DL/UL MU-MIMO.

Channel state information feedback method of next-generation system

As described above, in the next-generation WLAN system, as OFDMA technology is introduced, UL MU transmission by an STA is made possible.

As a result, even in the sounding protocol (or sequence) for reporting (or feeding back) the channel state information (or feedback information) for the DL channel, it is difficult for a plurality of STAs to simultaneously transmit the channel state information to the AP by UL MU. made possible

In this case, it is necessary to allocate UL MU transmission resources to each STA so that a collision does not occur between channel state information transmitted by a plurality of STAs.

Therefore, in the sounding protocol of the next-generation system, a procedure for transmitting and receiving a trigger frame including allocation information (or trigger information) of UL MU transmission resources for each STA may be required, which will be described later in detail with reference to FIG. 28 . .

28 is a diagram illustrating a sounding protocol according to an embodiment of the present invention.

7 to 11 may be applied in the same/similar manner to this drawing, and differences from FIGS. 7 to 11 will be mainly described below.

Referring to FIG. 28, in order to obtain channel state information for the DL channel, the AP informs the transmission of the NDP frame 2820 (or initiates the sounding protocol) NDPA frame (or NDPA function/information) 2810. can be transmitted to STAs.

The NDPA frame 2810 may include control information regarding a sounding protocol.

For example, the NDPA frame 2810 may include feedback indication information (or sounding indication information) regarding which STA measures which DL channel, in which way, and the like.

Also, the AP may transmit an NDP frame (or NDP function/information) 2820 indicating information on a target DL channel to be measured by the STA to the STAs.

The NDP frame 2820 may include HE-STF/LTF indicating information on a target DL channel to be measured (or HE- for DL channel sounding (or DL CSI (Channel State Information)) STF/LTF may be included).

In this case, the NDP frame 2820 may include a number of HE-LTFs equal to or greater than the number of spatial streams to which the STA will report the channel state.

In addition, the AP may transmit a trigger frame (or trigger function/information) 2830 for triggering UL MU transmission to the STAs.

The trigger frame 2830 may include resource allocation information on UL MU resources allocated to each STA for UL MU transmission of channel state information for a DL channel.

In this case, the description of the frequency resource allocation unit that can be allocated to each STA is as described above with reference to FIGS. 25 to 27 .

STAs that have received the trigger frame 2830 may acquire channel state information by measuring a target DL channel indicated by the NDPA frame 2810 and the trigger frame 2830 .

STAs generate a feedback frame (or beamforming frame/beamforming feedback frame) 2840 including the acquired channel state information, and transmit the generated feedback frame 2840 using the UL MU resource allocated to the UL MU. can be transmitted

Compared with the sounding protocol in the legacy system shown in FIG. 7 , in this sounding protocol, STAs simultaneously transmit a feedback frame including channel state information to UL MU, so there is an effect that overhead is small in terms of time. .

In the sounding protocol proposed in this specification, the NDPA frame 2810 , the NDP frame 2820 , and the trigger frame 2830 may be transmitted through different DL PPDUs, or transmitted through one DL PPDU according to an embodiment. it might be

29 is a diagram illustrating a sounding protocol according to the first embodiment of the present invention.

Referring to FIG. 29 , the NDPA frame, the NDP frame, and the trigger frame may be transmitted by being included in different

DL PPDUs, respectively, and may be transmitted sequentially.

In this figure, the preamble means a physical preamble including a legacy preamble and an HE preamble.

However, the preamble of the DL PPDU including the NDP frame may mean a physical preamble including a HE preamble excluding HE-STF and/or HE-LTF and a legacy preamble, in which case the NDP frame includes HE-STF and/or HE-LTF. HE-LTF may be included.

That is, the DL PPDU including the NDP frame includes the legacy preamble to the HE-STF and/or HE-LTF, and may mean a physical preamble in which only the data part is excluded from the PPDU.

In this case, each DL PPDU may be sequentially (or continuously) DL-transmitted at a predetermined time interval (eg, short interframe space (SIFS)).

For example, a first DL PPDU including an NDPA frame may be transmitted and a second DL PPDU including an NDP frame may be transmitted after SIFS.

In addition, the second DL PPDU may be transmitted and the third DL PPDU including the trigger frame may be transmitted after the SIFS.

In addition, the third DL PPDU may be transmitted and the UL PPDU including the feedback frame may be transmitted after the SIFS.

As such, when the NDPA frame, the NDP frame, and the trigger frame are transmitted on different DL PPDUs, there is a problem in that the overhead is large.

In the case of the above-described example, it can be seen that the overhead is very large in terms of time due to the preamble of the second DL PPDU, the preamble of the third DL PPDU, and the second SIFS.

Therefore, in order to reduce such overhead, in the present specification, an NDPA frame, an NDP frame, and a trigger frame are included in one or two DL PPDUs and transmitted, and in this case, overlapping information is deleted and transmitted.

A more detailed description related thereto will be described later in detail with reference to FIG. 30 .

30 is a diagram illustrating a sounding protocol according to the second and third embodiments of the present invention.

More specifically, FIG. 30(a) is a diagram illustrating a sounding protocol according to a second embodiment of the present invention, and FIG. 30(b) is a diagram illustrating a sounding protocol according to a third embodiment of the present invention.

Referring to FIG. 30A , in order to reduce the overhead described in FIG. 29 , the AP may transmit an NDP frame and a trigger frame through one DL PPDU.

In other words, in order to reduce overhead, the AP may combine the NDP frame and the trigger frame and transmit it through one DL PPDU.

This may be expressed as that the AP generates at least one frame that performs both the function of the NDP frame (or the NDP function) and the function (or the trigger function) of the trigger frame, and transmits the frame through one DL PPDU. .

For example, the AP may transmit a first DL PPDU including an NDPA frame and, after SIFS, transmit a second DL PPDU including an NPD frame (NDP function) and a trigger frame (trigger function).

Upon receiving the first and second DL PPDUs, the STA(s) generates a feedback frame including channel state information on the DL channel for which measurement is instructed, and transmits the UL (SU/MU) PPDU carrying the generated feedback frame to the AP. can be sent to

In the case of the second embodiment, there is an advantage in that the overhead (physical preamble of the DL PPDU including the SIFS and the NDP frame) that may occur when the NDP frame and the trigger frame are transmitted through different DL PPDUs is eliminated.

Referring to FIG. 30B , in order to reduce the overhead described in FIG. 29 , the AP may transmit an NDPA frame, an NDP frame, and a trigger frame through one DL PPDU.

In other words, in order to reduce overhead, the AP may transmit an NDPA frame, an NDP frame, and a trigger frame by combining the trigger frame through one DL PPDU.

In this case, the AP generates at least one frame that performs both the function of the NDPA frame (or NDPA function), the

function of the NDP frame (or NDP function), and the function (or trigger function) of the trigger frame, and converts the frame into one It may be expressed as being transmitted through a DL PPDU.

For example, the AP may transmit a DL PPDU including all of an NDPA frame (NDPA function), an NDP frame (NDP function), and a trigger frame (trigger function) to the STA(s), from which the STA(s) after SIFS may transmit a UL (SU/MU) PPDU carrying a feedback frame including channel state information for a DL channel for which measurement is instructed to the AP.

In the case of the third embodiment, overhead (physical preambles of DL PPDUs including two SIFS and NDP/trigger frames) that may occur when an NDPA frame, an NDP frame, and a trigger frame are transmitted through different DL PPDUs are eliminated. There are advantages to being

However, when the AP simply combines and transmits the NDPA frame, the NDP frame, and the trigger frame, the overhead that the same information existing for each frame is duplicated in one DL PPDU occurs.

In addition, as OFDMA technology is introduced in the next-generation WLAN system, the AP instructs the STA to measure and feed back which frequency resource units (eg, 26-tone resource units located 2nd and 3rd from the left in a 20MHz channel) It may be necessary to additionally transmit frequency information.

Accordingly, information that may be included in a frame transmitted and received in the second or third embodiment is proposed below.

31 is a diagram illustrating information respectively included in an NDPA frame, an NDP frame, and a trigger frame according to an embodiment of the present invention.

Referring to FIG. 31, the NDPA frame (or NDPA function) includes frequency information (or field) in addition to sounding (dialog) token information (or field), AID information (or field) of STA, Nc index information (or field). may additionally be included.

Here, the frequency information may indicate information indicating a frequency resource unit that is a measurement target to which the STA will report the channel state as described above.

Accordingly, the STA that has received the frequency information may measure the channel state of the frequency resource unit indicated by the received frequency information and feedback (or report) it to the AP.

Such frequency information may be selectively included in an NDPA frame according to an embodiment.

Meanwhile, the NDPA frame shown in this figure is only an embodiment, and some information (or fields) of the illustrated information (or fields) may be excluded or new information may be included to form an NDPA frame.

In the case of the trigger frame, since AID information (or field) overlaps with AID information (or field) of the STA included in the NDPA frame, the corresponding AID information may be excluded.

In addition, if the frequency/spatial resource allocated for the STA to transmit the feedback frame to the UL MU for the feedback frame is preset (that is, if it is fixed to a frequency resource unit of a preset size), the trigger frame is a resource allocation information may also be excluded.

As such, when some information of the trigger frame is excluded and configured, the number of constituent bits of the trigger frame is reduced as much as the excluded information.

Accordingly, when performing the sounding protocol according to the second or third embodiment, the AP may combine the trigger frame with the NDPA frame and/or the NDP frame to form one frame.

Hereinafter, a DL PPDU format transmitted and received in the sounding protocol of the third embodiment will be described in more detail.

That is, the format of the DL PPDU when the NDPA frame, the NDP frame, and the trigger frame are transmitted through one DL PPDU will be described in detail below.

32 illustrates a DL PPDU format transmitted and received in a sounding protocol according to a third embodiment of the present invention.

33 is a diagram illustrating a specific embodiment of the DL PPDU format of FIG. 32(a).

In these figures, L preamble means a legacy preamble.

Also, in these drawings, a trigger frame may mean a frame performing an NDPA function and a trigger function.

That is, in the drawings, the trigger frame may mean a frame configured by combining the NDPA frame and the trigger frame.

Referring to FIG. 32(a), in a DL PPDU for channel sounding, a trigger frame may be positioned before HE-STF and HE-LTF and configured.

That is, the DL PPDU for channel sounding may be configured in the order of a legacy preamble, a trigger frame, HE-STF, and HE-LTF.

The HE-STF and HE-LTF located after the trigger frame may be used as information for STAs to measure the DL channel state.

The trigger frame may be configured in a PHY structure or a MAC structure.

More specifically, referring to FIG. 33(a), the trigger frame of the PHY structure may be composed of a HE-SIG A field and a HE-SIG B field.

In this case, the trigger information may be included in the HE-SIG B field, and the NDPA information may be included in the HE-SIG A field or the HE-SIG B field.

In addition, referring to FIG. 33(b), the trigger frame of the MAC structure may have a PPDU structure excluding the legacy preamble (L-STF/LTF/SIG).

For example, the trigger frame of the MAC structure may be configured in an HE frame format including trigger information.

Alternatively, the trigger frame of the MAC structure may be configured by including the HE-frame including the HE-preamble and trigger information for robust transmission of the outdoor environment.

STA(s) not instructed to measure (or report) the channel state (that is, STA(s) that do not include AID in the AID field of the NDPA frame (or information)) is indicated by the HE-SIG A/B field NAV setting can be made with the TXOP duration (see FIG. 33(a)) or the MAC duration indicated by the trigger frame (see FIG. 33(b)).

In addition, the STA(s) instructed to measure (or report) the channel state (that is, the STA(s) including the AID in the AID field of the NDPA frame (or information)) reads the L-SIG duration and length can be found.

More specifically, in the case of 33(a), the STA(s) can read the L-SIG duration from the legacy preamble and know the length of the HE-SIG A/B field corresponding to the trigger frame configured with the PHY structure.

Alternatively, in the case of the embodiment of 33(b), the STA(s) may read the L-SIG duration and know the length of the trigger frame configured in the MAC structure.

In addition, the STA(s) can read the trigger frame (or information) to know that the corresponding frame is a frame indicating measurement of the DL channel state.

Furthermore, the STA(s) may know, through the trigger frame (or information), that HE-STF/LTF for DL channel state measurement is included after the trigger frame, and the configuration thereof.

As a result, the STA(s) may measure the DL channel state using the corresponding HE-STF/LTF, and UL transmit the measurement result to the AP as a feedback frame.

In addition, although not shown in FIG. 33, in order to buy time for the STA instructed to measure the channel to prepare for the channel measurement, the HE-STF/LTF located after the trigger frame is not transmitted immediately after the trigger frame, but is spaced apart from the SIFS. may be transmitted.

In this case, the AP may leave the SIFS interval empty (ie, transmit no signal during SIFS) or transmit a dummy signal.

Alternatively, the AP may buy the STA channel measurement preparation time by adding MAC or PHY padding between the trigger frame and the HE-STF/LTF.

Referring back to FIG. 32(b), in the DL PPDU for channel sounding, the trigger frame may be configured to be located behind HE-STF and HE-LTF, unlike in 32(a).

That is, the DL PPDU for channel sounding may be configured in the order of a legacy preamble, a HE-SIG field (eg, a HE-SIG A/B/C field), a HE-STF, a HE-LTF, and a trigger frame.

The HE-STF and HE-LTF located after the trigger frame may be used as information for STAs to measure the DL channel state.

In this embodiment, the DL PPDU including the trigger frame may be configured in a DL MU PPDU (DL MU PPDU including trigger frame) structure proposed in the 802.11ax system.

However, the HE-STF/LTF positioned before the trigger frame may have its function extended not only for the STA to read the trigger frame, but also for the purpose of measuring the DL channel state.

For example, even though the trigger frame is transmitted through one spatial stream, the HE-LTF may carry all channel information regarding 8 spatial streams and may be transmitted.

To this end, the HE-LTF may be transmitted by being included in the DL PPDU in a number equal to or greater than the number of spatial streams to be measured.

Therefore, in the case of the above example, 8 (or 8 or more) HE-LTFs may be included in the DL PPDU and transmitted.

The STA that has received the HE-LTF can estimate the channel for one spatial stream to which the trigger frame is transmitted to read the trigger frame, and estimate/measure the channels of 8 spatial streams to measure the DL channel state, , it is possible to generate channel state information for the corresponding channel.

If the AP instructs to report channel state information only for some spatial streams among all spatial streams (eg, through an NDPA frame (or information)), the STA only reports on the spatial stream specified by the AP. A channel may be estimated/measured, and a measurement result may be fed back to the AP.

An embodiment in which the AP indicates a channel measurement area (frequency/spatial stream) will be described in more detail below.

UL MU transmission of feedback frame

In order for STAs to simultaneously UL MU transmit a feedback frame without collision, each STA needs to know what resource unit is allocated to it.

To this end, as an embodiment, each STA may directly receive resource allocation information (or trigger information) for feedback frame transmission from the AP through a trigger frame.

Alternatively, as another embodiment, in order to reduce signaling overhead, a resource unit allocated to each STA for transmitting a feedback frame may be predetermined in advance.

Alternatively, each STA may directly obtain/guess resource allocation information for feedback frame transmission by calculating according to a preset equation.

A frequency unit may be defined as a minimum unit of a frequency resource allocated to each STA for feedback frame transmission.

Here, the frequency unit may be a concept corresponding to the resource unit described above with reference to FIGS. 25 to 27 .

Thus, a frequency unit may correspond to 26 tons, 52 tons, 106 tons, 242 tons, 484 tons or 996 tons resource units.

Hereinafter, for convenience of description, a case in which the frequency unit is a 26-ton resource unit will be described.

A predetermined number of frequency units may be sequentially allocated in the order of STA AIDs included in the AID field, and the number of frequency units allocated to each STA may be determined by the method proposed below.

1. How to divide and allocate by the number of STAs

The AP may allocate to each STA the number of frequency units obtained by dividing the total frequency units that can be allocated to the STAs by the number of STAs for UL MU transmission of the feedback frame.

That is, when (total number of frequency units/number of STAs = x, where x is a natural number), the AP may allocate x frequency units to each STA.

When the total number of allocable frequency units is not divided by the number of STAs, the frequency units located in the middle may be left blank without allocating to any STA, or may be allocated to a specific STA.

For example, the AP may allocate frequency units to a specific STA by the number (y) obtained by rounding up the number obtained by dividing all allocable frequency units by the number of STAs (ie, (ceiling(x) = y)), and to the remaining STAs It is possible to allocate as many frequency units as the number (z) rounded down (that is, (floor(x) = z)).

As such, the frequency units for which the number of allocations are determined may be sequentially allocated to each STA in the frequency domain.

For example, if three 26-tone resource units for feedback frame transmission are allocated to each of STAs 1 to 3, 26 tone resource units located in the first to third positions in the 20 MHz channel are assigned to STA 1, and the 20 MHz channel to STA 2 26 tone resource units located in fourth to sixth positions in , and 26 tone resource units located in seventh to ninth positions in a 20 MHz channel may be allocated to STA 3, respectively.

Therefore, each STA finds out the location of the frequency unit assigned to it by accumulating and calculating the number of frequency units assigned to STAs corresponding to other AIDs listed before its AID in the AID field included in the NDPA frame or trigger frame. can

2. How to allocate according to the amount of Feedback

The AP may determine the number of frequency units allocated to each STA based on the amount of feedback information to be transmitted by each STA.

More specifically, the AP may determine the number of frequency units allocated to each STA in proportion to the amount of feedback information (or the amount of channel state information) to be transmitted by each STA.

As an embodiment, the AP may determine the number of frequency units allocated to each STA based on the number of spatial streams to be fed back by each STA.

More specifically, the AP may determine the number of frequency units allocated to each STA in proportion to the number of spatial streams to be fed back to each STA.

For example, the AP may instruct STA 1 to feed back a channel state for one spatial stream and to STA 2 to feed back a channel state for eight spatial streams.

In this case, STA 1 needs to transmit channel state information for one spatial stream and STA 2 UL MU transmit channel state information for eight spatial streams, so the amount of feedback information to be transmitted by STA 2 may be greater than that of STA 1. have.

Accordingly, the AP may allocate one frequency unit to STA 1 and 8 frequency units to STA 2, respectively.

As another embodiment, the AP may determine the number of frequency units allocated to each STA based on a feedback unit in which each STA generates a feedback value.

More specifically, the AP may determine the number of frequency units allocated to each STA in inverse proportion to a feedback unit in which each STA generates a feedback value.

Here, the feedback value may include a signal to noise ratio (SNR) or a beamforming feedback matrix (or a beamforming feedback vector) of a predetermined feedback unit for an MCS level or a spatial stream, and if the beamforming method is changed, the changed beamforming It may include all beamforming feedback values for the method.

As the feedback unit in which the STA generates a feedback value increases, the amount of information to be fed back decreases, and as the feedback unit is smaller, the amount of information to be fed back increases.

For example, it may be assumed that the feedback unit for which the STA should generate a feedback value is 26 tons.

In this case, the STA needs to generate (or acquire) one feedback value every 26 tones, and in order to give feedback for a 20 MHz channel, the STA generates (or acquires) a total of 9 feedback values and transmits it to the AP as channel state information. .

Conversely, it may be assumed that the feedback unit for which the STA should generate a feedback value is a 20 MHz channel.

In this case, the STA should generate (or acquire) a total of one feedback value for the 20 MHz channel and transmit it to the AP as channel state information.

That is, the larger the feedback unit that the STA needs to feedback (or generate a feedback value) is, the smaller the amount of feedback information (or the amount of channel state information). Allocate frequency units.

As another embodiment, since the STAs know the length of the UL MU feedback frame by being instructed by the AP, the frequency unit required to transmit feedback information (or channel state information) to be transmitted according to the length of the UL MU feedback frame. can be directly calculated.

In addition, the STA accumulates and calculates not only the number of frequency units allocated to itself but also the number of frequency units allocated to other STA(s) corresponding to the AID(s) listed in front of the AID in the AID field. The frequency unit can be located.

3. How AP directly allocates

The AP may directly allocate at least one frequency unit to each STA, and transmit allocation information (or resource allocation information) of the frequency unit to each STA through a trigger frame.

In this case, the allocation information of the frequency unit may be signaled in various embodiments.

As an embodiment, the resource allocation information may be signaled to indicate the number of frequency units allocated to the STA as a bit value.

For example, when nine 26-tone resource units of a 20 MHz channel are allocated to each STA as a frequency unit, the resource allocation information may be configured with a bit size of 3 bits.

In this case, bit values '000' to '111' of the resource allocation information may indicate allocation of 1/2/3/4/5/6/7/9 frequency units (or 26 tone resource units), respectively. .

That is, upon receiving the resource allocation information of '000', the STA may recognize that there is one frequency unit (or 26 tone resource unit) allocated thereto, and may transmit a feedback frame to the UL MU using this.

As another embodiment, the frequency unit allocation information may be signaled to indicate the number of frequency units allocated to the STA in a toggle method.

For example, when nine 26-tone resource units of a 20 MHz channel are allocated to each STA as a frequency unit, the resource allocation information may consist of 9 bits sequentially corresponding to the nine 26-tone resource units.

In this case, the bit value of each of the plurality of bits constituting the resource allocation information may be switched to a bit value different from the bit value of the previous bit as the STA to which the resource unit corresponding to each bit is allocated is changed to another STA. have.

For example, resource allocation information of '000110011' may indicate that 3/2/2/2 frequency units are allocated, respectively, in the order of STAs included in the AID field.

4. How the AP indicates the index of the frequency unit

In the above-described embodiments, each STA directly acquires the position on the channel of the frequency unit assigned to it by accumulating and calculating the number of frequency units assigned to other STAs corresponding to the AID listed before its AID through the AID field. (or calculate).

However, such information may also be explicitly indicated to each STA as trigger information by the AP directly.

In this case, a different index may be allocated to each of the frequency units (or resource units) existing in the channel for each location, and the AP transmits these indexes to the STA to indicate the location of the frequency unit allocated to each STA. can

Assuming that the AP allocates frequency units continuously located on a frequency channel to each STA, the AP will inform only the index of the frequency unit located at the starting point (or the leftmost or the rightmost) among the frequency units continuously allocated to the STA. can

In this case, according to the above-described embodiments, since each STA can know the number of frequency units allocated to it, it can know the frequency units allocated to it by counting the number of frequency units allocated to it from the starting point. .

Alternatively, each STA does not apply the above-described embodiment, and reads the start point index of the frequency unit assigned to it and the start point index of the frequency unit assigned to the STA in the next order to determine the number and location of frequency units assigned to it. Able to know.

Alternatively, the AP may inform the index of the frequency unit located at the end point (or the last) among the frequency units allocated to each STA instead of the start point index.

In this case, each STA may additionally read the end point index of the STA corresponding to the AID before its AID from the received AID field to know the number and location of frequency units allocated to it.

As described above, a method for allocating and instructing UL MU resources to each STA for UL MU transmission of a feedback frame has been described.

A frequency unit for transmitting a feedback frame is allocated to each STA according to the above-described embodiments.

In this case, a case may occur in which the total number of frequency units allocated to the STA is greater than the number of frequency units included in the channel.

In this case, some STAs may transmit a feedback frame at the next opportunity.

To this end, the AP may receive the UL MU feedback frame and transmit a beamforming report poll frame or a trigger frame serving as a polling/ACK after SIFS, and information included in the trigger frame may be as follows.

- ACK information for previously fed back information

- The AID of the STAs to be fed back next (only the AID of the STA that will start UL MU transmission may be informed), re-ordered index information for each STA (if it informs the start point or end point index of the frequency unit assigned to each STA) case)

How to determine the DL channel measurement feedback unit

In this embodiment, a frequency unit for measuring/feedback of a DL channel is defined as a 'feedback unit', and various methods of determining the feedback unit will be described in detail.

In the existing system, the feedback unit was 1 to 4 subcarriers.

Therefore, the number of transmissions of the maximum feedback value had a large feedback overhead as the number of data subcarriers.

In 802.11ax, the next-generation WLAN system, the number of sub-carriers increases more than in the existing system, so if the method of the existing system is maintained, the feedback overhead can increase up to 4 times, and the channels of adjacent sub-carriers are similar. If necessary, it is possible to reduce the amount of feedback information by setting a feedback unit as in the following embodiments.

(1)

The entire transmission band of the UL MU PPDU may be configured as one feedback unit.

In this case, the STA reports only one feedback value to the AP.

(2) 26

A tone resource unit may be configured as one feedback unit.

In this case, if the entire transmission band of the UL MU PPDU carrying the feedback frame is a 20 MHz band, the STA reports a total of 9 feedback values to the AP.

In this case, the STA may report all nine feedback values or may report only some feedback values according to an instruction from the AP, which will be described in detail below.

(3) 20

A MHz subchannel may be configured as one feedback unit.

In this case, for example, if the entire transmission band of the UL MU PPDU carrying the feedback frame is an 80 MHz band, each STA reports a total of four feedback values to the AP.

Even in this case, the STA may report all four feedback values, or may report only some feedback values according to the direction of the AP, which will be described in detail below.

How to measure DL channel

In the existing system, the STA measured and fed back the HE-LTF of the entire transmission band of the DL/UL PPDU. However, since the OFDMA technology was introduced in 802.11ax, the next-generation WLAN system, the AP tells the STAs to measure and report only some frequency bands. you can request

That is, in the next-generation WLAN system, the AP may instruct the STA to measure and report not only the entire frequency

band but also some bands.

That is, the measurement band resource to be reported by the STAs may be set equal to or smaller than the frequency resource size of the NDP frame transmitted in the full frequency band.

In particular, when generating and transmitting a beamforming feedback matrix for a resource having the same size as the frequency resource of the NDP frame transmitted in the full band (or when transmitting through the feedback frame), the overhead is not small, so the STAs can report The measurement band resource (or to be fed back/transmit the beamforming feedback matrix) may be set equal to or smaller than the resource size of the NDP frame.

For example, the AP may instruct the STA to measure and report the channel state of only a specific 20 MHz band among the 80 MHz bands.

Alternatively, if the feedback unit is configured based on the 26-tone resource unit, the AP may instruct the STA to measure and report the channel state for a specific feedback unit.

For example, if an index is allocated to each 26-tone resource unit to distinguish a feedback unit, the AP transmits an index of a feedback unit to be reported/measured by the STA to the STA, thereby indicating the feedback unit to be measured by the STA. have.

In another embodiment, the AP may instruct the STA to feed back only a band having a good channel state among bands measured by the STA.

In this case, the STA may transmit information on a band having a good channel state and a feedback value of the corresponding band together.

For example, assuming that nine 26-tone resource unit-based feedback units are configured in a 20 MHz channel, the AP may instruct the STA to report only the feedback unit having the best channel state among the nine feedback units.

In this case, the STA may UL MU transmit information on a feedback unit having the best channel state (eg, index or location information of the corresponding feedback unit) and a feedback value measured for the corresponding feedback unit in a feedback frame.

34 is a flowchart illustrating a sounding method of an STA device according to an embodiment of the present invention.

The embodiments described above in relation to this flowchart may be equally applied.

Therefore, the overlapping description will be omitted below.

Referring to FIG. 34 , first, the STA may receive an NDPA frame indicating transmission of the NDP frame from the AP (S3410).

In this case, the NDPA frame received by the STA may include various control information related to the sounding protocol.

For example, the NDPA frame may include feedback indication information (or sounding indication information) regarding which STA will measure which DL channel, in which way, and the like.

Next, the STA may receive the NDP frame from the AP (S3420).

In this case, the NDP frame received by the STA may include HE-STF/LTF indicating information on a target DL channel to be measured by the STA (or DL channel sounding (or DL CSI (Channel State Information)).) for HE-STF/LTF may be included).

In addition, the NDP frame may include a number of HE-LTFs equal to or greater than the number of spatial streams to which the STA will report the channel state.

Next, the STA may receive a trigger frame from the AP (S3430).

In this case, the trigger frame received by the STAs may include resource allocation information on UL MU resources allocated to each STA so that the STAs can transmit UL MU channel state information on the DL channel.

Next, the STA may generate channel state information based on the training field included in the NDP frame (S3440).

More specifically, the STA may measure the state of the DL channel to be measured based on the HE-LTF included in the NDP frame, and may generate channel state information including the measurement result.

In this case, if the AP instructs to feed back only some frequency bands (via the NDPA frame), the STA may generate only channel state information for the corresponding band.

Next, the STA may UL MU transmit a feedback frame including the generated channel state information (S3450).

In this case, the STA may UL MU transmit the feedback frame using the UL MU resource indicated by the trigger frame received in step S3430.

In this flowchart, the NDPA frame, the NDP frame, and the trigger frame have been described based on the case where they are sequentially received by the STA at regular time intervals (eg, SIFS) (that is, received by the STA through different DL PPDUs). It is not limited, and as described above, the NDPA frame, the NDP frame, and the trigger frame may be received by the STAs on one DL PPDU to reduce overhead.

In this case, as described above, the AP may edit and transmit the same information in each frame so as not to transmit the same information redundantly.

35 is a block diagram of each STA device according to an embodiment of the present invention.

In FIG. 35 , the STA device 3510 may include a memory 3512 , a processor 3511 , and an RF unit 3513 .

And, as described above, the STA device is a HE STA device, and may be an AP or a non-AP STA.

The RF unit 3513 may be connected to the processor 3511 to transmit/receive a wireless signal.

The RF unit 3513 may transmit a signal by up-converting data received from the processor 3511 into a transmission/reception band.

The processor 3511 may be connected to the RF unit 3513 to implement a physical layer and/or a MAC layer according to the IEEE 802.11 system.

The processor 3511 may be configured to perform operations according to various embodiments of the present invention according to the drawings and descriptions described above.

In addition, a module implementing the operation of the STA 3510 according to various embodiments of the present invention described above may be stored in the memory 3512 and executed by the processor 3511 .

The memory 3512 is connected to the processor 3511 and stores various information for driving the processor 3511 .

The memory 3512 may be included in the processor 3511 or installed outside the processor 3511 to be connected to the processor 3511 by a known means.

Also, the STA device 3510 may include a single antenna or multiple antennas.

The specific configuration of the STA device 3510 of FIG. 35 may be implemented such that the matters described in the various embodiments of the present invention described above are independently applied or two or more embodiments are simultaneously applied.

The embodiments described above are those in which elements and features of the present invention are combined in a predetermined form.

Each component or feature should be considered optional unless explicitly stated otherwise.

Each component or feature may be implemented in a form that is not combined with other components or features.

It is also possible to configure embodiments of the present invention by combining some components and/or features.

The order of operations described in the embodiments of the present invention may be changed.

Some features or features of one embodiment may be included in another embodiment, or may be replaced with corresponding features or features of another embodiment.

It is obvious that claims that are not explicitly cited in the claims can be combined to form an embodiment or included as a new claim by amendment after filing.

Embodiments according to the present invention may be implemented by various means, for example, hardware, firmware, software, or a combination thereof.

In the case of implementation by hardware, an embodiment of the present invention provides one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), FPGAs (field programmable gate arrays), a processor, a controller, a microcontroller, a microprocessor, and

the like.

In the case of implementation by firmware or software, an embodiment of the present invention may be implemented in the form of a module, procedure, function, etc. that perform the functions or operations described above.

The software code may be stored in the memory and driven by the processor.

The memory may be located inside or outside the processor, and may transmit/receive data to and from the processor by various known means.

It is apparent to those skilled in the art that the present invention may be embodied in other specific forms without departing from the essential characteristics of the present invention.

Accordingly, the above detailed description should not be construed as restrictive in all respects but as exemplary.

The scope of the present invention should be determined by a reasonable interpretation of the appended claims, and all modifications within the equivalent scope of the present invention are included in the scope of the present invention.

All embodiments relating to the present invention have been described in the best mode for carrying out the invention.

Although the frame transmission method in the wireless communication system of the present invention has been described focusing on an example applied to the IEEE 802.11 system, it can be applied to various wireless communication systems in addition to the IEEE 802.11 system.

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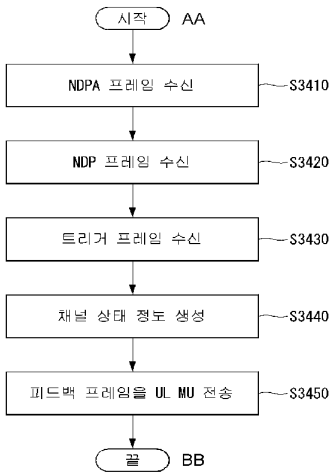
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[다음 쪽 계속]

(54) Title: CHANNEL SOUNDING METHOD IN WIRELESS COMMUNICATION SYSTEM, AND APPARATUS THEREFOR

(54) 발명의 명칭 : 무선 통신 시스템에서 채널 사운딩 방법 및 이를 위한 장치



S3410 ... Receive NDPA frame
S3420 ... Receive NDP frame
S3430 ... Receive trigger frame
S3440 ... Generate channel state information
S3450 ... Perform UL MU transmission of feedback frame
AA ... Start
BB ... End

(57) Abstract: A sounding method of a station (STA) for transmitting feedback information on a downlink (DL) channel state in a wireless LAN (WLAN) system, according to one embodiment of the present invention, comprises the steps of: receiving an NDP announcement (NDPA) frame notifying the transmission of a null data packet (NDP); receiving the NDP frame; receiving a trigger frame including resource allocation information assigned to the STA; generating channel state information on the basis of a training field included in the NDP frame; and performing uplink (UL) multi-user (MU) transmission of a feedback frame including the channel state information by using a frequency resource which the resource allocation information indicates.

(57) 요약서: 본 발명의 일 실시예에 따른, WLAN(Wireless LAN) 시스템에서 하향링크(DL: Downink) 채널 상태에 관한 피드백 정보를 전송하기 위한 STA(Station)의 사운딩 방법에 있어서, NDP(Null data packet) 프레임의 전송을 알리는 NDPA(NDP announcement) 프레임을 수신하는 단계; 상기 NDP 프레임을 수신하는 단계; 상기 STA 에 할당된 자원 할당 정보가 포함된 트리거 프레임을 수신하는 단계; 상기 NDP 프레임에 포함된 트레이닝 필드를 기초로 채널 상태 정보를 생성하는 단계; 및 상기 채널 상태 정보가 포함된 피드백 프레임을 상기 자원 할당 정보가 지시하는 주파수 자원을 이용하여 상향링크(UL: Uplink) 다중 사용자(MU: Multi-User) 전송하는 단계; 를 포함할 수 있다.

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— 국제조사보고서와 함께 (조약 제 21 조(3))

명세서

발명의 명칭: 무선 통신 시스템에서 채널 사운딩 방법 및 이를 위한 장치

기술분야

[1] 본 발명은 무선 통신 시스템에 관한 것으로서, 보다 상세하게는 STA이 측정한 채널 상태를 상향링크(Uplink) 다중 사용자(multi-user) 전송하기 위한 채널 사운딩 방법 및 이를 지원하는 장치에 관한 것이다.

배경기술

[2] 와이파이(Wi-Fi)는 2.4GHz, 5GHz 또는 60GHz 주파수 대역에서 기기가 인터넷에 접속 가능하게 하는 WLAN(Wireless Local Area Network) 기술이다.

[3] WLAN은 IEEE(institute of electrical and electronic engineers) 802.11 표준에 기반한다. IEEE 802.11의 WNG SC(Wireless Next Generation Standing Committee)는 차세대 WLAN(wireless local area network)을 중장기적으로 고민하는 애드혹 위원회(committee)이다.

[4] IEEE 802.11n은 네트워크의 속도와 신뢰성을 증가시키고, 무선 네트워크의 운영 거리를 확장하는데 목적을 두고 있다. 보다 구체적으로, IEEE 802.11n에서는 최대 600Mbps 데이터 처리 속도(data rate)를 제공하는 고처리율(HT: High Throughput)을 지원하며, 또한 전송 에러를 최소화하고 데이터 속도를 최적화하기 위해 송신부와 수신부 양단 모두에 다중 안테나를 사용하는 MIMO(Multiple Inputs and Multiple Outputs) 기술에 기반을 두고 있다.

[5] WLAN의 보급이 활성화되고 또한 이를 이용한 어플리케이션이 다양화됨에 따라, 초고처리율(VHT: Very High Throughput)를 지원하는 차세대 WLAN 시스템은 IEEE 802.11n WLAN 시스템의 다음 버전으로서, IEEE 802.11ac가 새롭게 제정되었다. IEEE 802.11ac는 80MHz 대역폭 전송 및/또는 더 높은 대역폭 전송(예를 들어, 160MHz)을 통해 1Gbps 이상의 데이터 처리 속도를 지원하고, 주로 5 GHz 대역에서 동작한다.

[6] 최근에는 IEEE 802.11ac이 지원하는 데이터 처리 속도보다 더 높은 처리율을 지원하기 위한 새로운 WLAN 시스템에 대한 필요성이 대두되고 있다.

[7] 일명 IEEE 802.11ax 또는 고효율(HEW: High Efficiency) WLAN라고 불리는 차세대 WLAN 태스크 그룹에서 주로 논의되는 IEEE 802.11ax의 범위(scope)는 1) 2.4GHz 및 5GHz 등의 대역에서 802.11 PHY(physical) 계층과 MAC(medium access control) 계층의 향상, 2) 스펙트럼 효율성(spectrum efficiency)과 영역 쓰루풋(area throughput) 향상, 3) 간섭 소스가 존재하는 환경, 밀집한 이종 네트워크(heterogeneous network) 환경 및 높은 사용자 부하가 존재하는 환경과 같은 실제 실내 환경 및 실외 환경에서 성능을 향상 등을 포함한다.

[8] IEEE 802.11ax에서 주로 고려되는 시나리오는 AP(access point)와

STA(station)이 많은 밀집 환경이며, IEEE 802.11ax는 이러한 상황에서 스펙트럼 효율(spectrum efficiency)과 공간 전송률(area throughput) 개선에 대해 논의한다. 특히, 실내 환경뿐만 아니라, 기존 WLAN에서 많이 고려되지 않던 실외 환경에서의 실질적 성능 개선에 관심을 가진다.

[9] IEEE 802.11ax에서는 무선 오피스(wireless office), 스마트 홈(smart home), 스타디움(Stadium), 핫스팟(Hotspot), 빌딩/아파트(building/apartment)와 같은 시나리오에 관심이 크며, 해당 시나리오 기반으로 AP와 STA가 많은 밀집 환경에서의 시스템 성능 향상에 대한 논의가 수행되고 있다.

[10] 앞으로 IEEE 802.11ax에서는 하나의 BSS(basic service set)에서의 단일 링크 성능 향상보다는, OBSS(overlapping basic service set) 환경에서의 시스템 성능 향상 및 실외 환경 성능 개선, 그리고 셀룰러 오프로딩(cellular offloading) 등에 대한 논의가 활발할 것으로 예상된다. 이러한 IEEE 802.11ax의 방향성은 차세대 WLAN이 점점 이동 통신과 유사한 기술 범위를 갖게 됨을 의미한다. 최근 스몰 셀(small cell) 및 D2D(Direct-to-Direct) 통신 영역에서 이동 통신과 WLAN 기술이 함께 논의되고 있는 상황을 고려해 볼 때, IEEE 802.11ax를 기반한 차세대 WLAN과 이동 통신의 기술적 및 사업적 융합은 더욱 활발해질 것으로 예측된다.

발명의 상세한 설명

기술적 과제

[11] 본 발명의 목적은 차세대 무선 통신 시스템에서 적용 가능한 새로운 사운딩 프로토콜을 제안하며, 사운딩 프로토콜을 위해 송수신되는 프레임들의 HE(High Efficiency) 포맷을 제안함을 목적으로 한다.

[12] 또한, 본 발명의 목적은 차세대 무선 통신 시스템에서 STA들이 측정한 채널 상태 정보를 상향링크 다중 사용자 전송하기 위한 효율적인 방법을 제안함을 목적으로 한다.

[13] 본 발명에서 이루고자 하는 기술적 과제들은 이상에서 언급한 기술적 과제들로 제한되지 않으며, 언급하지 않은 또 다른 기술적 과제들은 아래의 기재로부터 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 명확하게 이해될 수 있을 것이다.

과제 해결 수단

[14] 상술한 기술적 과제를 해결하기 위하여, WLAN(Wireless LAN) 시스템에서 하향링크(DL: Downlink) 채널 상태에 관한 피드백 정보를 전송하기 위한 STA(Station)의 사운딩 방법에 있어서, NDP(Null data packet) 프레임의 전송을 알리는 NDPA(NDP announcement) 프레임을 수신하는 단계; 상기 NDP 프레임을 수신하는 단계; 상기 STA에 할당된 자원 할당 정보가 포함된 트리거 프레임을 수신하는 단계; 상기 NDP 프레임에 포함된 트레이닝 필드를 기초로 채널 상태 정보를 생성하는 단계; 및 상기 채널 상태 정보가 포함된 피드백 프레임을 상기 자원 할당 정보가 지시하는 주파수 자원을 이용하여 상향링크(UL: Uplink) 다중

사용자(MU: Multi-User) 전송하는 단계; 를 포함할 수 있다.

[15] 또한, 상기 NDPA 프레임, 상기 NDP 프레임 및 상기 트리거 프레임은, 하나의 DL PPDU에 포함되어 수신되거나 서로 다른 DL PPDU들에 각각 포함되어 수신될 수 있다.

[16] 또한, 상기 NDPA 프레임, 상기 NDP 프레임 및 상기 트리거 프레임이 상기 서로 다른 DL PPPDU들에 각각 포함되어 수신되는 경우, 상기 서로 다른 DL PPDU들은 SIFS(Short interframe space) 간격으로 상기 STA에 수신될 수 있다.

[17] 또한, 상기 자원 할당 정보는 상기 피드백 프레임을 UL MU 전송하기 위해 상기 STA에 할당된 자원 유닛의 개수를 지시할 수 있다.

[18] 또한, 상기 자원 유닛은 26개의 서브 캐리어들로 구성된 26톤 자원 유닛일 수 있다.

[19] 또한, 상기 자원 할당 정보의 비트 값은 상기 STA에 할당된 자원 유닛의 개수를 지시할 수 있다.

[20] 또한, 상기 자원 할당 정보는 상기 피드백 프레임의 UL MU 전송을 위해 할당되는 자원 유닛들과 순차적으로 대응되는 복수의 비트들을 포함하며, 상기 복수의 비트들 각각의 비트 값은, 각 비트와 대응되는 자원 유닛이 할당되는 STA이 다른 STA으로 변경됨에 따라 이전 비트의 비트 값과 다른 비트 값으로 스위칭될 수 있다.

[21] 또한, 상기 피드백 프레임의 UL MU 전송을 위해 할당되는 자원 유닛들에 각각 서로 다른 인덱스가 할당되는 경우, 상기 자원 할당 정보는 상기 STA에 할당된 자원 유닛의 인덱스 정보를 포함할 수 있다.

[22] 또한, 상기 채널 상태 정보는 공간 스트림에 대해 기설정된 주파수 단위로 생성한 피드백 값을 포함하며, 상기 피드백 값은 상기 공간 스트림에 대한 상기 기설정된 주파수 단위의 SNR(Signal to Noise Ratio) 또는 빔포밍 피드백 행렬일 수 있다.

[23] 또한, 상기 기설정된 주파수 단위는 상기 NDP 프레임을 나르는 DL PPDU의 전체 전송 채널일 수 있다.

[24] 또한, 상기 기설정된 주파수 단위는 26톤 자원 유닛 또는 20MHz 채널일 수 있다.

[25] 또한, 상기 NDPA 프레임은 상기 STA이 측정해야 할 주파수 대역의 지시 정보를 포함할 수 있다.

[26] 또한, 상기 채널 상태 정보를 생성하는 단계는, 상기 지시 정보가 지시하는 상기 주파수 대역에 대한 상기 채널 상태 정보를 생성하는 단계일 수 있다.

[27] 또한, 상기 채널 상태를 측정하는 단계는, 소정의 크기의 주파수 대역에 대한 상기 채널 상태 정보를 생성하는 단계이고, 상기 소정의 크기는 상기 NDP 프레임이 전송되는 데 사용되는 주파수 대역의 크기와 같거나 작을 수 있다.

[28] 또한, 상기 생성된 채널 상태 정보는 상기 소정의 크기의 주파수 대역에 대한 빔포밍 피드백 행렬 정보일 수 있다.

[29] 또한, 상기 NDP 프레임의 상기 트레이닝 필드는 HE-LTF(High Efficiency-Long Training Field)일 수 있다.

[30] 또한, 본 발명의 다른 실시예에 따른 WLAN(Wireless LAN) 시스템에서 STA(Station) 장치에 있어서, 무선 신호를 송수신하는, RF 유닛; 및 상기 RF 유닛을 제어하는, 프로세서; 를 포함하고, 상기 프로세서는, NDP(Null data packet) 프레임의 전송을 알리는 NDPA(NDP announcement) 프레임을 수신하고, 상기 NDP 프레임을 수신하고, 상기 STA에 할당된 자원 할당 정보가 포함된 트리거 프레임을 수신하고, 상기 NDP 프레임에 포함된 트레이닝 필드를 기초로 채널 상태 정보를 생성하고, 및 상기 채널 상태 정보가 포함된 피드백 프레임을 상기 자원 할당 정보가 지시하는 주파수 자원을 이용하여 상향링크(UL: Uplink) 다중 사용자(MU: Multi-User) 전송할 수 있다.

[31] 이외에 본 발명의 다른 효과들에 대해서는 이하의 실시예들에서 추가로 설명하도록 한다.

발명의 효과

[32] 본 발명의 일 실시예에 따르면, OFDMA 기술이 적용되는 차세대 WLAN 시스템에서 효율적으로 적용될 수 있는 사운딩 프로토콜이 제안된다.

[33] 또한, 본 발명의 일 실시예에 따르면, AP는 STA들의 UL MU 피드백 프레임 전송을 위한 트리거 정보를 전송해주므로, 각 STA은 피드백 프레임의 UL MU 전송이 가능하다.

[34] 또한, 본 발명의 일 실시예에 따르면, STA들이 DL 채널에 대한 피드백 프레임을 UL MU 전송할 수 있으므로, AP는 보다 신속하게 DL 채널에 대한 채널 상태 정보를 획득할 수 있다.

[35] 이외에 본 발명의 다른 효과들에 대해서는 이하의 실시예들에서 추가로 설명하도록 한다.

도면의 간단한 설명

[36] 본 발명에 관한 이해를 돕기 위해 상세한 설명의 일부로 포함되는, 첨부 도면은 본 발명에 대한 실시예를 제공하고, 상세한 설명과 함께 본 발명의 기술적 특징을 설명한다.

[37] 도 1은 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 일례를 나타내는 도면이다.

[38] 도 2는 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 계층 아키텍처(layer architecture)의 구조를 예시하는 도면이다.

[39] 도 3은 본 발명이 적용될 수 있는 무선 통신 시스템의 non-HT 포맷 PPDU 및 HT 포맷 PPDU를 예시한다.

[40] 도 4는 본 발명이 적용될 수 있는 무선 통신 시스템의 VHT 포맷 PPDU 포맷을 예시한다.

[41] 도 5는 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 MAC 프레임 포맷을

예시한다.

[42] 도 6은 본 발명이 적용될 수 있는 무선 통신 시스템에서 MAC 프레임 내 프레임 제어(Frame Control) 필드를 예시하는 도면이다.

[43] 도 7은 본 발명이 적용될 수 있는 무선 통신 시스템에서 채널 사운딩(sounding) 방법을 개념적으로 나타내는 도면이다.

[44] 도 8은 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT NDPA 프레임을 예시하는 도면이다.

[45] 도 9는 본 발명이 적용될 수 있는 무선 통신 시스템에서 NDP PPDU을 예시하는 도면이다.

[46] 도 10은 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT 압축된 빔포밍(VHT compressed beamforming) 프레임 포맷을 예시하는 도면이다.

[47] 도 11은 본 발명이 적용될 수 있는 무선 통신 시스템에서 빔포밍 보고 폴(Beamforming Report Poll) 프레임 포맷을 예시하는 도면이다.

[48] 도 12는 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[49] 도 13은 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[50] 도 14는 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 MU-MIMO 전송 과정을 예시하는 도면이다.

[51] 도 15는 본 발명이 적용될 수 있는 무선 통신 시스템에서 ACK 프레임을 예시하는 도면이다.

[52] 도 16은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임을 예시하는 도면이다.

[53] 도 17은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임의 BAR 정보(BAR Information) 필드를 예시하는 도면이다.

[54] 도 18은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임을 예시하는 도면이다.

[55] 도 19는 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임의 BA 정보(BA Information) 필드를 예시하는 도면이다.

[56] 도 20은 본 발명의 일 실시예에 따른 HE(High Efficiency) 포맷 PPDU를 예시하는 도면이다.

[57] 도 21 내지 도 23은 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[58] 도 24는 본 발명의 일 실시예에 따른 상향링크 다중 사용자(multi-user) 전송 절차를 예시하는 도면이다.

[59] 도 25 내지 27은 본 발명의 일 실시예에 따른 OFDMA 다중 사용자(multi-user) 전송 방식에서 자원 할당 단위를 예시하는 도면이다.

[60] 도 28은 본 발명의 일 실시예에 따른 사운딩 프로토콜을 예시한 도면이다.

[61] 도 29는 본 발명의 제1 실시예에 따른 사운딩 프로토콜을 예시한 도면이다.

[62] 도 30은 본 발명의 제2 및 제3 실시예에 따른 사운딩 프로토콜을 예시한 도면이다.

[63] 도 31은 본 발명의 일 실시예에 따른 NDPA 프레임, NDP 프레임 및 트리거 프레임에 각각 포함되는 정보를 예시한 도면이다.

[64] 도 32는 본 발명의 제3 실시예에 따른 사운딩 프로토콜에서 송수신되는 DL PPDU 포맷을 예시한다.

[65] 도 33은 도 32(a)의 DL PPDU 포맷의 구체적인 실시예를 도시한 도면이다.

[66] 도 34는 본 발명의 일 실시예에 따른 STA 장치의 사운딩 방법을 나타낸 순서도이다.

[67] 도 35는 본 발명의 일 실시예에 따른 각 STA 장치의 블록도이다.

발명의 실시를 위한 최선의 형태

[68] 본 명세서에서 사용되는 용어는 본 명세서에서의 기능을 고려하면서 가능한 현재 널리 사용되는 일반적인 용어를 선택하였으나, 이는 당 분야에 종사하는 기술자의 의도, 관례 또는 새로운 기술의 출현 등에 따라 달라질 수 있다. 또한 특정 경우는 출원인이 임의로 선정한 용어도 있으며, 이 경우 해당되는 실시예의 설명 부분에서 그 의미를 기재할 것이다. 따라서 본 명세서에서 사용되는 용어는, 단순한 용어의 명칭이 아닌 그 용어가 아닌 실질적인 의미와 본 명세서의 전반에 걸친 내용을 토대로 해석되어야 함을 밝혀두고자 한다.

[69] 더욱이, 이하 첨부 도면들 및 첨부 도면들에 기재된 내용들을 참조하여 실시예를 상세하게 설명하지만, 실시예들에 의해 제한되거나 한정되는 것은 아니다.

[70] 이하, 첨부한 도면들을 참조하여 본 발명의 바람직한 실시예를 보다 상세하게 설명하고자 한다.

[71] 이하의 기술은 CDMA(code division multiple access), FDMA(frequency division multiple access), TDMA(time division multiple access), OFDMA(orthogonal frequency division multiple access), SC-FDMA(single carrier frequency division multiple access), NOMA(non-orthogonal multiple access) 등과 같은 다양한 무선 접속 시스템에 이용될 수 있다. CDMA는 UTRA(universal terrestrial radio access)나 CDMA2000과 같은 무선 기술(radio technology)로 구현될 수 있다. TDMA는 GSM(global system for mobile communications)/GPRS(general packet radio service)/EDGE(enhanced data rates for GSM evolution)와 같은 무선 기술로 구현될 수 있다. OFDMA는 IEEE(institute of electrical and electronics engineers) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802-20, E-UTRA(evolved UTRA) 등과 같은 무선 기술로 구현될 수 있다. UTRA는 UMTS(universal mobile telecommunications system)의 일부이다. 3GPP(3rd generation partnership project) LTE(long term evolution)은 E-UTRA를 사용하는 E-UMTS(evolved UMTS)의 일부로써,

하향링크에서 OFDMA를 채용하고 상향링크에서 SC-FDMA를 채용한다. LTE-A(advanced)는 3GPP LTE의 진화이다.

[72] 본 발명의 실시예들은 무선 접속 시스템들인 IEEE 802, 3GPP 및 3GPP2 중 적어도 하나에 개시된 표준 문서들에 의해 뒷받침될 수 있다. 즉, 본 발명의 실시예들 중 본 발명의 기술적 사상을 명확히 드러내기 위해 설명하지 않은 단계들 또는 부분들은 상기 문서들에 의해 뒷받침될 수 있다. 또한, 본 문서에서 개시하고 있는 모든 용어들은 상기 표준 문서에 의해 설명될 수 있다.

[73] 설명을 명확하게 하기 위해, IEEE 802.11 시스템을 위주로 기술하지만 본 발명의 기술적 특징이 이에 제한되는 것은 아니다.

[74]

[75] <u>시스템 일반</u>

[76] 도 1 은 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 일례를 나타내는 도면이다.

[77] IEEE 802.11 구조는 복수개의 구성요소들로 구성될 수 있고, 이들의 상호작용에 의해 상위계층에 대해 트랜스패런트(transparent)한 스테이션(STA: Station) 이동성을 지원하는 무선 통신 시스템이 제공될 수 있다. 기본 서비스 세트(BSS: Basic Service Set)는 IEEE 802.11 시스템에서의 기본적인 구성 블록에 해당할 수 있다.

[78] 도 1 에서는 3개의 BSS(BSS 1 내지 BSS 3)가 존재하고 각각의 BSS의 멤버로서 2개의 STA이 포함되는 것(STA 1 및 STA 2 는 BSS 1에 포함되고, STA 3 및 STA 4는 BSS 2에 포함되며, STA 5 및 STA 6은 BSS 3에 포함됨)을 예시적으로 도시한다.

[79] 도 1 에서 BSS를 나타내는 타원은 해당 BSS에 포함된 STA들이 통신을 유지하는 커버리지 영역을 나타내는 것으로도 이해될 수 있다. 이 영역을 기본 서비스 영역(BSA: Basic Service Area)이라고 칭할 수 있다. STA가 BSA 밖으로 이동하게 되면 해당 BSA 내의 다른 STA들과 직접적으로 통신할 수 없게 된다.

[80] IEEE 802.11 시스템에서 가장 기본적인 타입의 BSS는 독립적인 BSS(IBSS: Independent BSS)이다. 예를 들어, IBSS는 2 개의 STA만으로 구성된 최소의 형태를 가질 수 있다. 또한, 가장 단순한 형태이고 다른 구성요소들이 생략되어 있는 도 1 의 BSS 3이 IBSS의 대표적인 예시에 해당할 수 있다. 이러한 구성은 STA들이 직접 통신할 수 있는 경우에 가능하다. 또한, 이러한 형태의 LAN은 미리 계획되어서 구성되는 것이 아니라 LAN이 필요한 경우에 구성될 수 있으며, 이를 애드-혹(ad-hoc) 네트워크라고 칭할 수도 있다.

[81] STA의 켜지거나 꺼짐, STA가 BSS 영역에 들어오거나 나감 등에 의해서, BSS에서의 STA의 멤버십이 동적으로 변경될 수 있다. BSS의 멤버가 되기 위해서는, STA는 동기화 과정을 이용하여 BSS에 조인할 수 있다. BSS 기반 구조의 모든 서비스에 액세스하기 위해서는, STA는 BSS에 연계(associated)되어야 한다. 이러한 연계(association)는 동적으로 설정될 수

있고, 분배 시스템 서비스(DSS: Distribution System Service)의 이용을 포함할 수 있다.

[82] 802.11 시스템에서 직접적인 STA-대-STA의 거리는 물리 계층(PHY: physical) 성능에 의해서 제한될 수 있다. 어떠한 경우에는 이러한 거리의 한계가 충분할 수도 있지만, 경우에 따라서는 보다 먼 거리의 STA 간의 통신이 필요할 수도 있다. 확장된 커버리지를 지원하기 위해서 분배 시스템(DS: Distribution System)이 구성될 수 있다.

[83] DS는 BSS들이 상호 연결되는 구조를 의미한다. 구체적으로, 도 1 과 같이 BSS가 독립적으로 존재하는 대신에, 복수개의 BSS들로 구성된 네트워크의 확장된 형태의 구성요소로서 BSS가 존재할 수도 있다.

[84] DS는 논리적인 개념이며 분배 시스템 매체(DSM: Distribution System Medium)의 특성에 의해서 특정될 수 있다. 이와 관련하여, IEEE 802.11 표준에서는 무선 매체(WM: Wireless Medium)와 분배 시스템 매체(DSM: Distribution System Medium)을 논리적으로 구분하고 있다. 각각의 논리적 매체는 상이한 목적을 위해서 사용되며, 상이한 구성요소에 의해서 사용된다. IEEE 802.11 표준의 정의에서는 이러한 매체들이 동일한 것으로 제한하지도 않고 상이한 것으로 제한하지도 않는다. 이와 같이 복수개의 매체들이 논리적으로 상이하다는 점에서, IEEE 802.11 시스템의 구조(DS 구조 또는 다른 네트워크 구조)의 유연성이 설명될 수 있다. 즉, IEEE 802.11 시스템 구조는 다양하게 구현될 수 있으며, 각각의 구현예의 물리적인 특성에 의해서 독립적으로 해당 시스템 구조가 특정될 수 있다.

[85] DS는 복수개의 BSS들의 끊김 없는(seamless) 통합을 제공하고 목적지로의 어드레스를 다루는 데에 필요한 논리적 서비스들을 제공함으로써 이동 장치를 지원할 수 있다.

[86] AP는, 연계된 STA들에 대해서 WM을 통해서 DS로의 액세스를 가능하게 하고 STA 기능성을 가지는 개체를 의미한다. AP를 통해서 BSS 및 DS 간의 데이터 이동이 수행될 수 있다. 예를 들어, 도 1에서 도시하는 STA 2 및 STA 3은 STA의 기능성을 가지면서, 연계된 STA들(STA 1 및 STA 4)가 DS로 액세스하도록 하는 기능을 제공한다. 또한, 모든 AP는 기본적으로 STA에 해당하므로, 모든 AP는 어드레스 가능한 개체이다. WM 상에서의 통신을 위해 AP에 의해서 사용되는 어드레스와 DSM 상에서의 통신을 위해 AP에 의해서 사용되는 어드레스는 반드시 동일할 필요는 없다.

[87] AP에 연계된 STA들 중의 하나로부터 그 AP의 STA 어드레스로 전송되는 데이터는, 항상 비제어 포트(uncontrolled port)에서 수신되고 IEEE 802.1X 포트 액세스 개체에 의해서 처리될 수 있다. 또한, 제어 포트(controlled port)가 인증되면 전송 데이터(또는 프레임)는 DS로 전달될 수 있다.

[88] 임의의(arbitrary) 크기 및 복잡도를 가지는 무선 네트워크가 DS 및 BSS들로 구성될 수 있다. IEEE 802.11 시스템에서는 이러한 방식의 네트워크를 확장된

서비스 세트(ESS: Extended Service Set) 네트워크라고 칭한다. ESS는 하나의 DS에 연결된 BSS들의 집합에 해당할 수 있다. 그러나, ESS는 DS를 포함하지는 않는다. ESS 네트워크는 논리 링크 제어(LLC: Logical Link Control) 계층에서 IBSS 네트워크로 보이는 점이 특징이다. ESS에 포함되는 STA들은 서로 통신할 수 있고, 이동 STA들은 LLC에 트랜스패런트(transparent)하게 하나의 BSS에서 다른 BSS로(동일한 ESS 내에서) 이동할 수 있다.

[89] IEEE 802.11 시스템에서는 도 1 에서의 BSS들의 상대적인 물리적 위치에 대해서 아무것도 가정하지 않으며, 다음과 같은 형태가 모두 가능하다.

[90] 구체적으로, BSS들은 부분적으로 중첩될 수 있고, 이는 연속적인 커버리지를 제공하기 위해서 일반적으로 이용되는 형태이다. 또한, BSS들은 물리적으로 연결되어 있지 않을 수 있고, 논리적으로는 BSS들 간의 거리에 제한은 없다. 또한, BSS들은 물리적으로 동일한 위치에 위치할 수 있고, 이는 리던던시(redundancy)를 제공하기 위해서 이용될 수 있다. 또한, 하나 (또는 하나 이상의) IBSS 또는 ESS 네트워크들이 하나 또는 그 이상의 ESS 네트워크로서 동일한 공간에 물리적으로 존재할 수 있다. 이는 ESS 네트워크가 존재하는 위치에 ad-hoc 네트워크가 동작하는 경우나, 상이한 기관(organizations)에 의해서 물리적으로 중첩되는 IEEE 802.11 네트워크들이 구성되는 경우나, 동일한 위치에서 2 이상의 상이한 액세스 및 보안 정책이 필요한 경우 등에서의 ESS 네트워크 형태에 해당할 수 있다.

[91] WLAN 시스템에서 STA은 IEEE 802.11의 매체 접속 제어(MAC: Medium Access Control)/PHY 규정에 따라 동작하는 장치이다. STA의 기능이 AP와 개별적으로 구분되지 않는 한, STA는 AP STA과 비-AP STA(non-AP STA)를 포함할 수 있다. 다만, STA과 AP 간에 통신이 수행된다고 할 때, STA은 non-AP STA으로 이해될 수 있다. 도 1의 예시에서 STA 1, STA 4, STA 5 및 STA 6은 non-AP STA에 해당하고, STA 2 및 STA 3은 AP STA 에 해당한다.

[92] Non-AP STA는 랩탑 컴퓨터, 이동 전화기와 같이 일반적으로 사용자가 직접 다루는 장치에 해당한다. 이하의 설명에서 non-AP STA는 무선 장치(wireless device), 단말(terminal), 사용자 장치(UE: User Equipment), 이동국(MS: Mobile Station), 이동 단말(Mobile Terminal), 무선 단말(wireless terminal), 무선 송수신 유닛(WTRU: Wireless Transmit/Receive Unit), 네트워크 인터페이스 장치(network interface device), MTC(Machine-Type Communication) 장치, M2M(Machine-to-Machine) 장치 등으로 칭할 수도 있다.

[93] 또한, AP는 다른 무선 통신 분야에서의 기지국(BS: Base Station), 노드-B(Node-B), 발전된 노드-B(eNB: evolved Node-B), 기저 송수신 시스템(BTS: Base Transceiver System), 펨토 기지국(Femto BS) 등에 대응하는 개념이다.

[94] 이하, 본 명세서에서 하향링크(DL: downlink)는 AP에서 non-AP STA로의 통신을 의미하며, 상향링크(UL: uplink)는 non-AP STA에서 AP로의 통신을 의미한다. 하향링크에서 송신기는 AP의 일부이고, 수신기는 non-AP STA의

일부일 수 있다. 상향링크에서 송신기는 non-AP STA의 일부이고, 수신기는 AP의 일부일 수 있다.

[95]

[96] 도 2는 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 계층 아키텍처(layer architecture)의 구조를 예시하는 도면이다.

[97] 도 2를 참조하면, IEEE 802.11 시스템의 계층 아키텍처는 MAC 부계층(MAC sublayer)과 PHY 부계층(PHY sublayer)을 포함할 수 있다.

[98] PHY sublayer은 PLCP(Physical Layer Convergence Procedure) 개체(entity)와 PMD(Physical Medium Dependent) 개체로 구분될 수도 있다. 이 경우, PLCP 개체는 MAC sublayer와 데이터 프레임을 연결하는 역할을 수행하고, PMD 개체는 2개 또는 그 이상의 STA과 데이터를 무선으로 송수신하는 역할을 수행한다.

[99] MAC sublayer과 PHY sublayer 모두 관리 개체(Management Entity)를 포함할 수 있으며, 각각 MAC 서브계층 관리 개체(MLME: MAC Sublayer Management Entity)과 PHY 서브계층 관리 개체(PLME: Physical Sublayer Management Entity)로 지칭할 수 있다. 이들 관리 개체은 계층 관리 함수의 동작을 통해 계층 관리 서비스 인터페이스를 제공한다. MLME는 PLME와 연결되어 MAC sublayer의 관리 동작(management operation)을 수행할 수 있고, 마찬가지로 PLME도 MLME와 연결되어 PHY sublayer의 관리 동작(management operation)을 수행할 수 있다.

[100] 정확한 MAC 동작을 제공하기 위하여, SME(Station Management Entity)가 각 STA 내에 존재할 수 있다. SME는 각 계층과 독립적인 관리 개체로서, MLME와 PLME로부터 계층 기반 상태 정보를 수집하거나 각 계층의 특정 파라미터들의 값을 설정한다. SME는 일반 시스템 관리 개체들을 대신하여 이러한 기능을 수행할 수 있으며, 표준 관리 프로토콜을 구현할 수 있다.

[101] MLME, PLME 및 SME은 프리미티브(primitive)를 기반의 다양한 방법으로 상호 작용(interact)할 수 있다. 구체적으로, XX-GET.request 프리미티브는 관리 정보 베이스 속성(MIB attribute: Management Information Base attribute)의 값을 요청하기 위해 사용되고, XX-GET.confirm 프리미티브는 상태가 'SUCCESS'라면, 해당 MIB 속성 값을 리턴(return)하고, 그 외의 경우에는 상태 필드에 오류 표시를 하여 리턴한다. XX-SET.request 프리미티브는 지정된 MIB 속성을 주어진 값으로 설정하도록 요청하기 위해 사용된다. MIB 속성이 특정 동작으로 의미하고 있다면, 이 요청은 그 특정 동작의 실행을 요청한다. 그리고, XX-SET.confirm 프리미티브는 상태가 'SUCCESS'라면, 이는 지정된 MIB 속성이 요청된 값으로 설정되었음을 의미한다. 그 외의 경우에는, 상태 필드는 오류 상황을 나타낸다. 이 MIB 속성이 특정 동작을 의미한다면, 이 프리미티브는 해당 동작의 수행된 것을 확인해 줄 수 있다.

[102] 각 sublayer에서의 동작을 간략하게 설명하면 다음과 같다.

[103] MAC sublayer는 상위 계층(예를 들어, LLC 계층)으로부터 전달 받은 MAC 서비스 데이터 유닛(MSDU: MAC Service Data Unit) 또는 MSDU의 조각(fragment)에 MAC 헤더(header)와 프레임 체크 시퀀스(FCS: Frame Check Sequence)을 부착하여 하나 이상의 MAC 프로토콜 데이터 유닛(MPDU: MAC Protocol Data Unit)을 생성한다. 생성된 MPDU는 PHY sublayer로 전달된다.

[104] A-MSDU(aggregated MSDU) 기법(scheme)이 사용되는 경우, 복수 개의 MSDU는 단일의 A-MSDU(aggregated MSDU)로 병합될 수 있다. MSDU 병합 동작은 MAC 상위 계층에서 수행될 수 있다. A-MSDU는 단일의 MPDU(조각화(fragment)되지 않는 경우)로 PHY sublayer로 전달된다.

[105] PHY sublayer는 MAC sublayer으로부터 전달 받은 물리 서비스 데이터 유닛(PSDU: Physical Service Data Unit)에 물리 계층 송수신기에 의해 필요한 정보를 포함하는 부가필드를 덧붙여 물리 프로토콜 데이터 유닛(PPDU: Physical Protocol Data Unit)을 생성한다. PPDU는 무선 매체를 통해 전송된다.

[106] PSDU는 PHY sublayer가 MAC sublayer로부터 수신한 것이고, MPDU는 MAC sublayer가 PHY sublayer로 전송한 것이므로, PSDU는 실질적으로 MPDU와 동일하다.

[107] A-MPDU(aggregated MPDU) 기법(scheme)이 사용되는 경우, 복수의 MPDU(이때, 각 MPDU는 A-MSDU를 나를 수 있다.)는 단일의 A-MPDU로 병합될 수 있다. MPDU 병합 동작은 MAC 하위 계층에서 수행될 수 있다. A-MPDU는 다양한 타입의 MPDU(예를 들어, QoS 데이터, ACK(Acknowledge), 블록 ACK(BlockAck) 등)이 병합될 수 있다. PHY sublayer는 MAC sublayer로부터 단일의 PSDU로써 A-MPDU를 수신한다. 즉, PSDU는 복수의 MPDU로 구성된다. 따라서, A-MPDU는 단일의 PPDU 내에서 무선 매체를 통해 전송된다.

[108]

[109] **PPDU**(Physical Protocol Data Unit) 포맷

[110] PPDU(Physical Protocol Data Unit)는 물리 계층에서 발생되는 데이터 블록을 의미한다. 이하, 본 발명이 적용될 수 있는 IEEE 802.11 WLAN 시스템을 기초로 PPDU 포맷을 설명한다.

[111] 도 3은 본 발명이 적용될 수 있는 무선 통신 시스템의 non-HT 포맷 PPDU 및 HT 포맷 PPDU를 예시한다.

[112] 도 3의 (a)는 IEEE 802.11a/g 시스템을 지원하기 위한 non-HT 포맷 PPDU을 예시한다. non-HT PPDU은 레거시(legacy) PPDU으로도 불릴 수 있다.

[113] 도 3의 (a)를 참조하면, non-HT 포맷 PPDU은 L-STF(Legacy(또는, Non-HT) Short Training field), L-LTF(Legacy(또는, Non-HT) Long Training field) 및 L-SIG(Legacy(또는 Non-HT) SIGNAL) 필드로 구성되는 레가시 포맷 프리앰블과 데이터 필드를 포함하여 구성된다.

[114] L-STF는 짧은 트레이닝 OFDM(short training orthogonal frequency division multiplexing symbol)을 포함할 수 있다. L-STF는 프레임 타이밍 획득(frame timing

acquisition), 자동 이득 제어(AGC: Automatic Gain Control), 다이버시티 검출(diversity detection), 대략적인 주파수/시간 동기화(coarse frequency/time synchronization)을 위해 사용될 수 있다.

[115] L-LTF는 긴 트레이닝 OFDM 심볼(long training orthogonal frequency division multiplexing symbol)을 포함할 수 있다. L-LTF는 정밀한 주파수/시간 동기화(fine frequency/time synchronization) 및 채널 추정(channel estimation)을 위해 사용될 수 있다.

[116] L-SIG 필드는 데이터 필드의 복조 및 디코딩을 위한 제어 정보를 전송하기 위하여 사용될 수 있다.

[117] L-SIG 필드는 4 비트의 레이트(Rate) 필드, 1비트의 예비(Reserved) 비트, 12 비트의 길이(Length) 필드, 1비트의 패리티 비트, 6비트의 신호 테일(Signal Tail) 필드로 구성될 수 있다.

[118] 레이트 필드는 전송율 정보를 포함하고, 길이 필드는 PSDU의 옥텟의 수를 지시한다.

[119] 도 3의 (b)는 IEEE 802.11n 시스템 및 IEEE 802.11a/g 시스템을 모두 지원하기 위한 HT 혼합 포맷 PPDU(HT-mixed format PPDU)을 예시한다.

[120] 도 3의 (b)를 참조하면, HT 혼합 포맷 PPDU은 L-STF, L-LTF 및 L-SIG 필드로 구성되는 레가시 포맷 프리앰블과 HT-SIG(HT-Signal) 필드, HT-STF(HT Short Training field), HT-LTF(HT Long Training field)로 구성되는 HT 포맷 프리앰블 및 데이터 필드를 포함하여 구성된다.

[121] L-STF, L-LTF 및 L-SIG 필드는 하위 호환성(backward compatibility)를 위한 레가시 필드를 의미하므로, L-STF부터 L-SIG 필드까지 non-HT 포맷과 동일하다. L-STA은 HT 혼합 PPDU를 수신하여도 L-LTF, L-LTF 및 L-SIG 필드를 통해 데이터 필드를 해석할 수 있다. 다만 L-LTF는 HT-STA이 HT 혼합 PPDU를 수신하고 L-SIG 필드 및 HT-SIG 필드를 복조하기 위하여 수행할 채널 추정을 위한 정보를 더 포함할 수 있다.

[122] HT-STA는 레가시 필드 뒤에 오는 HT-SIG 필드 이용하여 HT-혼합 포맷 PPDU임을 알 수 있으며, 이를 기반으로 데이터 필드를 디코딩할 수 있다.

[123] HT-LTF 필드는 데이터 필드의 복조를 위한 채널 추정에 사용될 수 있다. IEEE 802.11n은 SU-MIMO(Single-User Multi-Input and Multi-Output)를 지원하므로 복수의 공간 스트림으로 전송되는 데이터 필드 각각에 대하여 채널 추정을 위해 HT-LTF 필드는 복수로 구성될 수 있다.

[124] HT-LTF 필드는 공간 스트림에 대한 채널 추정을 위하여 사용되는 데이터 HT-LTF(data HT-LTF)와 풀 채널 사운딩(full channel sounding)을 위해 추가적으로 사용되는 확장 HT-LTF(extension HT-LTF)로 구성될 수 있다. 따라서, 복수의 HT-LTF는 전송되는 공간 스트림의 개수보다 같거나 많을 수 있다.

[125] HT-혼합 포맷 PPDU은 L-STA도 수신하여 데이터를 획득할 수 있도록 하기 위해 L-STF, L-LTF 및 L-SIG 필드가 가장 먼저 전송된다. 이후 HT-STA을 위하여

전송되는 데이터의 복조 및 디코딩을 위해 HT-SIG 필드가 전송된다.

[126] HT-SIG 필드까지는 빔포밍을 수행하지 않고 전송하여 L-STA 및 HT-STA이 해당 PPDU를 수신하여 데이터를 획득할 수 있도록 하고, 이후 전송되는 HT-STF, HT-LTF 및 데이터 필드는 프리코딩을 통한 무선 신호 전송이 수행된다. 여기서 프리코딩을 하여 수신하는 STA에서 프리코딩에 의한 전력이 가변 되는 부분을 감안할 수 있도록 HT-STF 필드를 전송하고 그 이후에 복수의 HT-LTF 및 데이터 필드를 전송한다.

[127] 아래 표 1은 HT-SIG 필드를 예시하는 표이다.

[128] [표1]

필드	비트	설명(description)
변조 및 코딩 방식(Modulation and Coding Scheme)	7	변조 및 코딩 방식을 지시함
채널 대역폭(CBW) 20/40	1	20MHz 또는 40MHz 보다 크거나(upper) / 작은(lower) 경우, '0', 40MHz인 경우, '1'
HT 길이(Length)	16	PSDU 내 데이터 옥텟의 수를 지시함
스무딩(Smoothing)	1	채널 추정 스무딩(smoothing)이 권고되는 경우, '1', 캐리어 별로 독립적(unsmoothing)으로 채널 추정이 권고되는 경우, '0'
비 사운딩(Not Sounding)	1	PPDU가 사운딩(sounding) PPDU인 경우, '0', PPDU가 사운딩(sounding) PPDU가 아닌 경우, '1'
Reserved	1	1로 셋팅
병합(Aggregation)	1	PPDU가 A-MPDU를 포함하는 경우, '1', 그렇지 않은 경우, '0'
시공간 블록 코딩(STBC)	2	시공간 스트림(space-time stream, NSTS)의 수와 MCS에 의해 지시된 공간 스트림(spatial stream, NSS)의 수 간의 차이를 지시함 STBC가 사용되지 않는 경우, '00'
FEC 코딩	1	LDPC(low-density parity check)가 사용되는 경우, '1', BCC(binary convolutional code)가 사용되는 경우, '0'
짧은 GI(Short GI)	1	HT 트레이닝(training) 이후에 짧은 GI가 사용되는 경우, '1', 그렇지 않은 경우, '0'
확장 공간 스트림의 수(Number of extension spatial streams)	2	확장 공간 스트림(extension spatial stream, NESS)의 수를 지시함 확장 공간 스트림이 없는 경우, '0', 확장 공간 스트림이 1개인 경우, '1', 확장 공간 스트림이 2개인 경우, '2', 확장 공간 스트림이 3개인 경우, '3'
CRC	8	수신자에서 PPDU의 에러를 검출하기 위한 CRC를 포함함
테일 비트(Tail Bits)	6	컨볼루셔널 디코딩(convolutional decoder)의 트렐리스(trellis) 종료를 위해 사용함 '0'으로 설정됨

[129] 도 3의 (c)는 IEEE 802.11n 시스템만을 지원하기 위한 HT-GF 포맷 PPDU(HT-greenfield format PPDU)을 예시한다.

[130] 도 3의 (c)를 참조하면, HT-GF 포맷 PPDU은 HT-GF-STF, HT-LTF1, HT-SIG 필드, 복수의 HT-LTF2 및 데이터 필드를 포함한다.

[131] HT-GF-STF는 프레임 타이밍 획득 및 AGC를 위해 사용된다.

[132] HT-LTF1는 채널 추정을 위해 사용된다.

[133] HT-SIG 필드는 데이터 필드의 복조 및 디코딩을 위해 사용된다.

[134] HT-LTF2는 데이터 필드의 복조를 위한 채널 추정에 사용된다. 마찬가지로 HT-STA은 SU-MIMO를 사용하므로 복수의 공간 스트림으로 전송되는 데이터 필드 각각에 대하여 채널 추정을 요하므로 HT-LTF2는 복수로 구성될 수 있다.

[135] 복수의 HT-LTF2는 HT 혼합 PPDU의 HT-LTF 필드와 유사하게 복수의 Data HT-LTF와 복수의 확장 HT-LTF로 구성될 수 있다.

[136] 도 3의 (a) 내지 (c)에서 데이터 필드는 페이로드(payload)로서, 서비스 필드(SERVICE field), 스크램블링된 PSDU(scrambled PSDU) 필드, 테일 비트(Tail bits), 패딩 비트(padding bits)를 포함할 수 있다. 데이터 필드의 모든 비트는 스크램블된다.

[137] 도 3(d)는 데이터 필드에 포함되는 서비스 필드를 나타낸다. 서비스 필드는 16 비트를 가진다. 각 비트는 0번부터 15번까지 부여되며, 0번 비트부터 순차적으로 전송된다. 0번부터 6번 비트는 0으로 설정되고, 수신단 내 디스크램블러(descrambler)를 동기화하기 위하여 사용된다.

[138] IEEE 802.11ac WLAN 시스템은 무선채널을 효율적으로 이용하기 위하여 복수의 STA들이 동시에 채널에 액세스하는 하향링크 MU-MIMO(Multi User Multiple Input Multiple Output) 방식의 전송을 지원한다. MU-MIMO 전송 방식에 따르면, AP가 MIMO 페어링(pairing)된 하나 이상의 STA에게 동시에 패킷을 전송할 수 있다.

[139] DL MU 전송(downlink multi-user transmission)은 하나 이상의 안테나를 통해 AP가 동일한 시간 자원을 통해 PPDU를 복수의 non-AP STA에게 전송하는 기술을 의미한다.

[140] 이하, MU PPDU는 MU-MIMO 기술 또는 OFDMA 기술을 이용하여 하나 이상의 STA을 위한 하나 이상의 PSDU를 전달하는 PPDU를 의미한다. 그리고, SU PPDU는 하나의 PSDU만을 전달할 수 있거나 PSDU가 존재하지 않는 포맷을 가진 PPDU를 의미한다.

[141] MU-MIMO 전송을 위하여 802.11n 제어 정보의 크기에 비하여 STA에 전송되는 제어 정보의 크기가 상대적으로 클 수 있다. MU-MIMO 지원을 위해 추가적으로 요구되는 제어 정보의 일례로, 각 STA에 의해 수신되는 공간적 스트림(spatial stream)의 수를 지시하는 정보, 각 STA에 전송되는 데이터의 변조 및 코딩 관련 정보 등이 이에 해당될 수 있다.

[142] 따라서, 복수의 STA에 동시에 데이터 서비스를 제공하기 위하여 MU-MIMO 전송이 수행될 때, 전송되는 제어 정보의 크기는 수신하는 STA의 수에 따라 증가될 수 있다.

[143] 이와 같이 증가되는 제어 정보의 크기를 효율적으로 전송하기 위하여, MU-MIMO 전송을 위해 요구되는 복수의 제어 정보는 모든 STA에 공통으로 요구되는 공통 제어 정보(common control information)와 특정 STA에 개별적으로

요구되는 전용 제어 정보(dedicated control information)의 두 가지 타입의 정보로 구분하여 전송될 수 있다.

[144]

[145] 도 4는 본 발명이 적용될 수 있는 무선 통신 시스템의 VHT 포맷 PPDU 포맷을 예시한다.

[146] 도 4(a)는 IEEE 802.11ac 시스템을 지원하기 위한 VHT 포맷 PPDU(VHT format PPDU)을 예시한다.

[147] 도 4(a)를 참조하면, VHT 포맷 PPDU은 L-STF, L-LTF 및 L-SIG 필드로 구성되는 레가시 포맷 프리앰블과 VHT-SIG-A(VHT-Signal-A) 필드, VHT-STF(VHT Short Training field), VHT-LTF(VHT Long Training field), VHT-SIG-B(VHT-Signal-B) 필드로 구성되는 VHT 포맷 프리앰블 및 데이터 필드를 포함하여 구성된다.

[148] L-STF, L-LTF 및 L-SIG는 하위 호환성(backward compatibility)를 위한 레가시 필드를 의미하므로, L-STF부터 L-SIG 필드까지 non-HT 포맷과 동일하다. 다만, L-LTF는 L-SIG 필드 및 VHT-SIG-A 필드를 복조하기 위하여 수행할 채널 추정을 위한 정보를 더 포함할 수 있다.

[149] L-STF, L-LTF, L-SIG 필드 및 VHT-SIG-A 필드는 20MHz 채널 단위로 반복되어 전송될 수 있다. 예를 들어, PPDU가 4개의 20MHz 채널(즉, 80 MHz 대역폭)을 통해 전송될 때, L-STF, L-LTF, L-SIG 필드 및 VHT-SIG-A 필드는 매 20MHz 채널에서 반복되어 전송될 수 있다.

[150] VHT-STA는 레가시 필드 뒤에 오는 VHT-SIG-A 필드 이용하여 VHT 포맷 PPDU임을 알 수 있으며, 이를 기반으로 데이터 필드를 디코딩할 수 있다.

[151] VHT 포맷 PPDU은 L-STA도 수신하여 데이터를 획득할 수 있도록 하기 위해 L-STF, L-LTF 및 L-SIG 필드가 가장 먼저 전송된다. 이후, VHT-STA을 위하여 전송되는 데이터의 복조 및 디코딩을 위해 VHT-SIG-A 필드가 전송된다.

[152] VHT-SIG-A 필드는 AP와 MIMO 페이링된(paired) VHT STA들에게 공통되는 제어 정보 전송을 위한 필드로서, 이는 수신된 VHT 포맷 PPDU를 해석하기 위한 제어 정보를 포함하고 있다.

[153] VHT-SIG-A 필드는 VHT-SIG-A1 필드와 VHT-SIG-A2 필드를 포함할 수 있다.

[154] VHT-SIG-A1 필드는 사용하는 채널 대역폭(BW: bandwidth) 정보, 시공간 블록 코딩(STBC: Space Time Block Coding)의 적용 여부, MU-MIMO에서 그룹핑된 STA들의 그룹의 지시하기 위한 그룹 식별 정보(Group ID: Group Identifier), 사용되는 스트림의 개수(NSTS: Number of space-time stream)/부분 AID(Partial AID(association Identifier))에 대한 정보 및 전송 파워 세이브 금지(Transmit power save forbidden) 정보를 포함할 수 있다. 여기서, Group ID는 MU-MIMO 전송을 지원하기 위해 전송 대상 STA 그룹에 대하여 할당되는 식별자를 의미하며, 현재 사용된 MIMO 전송 방법이 MU-MIMO인지 또는 SU-MIMO 인지 여부를 나타낼 수 있다.

[155] 표 2은 VHT-SIG-A1 필드를 예시하는 표이다.

[156] [표2]

필드	비트	설명(description)
BW	2	20MHz 경우, '0', 40MHz 경우, '1', 80MHz 경우, '2', 160MHz 또는 80+80 MHz 경우, '3'으로 설정됨
Reserved	1	
STBC	1	VHT SU PPDU 경우: STBC가 사용된 경우, '1', 그렇지 않은 경우, '0'으로 설정됨 VHT MU PPDU 경우: '0'으로 설정됨
Group ID	6	Group ID를 지시함 '0' 또는 '63'은 VHT SU PPDU를 지시하나, 그렇지 않은 경우 VHT MU PPDU를 지시함
NSTS/Partial AID	12	VHT MU PPDU이 경우, 각각 3 비트씩 4 사용자 위치(user position, 'p')로 구분됨 시공간 스트림이 0인 경우, '0', 시공간 스트림이 1인 경우, '1', 시공간 스트림이 2인 경우, '2', 시공간 스트림이 3인 경우, '3', 시공간 스트림이 4인 경우, '4', VHT SU PPDU이 경우, 상위 3 비트는 다음과 같이 설정됨 시공간 스트림이 1인 경우, '0', 시공간 스트림이 2인 경우, '1', 시공간 스트림이 3인 경우, '2', 시공간 스트림이 4인 경우, '3', 시공간 스트림이 5인 경우, '4', 시공간 스트림이 6인 경우, '5', 시공간 스트림이 7인 경우, '6', 시공간 스트림이 8인 경우, '7', 하위 9비트는 부분 AID(Partial AID)를 지시함
TXOP_PS_NOT_ALLOWED	1	VHT AP가 non-AP VHT STA이 TXOP(transmission opportunity) 동안 파워 세이브 모드로 천이하는 것을 허가하는 경우, '0'으로 설정됨 그렇지 않은 경우, '1'로 설정됨 non-AP VHT STA에 의해 전송되는 VHT PPDU의 경우 '1'로 설정됨
Reserved	1	

[157] VHT-SIG-A2 필드는 짧은 보호구간(GI: Guard Interval) 사용 여부에 대한 정보, 포워드 에러 정정(FEC: Forward Error Correction) 정보, 단일 사용자에 대한 MCS(Modulation and Coding Scheme)에 관한 정보, 복수 사용자에 대한 채널

코딩의 종류에 관한 정보, 빔포밍 관련 정보, CRC(Cyclic Redundancy Checking)를 위한 여분 비트(redundancy bits)와 컨벌루셔널 디코딩(convolutional decoder)의 테일 비트(tail bit) 등을 포함할 수 있다.

[158] 표 3은 VHT-SIG-A2 필드를 예시하는 표이다.

[159] [표3]

필드	비트	설명(description)
Short GI	1	데이터 필드에 짧은 GI가 사용되지 않는 경우, '0', 데이터 필드에 짧은 GI가 사용되는 경우, '1'로 설정됨
Short GI 명확화 (disambiguation)	1	짧은 GI가 사용되고, PPDU의 페이로드를 위해 추가 심볼이 필요한 경우, '1', 추가 심볼이 필요하지 않은 경우, '0'으로 설정됨
SU/MU Coding	1	VHT SU PPDU 경우: BCC(binary convolutional code) 경우, '0', LDPC(low-density parity check) 경우, '1'로 설정됨 VHT MU PPDU 경우: 사용자 위치(user position)가 '0'인 사용자의 NSTS 필드가 '0'이 아닌 경우, 사용되는 코딩을 지시함 BCC 경우, '0', LDPC 경우, '1'로 설정됨 사용자 위치(user position)가 '0'인 사용자의 NSTS 필드가 '0'인 경우, 예비필드로써 '1'로 설정됨
LDPC Extra OFDM Symbol	1	LDPC PPDU 인코딩 절차(SU PPDU 경우) 또는 적어도 하나의 LDPC 사용자의 PPDU 인코딩 절차(VHT MU PPDU 경우)로 인하여 추가 OFDM 심볼(extra OFDM symbol)이 필요한 경우, '1'로 설정됨 그렇지 않은 경우, '0'으로 설정됨
SU VHT MCS/MU Coding	4	VHT SU PPDU 경우: VHT-MCS 인덱스를 나타냄 VHT MU PPDU 경우: 상위 비트부터 순서대로 사용자 위치(user position) '1' 내지 '3'에 대한 코딩을 지시함 각 사용자의 NSTS 필드가 '1'이 아닌 경우, 사용되는 코딩을 지시함 BCC 경우, '0', LDPC 경우, '1'로 설정됨 각 사용자의 NSTS 필드가 '0'인 경우, 예비필드로써 '1'로 설정됨
Beamformed	1	VHT SU PPDU 경우: 빔포밍 스티어링 행렬(Beamforming steering matrix)이 SU 전송에 적용되는 경우 '1'로 설정됨 그렇지 않은 경우 '0'으로 설정됨 VHT MU PPDU 경우: 예비필드로써 '1'로 설정됨
Reserved	1	
CRC	8	수신자에서 PPDU의 에러를 검출하기 위한 CRC를 포함함
Tail	6	컨볼루셔널 디코딩(convolutional decoder)의 트렐리스(trellis) 종료를 위해 사용함 '0'으로 설정됨

[160] VHT-STF는 MIMO 전송에 있어서 AGC 추정의 성능을 개선하기 위해 사용된다.

[161] VHT-LTF는 VHT-STA이 MIMO 채널을 추정하는데 사용된다. VHT WLAN 시스템은 MU-MIMO를 지원하기 때문에, VHT-LTF는 PPDU가 전송되는 공간 스트림의 개수만큼 설정될 수 있다. 추가적으로, 풀 채널 사운딩(full channel sounding)이 지원되는 경우, VHT-LTF의 수는 더 많아질 수 있다.

[162] VHT-SIG-B 필드는 MU-MIMO 페어링된 복수의 VHT-STA이 PPDU를 수신하여 데이터를 획득하는데 필요한 전용 제어 정보를 포함한다. 따라서, VHT-SIG-A 필드에 포함된 공통 제어 정보(common control information)가 현재 수신된 PPDU가 MU-MIMO 전송을 지시한 경우에만, VHT-STA은 VHT-SIG-B 필드를 디코딩(decoding)하도록 설계될 수 있다. 반면, 공통 제어 정보가 현재 수신된 PPDU가 단일 VHT-STA을 위한 것(SU-MIMO를 포함)임을 지시한 경우 STA은 VHT-SIG-B 필드를 디코딩하지 않도록 설계될 수 있다.

[163] VHT-SIG-B 필드는 VHT-SIG-B 길이(Length) 필드, VHT-MCS 필드, 예비(Reserved) 필드, 테일(Tail) 필드를 포함한다.

[164] VHT-SIG-B 길이(Length) 필드는 A-MPDU의 길이(EOF(end-of-frame) 패딩 이전)를 지시한다. VHT-MCS 필드는 각 VHT-STA들의 변조(modulation), 인코딩(encoding) 및 레이트 매칭(rate-matching)에 대한 정보를 포함한다.

[165] VHT-SIG-B 필드의 크기는 MIMO 전송의 유형(MU-MIMO 또는 SU-MIMO) 및 PPDU 전송을 위해 사용하는 채널 대역폭에 따라 다를 수 있다.

[166] 도 4(b)는 PPDU 전송 대역폭에 따른 VHT-SIG-B 필드를 예시한다.

[167] 도 4(b)를 참조하면, 40MHz 전송에 있어서, VHT-SIG-B 비트는 2번 반복된다. 80MHz 전송에 있어서, VHT-SIG-B 비트는 4번 반복되고, 0로 셋팅된 패드 비트가 부착된다.

[168] 160MHz 전송 및 80+80MHz 에 있어서, 먼저 80MHz 전송과 같이 VHT-SIG-B 비트는 4번 반복되고, 0로 셋팅된 패드 비트가 부착된다. 그리고, 전체 117 비트가 다시 반복된다.

[169] MU-MIMO를 지원하는 시스템에서 동일한 크기의 PPDU를 AP에 페어링된 STA들에게 전송하기 위하여, PPDU를 구성하는 데이터 필드의 비트 크기를 지시하는 정보 및/또는 특정 필드를 구성하는 비트 스트림 크기를 지시하는 정보가 VHT-SIG-A 필드에 포함될 수 있다.

[170] 다만, 효과적으로 PPDU 포맷을 사용하기 위하여 L-SIG 필드가 사용될 수도 있다. 동일한 크기의 PPDU가 모든 STA에게 전송되기 위하여 L-SIG 필드 내 포함되어 전송되는 길이 필드(length field) 및 레이트 필드(rate field)가 필요한 정보를 제공하기 위해 사용될 수 있다. 이 경우, MPDU(MAC Protocol Data Unit) 및/또는 A-MPDU(Aggregate MAC Protocol Data Unit)가 MAC 계층의 바이트(또는 옥텟(oct: octet)) 기반으로 설정되므로 물리 계층에서 추가적인 패딩(padding)이 요구될 수 있다.

[171] 도 4에서 데이터 필드는 페이로드(payload)로서, 서비스 필드(SERVICE field), 스크램블링된 PSDU(scrambled PSDU), 테일 비트(tail bits), 패딩 비트(padding bits)를 포함할 수 있다.

[172] 위와 같이 여러 가지의 PPDU의 포맷이 혼합되어 사용되기 때문에, STA은 수신한 PPDU의 포맷을 구분할 수 있어야 한다.

[173] 여기서, PPDU를 구분한다는 의미(또는, PPDU 포맷을 구분한다는 의미)는 다양한 의미를 가질 수 있다. 예를 들어, PPDU를 구분한다는 의미는 수신한 PPDU가 STA에 의해 디코딩(또는, 해석)이 가능한 PPDU인지 여부에 대하여 판단한다는 의미를 포함할 수 있다. 또한, PPDU를 구분한다는 의미는 수신한 PPDU가 STA에 의해 지원 가능한 PPDU인지 여부에 대하여 판단한다는 의미일 수도 있다. 또한, PPDU를 구분한다는 의미는 수신한 PPDU를 통해 전송된 정보가 어떠한 정보인지를 구분한다는 의미로도 해석될 수 있다.

[174] 이에 대하여 아래 도면을 참조하여 보다 상세히 설명한다.

[175]

[176] **MAC 프레임 포맷**

[177] 도 5는 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 MAC 프레임 포맷을 예시한다.

[178] 도 5를 참조하면, MAC 프레임(즉, MPDU)은 MAC 헤더(MAC Header), 프레임 몸체(Frame Body) 및 프레임 체크 시퀀스(FCS: frame check sequence)로 구성된다.

[179] MAC Header는 프레임 제어(Frame Control) 필드, 지속 시간/식별자(Duration/ID) 필드, 주소 1(Address 1) 필드, 주소 2(Address 2) 필드, 주소 3(Address 3) 필드, 시퀀스 제어(Sequence Control) 필드, 주소 4(Address 4) 필드, QoS 제어(QoS Control) 필드 및 HT 제어(HT Control) 필드를 포함하는 영역으로 정의된다.

[180] Frame Control 필드는 해당 MAC 프레임 특성에 대한 정보를 포함한다. Frame Control 필드에 대한 보다 상세한 설명은 후술한다.

[181] Duration/ID 필드는 해당 MAC 프레임의 타입 및 서브타입에 따른 다른 값을 가지도록 구현될 수 있다.

[182] 만약, 해당 MAC 프레임의 타입 및 서브타입이 파워 세이브(PS: power save) 운영을 위한 PS-폴(PS-Poll) 프레임의 경우, Duration/ID 필드는 프레임을 전송한 STA의 AID(association identifier)를 포함하도록 설정될 수 있다. 그 이외의 경우, Duration/ID 필드는 해당 MAC 프레임의 타입 및 서브타입에 따라 특정 지속시간 값을 가지도록 설정될 수 있다. 또한, 프레임이 A-MPDU(aggregate-MPDU) 포맷에 포함된 MPDU인 경우, MAC 헤더에 포함된 Duration/ID 필드는 모두 동일한 값을 가지도록 설정될 수도 있다.

[183] Address 1 필드 내지 Address 4 필드는 BSSID, 소스 주소(SA: source address), 목적 주소(DA: destination address), 전송 STA 주소를 나타내는 전송 주소 (TA: Transmitting Address), 수신 STA 주소를 나타내는 수신 주소(RA: Receiving Address)를 지시하기 위하여 사용된다.

[184] 한편, TA 필드로 구현된 주소 필드는 대역폭 시그널링 TA(bandwidth signaling TA) 값으로 설정될 수 있으며, 이 경우 TA 필드는 해당 MAC 프레임이 스크램블링 시퀀스에 추가적인 정보를 담고 있음을 지시할 수 있다. 대역폭 시그널링 TA는 해당 MAC 프레임을 전송하는 STA의 MAC 주소로 표현될 수 있으나, MAC 주소에 포함된 개별/그룹 비트(Individual/Group bit)가 특정 값(예를 들어, '1')으로 설정될 수 있다.

[185] Sequence Control 필드는 시퀀스 넘버(sequence number) 및 조각 넘버(fragment number)를 포함하도록 설정된다. 시퀀스 넘버를 해당 MAC 프레임에 할당된 시퀀스 넘버를 지시할 수 있다. 조각 넘버는 해당 MAC 프레임의 각 조각의 넘버를 지시할 수 있다.

[186] QoS Control 필드는 QoS와 관련된 정보를 포함한다. QoS Control 필드는 서브타입(Subtype) 서브필드에서 QoS 데이터 프레임을 지시하는 경우 포함될 수 있다.

[187] HT Control 필드는 HT 및/또는 VHT 송수신 기법과 관련된 제어 정보를 포함한다. HT Control 필드는 제어 래퍼(Control Wrapper) 프레임에 포함된다. 또한, 오더(Order) 서브필드 값이 1인 QoS 데이터(QoS Data) 프레임, 관리(Management) 프레임에 존재한다.

[188] Frame Body는 MAC 페이로드(payload)로 정의되고, 상위 계층에서 전송하고자 하는 데이터가 위치하게 되며, 가변적인 크기를 가진다. 예를 들어, 최대 MPDU의 크기는 11454 옥텟(octets)이고, 최대 PPDU 크기는 5.484 ms일 수 있다.

[189] FCS는 MAC 풋터(footer)로 정의되고, MAC 프레임의 에러 탐색을 위하여 사용된다.

[190] 처음 세 필드(Frame Control 필드, Duration/ID 필드 및 Address 1 필드)와 제일 마지막 필드(FCS 필드)는 최소 프레임 포맷을 구성하며, 모든 프레임에 존재한다. 그 외의 필드는 특정 프레임 타입에서만 존재할 수 있다.

[191]

[192] 도 6은 본 발명이 적용될 수 있는 무선 통신 시스템에서 MAC 프레임 내 프레임 제어(Frame Control) 필드를 예시하는 도면이다.

[193] 도 6을 참조하면, Frame Control 필드는 프로토콜 버전(Protocol Version) 서브필드, 타입(Type) 서브필드, 서브타입(Subtype) 서브필드, To DS 서브필드, From DS 서브필드, 추가 조각(More Fragments) 서브필드, 재시도(Retry) 서브필드, 파워 관리(Power Management) 서브필드, 추가 데이터(More Data) 서브필드, 보호된 프레임(Protected Frame) 서브필드 및 오더(Order) 서브필드로 구성된다.

[194] Protocol Version 서브필드는 해당 MAC 프레임에 적용된 WLAN 프로토콜의 버전을 지시할 수 있다.

[195] Type 서브필드 및 Subtype 서브필드는 해당 MAC 프레임의 기능을 식별하는 정보를 지시하도록 설정될 수 있다.

[196] MAC 프레임의 타입은 관리 프레임(Management Frame), 제어 프레임(Control Frame), 데이터 프레임(Data Frame) 3가지의 프레임 타입을 포함할 수 있다.

[197] 그리고, 각 프레임 타입들은 다시 서브타입으로 구분될 수 있다.

[198] 예를 들어, 제어 프레임(Control frames)은 RTS(request to send) 프레임, CTS(clear-to-send) 프레임, ACK(Acknowledgment) 프레임, PS-Poll 프레임, CF(contention free)-End 프레임, CF-End+CF-ACK 프레임, 블록 ACK 요청(BAR: Block Acknowledgment request) 프레임, 블록 ACK(BA: Block Acknowledgment) 프레임, 제어 래퍼(Control Wrapper(Control+HTcontrol)) 프레임, VHT 널 데이터 패킷 공지(NDPA: Null Data Packet Announcement), 빔포밍 보고 폴(Beamforming Report Poll) 프레임을 포함할 수 있다.

[199] 관리 프레임(Management frames)은 비콘(Beacon) 프레임, ATIM(Announcement Traffic Indication Message) 프레임, 연계해제(Disassociation) 프레임, 연계 요청/응답(Association Request/Response) 프레임, 재연계 요청/응답(Reassociation Request/Response) 프레임, 프로브 요청/응답(Probe Request/Response) 프레임, 인증(Authentication) 프레임, 인증해제(Deauthentication) 프레임, 동작(Action) 프레임, 동작 무응답(Action No ACK) 프레임, 타이밍 광고(Timing Advertisement) 프레임을 포함할 수 있다.

[200] To DS 서브필드 및 From DS 서브필드는 해당 MAC 프레임 헤더에 포함된 Address 1 필드 내지 Address 4 필드를 해석하기 위하여 필요한 정보를 포함할 수 있다. Control 프레임의 경우, To DS 서브필드 및 From DS 서브필드는 모두 '0'로 설정된다. Management 프레임의 경우, To DS 서브필드 및 From DS 서브필드는 해당 프레임이 QoS 관리 프레임(QMF: QoS Management frame)이면 순서대로 '1', '0'으로 설정되고, 해당 프레임이 QMF가 아니면 순서대로 모두 '0', '0'로 설정될 수 있다.

[201] More Fragments 서브필드는 해당 MAC 프레임에 이어 전송될 조각(fragment)이 존재하는지 여부를 지시할 수 있다. 현재 MSDU 또는 MMPDU의 또 다른 조각(fragment)가 존재하는 경우 '1'로 설정되고, 그렇지 않은 경우 '0'로 설정될 수 있다.

[202] Retry 서브필드는 해당 MAC 프레임이 이전 MAC 프레임의 재전송에 따른 것인지 여부를 지시할 수 있다. 이전 MAC 프레임의 재전송인 경우 '1'로 설정되고, 그렇지 않은 경우 '0'으로 설정될 수 있다.

[203] Power Management 서브필드는 STA의 파워 관리 모드를 지시할 수 있다. Power Management 서브필드 값이 '1'이면 STA이 파워 세이브 모드로 전환하는 것을 지시할 수 있다.

[204] More Data 서브필드는 추가적으로 전송될 MAC 프레임이 존재하는지 여부를 지시할 수 있다. 추가적으로 전송될 MAC 프레임이 존재하는 경우 '1'로 설정되고, 그렇지 않은 경우 '0'으로 설정될 수 있다.

[205] Protected Frame 서브필드는 프레임 바디(Frame Body) 필드가 암호화되었는지

여부를 지시할 수 있다. Frame Body 필드가 암호화된 인캡슐레이션 알고리즘(cryptographic encapsulation algorithm)에 의해 처리된 정보를 포함하는 경우 '1'로 설정되고, 그렇지 않은 경우 '0'으로 설정될 수 있다.

[206] 앞서 설명한 각 필드들에 포함되는 정보들은 IEEE 802.11 시스템의 정의를 따를 수 있다. 또한, 앞서 설명한 각 필드들은 MAC 프레임에 포함될 수 있는 필드들의 예시에 해당하며, 이에 한정되지 않는다. 즉, 앞서 설명한 각 필드가 다른 필드로 대체되거나 추가적인 필드가 더 포함될 수 있으며, 모든 필드가 필수적으로 포함되지 않을 수도 있다.

[207]

[208] **채널 상태 정보(Channel State Information) 피드백(feedback) 방법**

[209] 빔포머(Beamformer)가 모든 안테나를 하나의 빔포미(Beamformee)에 할당하여 통신하는 SU-MIMO 기술은 시공간을 이용한 다이버시티 이득(diversity gain)과 스트림(stream) 다중 전송을 통해 채널 용량을 증대시킨다. SU-MIMO 기술은 MIMO 기술을 적용하지 않을 때에 비해 안테나의 개수를 늘림으로써, 공간 자유도를 확장시켜 물리 계층의 성능 향상에 기여할 수 있다.

[210] 또한, Beamformer가 복수의 Beamformee에게 안테나를 할당하는 MU-MIMO 기술은 Beamformer에 접속한 복수의 Beamformee들의 다중 접속을 위한 링크 계층 프로토콜을 통하여, Beamformee 당 전송률을 높이거나 채널의 신뢰도를 높임으로써 MIMO 안테나의 성능을 향상시킬 수 있다.

[211] MIMO 환경에서는 Beamformer가 채널 정보를 얼마나 정확히 알고 있는지가 성능에 큰 영향을 미칠 수 있으므로, 채널 정보 획득을 위한 피드백 절차가 요구된다.

[212] 채널 정보 획득을 위한 피드백 절차는 크게 두 가지 방식이 지원될 수 있다. 하나는 제어 프레임(Control frame)을 이용하는 방식이며, 남은 하나는 데이터 필드가 포함되지 않은 채널 사운딩(channel sounding) 절차를 이용하는 방식이다. 사운딩은 프리엠블 트레이닝 필드(training field)를 포함하는 PPDU의 데이터 복조 이외의 목적을 위해 채널을 측정하기 위하여 해당 트레이닝 필드(training field)를 이용하는 것을 의미한다.

[213] 이하, 제어 프레임(Control frame)을 이용한 채널 정보 피드백 방법과 NDP(null data packet)을 이용한 채널 정보 피드백 방법에 대하여 보다 구체적으로 살펴본다.

[214] 1) 제어 프레임(Control frame)을 이용한 피드백 방법

[215] MIMO 환경에서 Beamformer는 MAC 헤더에 포함된 HT control 필드를 통해 채널 상태 정보의 피드백을 지시하거나, Beamformee는 MAC 프레임 헤더에 포함된 HT control 필드를 통해 채널 상태 정보를 보고할 수 있다(도 8 참조). HT control 필드는 Control Wrapper 프레임이나 MAC 헤더의 Order 서브필드가 1로 설정된 QoS Data 프레임, 관리 프레임에 포함될 수 있다.

[216] 2) 채널 사운딩(channel sounding)을 이용한 피드백 방법

[217] 도 7은 본 발명이 적용될 수 있는 무선 통신 시스템에서 채널 사운딩(sounding) 방법을 개념적으로 나타내는 도면이다.

[218] 도 7에서는 사운딩 프로토콜(sounding protocol)을 기초로 Beamformer(예를 들어, AP)와 Beamformee(예를 들어, non-AP STA) 간의 채널 상태 정보(channel state information)를 피드백하는 방법을 예시한다. 사운딩 프로토콜(sounding protocol)은 채널 상태 정보에 대한 정보를 피드백 받는 절차를 의미할 수 있다.

[219] 사운딩 프로토콜을 기초로 한 Beamformer와 Beamformee 간의 채널 상태 정보 사운딩 방법을 아래와 같은 단계로 수행될 수 있다.

[220] (1) Beamformer에서 Beamformee의 피드백을 위한 사운딩 전송을 알리는 VHT NDPA(VHT Null Data Packet Announcement) 프레임을 전송한다.

[221] VHT NDPA 프레임은 채널 사운딩이 개시되고, NDP(Null Data Packet)이 전송될 것임을 알리기 위해 사용되는 제어 프레임(control frame)을 의미한다. 다시 말해, NDP을 전송하기 전 VHT NDPA 프레임을 전송함으로써 Beamformee가 NDP 프레임을 수신하기 전 채널 상태 정보를 피드백 하기 위한 준비를 하도록 할 수 있다.

[222] VHT NDPA 프레임은 NDP을 전송할 Beamformee의 AID(association identifier) 정보, 피드백 타입 정보 등을 포함할 수 있다. VHT NDPA 프레임에 대한 보다 상세한 설명은 후술한다.

[223] VHT NDPA 프레임은 MU-MIMO를 사용하여 데이터를 전송하는 경우와 SU-MIMO를 사용하여 데이터를 전송하는 경우 서로 다른 전송 방식으로 전송될 수 있다. 예를 들어, MU-MIMO를 위한 채널 사운딩을 수행하는 경우 VHT NDPA 프레임을 브로드캐스트(broadcast) 방식으로 전송하나, SU-MIMO를 위한 채널 사운딩을 수행하는 경우 하나의 대상 STA으로 VHT NDPA 프레임을 유니캐스트(unicast) 방식으로 전송할 수 있다.

[224] (2) Beamformer는 VHT NDPA 프레임을 전송한 후, SIFS 시간 후에 NDP을 전송한다. NDP은 데이터 필드를 제외한 VHT PPDU 구조를 가진다.

[225] VHT NDPA 프레임을 수신한 Beamformee들은 STA 정보 필드에 포함된 AID12 서브필드 값을 확인하고, 자신이 사운딩 대상 STA인지 확인할 수 있다.

[226] 또한, Beamformee들은 NDPA에 포함된 STA Info 필드의 순서를 통해 피드백 순서를 알 수 있다. 도 11에서는 피드백 순서가 Beamformee 1, Beamformee 2, Beamformee 3의 순서로 진행되는 경우를 예시한다.

[227] (3) Beamformee 1은 NDP에 포함된 트레이닝 필드(training field)를 기초로 하향링크 채널 상태 정보를 획득하여, Beamformer에게 전송할 피드백 정보를 생성한다.

[228] Beamformee 1은 NDP 프레임을 수신 후 SIFS 이후에 피드백 정보를 포함한 VHT 압축된 빔포밍(VHT Compressed Beamforming) 프레임을 Beamformer에게 전송한다.

[229] VHT Compressed Beamforming 프레임은 시공간 스트림(space-time stream)에

대한 SNR 값, 서브캐리어(subcarrier)에 대한 압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)에 대한 정보 등이 포함될 수 있다. VHT Compressed Beamforming 프레임에 대한 보다 상세한 설명은 후술한다.

[230] (4) Beamformer는 Beamformee 1으로부터 VHT Compressed Beamforming 프레임 수신 후, SIFS 이후에 Beamformee 2로부터 채널 정보를 얻기 위해 빔포밍 보고 폴(Beamforming Report Poll) 프레임을 Beamformee 2에게 전송한다.

[231] Beamforming Report Poll 프레임은 NDP 프레임과 동일한 역할을 수행하는 프레임으로서, Beamformee 2는 전송되는 Beamforming Report Poll 프레임을 기초로 채널 상태를 측정할 수 있다.

[232] Beamforming report poll frame 프레임에 대한 보다 상세한 설명은 후술한다.

[233] (5) Beamforming Report Poll 프레임을 수신한 Beamformee 2는 SIFS 이후에 피드백 정보를 포함한 VHT Compressed Beamforming 프레임을 Beamformer에게 전송한다.

[234] (6) Beamformer는 Beamformee 2로부터 VHT Compressed Beamforming 프레임 수신 후, SIFS 이후에 Beamformee 3로부터 채널 정보를 얻기 위해 Beamforming Report Poll 프레임을 Beamformee 3에게 전송한다.

[235] (7) Beamforming Report Poll 프레임을 수신한 Beamformee 3은 SIFS 이후에 피드백 정보를 포함한 VHT Compressed Beamforming 프레임을 Beamformer에게 전송한다.

[236] 이하, 앞서 설명한 채널 사운딩 절차에서 사용되는 프레임에 대하여 살펴본다.

[237]

[238] 도 8은 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT NDPA 프레임을 예시하는 도면이다.

[239] 도 8을 참조하면, VHT NDPA 프레임은 프레임 제어(Frame Control) 필드, 지속 시간(Duration) 필드, RA(Receiving Address) 필드, TA(Transmitting Address) 필드, 사운딩 다이얼로그 토큰(Sounding Dialog Token) 필드, STA 정보 1(STA Info 1) 필드 내지 STA 정보 n(STA Info n) 필드 및 FCS로 구성될 수 있다.

[240] RA 필드 값은 VHT NDPA 프레임을 수신하는 수신자 주소(receiver address) 또는 STA 주소를 나타낸다.

[241] VHT NDPA 프레임이 하나의 STA Info 필드를 포함하는 경우, RA 필드 값은 STA Info 필드 내 AID에 의해 식별되는 STA의 주소를 가진다. 예를 들어, SU-MIMO 채널 사운딩을 위하여 하나의 대상 STA으로 VHT NDPA 프레임을 전송하는 경우, AP는 VHT NDPA 프레임을 대상 STA에게 유니캐스트(unicast)로 전송한다.

[242] 반면, VHT NDPA 프레임이 하나 이상의 STA Info 필드를 포함하는 경우, RA 필드 값은 브로드캐스트 주소(broadcast address)를 가진다. 예를 들어, MU-MIMO 채널 사운딩을 위하여 적어도 하나 이상의 대상 STA으로 VHT NDPA 프레임을 전송하는 경우, AP는 VHT NDPA 프레임을 브로드캐스팅한다.

[243] TA 필드 값은 VHT NDPA 프레임을 전송하는 송신자 주소(transmitter address) 또는 전송하는 STA의 주소 또는 TA를 시그널링하는 대역폭을 나타낸다.

[244] Sounding Dialog Token 필드는 사운딩 시퀀스(Sounding Sequence) 필드로 불릴 수도 있다. Sounding Dialog Token 필드 내 사운딩 다이얼로그 토큰 번호(Sounding Dialog Token Number) 서브필드는 VHT NDPA 프레임을 식별하기 위하여 Beamformer에 의해 선택된 값을 포함한다.

[245] VHT NDPA 프레임은 적어도 하나의 STA Info 필드를 포함한다. 즉, VHT NDPA 프레임은 사운딩 대상 STA에 대한 정보를 포함하는 STA Info 필드를 포함한다. STA Info 필드는 사운딩 대상 STA 마다 하나씩 포함될 수 있다.

[246] 각 STA Info 필드는 AID12 서브필드, 피드백 타입(Feedback Type) 서브필드 및 Nc 인덱스(Nc Index) 서브필드로 구성될 수 있다.

[247] 표 4는 VHT NDPA 프레임에 포함되는 STA Info 필드의 서브필드를 나타낸다.

[248] [표4]

서브필드	설명(description)
AID12	사운딩 피드백 대상이 되는 STA의 AID를 포함함 대상 STA이 AP이거나 메쉬(mesh) STA이거나 IBSS 멤버인 STA인 경우, AID12 서브필드 값은 '0'로 설정함
Feedback Type	사운딩 대상 STA에 대한 피드백 요청 타입을 지시함 SU-MIMO인 경우 '0' MU-MIMO인 경우 '1'
Nc Index	Feedback Type 서브필드가 MU-MIMO를 지시하는 경우, 압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)의 열(column) 개수(Nc)에서 1을 차감한 값을 지시함 Nc=1 경우, '0', Nc=2 경우, '1', ... Nc=8 경우, '7' SU-MIMO인 경우, 예비 서브필드로 설정됨

[249] 앞서 설명한 각 필드들에 포함되는 정보들은 IEEE 802.11 시스템의 정의를 따를 수 있다. 또한, 앞서 설명한 각 필드들은 MAC 프레임에 포함될 수 있는 필드들의 예시에 해당하며, 다른 필드로 대체되거나, 추가적인 필드가 더 포함될 수 있다.

[250]

[251] 도 9는 본 발명이 적용될 수 있는 무선 통신 시스템에서 NDP PPDU을 예시하는 도면이다.

[252] 도 9를 참조하면, NDP은 앞서 도 4와 같은 VHT PPDU 포맷에서 데이터 필드가 생략된 포맷을 가질 수 있다. NDP은 특정 프리코딩 행렬(precoding matrix)를 기반으로 프리코딩(precoding)되어 사운딩 대상 STA으로 전송될 수 있다.

[253] NDP의 L-SIG 필드에서 데이터 필드에 포함된 PSDU 길이를 지시하는 길이 필드는 '0'으로 설정된다.

[254] NDP의 VHT-SIG-A 필드에서 NDP 전송을 위해 사용된 전송 기법이 MU-MIMO 인지 또는 SU-MIMO 인지 지시하는 Group ID 필드는 SU-MIMO 전송을 지시하는 값으로 설정된다.

[255] NDP의 VHT-SIG-B 필드의 데이터 비트는 대역폭 별로 고정된 비트 패턴(bit pattern)으로 설정된다.

[256] 사운딩 대상 STA은 NDP를 수신하면, NDP의 VHT-LTF 필드를 기반으로 채널을 추정하고 채널 상태 정보를 획득한다.

[257]

[258] 도 10은 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT 압축된 빔포밍(VHT compressed beamforming) 프레임 포맷을 예시하는 도면이다.

[259] 도 10을 참조하면, VHT compressed beamforming 프레임은 VHT 기능을 지원하기 위한 VHT 동작(VHT Action) 프레임으로서, Frame Body에 Action 필드를 포함한다. Action 필드는 MAC 프레임의 Frame Body에 포함되어 확장된 관리 동작들을 명시하기 위한 메커니즘을 제공한다.

[260] Action 필드는 카테고리(Category) 필드, VHT 동작(VHT Action) 필드, VHT MIMO 제어(VHT MIMO Control) 필드, VHT 압축된 빔포밍 보고(VHT Compressed Beamforming Report) 필드 및 MU 전용 빔포밍 보고(MU Exclusive Beamforming Report) 필드로 구성된다.

[261] Category 필드는 VHT 카테고리(즉, VHT Action 프레임)를 지시하는 값으로 설정되고, VHT Action 필드는 VHT Compressed Beamforming 프레임을 지시하는 값으로 설정된다.

[262] VHT MIMO Control 필드는 빔포밍 피드백과 관련된 제어 정보를 피드백하기 위하여 사용된다. VHT MIMO Control 필드는 VHT Compressed Beamforming 프레임에 항상 존재할 수 있다.

[263] VHT Compressed Beamforming Report 필드는 데이터를 전송하는데 사용되는 시공간 스트림(space-time stream)에 대한 SNR 정보가 포함된 빔포밍 매트릭에 대한 정보를 피드백하기 위하여 사용된다.

[264] MU Exclusive Beamforming Report 필드는 MU-MIMO 전송을 수행하는 경우 공간적 스트림(spatial stream)에 대한 SNR 정보를 피드백하기 위하여 사용된다.

[265] VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드의 존재 여부 및 내용(content)은 VHT MIMO Control 필드의 피드백 타입(Feedback Type) 서브필드, 잔여 피드백 세그먼트(Remaining Feedback Segments) 서브필드, 최초 피드백 세그먼트(First Feedback Segment) 서브필드의 값에 따라 결정될 수 있다.

[266] 이하, VHT MIMO Control 필드, VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드에 대하여 보다 구체적으로 살펴본다.

[267] 1) VHT MIMO Control 필드는 Nc 인덱스(Nc Index) 서브필드, Nr 인덱스(Nr Index) 서브필드, 채널 폭(Channel Width) 서브필드, 그룹핑(Grouping) 서브필드,

코드북 정보(Codebook Information) 서브필드, 피드백 타입(Feedback Type) 서브필드, 잔여 피드백 세그먼트(Remaining Feedback Segments) 서브필드, 최초 피드백 세그먼트(First Feedback Segment) 서브필드, 예비(reserved) 서브필드 및 사운딩 다이얼로그 토큰 번호(Sounding Dialog Token Number) 서브필드로 구성된다.

[268] 표 5는 VHT MIMO Control 필드의 서브필드를 나타낸다.

[269] [표5]

서브필드	비트수	설명(description)
Nc Index	3	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)의 열(column) 개수(Nc)에서 1을 차감한 값을 지시함. Nc=1 경우, '0', Nc=2 경우, '1', ... Nc=8 경우, '7'
Nr Index	3	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)의 행(row) 개수(Nr)에서 1을 차감한 값을 지시함. Nr=1 경우, '0', Nr=2 경우, '1', ... Nr=8 경우, '7'
Channel Width	2	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)을 생성하기 위하여 측정되는 채널의 대역폭을 지시함. 20 MHz 경우, '0', 40 MHz 경우,'1', 80 MHz 경우, '2',160 MHz 또는 80+80 MHz 경우, '3'
Grouping	2	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)에 사용된 서브캐리어 그룹핑(Ng)을 지시함. Ng=1(그룹핑 없음) 경우, '0', Ng=2 경우, '1', Ng=4 경우, '2', '3' 값은 예비 값으로 설정됨
Codebook Information	1	코드북 엔트리(entries)의 사이즈를 지시함 피드백 타입이 SU-MIMO 경우, bΨ=2, bΦ=4 경우, '0', bΨ=4, bΦ=6 경우, '1' 피드백 타입이 MU-MIMO 경우, bΨ=5, bΦ=7 경우, '0', bΨ=7, bΦ=9 경우, '1' 여기서, bΨ 및 bΦ는 양자화된 비트 수를 의미함
Feedback Type	1	피드백 타입을 지시함 SU-MIMO 경우, '0', MU-MIMO 경우, '1'
Remaining Feedback Segments	3	관련된 VHT Compressed Beamforming 프레임에 대한 잔여 피드백 세그먼트의 개수를 지시함. 분할된 보고(segmented report)의 마지막 피드백 세그먼트 또는 분할되지 않은 보고(unsegmented report)의 세그먼트인 경우, '0'으로 설정됨. 분할된 보고(segmented report)의 최초 그리고 마지막 피드백 세그먼트가 아닌 경우, '1'에서 '6'사이의 값으로 설정됨. 분할된 보고(segmented report)의 마지막 세그먼트가 아닌 피드백 세그먼트인 경우, '1'에서 '6'사이의 값으로 설정됨 재전송 피드백 세그먼트의 경우, 필드는 본래 전송(original transmission)의 관련된 세그먼트와 동일한 값으로 설정됨
First Feedback Segment	1	분할된 보고(segmented report)의 최초 피드백 세그먼트 또는 분할되지 않은 보고(unsegmented report)의 피드백 세그먼트인 경우, '1'로 설정됨 최초 피드백 세그먼트가 아닌 경우 또는 VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드가 프레임에 존재하지 않는 경우, '0'으로 설정됨 재전송 피드백 세그먼트의 경우, 필드는 본래 전송(original transmission)의 관련된 세그먼트와 동일한 값으로 설정됨
Sounding Dialog Token Number	6	NDPA 프레임의 사운딩 다이얼로그 토큰(Sounding Dialog Token) 값으로 설정됨

[270] VHT Compressed Beamforming 프레임이 VHT Compressed Beamforming Report 필드의 전부 또는 일부를 전달하지 않는 경우, Nc Index 서브필드, Channel Width 서브필드, Grouping 서브필드, Codebook Information 서브필드, Feedback Type 서브필드 및 Sounding Dialog Token Number 서브필드는 예비 필드로 설정되고,

First Feedback Segment 서브필드는 '0'로 설정되며, Remaining Feedback Segments 서브필드는 '7'로 설정된다.

[271] Sounding Dialog Token Number 서브필드는 사운딩 시퀀스 번호(Sounding Sequence Number) 서브필드로 불릴 수도 있다.

[272] 2) VHT compressed beamforming report 필드는 전송 Beamformer가 스티어링 행렬(steering matix) 'Q'를 결정하기 위해 사용하는 압축된 빔포밍 피드백 행렬(comporessed beamforming feedback matrix) 'V'를 각도의 형태로 나타낸 명시적인 피드백 정보를 전달하기 위하여 사용된다.

[273] 표 6은 VHT compressed beamforming report 필드의 서브필드를 나타낸다.

[274] [표6]

서브필드	비트수	설명(description)
시공간 스트림 1의 평균 SNR (Average SNR of Space-Time Stream 1)	8	Beamformee에서 시공간 스트림 1에 대한 모든 서브캐리어들 상에서의 평균 SNR
...	...	...
시공간 스트림 Nc의 평균 SNR (Average SNR of Space-Time Stream Nc)	8	Beamformee에서 시공간 스트림 Nc에 대한 모든 서브캐리어들 상에서의 평균 SNR
서브캐리이 k=scidx(0)에 대한 압축된 빔포밍 피드백 행렬 V (Compressed Beamforming Feedback Matrix V for subcarrier k=scidx(0))	Na*(bψ+bΦ)/2	해당 서브캐리이에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix)의 각도의 순서
서브캐리어 k=scidx(1)에 대한 압축된 빔포밍 피드백 행렬 V (Compressed Beamforming Feedback Matrix V for subcarrier k=scidx(1))	Na*(bψ+bΦ)/2	해당 서브캐리어에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix)의 각도의 순서
...	...	...
서브캐리이 k=scidx(Ns-1)에 대한 압축된 빔포밍 피드백 행렬 V (Compressed Beamforming Feedback Matrix V for subcarrier k=scidx(Ns-1))	Na*(bψ+bΦ)/2	해당 서브캐리어에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix)의 각도의 순서

[275] 표 6을 참조하면, VHT compressed beamforming report 필드에서는 시공간 스트림 각각에 대한 평균 SNR과 각각의 서브캐리어에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix) 'V'가 포함될 수 있다. 압축된 빔포밍 피드백 행렬은 채널 상황에 대한 정보를 포함한 행렬로서 MIMO를 사용한 전송 방법에서 채널 행렬(즉, 스티어링 행렬(steering matix) 'Q')을 산출하기 위하여 사용된다.

[276] scidx()는 Compressed Beamforming Feedback Matrix 서브필드가 전송되는

서브캐리어를 의미한다. Na는 Nr × Nc 값에 의해 고정된다(예를 들어, Nr × Nc= 2 × 1인 경우, Φ11, Ψ21, ...).

[277] Ns는 Beamformer에게 압축된 빔포밍 피드백 행렬이 전송되는 서브캐리어의 개수를 의미한다. Beamformee는 그룹핑 방법을 사용하여 압축된 빔포밍 피드백 행렬이 전송되는 Ns의 수를 줄일 수 있다. 예를 들어, 복수의 서브캐리어를 하나의 그룹으로 묶고 해당 그룹 별로 압축된 빔포밍 피드백 행렬을 전송함으로써 피드백되는 압축된 빔포밍 피드백 행렬의 개수를 줄일 수 있다. Ns는 VHT MIMO Control 필드에 포함된 Channel Width 서브필드와 Grouping 서브필드로부터 산출될 수 있다.

[278] 표 7은 시공간 스트림의 평균 SNR(Average SNR of Space-Time) Stream 서브필드를 예시한다.

[279] [표7]

Average SNR of Space-Time i 서브필드	AvgSNR_i
-128	≤ -10 dB
-127	-9.75 dB
-126	-9.5 dB
...	...
+126	53.5 dB
+127	≥ 53.75 dB

[280] 표 7을 참조하면, 시공간 스트림 각각에 대한 평균 SNR은 채널에 포함되는 서브캐리어 전체에 대한 평균 SNR 값을 산출하여 그 값을 -128~+128 범위로 매핑하여 산출된다.

[281] 3) MU Exclusive Beamforming Report 필드는 델타() SNR의 형태로 나타낸 명시적인 피드백 정보를 전달하기 위하여 사용된다. VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드 내 정보는 MU Beamformer가 스티어링 행렬(steering matix) 'Q'를 결정하기 위하여 사용될 수 있다.

[282] 표 8은 VHT compressed beamforming 프레임에 포함되는 MU Exclusive Beamforming Report 필드의 서브필드를 나타낸다.

[283] [표8]

서브필드	비트수	설명(description)
시공간 스트림 1, 서브캐리어 k=sscidx(0)에 대한 델타 SNR (Delta SNR for space-time stream 1 for subcarrier k=sscidx(0))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 Nc, 서브캐리어 k=sscidx(0)에 대한 델타 SNR (Delta SNR for space-time stream Nc for subcarrier k=sscidx(0))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 1, 서브캐리어 k=sscidx(1)에 대한 델타 SNR (Delta SNR for space-time stream 1 for subcarrier k=sscidx(1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 Nc, 서브캐리어 k=sscidx(1)에 대한 델타 SNR (Delta SNR for space-time stream Nc for subcarrier k=sscidx(1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스드림 1, 서브캐리어 k=sscidx(Ns'-1)에 대한 델타 SNR (Delta SNR for space-time stream 1 for subcarrier k=sscidx(Ns'-1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 Nc, 서브캐리어 k=sscidx(Ns'-1)에 대한 델타 SNR (Delta SNR for space-time stream Nc for subcarrier k=sscidx(Ns'-1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차

[284] 표 8을 참조하면, MU Exclusive Beamforming Report 필드에서는 서브캐리어 별로 시공간 스트림 당 SNR이 포함될 수 있다.

[285] 각 Delta SNR 서브필드는 -8dB에서 7dB 사이에서 1dB씩 증가되는 값을 가진다.

[286] scidx()는 Delta SNR 서브필드가 전송되는 서브캐리어(들)을 의미하고, Ns는 Beamformer로 Delta SNR 서브필드가 전송되는 서브캐리어의 수를 의미한다.

[287]

[288] 도 11은 본 발명이 적용될 수 있는 무선 통신 시스템에서 빔포밍 보고 폴(Beamforming Report Poll) 프레임 포맷을 예시하는 도면이다.

[289] 도 11을 참조하면, Beamforming Report Poll 프레임은 프레임 제어(Frame Control) 필드, 지속 시간(Duration) 필드, RA(Receiving Address) 필드,

TA(Transmitting Address) 필드, 피드백 세그먼트 재전송 비트맵(Feedback Segment Retransmission Bitmap) 필드 및 FCS를 포함하여 구성된다.

[290] RA 필드 값은 대상 수신자(intended recipient)의 주소를 나타낸다.

[291] TA 필드 값은 Beamforming Report Poll 프레임을 전송하는 STA의 주소 또는 TA를 시그널링하는 대역폭을 나타낸다.

[292] Feedback Segment Retransmission Bitmap 필드는 VHT 압축된 빔포밍 보고(VHT Compressed Beamforming report)에서 요청되는 피드백 세그먼트를 지시한다.

[293] Feedback Segment Retransmission Bitmap 필드 값에서 위치 n의 비트가 '1'이면(LSB 경우 n=0, MSB 경우 n=7), VHT compressed beamforming 프레임의 VHT MIMO Control 필드 내 Remaining Feedback Segments 서브필드에서 n과 상응하는 피드백 세그먼트가 요청된다. 반면, 위치 n의 비트가 '0'이면, VHT MIMO Control 필드 내 Remaining Feedback Segments 서브필드에서 n과 상응하는 피드백 세그먼트가 요청되지 않는다.

[294]

[295] <u>하향링크 MU-MIMO 프레임(DL MU-MIMO Frame)</u>

[296] 도 12는 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[297] 도 12를 참조하면, PPDU은 프리앰블 및 데이터 필드(Data field)를 포함하여 구성된다. 데이터 필드는 서비스 필드(SERVICE field), 스크램블링된 PSDU(scrambled PSDU) 필드, 테일 비트(Tail bits), 패딩 비트(padding bits)를 포함할 수 있다.

[298] AP는 MPDU를 병합(aggregation)하여 A-MPDU(aggregated MPDU) 포맷으로 데이터 프레임을 전송할 수 있다. 이 경우, 스크램블링된 PSDU(scrambled PSDU) 필드는 A-MPDU로 구성될 수 있다.

[299] A-MPDU는 하나 이상의 A-MPDU 서브프레임(A-MPDU subframe)의 배열(sequence)로 구성된다.

[300] VHT PPDU의 경우, 각 A-MPDU 서브프레임의 길이가 4 옥텟의 배수이므로, A-MPDU는 PSDU의 마지막 옥텟에 A-MPDU를 맞추기 위하여 마지막 A-MPDU 서브프레임(A-MPDU subframe) 이후에 0 내지 3 옥텟의 EOF(end-of-frame) 패드(pad)를 포함할 수 있다.

[301] A-MPDU 서브프레임은 MPDU 딜리미터(delimiter)로 구성되고, 선택적으로 MPDU가 MPDU 딜리미터(Delimiter) 이후에 포함될 수 있다. 또한, 하나의 A-MPDU 내 마지막 A-MPDU 서브프레임을 제외하고, 각 A-MPDU 서브프레임의 길이를 4 옥텟의 배수로 만들기 위하여 패드 옥텟이 MPDU 이후에 부착된다.

[302] MPDU Delimiter는 예비(Reserved) 필드, MPDU 길이(MPDU Length) 필드, CRC (cyclic redundancy check) 필드, 딜리미터 시그니처(Delimiter Signature) 필드로 구성된다.

[303] VHT PPDU의 경우, MPDU Delimiter는 EOF(end-of-frame) 필드를 더 포함할 수 있다. MPDU Length 필드가 0이고 패딩하기 위하여 사용되는 A-MPDU 서브프레임, 또는 A-MPDU가 하나의 MPDU만으로 구성되는 경우 해당 MPDU가 실어지는 A-MPDU 서브프레임의 경우, EOF 필드는 '1'로 셋팅된다. 그렇지 않은 경우 '0'으로 셋팅된다.

[304] MPDU Length 필드는 MPDU의 길이에 대한 정보를 포함한다.

[305] 해당 A-MPDU 서브프레임에 MPDU가 존재하지 않는 경우 '0'으로 셋팅된다. MPDU Length 필드가 '0' 값을 가지는 A-MPDU 서브프레임은 VHT PPDU 내 가용한 옥텟에 A-MPDU를 맞추기 위해 해당 A-MPDU에 패딩할 때 사용된다.

[306] CRC 필드는 에러 체크를 위한 CRC 정보, Delimiter Signature 필드는 MPDU 딜리미터를 검색하기 위하여 사용되는 패턴 정보를 포함한다.

[307] 그리고, MPDU는 MAC 헤더(MAC Header), 프레임 몸체(Frame Body) 및 프레임 체크 시퀀스(FCS)로 구성된다.

[308]

[309] 도 13은 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[310] 도 13은 해당 PPDU를 수신하는 STA의 개수가 3개이고, 각 STA에 할당되는 공간적 스트림(spatial stream)의 개수가 1이라고 가정하나 AP에 페어링된 STA의 수, 각 STA에 할당되는 공간적 스트림의 수는 이에 한정되지 않는다.

[311] 도 13을 참조하면, MU PPDU는 L-TFs 필드(L-STF 필드 및 L-LTF 필드), L-SIG 필드, VHT-SIG-A 필드, VHT-TFs 필드(VHT-STF 필드 및 VHT-LTF 필드), VHT-SIG-B 필드, Service 필드, 하나 이상의 PSDU, padding 필드 및 Tail 비트를 포함하여 구성된다. L-TFs 필드, L-SIG 필드, VHT-SIG-A 필드, VHT-TFs 필드, VHT-SIG-B 필드는 앞서 도 4의 예시와 동일하므로 이하 상세한 설명은 생략한다.

[312] PPDU 지속기간을 지시하기 위한 정보가 L-SIG 필드에 포함될 수 있다. PPDU 내에서, L-SIG 필드에 의해 지시된 PPDU 지속기간은 VHT-SIG-A 필드가 할당된 심볼, VHT-TFs 필드가 할당된 심볼, VHT-SIG-B 필드가 할당된 필드, Service 필드를 구성하는 비트, PSDU를 구성하는 비트, padding 필드를 구성하는 비트 및 Tail 필드를 구성하는 비트를 포함한다. PPDU를 수신하는 STA은 L-SIG 필드에 포함된 PPDU 지속시간을 지시하는 정보를 통해 PPDU의 지속기간에 대한 정보를 획득할 수 있다.

[313] 상술한 바와 같이, VHT-SIG-A를 통해 Group ID 정보, 각 사용자 당 시공간 스트림 수 정보가 전송되고, VHT-SIG-B를 통해 코딩(coding) 방법 및 MCS 정보 등이 전송된다. 따라서, Beamformee들은 VHT-SIG-A와 VHT-SIG-B를 확인하고, 자신이 속한 MU MIMO 프레임인지 여부를 알 수 있다. 따라서, 해당 Group ID의 멤버 STA이 아니거나 해당 Group ID의 멤버이나 할당된 스트림 수가 '0'인 STA은 VHT-SIG-A 필드 이후부터 PPDU 끝까지 물리 계층의 수신을 중단하도록

설정함으로써 전력 소모를 절감할 수 있다.

[314] Group ID는 사전에 Beamformer가 전송하는 Group ID Management 프레임을 수신함으로써, Beamformee가 어떤 MU 그룹에 속하는지, 자신이 속하는 그룹 중에서 몇 번째 사용자인지, 즉 어떤 스트림을 통해 PPDU를 수신하는지 알 수 있다.

[315] 802.11ac을 기반으로 하는 VHT MU PPDU 내 전송되는 모든 MPDU는 A-MPDU에 포함된다. 도 13의 데이터 필드에서 각 VHT A-MPDU는 서로 다른 스트림으로 전송될 수 있다.

[316] 도 13에서 각 STA에 전송되는 데이터의 크기가 상이할 수 있으므로, 각각의 A-MPDU는 서로 다른 비트 크기를 가질 수 있다.

[317] 이 경우, Beamformer가 전송하는 복수의 데이터 프레임의 전송이 종료되는 시간은 최대 구간 전송 데이터 프레임의 전송이 종료되는 시간과 동일하도록 널 패딩(null padding)을 수행할 수 있다. 최대 구간 전송 데이터 프레임은 Beamformer에 의해 유효 하향링크 데이터가 가장 오랜 구간 동안 전송되는 프레임일 수 있다. 유효 하향링크 데이터는 널 패딩되지 않은 하향링크 데이터일 수 있다. 예를 들어, 유효 하향링크 데이터는 A-MPDU에 포함되어 전송될 수 있다. 복수의 데이터 프레임 중 최대 구간 전송 데이터 프레임을 제외한 나머지 데이터 프레임은 널 패딩을 수행할 수 있다.

[318] 널 패딩을 위해 Beamformer는 A-MPDU 프레임 내 복수의 A-MPDU 서브프레임에서 시간적으로 후순위에 위치한 하나 이상의 A-MPDU 서브프레임을 MPDU delimiter 필드만으로 인코딩하여 채울 수 있다. MPDU 길이가 0인 A-MPDU 서브프레임을 널 서브프레임(Null subframe)으로 지칭할 수 있다.

[319] 앞서 살펴본 바와 같이, 널 서브프레임은 MPDU Delimiter의 EOF 필드가 '1'로 셋팅된다. 따라서, 수신측 STA의 MAC 계층에서는 1로 셋팅된 EOF 필드를 감지하면, 물리 계층에 수신을 중단하도록 설정함으로써 전력 소모를 절감할 수 있다.

[320]

[321] <u>블록 ACK(Block Ack) 절차</u>

[322] 도 14는 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 MU-MIMO 전송 과정을 예시하는 도면이다.

[323] 802.11ac에서는 MU-MIMO는 AP로부터 클라이언트(즉, non-AP STA)으로 향하는 하향링크에서 정의된다. 이때, 다중 사용자 프레임(multi-user frame)은 다중 수신자에게 동시에 전송되나, 수신 확인(acknowledgement)은 상향링크에서 개별적으로 전송되어야 한다.

[324] 802.11ac을 기반으로 하는 VHT MU PPDU 내 전송되는 모든 MPDU는 A-MPDU에 포함되므로, VHT MU PPDU에 대한 즉각적인 응답이 아닌 VHT MU PPDU 내 A-MPDU에 대한 응답은 AP에 의한 블록 ACK 요청(BAR: Block Ack

Request) 프레임에 대한 응답으로 전송된다.

[325] 먼저, AP는 모든 수신자(즉, STA 1, STA 2, STA 3)에게 VHT MU PPDU(즉, 프리앰블 및 데이터)를 전송한다. VHT MU PPDU는 각 STA에 전송되는 VHT A-MPDU를 포함한다.

[326] AP로부터 VHT MU PPDU를 수신한 STA 1은 SIFS 이후에 블록 ACK(BA: Block Acknowledgement) 프레임을 AP로 전송한다. BA 프레임에 대하여 보다 상세한 설명은 후술한다.

[327] STA 1으로부터 BA를 수신한 AP는 SIFS 이후에 BAR(block acknowledgement request) 프레임을 다음 STA 2로 전송하고, STA 2는 SIFS 이후에 BA 프레임을 AP로 전송한다. STA 2로부터 BA 프레임을 수신한 AP는 SIFS 이후에 BAR 프레임을 STA 3로 전송하고, STA 3은 SIFS 이후에 BA 프레임을 AP로 전송한다.

[328] 이러한 과정이 모든 STA들에 대해 수행되면, AP는 다음 MU PPDU를 모든 STA에게 전송한다.

[329]

[330] **ACK**(Acknowledgement)/블록 ACK(Block ACK) 프레임

[331] 일반적으로 MPDU의 응답으로 ACK 프레임을 사용하고, A-MPDU의 응답으로 블록 ACK 프레임을 사용한다.

[332] 도 15는 본 발명이 적용될 수 있는 무선 통신 시스템에서 ACK 프레임을 예시하는 도면이다.

[333] 도 15를 참조하면, ACK 프레임은 프레임 제어(Frame Control) 필드, 지속기간(Duration) 필드, RA 필드 및 FCS로 구성된다.

[334] RA 필드는 직전에 수신된 데이터(Data) 프레임, 관리(Management) 프레임, 블록 ACK 요청(Block Ack Request) 프레임, 블록 ACK(Block Ack) 프레임 또는 PS-Poll 프레임의 제2 주소(Address 2) 필드의 값으로 설정된다.

[335] 비 QoS(non-QoS) STA에 의해 ACK 프레임이 전송되는 경우, 직전에 수신된 데이터(Data) 프레임, 관리(Management) 프레임의 프레임 제어(Frame Control) 필드 내 모어 프래그먼트(More Fragments) 서브필드가 '0'이면, 지속기간(duration) 값은 '0'으로 설정된다.

[336] 비 QoS(non-QoS) STA에 의해 전송되지 않는 ACK 프레임에서 지속기간(duration) 값은 직전에 수신된 데이터(Data) 프레임, 관리(Management) 프레임, 블록 ACK 요청(Block Ack Request) 프레임, 블록 ACK(Block Ack) 프레임 또는 PS-Poll 프레임의 Duration/ID 필드에서 ACK 프레임 전송을 위해 요구되는 시간 및 SIFS 구간을 차감한 값(ms)으로 설정된다. 계산된 지속기간(duration) 값이 정수 값이 아닌 경우, 반올림된다.

[337] 이하, 블록 ACK (요청) 프레임에 대하여 살펴본다.

[338]

[339] 도 16은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임을 예시하는 도면이다.

[340] 도 16을 참조하면, 블록 ACK 요청(BAR) 프레임은 프레임 제어(Frame Control) 필드, 지속기간/식별자(Duration/ID) 필드, 수신 주소(RA) 필드, 전송 주소(TA) 필드, BAR 제어(BAR control) 필드, BAR 정보(BAR Information) 필드 및 프레임 체크 시퀀스(FCS)로 구성된다.

[341] RA 필드는 BAR 프레임을 수신하는 STA의 주소로 설정될 수 있다.

[342] TA 필드는 BAR 프레임을 전송하는 STA의 주소로 설정될 수 있다.

[343] BAR control 필드는 BAR Ack 정책(BAR Ack Policy) 서브필드, 다중-TID(Multi-TID) 서브필드, 압축 비트맵(Compressed Bitmap) 서브필드, 예비(Reserved) 서브필드 및 TID 정보(TID_Info) 서브필드를 포함한다.

[344] 표 9는 BAR control 필드를 예시하는 표이다.

[345] [표9]

서브필드	비트	설명(description)
BAR Ack Policy	1	송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하는 경우, '0'로 설정됨. 송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하지 않는 경우, '1'로 설정됨
Multi-TID	1	Multi-TID 서브필드 및 Compressed Bitmap 서브필드 값에 따라 BAR 프레임의 타입을 지시함 00: 기본 BAR(Basic BAR) 01: 압축 BAR(Compressed BAR) 10: 예비 값 11: 다중 TID BAR(Multi-TID BAR)
Compressed Bitmap	1	
Reserved	9	
TID_Info	4	BAR 프레임의 타입에 따라 TID_Info 필드의 의미가 결정됨 Basic BAR 프레임, Compressed BAR 프레임의 경우, BA 프레임이 요청되는 TID를 포함함 Multi-TID BAR 프레임의 경우, TID의 개수를 포함함

[346] BAR Information 필드는 BAR 프레임의 타입에 따라 상이한 정보가 포함된다. 이에 대하여 도 17을 참조하여 설명한다.

[347]

[348] 도 17은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임의 BAR 정보(BAR Information) 필드를 예시하는 도면이다.

[349] 도 17(a)는 Basic BAR 프레임 및 Compressed BAR 프레임의 BAR Information 필드를 예시하고, 도 17(b)는 Multi-TID BAR 프레임의 BAR Information 필드를 예시한다.

[350] 도 17(a)를 참조하면, Basic BAR 프레임 및 Compressed BAR 프레임의 경우, BAR Information 필드는 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드를 포함한다.

[351] 그리고, Block Ack Starting Sequence Control 서브필드는 조각 번호(Fragment Number) 서브필드, 시작 시퀀스 번호(Starting Sequence Number) 서브필드를

포함한다.

[352] Fragment Number 서브필드는 0으로 설정된다.

[353] Basic BAR 프레임의 경우, Starting Sequence Number 서브필드는 해당 BAR 프레임이 전송되는 첫 번째 MSDU의 시퀀스 번호를 포함한다. Compressed BAR 프레임의 경우, Starting Sequence Control 서브필드는 해당 BAR 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함한다.

[354] 도 17(b)를 참조하면, Multi-TID BAR 프레임의 경우, BAR Information 필드는 TID 별 정보(Per TID Info) 서브필드 및 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드가 하나 이상의 TID 별로 반복되어 구성된다.

[355] Per TID Info 서브필드는 예비(Reserved) 서브필드 및 TID 값(TID Value) 서브필드를 포함한다. TID Value 서브필드는 TID 값을 포함한다.

[356] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 및 Starting Sequence Number 서브필드를 포함한다. Fragment Number 서브필드는 0으로 설정된다. Starting Sequence Control 서브필드는 해당 BAR 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함한다.

[357]

[358] 도 18은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임을 예시하는 도면이다.

[359] 도 18을 참조하면, 블록 ACK(BA) 프레임은 프레임 제어(Frame Control) 필드, 지속기간/식별자(Duration/ID) 필드, 수신 주소(RA) 필드, 전송 주소(TA) 필드, BA 제어(BA control) 필드, BA 정보(BA Information) 필드 및 프레임 체크 시퀀스(FCS)로 구성된다.

[360] RA 필드는 블록 ACK을 요청한 STA의 주소로 설정될 수 있다.

[361] TA 필드는 BA 프레임을 전송하는 STA의 주소로 설정될 수 있다.

[362] BA control 필드는 BA Ack 정책(BA Ack Policy) 서브필드, 다중-TID(Multi-TID) 서브필드, 압축 비트맵(Compressed Bitmap) 서브필드, 예비(Reserved) 서브필드 및 TID 정보(TID_Info) 서브필드를 포함한다.

[363] 표 10은 BA control 필드를 예시하는 표이다.

[364] [표10]

서브필드	비트	설명(description)
BA Ack Policy	1	송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하는 경우, '0'로 설정됨. 송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하지 않는 경우, '1'로 설정됨
Multi-TID	1	Multi-TID 서브필드 및 Compressed Bitmap 서브필드 값에 따라 BA 프레임의 타입을 지시함 00: 기본 BA(Basic BA) 01: 압축 BA(Compressed BA) 10: 예비 값 11: 다중 TID BA(Multi-TID BA)
Compressed Bitmap	1	
Reserved	9	
TID_Info	4	BA 프레임의 타입에 따라 TID_Info 필드의 의미가 결정됨 Basic BA 프레임 및 Compressed BA 프레임의 경우, BA 프레임이 전송되는 TID를 포함함 Multi-TID BA 프레임의 경우, TID의 개수를 포함함

[365] BA Information 필드는 BA 프레임의 타입에 따라 상이한 정보가 포함된다. 이에 대하여 도 19를 참조하여 설명한다.

[366]

[367] 도 19는 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임의 BA 정보(BA Information) 필드를 예시하는 도면이다.

[368] 도 19(a)의 Basic BA 프레임의 BA Information 필드를 예시하고, 도 19(b)는 Compressed BA 프레임의 BA Information 필드를 예시하고, 도 19(c)는 Multi-TID BA 프레임의 BA Information 필드를 예시한다.

[369] 도 19(a)를 참조하면, Basic BA 프레임의 경우, BA Information 필드는 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드 및 블록 ACK 비트맵(Block Ack Bitmap) 서브필드를 포함한다.

[370] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 서브필드 및 Starting Sequence Number 서브필드를 포함한다.

[371] Fragment Number 서브필드는 0으로 설정된다.

[372] Starting Sequence Number 서브필드는 해당 BA 프레임이 전송되기 위한 첫 번째 MSDU의 시퀀스 번호를 포함하고, 직전에 수신한 Basic BAR 프레임과 동일한 값으로 설정된다.

[373] Block Ack Bitmap 서브필드는 128 옥텟의 길이로 구성되고, 최대 64개의 MSDU의 수신 상태를 지시하기 위하여 사용된다. Block Ack Bitmap 서브필드에서 '1' 값은 해당 비트 위치에 대응되는 MPDU가 성공적으로 수신되었음을 지시하고, '0' 값은 해당 비트 위치에 대응되는 MPDU가 성공적으로 수신되지 않았음을 지시한다.

[374] 도 19(b)를 참조하면, Compressed BA 프레임의 경우, BA Information 필드는

블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드 및 블록 ACK 비트맵(Block Ack Bitmap) 서브필드를 포함한다.

[375] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 서브필드 및 Starting Sequence Number 서브필드를 포함한다.

[376] Fragment Number 서브필드는 0으로 설정된다.

[377] Starting Sequence Number 서브필드는 해당 BA 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함하고, 직전에 수신한 Basic BAR 프레임과 동일한 값으로 설정된다.

[378] Block Ack Bitmap 서브필드는 8 옥텟의 길이로 구성되고, 최대 64개의 MSDU 및 A-MSDU의 수신 상태를 지시하기 위하여 사용된다. Block Ack Bitmap 서브필드에서 '1' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되었음을 지시하고, '0' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되지 않았음을 지시한다.

[379] 도 19(c)를 참조하면, Multi-TID BA 프레임의 경우, BA Information 필드는 TID 별 정보(Per TID Info) 서브필드, 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드 및 블록 ACK 비트맵(Block Ack Bitmap) 서브필드가 하나 이상의 TID 별로 반복되어 구성되고, TID가 증가되는 순서대로 구성된다.

[380] Per TID Info 서브필드는 예비(Reserved) 서브필드 및 TID 값(TID Value) 서브필드를 포함한다. TID Value 서브필드는 TID 값을 포함한다.

[381] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 및 Starting Sequence Number 서브필드를 포함한다. Fragment Number 서브필드는 0으로 설정된다. Starting Sequence Control 서브필드는 해당 BA 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함한다.

[382] Block Ack Bitmap 서브필드는 8 옥텟의 길이로 구성된다. Block Ack Bitmap 서브필드에서 '1' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되었음을 지시하고, '0' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되지 않았음을 지시한다.

[383]

[384] <u>상향링크 다중 사용자 전송 방법</u>

[385] 차세대 WiFi에 대한 다양한 분야의 벤더들의 많은 관심과 802.11ac 이후의 높은 스루풋(high throughput) 및 QoE(quality of experience) 성능 향상에 대한 요구가 높아지고 있는 상황에서 차세대 WLAN 시스템인 802.11ax 시스템을 위한 새로운 프레임 포맷 및 뉴머롤로지(numerology)에 대한 논의가 활발히 진행 중이다.

[386] IEEE 802.11ax은 더 높은 데이터 처리율(data rate)을 지원하고 더 높은 사용자 부하(user load)를 처리하기 위한 차세대 WLAN 시스템으로서 최근에 새롭게 제안되고 있는 WLAN 시스템 중 하나로서, 일명 고효율 WLAN(HEW: High Efficiency WLAN)라고 불린다.

[387] IEEE 802.11ax WLAN 시스템은 기존 WLAN 시스템과 동일하게 2.4 GHz 주파수 대역 및 5 GHz 주파수 대역에서 동작할 수 있다. 또한, 그보다 높은 60 GHz 주파수 대역에서도 동작할 수 있다.

[388] IEEE 802.11ax 시스템에서는 평균 스루풋 향상(average throughput enhancement)과 실외 환경에서의 심볼 간 간섭(inter-symbol interference)에 대한 강인한 전송(outdoor robust transmission)을 위해서 기존 IEEE 802.11 OFDM system (IEEE 802.11a, 802.11n, 802.11ac 등)보다 각 대역폭에서 4배 큰 FFT 크기를 사용할 수 있다. 이에 대하여 아래 도면을 참조하여 설명한다.

[389] 이하, 본 발명에 HE 포맷 PPDU에 대한 설명에 있어서, 별도의 언급이 없더라도 앞서 설명한 non-HT 포맷 PPDU, HT-mixed 포맷 PPDU, HT-greenfield 포맷 PPDU 및/또는 VHT 포맷 PPDU에 대한 설명이 HE 포맷 PPDU에 대한 설명에 병합될 수 있다.

[390]

[391] 도 20은 본 발명의 일 실시예에 따른 HE(High Efficiency) 포맷 PPDU를 예시하는 도면이다.

[392] 도 20(a)는 HE 포맷 PPDU의 개략적인 구조를 예시하고, 도 20(b) 내지 (d)는 HE 포맷 PPDU의 보다 구체적인 구조를 예시한다.

[393] 도 20(a)를 참조하면, HEW를 위한 HE 포맷 PPDU는 크게 레가시 부분(L-part: legacy-part), HE 부분(HE-part) 및 데이터 필드(HE-data)로 구성될 수 있다.

[394] L-part는 기존의 WLAN 시스템에서 유지하는 형태와 동일하게 L-STF 필드, L-LTF 필드 및 L-SIG 필드로 구성된다. L-STF 필드, L-LTF 필드 및 L-SIG 필드를 레가시 프리앰블(legacy preamble)이라고 지칭할 수 있다.

[395] HE-part는 802.11ax 표준을 위하여 새롭게 정의되는 부분으로서, HE-STF 필드, HE-SIG 필드 및 HE-LTF 필드를 포함할 수 있다. 도 25(a)에서는 HE-STF 필드, HE-SIG 필드 및 HE-LTF 필드의 순서를 예시하고 있으나, 이와 상이한 순서로 구성될 수 있다. 또한, HE-LTF는 생략될 수도 있다. HE-STF 필드 및 HE-LTF 필드뿐만 아니라 HE-SIG 필드를 포함하여 HE-preamble로 통칭할 수도 있다.

[396] 또한, L-part, HE-part(또는, HE-preamble)을 물리 프리앰블(PHY(physical) preamble)로 통칭할 수 있다.

[397] HE-SIG는 HE-data 필드를 디코딩하기 위한 정보(예를 들어, OFDMA, UL MU MIMO, 향상된 MCS 등)을 포함할 수 있다.

[398] L-part와 HE-part는 서로 다른 FFT(Fast Fourier Transform) 크기(즉, 서브캐리어 간격(spacing))을 가질 수 있으며, 서로 다른 CP(Cyclic Prefix)를 사용할 수도 있다.

[399] 802.11ax 시스템에서는 레가시 WLAN 시스템에 비하여 4배 큰(4×) FFT 크기를 사용할 수 있다. 즉, L-part는 1× 심볼 구조로 구성되고, HE-part(특히, HE-preamble 및 HE-data)는 4× 심볼 구조로 구성될 수 있다. 여기서, 1×, 2×, 4× 크기의 FFT는 레가시 WLAN 시스템(예를 들어, IEEE 802.11a, 802.11n, 802.11ac

등)에 대한 상대적인 크기를 의미한다.

[400] 예를 들어, L-part에 이용되는 FFT 크기는 20MHz, 40MHz, 80MHz 및 160MHz에서 각각 64, 128, 256, 512라면, HE-part에 이용되는 FFT 크기는 20MHz, 40MHz, 80MHz 및 160MHz에서 각각 256, 512, 1024, 2048일 수 있다.

[401] 이와 같이 레가시 WLAN 시스템 보다 FFT 크기가 커지면, 서브캐리어 주파수 간격(subcarrier frequency spacing)이 작아지므로 단위 주파수 당 서브캐리어의 수가 증가되나, OFDM 심볼 길이가 길어진다.

[402] 즉, 보다 큰 FFT 크기가 사용된다는 것은 서브캐리어 간격이 좁아진다는 의미이며, 마찬가지로 IDFT(Inverse Discrete Fourier Transform)/DFT(Discrete Fourier Transform) 주기(period)가 늘어난다는 의미이다. 여기서, IDFT/DFT 주기는 OFDM 심볼에서 보호 구간(GI)을 제외한 심볼 길이를 의미할 수 있다.

[403] 따라서, HE-part(특히, HE-preamble 및 HE-data)는 L-part에 비하여 4배 큰 FFT 크기가 사용된다면, HE-part의 서브캐리어 간격은 L-part의 서브캐리어 간격의 1/4 배가 되고, HE-part의 IDFT/DFT 주기는 L-part의 IDFT/DFT 주기의 4배가 된다. 예를 들어, L-part의 서브캐리어 간격이 312.5kHz(=20MHz/64, 40MHZ/128, 80MHz/256 및/또는 160MHz/512)라면 HE-part의 서브캐리어 간격은 78.125kHz(=20MHz/256, 40MHZ/512, 80MHz/1024 및/또는 160MHz/2048)일 수 있다. 또한, L-part의 IDFT/DFT 주기가 3.2μs(=1/312.5kHz)이라면, HE-part의 IDFT/DFT 주기는 12.8μs(=1/78.125kHz)일 수 있다.

[404] 여기서, GI는 0.8μs, 1.6μs, 3.2μs 중 하나가 사용될 수 있으므로, GI를 포함하는 HE-part의 OFDM 심볼 길이(또는 심볼 간격(symbol interval))은 GI에 따라 13.6μs, 14.4μs, 16μs일 수 있다.

[405] 도 20(b)를 참조하면, HE-SIG 필드는 HE-SIG-A 필드와 HE-SIG-B 필드로 구분될 수 있다.

[406] 예를 들어, HE 포맷 PPDU의 HE-part는 12.8μs 길이를 가지는 HE-SIG-A 필드, 1 OFDM 심볼의 HE-STF 필드, 하나 이상의 HE-LTF 필드 및 1 OFDM 심볼의 HE-SIG-B 필드를 포함할 수 있다.

[407] 또한, HE-part에서 HE-SIG-A 필드는 제외하고 HE-STF 필드부터는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다. 즉, 256, 512, 1024 및 2048 크기의 FFT가 각각 20MHz, 40MHz, 80MHz 및 160MHz의 HE 포맷 PPDU의 HE-STF 필드부터 적용될 수 있다.

[408] 다만, 도 20(b)와 같이 HE-SIG가 HE-SIG-A 필드와 HE-SIG-B 필드로 구분되어 전송될 때, HE-SIG-A 필드 및 HE-SIG-B 필드의 위치는 도 25(b)와 상이할 수 있다. 예를 들어, HE-SIG-A 필드 다음에 HE-SIG-B 필드가 전송되고, HE-SIG-B 필드 다음에 HE-STF 필드와 HE-LTF 필드가 전송될 수 있다. 이 경우에도 마찬가지로 HE-STF 필드부터는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다.

[409] 도 20(c)를 참조하면, HE-SIG 필드는 HE-SIG-A 필드와 HE-SIG-B 필드로

구분되지 않을 수 있다.

[410] 예를 들어, HE 포맷 PPDU의 HE-part는 1 OFDM 심볼의 HE-STF 필드, 1 OFDM 심볼의 HE-SIG 필드 및 하나 이상의 HE-LTF 필드를 포함할 수 있다.

[411] 위와 유사하게 HE-part는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다. 즉, 256, 512, 1024 및 2048 크기의 FFT가 각각 20MHz, 40MHz, 80MHz 및 160MHz의 HE 포맷 PPDU의 HE-STF 필드부터 적용될 수 있다.

[412] 도 20(d)를 참조하면, HE-SIG 필드는 HE-SIG-A 필드와 HE-SIG-B 필드로 구분되지 않으며, HE-LTF 필드는 생략될 수 있다.

[413] 예를 들어, HE 포맷 PPDU의 HE-part는 1 OFDM 심볼의 HE-STF 필드 및 1 OFDM 심볼의 HE-SIG 필드를 포함할 수 있다.

[414] 위와 유사하게 HE-part는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다. 즉, 256, 512, 1024 및 2048 크기의 FFT가 각각 20MHz, 40MHz, 80MHz 및 160MHz의 HE 포맷 PPDU의 HE-STF 필드부터 적용될 수 있다.

[415] 본 발명에 따른 WLAN 시스템을 위한 HE 포맷 PPDU는 적어도 하나의 20MHz 채널을 통해 전송될 수 있다. 예를 들어, HE 포맷 PPDU은 총 4개의 20MHz 채널을 통해 40MHz, 80MHz 또는 160MHz 주파수 대역에서 전송될 수 있다. 이에 대하여 아래 도면을 참조하여 보다 상세히 설명한다.

[416]

[417] 도 21은 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[418] 도 21에서는 하나의 STA에 80MHz가 할당된 경우(또는 80MHz 내 복수의 STA에게 OFDMA 자원 유닛이 할당된 경우) 혹은 복수의 STA에게 각각 80MHz의 서로 다른 스트림이 할당된 경우의 PPDU 포맷을 예시한다.

[419] 도 21을 참조하면, L-STF, L-LTF 및 L-SIG은 각 20MHz 채널에서 64 FFT 포인트(또는 64 서브캐리어)에 기반하여 생성된 OFDM 심볼로 전송될 수 있다.

[420] 또한, HE-SIG B 필드가 HE-SIG A 필드 다음에 위치할 수 있다. 이 경우, 단위 주파수 당 FFT 크기는 HE-STF(또는 HE-SIG B) 이후부터 더욱 커질 수 있다. 예를 들어, HE-STF(또는 HE-SIG B)부터 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다.

[421] HE-SIG A 필드는 PPDU를 수신하는 STA들에게 공통으로 전송되는 공통 제어 정보를 포함할 수 있다. HE-SIG A 필드는 1개 내지 3개의 OFDM 심볼에서 전송될 수 있다. HE-SIG A 필드는 20MHz 단위로 복사되어 동일한 정보를 포함한다. 또한, HE-SIG-A 필드는 시스템의 전체 대역폭 정보를 알려준다.

[422] 표 11은 HE-SIG A 필드에 포함되는 정보를 예시하는 표이다.

[423] [표11]

필드	비트	설명(description)
대역폭 (bandwidth)	2	PPDU가 전송되는 대역폭을 지시함 예를 들어, 20MHz, 40MHz, 80MHz 또는 160MHz
그룹 식별자 (Group ID)	6	PPDU를 수신할 STA 또는 STA들의 그룹을 지시함
스트림 정보 (Stream information)	12	각 STA을 위한 공간 스트림(spatial stream)의 위치 또는 번호를 지시하거나 STA의 그룹을 위한 공간 스트림의 위치 또는 번호 지시함
상향링크 지시 (UL indication)	1	PPDU가 AP로 향하는지(uplink) 또는 STA으로 향하는지(downlink) 지시함
MU 지시 (MU indication)	1	PPDU가 SU-MIMO PPDU 인지 MU-MIMO PPDU인지 지시함
가드 인터벌 지시 (GI indication)	1	짧은 GI가 사용되는지 긴 GI가 사용되는지 지시함
할당 정보 (Allocation information)	12	PPDU가 전송되는 대역에서 각 STA에 할당된 밴드 또는 채널(서브채널 인덱스 또는 서브밴드 인덱스) 지시함
전송 파워 (Transmission power)	12	각 채널 또는 각 STA을 위한 전송 파워를 지시함

[424] 표 11에 예시되는 각 필드들에 포함되는 정보들은 IEEE 802.11 시스템의 정의를 따를 수 있다. 또한, 앞서 설명한 각 필드들은 PPDU에 포함될 수 있는 필드들의 예시에 해당하며, 이에 한정되지 않는다. 즉, 앞서 설명한 각 필드가 다른 필드로 대체되거나 추가적인 필드가 더 포함될 수 있으며, 모든 필드가 필수적으로 포함되지 않을 수도 있다. HE-SIG A 필드에 포함되는 정보의 또 다른 실시예는 도 34와 관련하여 이하에서 후술하기로 한다.

[425] HE-STF는 MIMO 전송에 있어서 AGC 추정의 성능을 개선하기 위해 사용된다.

[426] HE-SIG B 필드는 각 STA이 자신의 데이터(예를 들어, PSDU)를 수신하기 위하여 요구되는 사용자 특정(user-specific) 정보를 포함할 수 있다. HE-SIG B 필드는 하나 또는 두 개의 OFDM 심볼에서 전송될 수 있다. 예를 들어, HE-SIG B 필드는 해당 PSDU의 변조 및 코딩 기법(MCS) 및 해당 PSDU의 길이에 관한 정보를 포함할 수 있다.

[427] L-STF, L-LTF, L-SIG 및 HE-SIG A 필드는 20MHz 채널 단위로 반복되어 전송될 수 있다. 예를 들어, PPDU가 4개의 20MHz 채널(즉, 80MHz 대역)을 통해 전송될 때, L-STF, L-LTF, L-SIG 및 HE-SIG A 필드는 매 20MHz 채널에서 반복되어 전송될 수 있다.

[428] FFT 크기가 커지면, 기존의 IEEE 802.11a/g/n/ac를 지원하는 레가시 STA은 해당 HE PPDU를 디코딩하지 못할 수 있다. 레가시 STA과 HE STA이 공존(coexistence)하기 위하여, L-STF, L-LTF 및 L-SIG 필드는 레가시 STA이 수신할 수 있도록 20MHz 채널에서 64 FFT를 통해 전송된다. 예를 들어, L-SIG 필드는 하나의 OFDM 심볼을 점유하고, 하나의 OFDM 심볼 시간은 4μs이며,

GI는 0.8㎲일 수 있다.

[429] 각 주파수 단위 별 FFT 크기는 HE-STF(또는 HE-SIG A)부터 더욱 커질 수 있다. 예를 들어, 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다. FFT 크기가 커지면, OFDM 서브캐리어 간의 간격이 작아지므로 단위 주파수 당 OFDM 서브캐리어의 수가 증가되나, OFDM 심볼 시간은 길어진다. 시스템의 효율을 향상시키기 위하여 HE-STF 이후의 GI의 길이는 HE-SIG A의 GI의 길이와 동일하게 설정될 수 있다.

[430] HE-SIG A 필드는 HE STA이 HE PPDU를 디코딩하기 위하여 요구되는 정보를 포함할 수 있다. 그러나, HE-SIG A 필드는 레가시 STA과 HE STA이 모두 수신할 수 있도록 20MHz 채널에서 64 FFT를 통해 전송될 수 있다. 이는 HE STA가 HE 포맷 PPDU 뿐만 아니라 기존의 HT/VHT 포맷 PPDU를 수신할 수 있으며, 레가시 STA 및 HE STA이 HT/VHT 포맷 PPDU와 HE 포맷 PPDU를 구분하여야 하기 때문이다.

[431]

[432] 도 22는 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[433] 도 22에서는 20MHz 채널들이 각각 서로 다른 STA들(예를 들어, STA 1, STA 2, STA 3 및 STA 4)에 할당되는 경우를 가정한다.

[434] 도 22를 참조하면, 단위 주파수 당 FFT 크기는 HE-STF(또는 HE-SIG-B)부터 더욱 커질 수 있다. 예를 들어, HE-STF(또는 HE-SIG-B)부터 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다.

[435] PPDU에 포함되는 각 필드에서 전송되는 정보는 앞서 도 26의 예시와 동일하므로 이하 설명을 생략한다.

[436] HE-SIG-B 필드는 각 STA에 특정된 정보를 포함할 수 있으나, 전체 밴드(즉, HE-SIG-A 필드에서 지시)에 걸쳐서 인코딩될 수 있다. 즉, HE-SIG-B 필드는 모든 STA에 대한 정보를 포함하며 모든 STA들이 수신하게 된다.

[437] HE-SIG-B 필드는 각 STA 별로 할당되는 주파수 대역폭 정보 및/또는 해당 주파수 대역에서 스트림 정보를 알려줄 수 있다. 예를 들어, 도 27에서 HE-SIG-B는 STA 1는 20MHz, STA 2는 그 다음 20MHz, STA 3는 그 다음 20MHz, STA 4는 그 다음 20MHz가 할당될 수 있다. 또한, STA 1과 STA 2는 40MHz를 할당하고, STA 3와 STA 4는 그 다음 40MHz를 할당할 수 있다. 이 경우, STA 1과 STA 2는 서로 다른 스트림을 할당하고, STA 3와 STA 4는 서로 다른 스트림을 할당할 수 있다.

[438] 또한, HE-SIG-C 필드를 정의하여, 도 27의 예시에 HE-SIG C 필드가 추가될 수 있다. 이 경우, HE-SIG-B 필드에서는 전대역에 걸쳐서 모든 STA에 대한 정보가 전송되고, 각 STA에 특정한 제어 정보는 HE-SIG-C 필드를 통해 20MHz 단위로 전송될 수도 있다.

[439] 또한, 도 21 및 22의 예시와 상이하게 HE-SIG-B 필드는 전대역에 걸쳐 전송하지 않고 HE-SIG-A 필드와 동일하게 20MHz 단위로 전송될 수 있다. 이에 대하여 아래 도면을 참조하여 설명한다.

[440]

[441] 도 23은 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[442] 도 23에서는 20MHz 채널들이 각각 서로 다른 STA들(예를 들어, STA 1, STA 2, STA 3 및 STA 4)에 할당되는 경우를 가정한다.

[443] 도 23을 참조하면, HE-SIG-B 필드는 전대역에 걸쳐 전송되지 않고, HE-SIG-A 필드와 동일하게 20MHz 단위로 전송된다. 다만, 이때 HE-SIG-B는 HE-SIG-A 필드와 상이하게 20MHz 단위로 인코딩되어 전송되나, 20MHz 단위로 복제되어 전송되지는 않을 수 있다.

[444] 이 경우, 단위 주파수 당 FFT 크기는 HE-STF(또는 HE-SIG-B)부터 더욱 커질 수 있다. 예를 들어, HE-STF(또는 HE-SIG-B)부터 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다.

[445] PPDU에 포함되는 각 필드에서 전송되는 정보는 앞서 도 26의 예시와 동일하므로 이하 설명을 생략한다.

[446] HE-SIG-A 필드는 20MHz 단위로 복사되어(duplicated) 전송된다.

[447] HE-SIG-B 필드는 각 STA 별로 할당되는 주파수 대역폭 정보 및/또는 해당 주파수 대역에서 스트림 정보를 알려줄 수 있다. HE-SIG-B 필드는 각 STA에 대한 정보를 포함하므로 20MHz 단위의 각 HE-SIG-B 필드 별로 각 STA에 대한 정보가 포함될 수 있다. 이때, 도 23의 예시에서는 각 STA 별로 20MHz가 할당되는 경우를 예시하고 있으나, 예를 들어 STA에 40MHz가 할당되는 경우, 20MHz 단위로 HE-SIG-B 필드가 복사되어 전송될 수도 있다.

[448] 각 BSS 별로 서로 다른 대역폭을 지원하는 상황에서 인접한 BSS로부터의 간섭 레벨이 적은 일부의 대역폭을 STA에게 할당하는 경우에 위와 같이 HE-SIG-B 필드를 전대역에 걸쳐서 전송하지 않는 것이 보다 바람직할 수 있다.

[449] 이하에서는 설명의 편의를 위해 도 28의 HE 포맷 PPDU를 기준으로 설명하기로 한다.

[450] 도 21 내지 도 23에서 데이터 필드는 페이로드(payload)로서, 서비스 필드(SERVICE field), 스크램블링된 PSDU, 테일 비트(tail bits), 패딩 비트(padding bits)를 포함할 수 있다.

[451] 한편, 앞서 도 21 내지 도 23과 같은 HE 포맷 PPDU는 L-SIG 필드의 반복 심볼인 RL-SIG(Repeated L-SIG) 필드를 통해서 구분될 수 있다. RL-SIG 필드는 HE SIG-A 필드 앞에 삽입되며, 각 STA은 RL-SIG 필드를 이용하여 수신된 PPDU의 포맷을 HE 포맷 PPDU로서 구분할 수 있다.

[452]

[453] 이하, WLAN 시스템에서 다중 사용자(multi-user) 상향링크 전송 방법에 대하여

설명한다.

[454] WLAN 시스템에서 동작하는 AP가 동일한 시간 자원 상에서 복수의 STA으로 데이터를 전송하는 방식을 DL MU 전송(downlink multi-user transmission)이라고 지칭할 수 있다. 반대로, WLAN 시스템에서 동작하는 복수의 STA이 동일한 시간 자원 상에서 AP로 데이터를 전송하는 방식을 UL MU 전송(uplink multi-user transmission)이라고 지칭할 수 있다.

[455] 이러한 DL MU 전송 또는 UL MU 전송은 주파수 도메인 또는 공간 도메인(spatial domain) 상에서 다중화될 수 있다.

[456] 주파수 도메인 상에서 다중화되는 경우, OFDMA(orthogonal frequency division multiplexing)를 기반으로 복수의 STA 각각에 대해 서로 다른 주파수 자원(예를 들어, 서브캐리어 또는 톤(tone))이 하향링크 또는 상향링크 자원으로 할당될 수 있다. 이러한 동일한 시간 자원에서 서로 다른 주파수 자원을 통한 전송 방식을 'DL/UL MU OFDMA 전송'이라고 지칭할 수 있다.

[457] 공간 도메인(spatial domain) 상에서 다중화되는 경우, 복수의 STA 각각에 대해 서로 다른 공간 스트림이 하향링크 또는 상향링크 자원으로 할당될 수 있다. 이러한 동일한 시간 자원에서 서로 다른 공간적 스트림을 통한 전송 식을 'DL/UL MU MIMO' 전송이라고 지칭할 수 있다.

[458] 현재 WLAN 시스템에서는 아래와 같은 제약 사항으로 인해 UL MU 전송을 지원하지 못한다.

[459] 현재 WLAN 시스템에서는 복수의 STA으로부터 전송되는 상향링크 데이터의 전송 타이밍에 대한 동기화가 지원되지 않는다. 예를 들어, 기존의 WLAN 시스템에서 복수의 STA들이 동일한 시간 자원을 통해 상향링크 데이터를 전송하는 경우를 가정하면, 현재 WLAN 시스템에서는 복수의 STA 각각은 다른 STA의 상향링크 데이터의 전송 타이밍을 알 수 없다. 따라서, AP는 복수의 STA 각각으로부터 동일한 시간 자원 상에서 상향링크 데이터를 수신하기 어렵다.

[460] 또한, 현재 WLAN 시스템에서는 복수의 STA에 의해 상향링크 데이터를 전송하기 위해 사용되는 주파수 자원 간의 중첩이 발생될 수 있다. 예를 들어, 복수의 STA 각각의 오실레이터(oscillator)가 다를 경우, 주파수 오프셋(frequency offset)이 다르게 나타날 수 있다. 만약, 주파수 오프셋이 다른 복수의 STA 각각이 서로 다른 주파수 자원을 통해 동시에 상향링크 전송을 수행하는 경우, 복수의 STA 각각에 의해 사용되는 주파수 영역 중 일부가 중첩될 수 있다.

[461] 또한, 기존의 WLAN 시스템에서는 복수의 STA 각각에 대한 파워 제어가 수행되지 않는다. 복수의 STA 각각과 AP 사이의 거리와 채널 환경에 종속적으로 AP는 복수의 STA 각각으로부터 서로 다른 파워의 신호를 수신할 수 있다. 이러한 경우, 약한 파워로 도착하는 신호는 강한 파워로 도착하는 신호에 비해 상대적으로 AP에 의해 검출되기 어려울 수 있다.

[462] 이에 따라, 본 발명은 WLAN 시스템에서의 UL MU 전송 방법을 제안한다.

[463]

[464] 도 24는 본 발명의 일 실시예에 따른 상향링크 다중 사용자(multi-user) 전송 절차를 예시하는 도면이다.

[465] 도 24를 참조하면, AP가 UL MU 전송에 참여하는 STA들에게 UL MU 전송을 준비할 것을 지시하고, 해당 STA들로부터 UL MU 데이터 프레임을 수신하며, UL MU 데이터 프레임에 대한 응답으로 ACK 프레임(BA(Block Ack) 프레임)을 전송한다.

[466] 먼저 AP는 UL MU 트리거 프레임(UL MU Trigger frame, 2410)을 전송함으로써, UL MU 데이터를 전송할 STA들에게 UL MU 전송을 준비할 것을 지시한다. 여기서, UL MU 스케줄링 프레임은 'UL MU 스케줄링(scheduling) 프레임'의 용어로 불릴 수도 있다.

[467] 여기서, UL MU 트리거 프레임(2410)은 STA 식별자(ID: Identifier)/주소(address) 정보, 각 STA이 사용할 자원 할당 정보, 지속기간(duration) 정보 등과 같은 제어 정보를 포함할 수 있다.

[468] STA ID/주소 정보는 상향링크 데이터를 전송하는 각 STA을 특정하기 위한 식별자 또는 주소에 대한 정보를 의미한다.

[469] 자원 할당 정보는 각 STA 별로 할당되는 상향링크 전송 자원(예를 들어, UL MU OFDMA 전송의 경우 각 STA에게 할당되는 주파수/서브캐리어 정보, UL MU MIMO 전송의 경우 각 STA에게 할당되는 스트림 인덱스)에 대한 정보를 의미한다.

[470] 지속기간(duration) 정보는 복수의 STA 각각에 의해 전송되는 상향링크 데이터 프레임의 전송을 위한 시간 자원을 결정하기 위한 정보를 의미한다.

[471] 예를 들어, 지속 기간 정보는 각 STA의 상향링크 전송을 위해 할당된 TXOP(Transmit Opportunity)의 구간 정보 혹은 상향링크 프레임 길이(frame length)에 대한 정보(예를 들어, 비트 또는 심볼)를 포함할 수 있다.

[472] 또한, UL MU 트리거 프레임(2410)은 각 STA 별로 UL MU 데이터 프레임 전송 시 사용해야 할 MCS 정보, 코딩(Coding) 정보 등과 같은 제어 정보를 더 포함할 수도 있다.

[473] 위와 같은 제어 정보는 UL MU 트리거 프레임(2410)을 전달하는 PPDU의 HE-part(예를 들어, HE-SIG A 필드 또는 HE-SIG B 필드)나 UL MU 트리거 프레임(2410)의 제어 필드(예를 들어, MAC 프레임의 Frame Control 필드 등)에서 전송될 수 있다.

[474] UL MU 트리거 프레임(2410)을 전달하는 PPDU는 L-part(예를 들어, L-STF 필드, L-LTF 필드, L-SIG 필드 등)으로 시작하는 구조를 가진다. 이에 따라, 레가시 STA들은 L-SIG 필드로부터 L-SIG 보호(L-SIG protection)을 통해 NAV(Network Allocation Vector) 셋팅을 수행할 수 있다. 예를 들어, 레가시 STA들은 L-SIG에서 데이터 길이(length) 및 데이터율(data rate) 정보를 기반으로 NAV 셋팅을 위한 구간(이하, 'L-SIG 보호 구간')을 산출할 수 있다. 그리고, 레가시 STA들은 산출된 L-SIG 보호 구간 동안에는 자신에게 전송될 데이터가

없다고 판단할 수 있다.

[475] 예를 들어, L-SIG 보호 구간은 UL MU 트리거 프레임(2410)의 MAC duration 필드 값과 UL MU 트리거 프레임(2410)을 나르는 PPDU의 L-SIG 필드 이후의 잔여 구간의 합으로 결정될 수 있다. 이에 따라, L-SIG 보호 구간은 UL MU 트리거 프레임(2410)의 MAC duration 값에 따라 각 STA에게 전송되는 ACK 프레임(2430)(또는 BA 프레임)을 전송하는 구간까지의 값으로 설정될 수 있다.

[476] 이하, 각 STA에게 UL MU 전송을 위한 자원 할당 방법을 보다 구체적으로 살펴본다. 설명의 편의를 위해 제어 정보가 포함되는 필드를 구분하여 설명하나 본 발명이 이에 한정되는 것은 아니다.

[477] 제1 필드는 UL MU OFDMA 전송과 UL MU MIMO 전송을 구분하여 지시할 수 있다. 예를 들어, '0'이면 UL MU OFDMA 전송을 지시하고, '1'이면 UL MU MIMO 전송을 지시할 수 있다. 제1 필드의 크기는 1 비트로 구성될 수 있다.

[478] 제2 필드(예를 들어, STA ID/주소 필드)는 UL MU 전송에 참여할 STA ID 혹은 STA 주소들을 알려준다. 제2 필드의 크기는 STA ID를 알려주기 위한 비트 수 × UL MU에 참여할 STA 수로 구성될 수 있다. 예를 들어, 제2 필드가 12 비트로 구성되는 경우, 4 비트 별로 각 STA의 ID/주소를 지시할 수 있다.

[479] 제3 필드(예를 들어, 자원 할당 필드)는 UL MU 전송을 위해 각 STA에 할당되는 자원 영역을 지시한다. 이때, 각 STA에 할당되는 자원 영역은 앞서 제2 필드의 순서에 따라 각 STA에게 순차적으로 지시될 수 있다.

[480] 만약, 제1 필드 값이 '0'인 경우, 제2 필드에 포함된 STA ID/주소의 순서대로 UL MU 전송을 위한 주파수 정보(예를 들어, 주파수 인덱스, 서브캐리어 인덱스 등)를 나타내고, 제1 필드 값이 '1'인 경우, 제2 필드에 포함된 STA ID/주소의 순서대로 UL MU 전송을 위한 MIMO 정보(예를 들어, 스트림 인덱스 등)를 나타낸다.

[481] 이때, 하나의 STA에게 여러 개의 인덱스(즉, 주파수/서브캐리어 인덱스 또는 스트림 인덱스)를 알려줄 수도 있으므로, 제3 필드의 크기는 복수의 비트(혹은, 비트맵(bitmap) 형식으로 구성될 수 있음) × UL MU 전송에 참여할 STA 개수로 구성될 수 있다.

[482] 예를 들어, 제2 필드가 'STA 1', 'STA 2'의 순서로 설정되고, 제3 필드가 '2', '2'의 순서로 설정된다고 가정한다.

[483] 이 경우, 제1 필드가 '0'인 경우, STA 1은 상위(또는, 하위) 주파수 영역부터 주파수 자원이 할당되고, STA 2는 그 다음의 주파수 자원이 순차적으로 할당될 수 있다. 일례로, 80MHz 대역에서 20MHz 단위의 OFDMA를 지원하는 경우, STA 1은 상위(또는, 하위) 40MHz 대역, STA 2는 그 다음의 40MHz 대역을 사용할 수 있다.

[484] 반면, 제1 필드가 '1'인 경우, STA 1은 상위(또는, 하위) 스트림이 할당되고, STA 2는 그 다음 스트림이 순차적으로 할당될 수 있다. 이때, 각 스트림에 따른 빔포밍 방식은 사전에 지정되어 있거나, 제3 필드 또는 제4 필드에서 스트림에

따른 빔포밍 방식에 대한 보다 구체적인 정보가 포함될 수도 있다.

[485] 각 STA은 AP에 의해 전송되는 UL MU 트리거 프레임(2410)을 기반으로 UL MU 데이터 프레임(UL MU Data frame, 2421, 2422, 2423)을 AP에 전송한다. 여기서, 각 STA은 AP로부터 UL MU 트리거 프레임(2410)을 수신 후 SIFS 이후에 UL MU 데이터 프레임(2421, 2422, 2423)을 AP에 전송할 수 있다.

[486] 각 STA은 UL MU 트리거 프레임(2410)의 자원 할당 정보를 기반으로 UL MU OFDMA 전송을 위한 특정한 주파수 자원 또는 UL MU MIMO 전송을 위한 공간적 스트림을 결정할 수 있다.

[487] 구체적으로, UL MU OFDMA 전송의 경우, 각 STA은 서로 다른 주파수 자원을 통해 동일한 시간 자원 상에서 상향링크 데이터 프레임을 전송할 수 있다.

[488] 여기서, STA 1 내지 STA 3 각각은 UL MU 트리거 프레임(2410)에 포함된 STA ID/주소 정보 및 자원 할당 정보를 기반으로 상향링크 데이터 프레임 전송을 위한 서로 다른 주파수 자원을 할당 받을 수 있다. 예를 들어, STA ID/주소 정보가 STA 1 내지 STA 3을 순차적으로 지시하고, 자원 할당 정보가 주파수 자원 1, 주파수 자원 2, 주파수 자원 3을 순차적으로 지시할 수 있다. 이 경우, STA ID/주소 정보를 기반으로 순차적으로 지시된 STA 1 내지 STA 3은 자원 할당 정보를 기반으로 순차적으로 지시된 주파수 자원 1, 주파수 자원 2, 주파수 자원 3을 각각 할당 받을 수 있다. 즉, STA 1은 주파수 자원 1, STA 2는 주파수 자원 2, STA 3은 주파수 자원 3을 통해 상향링크 데이터 프레임(2421, 2422, 2423)을 AP로 전송할 수 있다.

[489] 또한, UL MU MIMO 전송의 경우, 각 STA은 복수의 공간적 스트림 중 적어도 하나의 서로 다른 스트림을 통해 동일한 시간 자원 상에서 상향링크 데이터 프레임을 전송할 수 있다.

[490] 여기서, STA 1 내지 STA 3 각각은 UL MU 트리거 프레임(2410)에 포함된 STA ID/주소 정보 및 자원 할당 정보 기반으로 상향링크 데이터 프레임 전송을 위한 공간적 스트림을 할당 받을 수 있다. 예를 들어, STA ID/주소 정보가 STA 1 내지 STA 3을 순차적으로 지시하고, 자원 할당 정보가 공간적 스트림 1, 공간적 스트림 2, 공간적 스트림 3을 순차적으로 지시할 수 있다. 이 경우, STA ID/주소 정보를 기반으로 순차적으로 지시된 STA 1 내지 STA 3은 자원 할당 정보 기반으로 순차적으로 지시된 공간적 스트림 1, 공간적 스트림 2, 공간적 스트림 3을 각각 할당 받을 수 있다. 즉, STA 1은 공간적 스트림 1, STA 2는 공간적 스트림 2, STA 3은 공간적 스트림 3을 통해 상향링크 데이터 프레임(2421, 2422, 2423)을 AP로 전송할 수 있다.

[491] 상향링크 데이터 프레임(2421, 2422, 2423)을 전달하는 PPDU는 L-part 없이도 새로운 구조로도 구성이 가능하다.

[492] 또한, UL MU MIMO 전송이거나 20MHz 미만의 서브밴드 형태의 UL MU OFDMA 전송의 경우, 상향링크 데이터 프레임(2421, 2422, 2423)을 전달하는 PPDU의 L-part는 SFN 형태(즉, 모든 STA이 동일한 L-part 구성과 내용을 동시에

전송)로 전송될 수 있다. 반면, 20MHz 이상의 서브밴드 형태의 UL MU OFDMA 전송의 경우, 상향링크 데이터 프레임(2421, 2422, 2423)을 전달하는 PPDU의 L-part는 각 STA이 할당된 대역에서 20MHz 단위로 각각 L-part가 전송될 수 있다.

[493] UL MU 트리거 프레임(2410)의 정보로 상향링크 데이터 프레임을 충분히 구성할 수 있다면, 상향링크 데이터 프레임(2421, 2422, 2423)을 전달하는 PPDU 내 HE-SIG 필드(즉, 데이터 프레임의 구성 방식에 대한 제어 정보를 전송하는 영역)도 필요 없을 수 있다. 예를 들어, HE-SIG-A 필드 및/또는 HE-SIG-B가 전송되지 않을 수 있다. 또한, HE-SIG-A 필드와 HE-SIG-C 필드는 전송되고, HE-SIG-B 필드는 전송되지 않을 수 있다.

[494] AP는 각 STA으로부터 수신한 상향링크 데이터 프레임(2421, 2422, 2423)에 대한 응답으로 ACK 프레임(ACK frame, 2430)(또는 BA 프레임)을 전송할 수 있다. 여기서, AP는 각 STA으로부터 상향링크 데이터 프레임(2421, 2422, 2423)을 수신하고 SIFS 이후에 ACK 프레임(2430)을 각 STA에게 전송할 수 있다.

[495] 만일, 기존의 ACK 프레임의 구조를 동일하게 이용한다면, 6 옥텟 크기를 가지는 RA 필드에 UL MU 전송에 참여하는 STA들의 AID(혹은, 부분 AID(Partial AID))를 포함하여 구성할 수 있다.

[496] 또는, 새로운 구조의 ACK 프레임을 구성한다면 DL SU 전송 또는 DL MU 전송을 위한 형태로 구성이 가능하다.

[497] AP는 수신에 성공한 UL MU 데이터 프레임에 대한 ACK 프레임(2430)만을 해당 STA에게 전송할 수 있다. 또한, AP는 ACK 프레임(2430)을 통해 수신 성공 여부를 ACK 또는 NACK으로 알려줄 수 있다. 만약 ACK 프레임(2430)이 NACK 정보를 포함한다면, NACK에 대한 이유나 그 후의 절차를 위한 정보(예를 들어, UL MU 스케줄링 정보 등)도 포함할 수 있다.

[498] 또는, ACK 프레임(2430)을 전달하는 PPDU는 L-part 없이 새로운 구조로 구성할 수도 있다.

[499] ACK 프레임(2430)은 STA ID 혹은 주소 정보를 포함할 수도 있으나, UL MU 트리거 프레임(2410)에서 지시된 STA의 순서를 동일하게 적용한다면, STA ID 혹은 주소 정보를 생략할 수도 있다.

[500] 또한, ACK 프레임(2430)의 TXOP(즉, L-SIG 보호 구간)을 연장하여 다음의 UL MU 스케줄링을 위한 프레임이나, 다음의 UL MU 전송을 위한 보정 정보 등을 포함하는 제어 프레임이 TXOP 내 포함될 수도 있다.

[501] 한편, UL MU 전송을 위하여 STA들 간에 동기를 맞추는 등의 보정(adjustment) 과정을 추가될 수도 있다.

[502]

[503] 도 25 내지 27은 본 발명의 일 실시예에 따른 OFDMA 다중 사용자(multi-user) 전송 방식에서 자원 할당 단위를 예시하는 도면이다.

[504] DL/UL OFDMA 전송 방식이 사용될 때, PPDU 대역폭 내에서 n개의 톤(tone)(또는 서브캐리어(subcarrier)) 단위로 복수 개의 자원 유닛(Resource

Unit)이 정의될 수 있다.

[505] 자원 유닛은 DL/UL OFDMA 전송을 위한 주파수 자원의 할당 단위를 의미한다.

[506] 하나의 STA에게 DL/UL 주파수 자원으로 하나 이상의 자원 유닛이 할당되어, 복수 개의 STA에게 각각 서로 다른 자원 유닛이 할당될 수 있다.

[507] 도 25에서는 PPDU 대역폭이 20MHz인 경우를 예시한다.

[508] 20MHz PPDU 대역폭(bandwidth)의 중심 주파수 영역에는 7개의 DC 톤들이 위치할 수 있다. 또한, 20MHz PPDU 대역폭의 양측에는 6개의 레프트 가드 톤들(left guard tones) 및 5개의 라이트 가드 톤들(right guard tones)이 각각 위치할 수 있다.

[509] 도 25(a)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 26개의 톤으로 구성될 수 있다. 또한, 도 25(b)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 52개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 또한, 도 25(c)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 106개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 또한, 도 25(d)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 242개의 톤으로 구성될 수 있다.

[510] 26 톤으로 구성된 자원 유닛은 2개의 파일럿 톤을 포함할 수 있으며, 52 톤으로 구성된 자원 유닛은 4개의 파일럿 톤을 포함할 수 있으며, 106 톤으로 구성된 자원 유닛은 4개의 파일럿 톤을 포함할 수 있다.

[511] 도 25(a)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 9개의 STA까지 지원할 수 있다. 또한, 도 25(b)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 5개의 STA까지 지원할 수 있다. 또한, 도 25(c)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 3개의 STA까지 지원할 수 있다. 또한, 25(d)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역은 하나의 STA에게 할당될 수 있다.

[512] DL/UL OFDMA 전송에 참여하는 STA의 수 및/또는 해당 STA이 전송하는 혹은 수신하는 데이터의 양 등에 기반하여 도 25(a) 내지 도 25(d) 중에 어느 하나의 자원 유닛 구성 방식이 적용되거나 또는, 도 25(a) 내지 도 25(d)이 조합된 자원 유닛 구성 방식이 적용될 수 있다.

[513] 도 26에서는 PPDU 대역폭이 40MHz인 경우를 예시한다.

[514] 40MHz PPDU 대역폭의 중심 주파수 영역에는 5개의 DC 톤들이 위치할 수 있다. 또한, 40MHz PPDU 대역폭의 양측에는 12개의 레프트 가드 톤들 및 11개의 라이트 가드 톤들이 각각 위치할 수 있다.

[515] 도 26(a)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 26개의 톤으로 구성될 수 있다. 또한, 도 26(b)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 52개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다.

또한, 도 26(c)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 106개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 또한, 도 26(d)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 242개의 톤으로 구성될 수 있다. 또한, 도 26(e)과 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 484개의 톤으로 구성될 수 있다.

[516] 26 톤으로 구성된 자원 유닛은 2개의 파일럿 톤을 포함할 수 있으며, 52 톤으로 구성된 자원 유닛은 4개의 파일럿 톤을 포함할 수 있으며, 106 톤으로 구성된 자원 유닛은 4개의 파일럿 톤을 포함할 수 있으며, 242 톤으로 구성된 자원 유닛은 8개의 파일럿 톤을 포함할 수 있으며, 484 톤으로 구성된 자원 유닛은 16개의 파일럿 톤을 포함할 수 있다.

[517] 도 26(a)와 같이 자원 유닛이 구성되는 경우, 40MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 18개의 STA까지 지원할 수 있다. 또한, 도 26(b)와 같이 자원 유닛이 구성되는 경우, 40MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 10개의 STA까지 지원할 수 있다. 또한, 도 26(c)와 같이 자원 유닛이 구성되는 경우, 40MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 6개의 STA까지 지원할 수 있다. 또한, 26(d)와 같이 자원 유닛이 구성되는 경우, 40MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 2개의 STA까지 지원할 수 있다. 또한, 26(e)와 같이 자원 유닛이 구성되는 경우, 해당 자원 유닛은 40MHz 대역에서 SU DL/UL 전송을 위해 1개의 STA에 할당될 수 있다.

[518] DL/UL OFDMA 전송에 참여하는 STA의 수 및/또는 해당 STA이 전송하는 혹은 수신하는 데이터의 양 등에 기반하여 도 26(a) 내지 도 26(e) 중에 어느 하나의 자원 유닛 구성 방식이 적용되거나 또는, 도 26(a) 내지 도 26(e)이 조합된 자원 유닛 구성 방식이 적용될 수 있다.

[519] 도 27에서는 PPDU 대역폭이 80MHz인 경우를 예시한다.

[520] 80MHz PPDU 대역폭의 중심 주파수 영역에는 7개의 DC 톤들이 위치할 수 있다. 다만, 80MHz PPDU 대역폭이 하나의 STA에 할당된 경우에(즉, 996 톤으로 구성된 자원 유닛이 하나의 STA에 할당된 경우) 중심 주파수 영역에는 5개의 DC 톤들이 위치할 수 있다. 또한, 80MHz PPDU 대역폭의 양측에는 12개의 레프트 가드 톤들 및 11개의 라이트 가드 톤들이 각각 위치할 수 있다.

[521] 도 27(a)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 26개의 톤으로 구성될 수 있다. 또한, 도 27(b)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 52개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 또한, 도 27(c)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 106개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 또한, 도 27(d)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 242개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 도 27(e)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 484개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 도 27(f)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 996개의

톤으로 구성될 수 있다.

[522] 26 톤으로 구성된 자원 유닛은 2개의 파일럿 톤을 포함할 수 있으며, 52 톤으로 구성된 자원 유닛은 4개의 파일럿 톤을 포함할 수 있으며, 106 톤으로 구성된 자원 유닛은 4개의 파일럿 톤을 포함할 수 있으며, 242 톤으로 구성된 자원 유닛은 8개의 파일럿 톤을 포함할 수 있으며, 484 톤으로 구성된 자원 유닛은 16개의 파일럿 톤을 포함할 수 있으며, 996 톤으로 구성된 자원 유닛은 16개의 파일럿 톤을 포함할 수 있다.

[523] 도 27(a)와 같이 자원 유닛이 구성되는 경우, 80MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 37개의 STA까지 지원할 수 있다. 또한, 도 27(b)와 같이 자원 유닛이 구성되는 경우, 80MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 21개의 STA까지 지원할 수 있다. 또한, 도 27(c)와 같이 자원 유닛이 구성되는 경우, 80MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 13개의 STA까지 지원할 수 있다. 또한, 27(d)와 같이 자원 유닛이 구성되는 경우, 80MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 5개의 STA까지 지원할 수 있다. 또한, 27(e)와 같이 자원 유닛이 구성되는 경우, 80MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 3개의 STA까지 지원할 수 있다. 또한, 27(f)와 같이 자원 유닛이 구성되는 경우, 해당 자원 유닛은 80MHz 대역에서 SU DL/UL 전송을 위해 1개의 STA에 할당될 수 있다.

[524] DL/UL OFDMA 전송에 참여하는 STA의 수 및/또는 해당 STA이 전송하는 혹은 수신하는 데이터의 양 등에 기반하여 도 27(a) 내지 도 27(f) 중에 어느 하나의 자원 유닛 구성 방식이 적용되거나 또는, 도 27(a) 내지 도 27(f)이 조합된 자원 유닛 구성 방식이 적용될 수 있다.

[525] 이외에도 도면에는 도시하지 않았으나, PPDU 대역폭이 160MHz인 경우의 자원 유닛의 구성 방식도 제안될 수 있다. 이 경우, 160MHz PPDU의 대역폭은 도 32에서 상술한 80MHz PPDU 대역폭이 2번 반복된 구조를 가질 수 있다.

[526] 상술한 자원 유닛 구성 방식에 따라 결정된 전체 자원 유닛 중 DL/UL OFDMA 전송을 위해 일부의 자원 유닛만이 이용될 수도 있다. 예를 들어, 20MHz 내에서도 30(a)과 같이 자원 유닛이 구성되는 경우, 9개 미만의 STA에게 각각 하나씩 자원 유닛이 할당되고, 나머지 자원 유닛은 어느 STA에게도 할당되지 않을 수 있다.

[527] DL OFDMA 전송의 경우, PPDU의 데이터 필드는 각 STA에게 할당된 자원 유닛 단위로 주파수 영역(frequency domain)에서 다중화되어 전송된다.

[528] 반면, UL OFDMA 전송의 경우, 각 STA 별로 각각 자신이 할당 받은 자원 유닛 단위로 PPDU의 데이터 필드를 구성하고 동시에 AP에게 전송할 수 있다. 이처럼 각 STA이 동시에 PPDU를 전송하므로, 수신단인 AP 입장에서는 각 STA으로부터 전송되는 PPDU의 데이터 필드가 주파수 영역(frequency domain)에서 다중화되어 전송되는 것으로 인식될 수 있다.

[529] 또한, DL/UL OFDMA 전송과 DL/UL MU-MIMO 전송이 동시에 지원되는 경우,

하나의 자원 유닛은 공간 영역(spatial domain)에서 복수의 스트림으로 구성될 수 있다. 그리고, 하나의 STA에게 DL/UL 공간 자원(spatial resource)으로서 하나 이상의 스트림이 할당되어, 복수 개의 STA에게 각각 서로 다른 스트림이 할당될 수 있다.

[530] 예를 들어, 도 25(c)에서 106 톤으로 구성되는 자원 유닛은 공간 영역(spatial domain)에서 복수의 스트림으로 구성되어 DL/UL OFDMA와 DL/UL MU-MIMO를 동시에 지원할 수 있다.

[531]

[532] **차세대 시스템의 채널 상태 정보 피드백 방법**

[533] 앞서 상술한 바와 같이, 차세대 WLAN 시스템에서는 OFDMA 기술이 도입됨에 따라 STA의 UL MU 전송이 가능하게 되었다. 그 결과, DL 채널에 대한 채널 상태 정보(또는 피드백 정보)를 보고하기 위한(또는 피드백하기 위한) 사운딩 프로토콜(또는 시퀀스)에서도, 복수의 STA들이 채널 상태 정보를 동시에 AP로 UL MU 전송하는 것이 가능하게 되었다. 이 경우, 복수의 STA들이 전송하는 채널 상태 정보 간 충돌이 발생하지 않도록 각 STA에 UL MU 전송 자원이 할당될 필요가 있다. 따라서, 차세대 시스템의 사운딩 프로토콜에서는 각 STA에 대한 UL MU 전송 자원의 할당 정보(또는 트리거 정보)가 포함된 트리거 프레임의 송수신 절차가 요구될 수 있으며, 이에 관하여는 도 28에서 상세히 후술하기로 한다.

[534] 도 28은 본 발명의 일 실시예에 따른 사운딩 프로토콜을 예시한 도면이다. 본 도면에는 도 7 내지 11에서 상술한 설명이 동일/유사하게 적용될 수 있으며, 이하에서는 도 7 내지 11과의 차이점을 중심으로 설명한다.

[535] 도 28을 참조하면, DL 채널에 대한 채널 상태 정보를 획득하기 위해 AP는 NDP 프레임(2820)의 전송을 알리는(또는 사운딩 프로토콜을 개시하는) NDPA 프레임(또는 NDPA 기능/정보)(2810)을 STA들에 전송할 수 있다. NDPA 프레임(2810)에는 사운딩 프로토콜에 관한 제어 정보가 포함되어 있을 수 있다. 예를 들어, NDPA 프레임(2810)에는 어떤 STA이, 어떤 DL 채널을, 어떠한 방식으로 측정할지 등에 관한 피드백 지시 정보(또는 사운딩 지시 정보)가 포함되어 있을 수 있다.

[536] 또한, AP는 STA이 측정할 대상 DL 채널에 관한 정보를 지시하는 NDP 프레임(또는 NDP 기능/정보)(2820)을 STA들에 전송할 수 있다. NDP 프레임(2820)에는 측정할 대상 DL 채널에 관한 정보를 지시하는 HE-STF/LTF가 포함되어 있을 수 있다(또는, DL 채널의 사운딩(또는 DL CSI(Channel State Information))을 위한 HE-STF/LTF가 포함되어 있을 수 있다). 이때, NDP 프레임(2820)에는 STA이 채널 상태를 보고할 공간 스트림의 개수와 같거나 보다 많은 수의 HE-LTF가 포함되어 있을 수 있다.

[537] 또한, AP는 UL MU 전송을 트리거하는 트리거 프레임(또는 트리거 기능/정보)(2830)을 STA들에 전송할 수 있다. 트리거 프레임(2830)에는 DL

채널에 대한 채널 상태 정보의 UL MU 전송을 위해 각 STA들에 할당된 UL MU 자원에 관한 자원 할당 정보가 포함되어 있을 수 있다. 이때, 각 STA에 할당될 수 있는 주파수 자원 할당 단위에 관한 설명은 도 25 내지 27과 관련하여 상술한 바와 같다.

[538] 트리거 프레임(2830)을 수신한 STA들은 NDPA 프레임(2810) 및 트리거 프레임(2830)에서 지시하는 대상 DL 채널을 측정하여 채널 상태 정보를 획득할 수 있다. STA들은 획득한 채널 상태 정보가 포함된 피드백 프레임(또는 빔포밍 프레임/빔포밍 피드백 프레임)(2840)을 생성하고, 자신에게 할당된 UL MU 자원을 이용하여 생성한 피드백 프레임(2840)을 UL MU 전송할 수 있다.

[539] 도 7에 도시된 레가시 시스템에서의 사운딩 프로토콜과 비교하면, 본 사운딩 프로토콜에서 STA들은 채널 상태 정보가 포함된 피드백 프레임을 동시에 UL MU 전송하므로, 시간 측면에서 오버헤드가 적다는 효과가 존재한다.

[540] 본 명세서에서 제안되는 사운딩 프로토콜에서 NDPA 프레임(2810), NDP 프레임(2820) 및 트리거 프레임(2830)은 실시예에 따라 서로 다른 DL PPDU를 통해 전송될 수 있으며, 또는 하나의 DL PPDU를 통해 전송될 수도 있다.

[541] 도 29는 본 발명의 제1 실시예에 따른 사운딩 프로토콜을 예시한 도면이다.

[542] 도 29를 참조하면, NDPA 프레임, NDP 프레임 및 트리거 프레임을 각각 서로 다른 DL PPDU들에 포함되어 전송될 수 있으며, 순차적으로 전송될 수 있다. 본 도면에서 preamble은 레가시 프리앰블과 HE 프리앰블이 포함된 물리적 프리앰블을 의미한다. 다만, NDP 프레임이 포함된 DL PPDU의 preamble은 HE-STF 및/또는 HE-LTF가 제외된 HE 프리앰블과 레가시 프리앰블이 포함된 물리적 프리앰블을 의미할 수 있으며, 이때 NDP 프레임에는 HE-STF 및/또는 HE-LTF가 포함될 수 있다. 즉, NDP 프레임이 포함된 DL PPDU는 레가시 프리앰블부터 HE-STF 및/또는 HE-LTF까지 포함되며, PPDU에서 데이터 부분만 제외된 물리적 프리앰블을 의미할 수 있다.

[543] 이때, 각 DL PPDU들은 순차적으로(또는 연속적으로) 일정한 시간 간격(예를 들어, SIFS(Short interframe space))을 두고 DL 전송될 수 있다. 예를 들어, NDPA 프레임이 포함된 제1 DL PPDU가 전송되고 SIFS 후에 NDP 프레임이 포함된 제2 DL PPDU가 전송될 수 있다. 또한, 제2 DL PPDU가 전송되고 SIFS 후에 트리거 프레임이 포함된 제3 DL PPDU가 전송될 수 있다. 또한, 제3 DL PPDU가 전송되고 SIFS 후에 피드백 프레임이 포함된 UL PPDU가 전송될 수 있다.

[544] 이렇듯, NDPA 프레임, NDP 프레임 및 트리거 프레임이 각각 서로 다른 DL PPDU에 실려 전송되는 경우, 오버헤드가 크다는 문제점이 존재한다. 상술한 예의 경우, 제2 DL PPDU의 preamble과 제3 DL PPDU의 preamble, 그리고 2번의 SIFS로 인해 시간 측면에서 오버헤드가 매우 크다는 것을 확인할 수 있다.

[545] 따라서, 이러한 오버헤드를 줄이기 위해 본 명세서에서는 NDPA 프레임, NDP 프레임 및 트리거 프레임을 하나 또는 두 개의 DL PPDU에 함께 포함하여 전송하고, 이 경우 중복되는 정보는 삭제하여 전송하는 방법을 제안한다. 이와

관련된 보다 상세한 설명은 도 30과 관련하여 이하에서 상세히 후술하기로 한다.

[546] 도 30은 본 발명의 제2 및 제3 실시예에 따른 사운딩 프로토콜을 예시한 도면이다. 보다 상세하게는, 도 30(a)는 본 발명의 제2 실시예에 따른 사운딩 프로토콜, 도 30(b)는 본 발명의 제3 실시예에 따른 사운딩 프로토콜을 각각 예시한 도면이다.

[547] 도 30(a)를 참조하면, 도 29에서 상술한 오버헤드를 줄이기 위해, AP는 NDP 프레임과 트리거 프레임을 하나의 DL PPDU를 통해 전송할 수 있다. 다시 말하면, AP는 오버헤드를 줄이기 위해 NDP 프레임과 트리거 프레임을 결합하여 하나의 DL PPDU를 통해 전송할 수 있다. 이는, AP가 NDP 프레임의 기능(또는 NDP 기능) 및 트리거 프레임의 기능(또는 트리거 기능)을 함께 수행하는 적어도 하나의 프레임을 생성하고, 해당 프레임을 하나의 DL PPDU를 통해 전송한다고 표현될 수도 있다.

[548] 예를 들어, AP는 NDPA 프레임이 포함된 제1 DL PPDU를 전송하고 SIFS 후에, NPD 프레임(NDP 기능)과 트레거 프레임(트리거 기능)이 포함된 제2 DL PPDU를 전송할 수 있다. 제1 및 제2 DL PPDU를 수신한 STA(들)은 측정을 지시 받은 DL 채널에 대한 채널 상태 정보가 포함된 피드백 프레임을 생성하고, 생성된 피드백 프레임이 실린 UL (SU/MU) PPDU를 AP로 전송할 수 있다.

[549] 제2 실시예의 경우, NDP 프레임과 트리거 프레임이 서로 다른 DL PPDU를 통해 전송되는 경우에 발생할 수 있는 오버헤드(SIFS 및 NDP 프레임을 포함하는 DL PPDU의 물리 프리앰블)가 제거된다는 장점이 존재한다.

[550] 도 30(b)를 참조하면, 도 29에서 상술한 오버헤드를 줄이기 위해, AP는 NDPA 프레임, NDP 프레임과 트리거 프레임을 하나의 DL PPDU를 통해 전송할 수 있다. 다시 말하면, AP는 오버헤드를 줄이기 위해 NDPA 프레임, NDP 프레임과 트리거 프레임을 결합하여 하나의 DL PPDU를 통해 전송할 수 있다. 이는, AP가 NDPA 프레임의 기능(또는 NDPA 기능), NDP 프레임의 기능(또는 NDP 기능) 및 트리거 프레임의 기능(또는 트리거 기능)을 모두 수행하는 적어도 하나의 프레임을 생성하고, 해당 프레임을 하나의 DL PPDU를 통해 전송한다고 표현될 수도 있다.

[551] 예를 들어, AP는 NDPA 프레임(NDPA 기능), NDP 프레임(NDP 기능) 및 트리거 프레임(트리거 기능)이 모두 포함된 DL PPDU를 STA(들)로 전송할 수 있으며, 이로부터 SIFS 후에 STA(들)은 측정을 지시 받은 DL 채널에 대한 채널 상태 정보가 포함된 피드백 프레임이 실린 UL (SU/MU) PPDU를 AP로 전송할 수 있다.

[552] 제3 실시예의 경우, NDPA 프레임, NDP 프레임 및 트리거 프레임이 서로 다른 DL PPDU를 통해 전송되는 경우에 발생할 수 있는 오버헤드(2번의 SIFS 및 NDP/트리거 프레임을 포함하는 DL PPDU들의 물리 프리앰블)가 제거된다는 장점이 존재한다.

[553] 다만, AP가 NDPA 프레임, NDP 프레임 및 트리거 프레임을 단순히 결합하여

전송하는 경우, 각 프레임 별로 존재하는 동일한 정보가 하나의 DL PPDU 내에서 중복되어 존재한다는 오버헤드가 발생한다. 또한, 차세대 WLAN 시스템에 OFDMA 기술이 도입됨에 따라, AP는 STA에게 어떤 주파수 자원 유닛(예를 들어, 20MHz 채널에서 좌측으로부터 2번째 및 3번째에 위치한 26톤 자원 유닛들)을 측정하여 피드백할지를 지시하는 주파수 정보를 추가로 전송해야 할 수도 있다. 따라서, 이하에서는 제2 또는 제3 실시예에서 송수신되는 프레임에 포함될 수 있는 정보를 제안한다.

[554] 도 31은 본 발명의 일 실시예에 따른 NDPA 프레임, NDP 프레임 및 트리거 프레임에 각각 포함되는 정보를 예시한 도면이다.

[555] 도 31을 참조하면, NDPA 프레임(또는 NDPA 기능)에는 사운딩 (다이얼로그) 토큰 정보(또는 필드), STA의 AID 정보(또는 필드), Nc index 정보(또는 필드) 외에 주파수 정보(또는 필드)가 추가로 포함될 수 있다. 여기서 주파수 정보는 앞서 상술한 바와 같이 STA이 채널 상태를 보고할 측정 대상인 주파수 자원 유닛을 지시하는 정보를 나타낼 수 있다. 따라서, 주파수 정보를 수신한 STA은, 수신한 주파수 정보가 지시하는 주파수 자원 유닛의 채널 상태를 측정하여 AP에 피드백(또는 보고)할 수 있다. 이러한 주파수 정보는 실시예에 따라 NDPA 프레임에 선택적으로 포함될 수 있다. 한편, 본 도면에 도시한 NDPA 프레임은 실시예에 불과하며, 도시된 정보(또는 필드) 중 일부 정보(또는 필드)가 제외되거나 새로운 정보가 포함되어 NDPA 프레임이 구성될 수도 있다.

[556] 트리거 프레임의 경우, AID 정보(또는 필드)는 NDPA 프레임에 포함되어 있는 STA의 AID 정보(또는 필드)와 중복되므로 해당 AID 정보는 제외되어 구성될 수 있다. 또한, 만일 STA이 피드백 프레임을 피드백 프레임을 UL MU 전송하기 위해 할당된 주파수/공간 자원이 미리 설정되어 있는 경우(즉, 기설정된 크기의 주파수 자원 유닛으로 고정되어 있는 경우), 트리거 프레임은 자원 할당 정보 역시 제외되어 구성될 수 있다.

[557] 이렇듯 트리거 프레임의 일부 정보가 제외되어 구성되는 경우, 제외된 정보만큼 트리거 프레임의 구성 비트 수가 줄어들게 된다. 따라서, 제2 또는 제3 실시예에 따라 사운딩 프로토콜을 수행하는 경우, AP는 트리거 프레임을 NDPA 프레임 및/또는 NDP 프레임과 결합하여 하나의 프레임으로 구성하는 것이 가능하다.

[558] 이하에서는 제3 실시예의 사운딩 프로토콜에서 송수신되는 DL PPDU 포맷에 대해 보다 상세히 살펴보기로 한다. 즉, 이하에서는 NDPA 프레임, NDP 프레임 및 트리거 프레임이 하나의 DL PPDU를 통해 전송되는 경우 DL PPDU의 포맷에 대해 상세히 살펴보기로 한다.

[559] 도 32는 본 발명의 제3 실시예에 따른 사운딩 프로토콜에서 송수신되는 DL PPDU 포맷을 예시한다. 도 33은 도 32(a)의 DL PPDU 포맷의 구체적인 실시예를 도시한 도면이다. 본 도면들에서 L preamble은 레가시 프리앰블을 의미한다. 또한 본 도면들에서 트리거 프레임은 NDPA 기능 및 트리거 기능을 수행하는

프레임을 의미할 수 있다. 즉, 본 도면들에서 트리거 프레임은 NDPA 프레임 및 트리거 프레임이 결합되어 구성된 프레임을 의미할 수 있다.

[560] 도 32(a)를 참조하면, 채널 사운딩을 위한 DL PPDU에서 트리거 프레임은 HE-STF 및 HE-LTF 앞에 위치하여 구성될 수 있다. 즉, 채널 사운딩을 위한 DL PPDU는 레가시 프리앰블, 트리거 프레임, HE-STF 및 HE-LTF 순으로 구성될 수 있다. 트리거 프레임 뒤에 위치하는 HE-STF 및 HE-LTF는 STA들이 DL 채널 상태를 측정하기 위한 정보로 사용될 수 있다.

[561] 트리거 프레임은 PHY 구조 또는 MAC 구조로 구성될 수 있다. 보다 상세하게는, 도 33(a)를 참조하면, PHY 구조의 트리거 프레임은 HE-SIG A 필드와 HE-SIG B 필드로 구성될 수 있다. 이때 트리거 정보는 HE-SIG B 필드에 포함될 수 있으며, NDPA 정보는 HE-SIG A 필드 또는 HE-SIG B 필드에 포함될 수 있다. 또한, 도 33(b)를 참조하면, MAC 구조의 트리거 프레임은 레가시 프리앰블(L-STF/LTF/SIG)를 제외한 PPDU 구조로 구성될 수 있다. 예를 들어, MAC 구조의 트리거 프레임은 트리거 정보가 포함된 HE 프레임 포맷으로 구성될 수 있다. 또는 MAC 구조의 트리거 프레임은 outdoor 환경의 강인한(robust) 전송을 위해 HE-프리앰블 및 트리거 정보가 포함된 HE-프레임이 포함되어 구성될 수 있다.

[562] 채널 상태의 측정(또는 보고)을 지시 받지 않은 STA(들)(즉, NDPA 프레임(또는 정보)의 AID 필드에 AID가 포함되어 있지 않은 STA(들))은 HE-SIG A/B 필드가 지시하는 TXOP duration(도 33(a) 참조)이나 트리거 프레임이 지시하는 MAC duration으로(도 33(b) 참조) NAV setting을 할 수 있다.

[563] 또한, 채널 상태의 측정(또는 보고)을 지시 받은 STA(들)(즉, NDPA 프레임(또는 정보)의 AID 필드에 AID가 포함되어 있는 STA(들))은 L-SIG duration을 읽고 트리거 프레임의 길이를 알 수 있다. 보다 상세하게는, 33(a)의 경우, STA(들)은 레가시 프리앰블에서 L-SIG duration을 읽고, PHY 구조로 구성된 트리거 프레임에 해당하는 HE-SIG A/B 필드의 길이를 알 수 있다. 혹은 33(b)의 실시예의 경우, STA(들)은 L-SIG duration을 읽고 MAC 구조로 구성된 트리거 프레임의 길이를 알 수 있다. 또한 상기 STA(들)은 트리거 프레임(또는 정보)을 읽어 해당 프레임이 DL 채널 상태를 측정을 지시하는 프레임임을 알 수 있다. 나아가, STA(들)은 트리거 프레임(또는 정보)을 통해, 트리거 프레임 뒤에 DL 채널 상태 측정을 위한 HE-STF/LTF가 포함되어 있으며, 그 구성이 어떠한지 알 수 있다. 그 결과, STA(들)은 해당 HE-STF/LTF를 이용하여 DL 채널 상태를 측정하고, 측정한 결과를 피드백 프레임으로서 AP로 UL 전송할 수 있다.

[564] 또한, 도 33에는 도시하지 않았으나, 채널 측정을 지시 받은 STA이 채널 측정을 준비하는 시간을 벌어주기 위해, 트리거 프레임 뒤에 위치한 HE-STF/LTF는 트리거 프레임의 바로 뒤에 전송되지 않고 SIFS의 간격을 두고 전송될 수도 있다. 이때, AP는 SIFS의 간격을 비워두거나(즉, SIFS 동안 아무런 신호도 전송하지 않거나) 더미 신호를 전송할 수도 있다. 혹은 AP는 트리거 프레임과

HE-STF/LTF 사이에 뒤에 MAC or PHY padding을 추가함으로써 STA의 채널 측정 준비 시간을 벌어줄 수도 있다.

[565] 다시 도 32(b)를 참조하면, 채널 사운딩을 위한 DL PPDU에서 트리거 프레임은 32(a)에서와 달리, HE-STF 및 HE-LTF 뒤에 위치하여 구성될 수 있다. 즉, 채널 사운딩을 위한 DL PPDU는 레가시 프리앰블, HE-SIG 필드(예를 들어, HE-SIG A/B/C 필드), HE-STF, HE-LTF 및 트리거 프레임 순으로 구성될 수 있다. 트리거 프레임 뒤에 위치하는 HE-STF 및 HE-LTF는 STA들이 DL 채널 상태를 측정하기 위한 정보로 사용될 수 있다.

[566] 본 실시예에서 트리거 프레임이 포함된 DL PPDU는 802.11ax 시스템에서 제안되는 DL MU PPDU(트리거 프레임이 포함된 DL MU PPDU) 구조로 구성될 수 있다. 다만, 트리거 프레임 앞에 위치하는 HE-STF/LTF는 STA이 트리거 프레임을 읽기 위한 용도뿐 아니라, DL 채널 상태를 측정하기 위한 용도로 그 기능이 확장될 수 있다.

[567] 예를 들어, 트리거 프레임은 1개의 공간 스트림을 통해 전송되더라도 HE-LTF에는 8개의 공간 스트림에 관한 채널 정보가 모두 실려 전송될 수 있다. 이를 위해, HE-LTF는 측정할 공간 스트림 개수와 같거나 보다 많은 개수로 DL PPDU에 포함되어 전송될 수 있다. 따라서 상기 예의 경우, 8개(혹은 8개 이상)의 HE-LTF가 DL PPDU에 포함되어 전송될 수 있다. 해당 HE-LTF를 수신한 STA은 트리거 프레임을 읽기 위해 트리거 프레임이 전송된 1개의 공간 스트림에 대한 채널을 추정할 수 있으며, DL 채널 상태를 측정하기 위해 8개의 공간 스트림들의 채널을 추정/측정하고, 해당 채널에 대한 채널 상태 정보를 생성할 수 있다.

[568] 만일, AP가 전체 공간 스트림들 중 일부 공간 스트림에 대해서만 채널 상태 정보를 보고할 것을 지시한 경우(예를 들어, NDPA 프레임(또는 정보)를 통해 지시), STA은 AP가 지정해 준 공간 스트림에 대해서만 채널을 추정/측정하고, 측정 결과를 AP에 피드백할 수 있다. AP가 채널 측정 영역(주파수/공간 스트림)을 지시하는 실시예는 이하에서 보다 상세히 후술하기로 한다.

[569]

[570] **<u>피드백 프레임의 UL MU 전송</u>**

[571] STA들이 충돌 없이 피드백 프레임을 동시에 UL MU 전송하기 위해서는, 각 STA들은 자신에게 할당된 자원 유닛이 무엇인지 알고 있어야 한다. 이를 위해, 일 실시예로서, 각 STA은 피드백 프레임 전송을 위한 자원 할당 정보(또는 트리거 정보)를 트리거 프레임을 통해 AP로부터 직접 수신할 수 있다. 또는, 다른 실시예로서, 시그널링 오버헤드를 줄이고자, 피드백 프레임 전송을 위해 각 STA에 할당된 자원 유닛이 사전에 미리 결정되어 있을 수 있다. 또는, 각 STA이 미리 설정된 수학식에 따라 계산하여 피드백 프레임 전송을 위한 자원 할당 정보를 직접 획득/추측할 수도 있다.

[572] 피드백 프레임 전송을 위해 각 STA에 할당되는 주파수 자원의 최소 단위로서 주파수 유닛(Frequency Unit)이 정의될 수 있다. 여기서, 주파수 유닛은 도 25 내지

27에서 상술한 자원 유닛과 대응되는 개념일 수 있다. 따라서, 주파수 유닛은 26톤, 52톤, 106톤, 242톤, 484톤 또는 996톤 자원 유닛에 해당할 수 있다. 이하에선 설명의 편의를 위해 주파수 유닛이 26톤 자원 유닛인 경우를 기준으로 설명한다.

[573] 주파수 유닛은 소정의 개수씩 AID 필드에 포함된 STA AID 순서대로 순차적으로 할당될 수 있으며, 각 STA에 할당되는 주파수 유닛의 할당 개수는 아래에서 제안되는 방법에 의해 결정될 수 있다.

[574] 1. STA 수만큼 나눠서 할당하는 방법

[575] AP는 피드백 프레임의 UL MU 전송을 위해 STA들에게 할당할 수 있는 전체 주파수 유닛들을 STA 수로 나눈 개수의 주파수 유닛들을 각 STA에 할당할 수 있다. 즉, (전체 주파수 유닛 개수/STA 수 = x, x는 자연수)인 경우, AP는 x개의 주파수 유닛을 각 STA에게 할당할 수 있다. 전체 할당 가능한 주파수 유닛 개수가 STA 수로 나눠 떨어지지 않을 경우에는 중간에 위치한 주파수 유닛을 어느 STA에도 할당하지 않고 비워두거나, 특정 STA에 몰아서 할당해줄 수 있다. 예를 들어, AP는 특정 STA에는 전체 할당 가능한 주파수 유닛들을 STA 수로 나눈 수를 올림(즉, (ceiling(x) = y))한 수(y)만큼 주파수 유닛을 할당할 수 있으며, 나머지 STA에는 내림(즉, (floor(x) = z))한 수(z)만큼 주파수 유닛을 할당할 수 있다.

[576] 이렇듯, 할당 개수가 결정된 주파수 유닛들은 주파수 도메인에서 순차적으로 각 STA에 할당될 수 있다. 예를 들어, STA 1~3 각각에 피드백 프레임 전송을 위한 26톤 자원 유닛이 3개씩 할당된 경우, STA 1에는 20MHz 채널에서 첫 번째~세 번째에 위치한 26톤 자원 유닛들이, STA 2에는 20MHz 채널에서 네 번째~여섯 번째에 위치한 26톤 자원 유닛들이, STA 3에는 20MHz 채널에서 일곱 번째~아홉 번째 위치한 26톤 자원 유닛들이 각각 할당될 수 있다.

[577] 따라서, 각 STA은 NDPA 프레임 또는 트리거 프레임에 포함된 AID 필드에서 자신의 AID 앞에 나열된 다른 AID에 대응되는 STA들에게 할당된 주파수 유닛의 개수를 누적하여 계산함으로써 자신에게 할당된 주파수 유닛의 위치를 알아낼 수 있다.

[578] 2. Feedback 양에 따라 할당하는 방법

[579] AP는 각 STA이 전송해야 할 피드백 정보량을 기초로 각 STA에 할당하는 주파수 유닛의 개수를 결정할 수 있다. 보다 상세하게는, AP는 각 STA이 전송해야 할 피드백 정보량(또는 채널 상태 정보량)과 비례하게 각 STA에 할당되는 주파수 유닛의 개수를 결정할 수 있다.

[580] 일 실시예로서, AP는 각 STA이 피드백해야 할 공간 스트림 개수를 기초로 각 STA에 할당하는 주파수 유닛의 개수를 결정할 수 있다. 보다 상세하게는, AP는 각 STA이 피드백해야 할 공간 스트림 개수와 비례하게 각 STA에 할당되는 주파수 유닛의 개수를 결정할 수 있다. 예를 들어, AP는 STA 1에게 1개의 공간 스트림에 대한 채널 상태를, STA 2에게 8개의 공간 스트림에 대한 채널 상태를

피드백할 것을 지시할 수 있다. 이 경우, STA 1은 1개의 공간 스트림에 대한 채널 상태 정보를, STA 2는 8개의 공간 스트림에 대한 채널 상태 정보를 UL MU 전송해야 하므로, STA 2가 전송해야 할 피드백 정보량은 STA 1보다 많을 수 있다. 따라서, AP는 STA 1에는 1개의 주파수 유닛을, STA 2에는 8개의 주파수 유닛을 각각 할당할 수 있다.

[581] 다른 실시예로서, AP는 각 STA이 피드백 값을 생성하는 피드백 단위를 기초로 각 STA에 할당하는 주파수 유닛의 개수를 결정할 수 있다. 보다 상세하게는, AP는 각 STA이 피드백 값을 생성하게 되는 피드백 단위에 반비례하게 각 STA에 할당되는 주파수 유닛의 개수를 결정할 수 있다. 여기서 피드백 값은 MCS 레벨 또는 공간 스트림에 대한 기설정된 피드백 단위의 SNR(Signal to Noise Ratio) 또는 빔포밍 피드백 행렬(또는 빔포밍 피드백 벡터)을 포함할 수 있으며, 빔포밍 방법이 변경된다면 변경된 빔포밍 방법에 대한 빔포밍 피드백 값을 모두 포함할 수 있다.

[582] STA이 피드백 값을 생성해야 하는 피드백 단위가 커질수록 피드백 해야 하는 정보량은 줄어들고, 피드백 단위가 작을수록 피드백 해야 하는 정보량은 늘어난다. 예를 들어, STA이 피드백 값을 생성해야 하는 피드백 단위가 26톤인 경우를 가정해볼 수 있다. 이 경우, STA은 26톤마다 하나의 피드백 값을 생성(또는 획득)해야 하며, 20MHz 채널에 대해 피드백하려면 STA은 총 9개의 피드백 값을 생성(또는 획득)하여 채널 상태 정보로서 AP로 전송해야 한다. 반대로, STA이 피드백 값을 생성해야 하는 피드백 단위가 20MHz 채널인 경우를 가정해볼 수 있다. 이 경우, STA은 20MHz 채널에 대한 총 1개의 피드백 값을 생성(또는 획득)하여 채널 상태 정보로서 AP로 전송해야 한다. 즉, STA이 피드백해야 하는(또는 피드백 값을 생성해야 하는) 피드백 단위가 클수록 피드백 정보량(또는 채널 상태 정보량)은 적으므로, AP는 피드백 생성 피드백 단위가 26톤인 경우에 20MHz 채널인 경우보다 더 많은 주파수 유닛을 할당한다.

[583] 다른 실시예로서, STA들은 UL MU 피드백 프레임의 길이를 AP로부터 지시받아 알기 때문에, 자신이 전송해야 할 피드백 정보(또는 채널 상태 정보)를 지시 받은 UL MU 피드백 프레임 길이에 맞춰 전송하기 위해 필요한 주파수 유닛의 개수를 직접 계산할 수 있다. 또한, STA은 자신에게 할당된 주파수 유닛의 개수뿐만 아니라 AID 필드에서 자신의 AID 앞에 나열된 AID(들)과 대응되는 다른 STA(들)에 할당된 주파수 유닛의 개수도 누적하여 계산해서 자신에게 할당된 주파수 유닛의 위치를 알아낼 수 있다.

[584] 3. AP가 직접 할당해주는 방법

[585] AP가 직접 각 STA에 적어도 하나의 주파수 유닛을 할당하고, 주파수 유닛의 할당 정보(또는 자원 할당 정보)를 트리거 프레임을 통해 각 STA에 전송해줄 수 있다. 이때, 주파수 유닛의 할당 정보는 다양한 실시예로서 시그널링될 수 있다.

[586] 일 실시예로서, 자원 할당 정보는 비트 값으로 STA에 할당된 주파수 유닛의 개수를 지시하도록 시그널링될 수 있다. 예를 들어, 20MHz 채널의 9개의 26톤

자원 유닛들이 주파수 유닛으로서 각 STA에 할당된 경우, 자원 할당 정보는 3bits의 비트 사이즈로 구성될 수 있다. 이 경우, 자원 할당 정보의 비트 값 '000'부터 '111'은 각각 1/2/3/4/5/6/7/9개의 주파수 유닛(또는 26톤 자원 유닛)의 할당을 지시할 수 있다. 즉, '000'인 자원 할당 정보를 수신한 STA은 자신에게 할당된 주파수 유닛(또는 26톤 자원 유닛)이 1개임을 인식하고, 이를 이용하여 피드백 프레임을 UL MU 전송할 수 있다.

[587] 다른 실시예로서, 주파수 유닛의 할당 정보는 토글링 방식으로 STA에 할당된 주파수 유닛의 개수를 지시하도록 시그널링될 수 있다. 예를 들어, 20MHz 채널의 9개의 26톤 자원 유닛들이 주파수 유닛으로서 각 STA에 할당된 경우, 자원 할당 정보는 9개의 26톤 자원 유닛들과 순차적으로 대응되는 9bits로 구성될 수 있다. 이 경우, 자원 할당 정보를 구성하는 복수의 비트들 각각의 비트 값은, 각 비트와 대응되는 자원 유닛이 할당되는 STA이 다른 STA으로 변경됨에 따라 이전 비트의 비트 값과 다른 비트 값으로 스위칭될 수 있다. 예를 들어, '000110011'인 자원 할당 정보는, AID 필드에 포함된 STA 순서대로 각각 3/2/2/2개의 주파수 유닛들이 할당되었음을 지시할 수 있다.

[588] 4. AP가 주파수 유닛의 인덱스를 지시하는 방법

[589] 상술한 실시예들에서 각 STA은 자신에게 할당된 주파수 유닛의 채널 상의 위치는 AID 필드를 통해 자신의 AID 앞에 나열된 AID와 대응되는 다른 STA들에게 할당된 주파수 유닛의 개수를 누적하여 계산함으로써 직접 획득(또는 계산)할 수 있다. 그러나, 이러한 정보도 AP가 직접 트리거 정보로서 각 STA에게 explicit하게 지시해줄 수도 있다. 이 경우, 채널에 존재하는 주파수 유닛(또는 자원 유닛)들 각각에는 위치 별로 서로 다른 인덱스가 할당될 수 있으며, AP는 이러한 인덱스를 STA에게 전송해줌으로써 각 STA에 할당된 주파수 유닛의 위치를 지시할 수 있다.

[590] AP가 각 STA에게 주파수 채널 상에서 연속적으로 위치하는 주파수 유닛들을 할당한다고 가정할 때, AP는 STA에게 연속적으로 할당된 주파수 유닛들 중 시작점(또는 최좌측또는 최우측)에 위치한 주파수 유닛의 인덱스만을 알려줄 수 있다. 이 경우, 상술한 실시예들을 따를 때, 각 STA은 자신에게 할당된 주파수 유닛의 개수를 알 수 있으므로, 시작점으로부터 자신에게 할당된 주파수 유닛의 개수만큼 카운팅하여 자신에게 할당된 주파수 유닛을 알 수 있다.

[591] 또는, 각 STA은 상술한 실시예를 적용하지 않고, 자신에게 할당된 주파수 유닛의 시작점 인덱스와 다음 순서의 STA에 할당된 주파수 유닛의 시작점 인덱스를 읽음으로써 자신에게 할당된 주파수 유닛의 개수 및 위치를 알 수 있다. 또는, AP가 시작점 인덱스 대신 각 STA에 할당된 주파수 유닛들 중 끝지점(또는 마지막)에 위치한 주파수 유닛의 인덱스를 알려줄 수도 있다. 이 경우, 각 STA은 수신한 AID 필드에서 자신의 AID 이전의 AID와 대응되는 STA의 끝지점 인덱스를 추가로 읽어와 자신에게 할당된 주파수 유닛의 개수 및 위치를 알 수 있다.

[592] 이상으로, 피드백 프레임을 UL MU 전송하기 위해 각 STA에 UL MU 자원을 할당 및 지시하는 방법에 관하여 살펴보았다. 상술한 실시예들에 따라 각 STA에 피드백 프레임 전송을 위한 주파수 유닛이 할당된다. 이때, STA에 할당되는 총 주파수 유닛의 개수가 채널에 포함된 주파수 유닛의 개수보다 많아지는 경우가 발생할 수 있다. 이 경우, 일부 STA은 다음 기회에 피드백 프레임을 전송할 수 있다. 이를 위해, AP는 UL MU 피드백 프레임을 수신하고 SIFS 후에 Beamforming report poll frame 혹은 Polling/ACK 역할을 하는 트리거 프레임을 전송해줄 수 있으며, 트리거 프레임에 포함되는 정보는 다음과 같을 수 있다.

[593] - 이전 피드백한 정보들에 대한 ACK 정보

[594] - 다음 피드백할 STA들의 AID(UL MU 전송을 시작할 STA의 AID만 알려줄 수도 있다), 각 STA에 대해 re-ordering된 인덱스 정보(만약 각 STA에 할당된 주파수 유닛의 시작점 혹은 끝지점 인덱스를 알려주는 경우)

[595]

[596] **DL 채널 측정 피드백 단위 결정 방법**

[597] 본 실시예에서는 DL 채널을 측정/피드백하는 주파수 단위를 '피드백 유닛'으로 정의하고, 피드백 유닛을 결정하는 다양한 방법에 관하여 상세히 설명하기로 한다.

[598] 기존 시스템에서는 피드백 유닛이 1~4개의 서브캐리어였다. 따라서 최대 피드백 값의 전송 개수는 데이터 서브 캐리어 개수만큼으로 피드백 오버헤드가 많았다.

[599] 차세대 WLAN 시스템인 802.11ax에서는 기존 시스템보다 서브 캐리어의 개수가 더 늘어나기 때문에 기존 시스템의 방식을 유지한다면 피드백 오버헤드가 최대 4배까지 늘어날 수 있고, 인접 서브 캐리어의 채널은 비슷하다고 볼 수 있기 때문에 필요에 따라 아래의 실시예들과 같이 피드백 유닛을 설정함으로써 피드백 정보량을 줄일 수 있다.

[600] (1) UL MU PPDU의 전체 전송 대역이 하나의 피드백 유닛으로 설정될 수 있다. 이 경우, STA은 하나의 피드백 값만을 AP에 보고하게 된다.

[601] (2) 26톤 자원 유닛이 하나의 피드백 유닛으로 설정될 수 있다. 이 경우, STA은 피드백 프레임을 나르는 UL MU PPDU의 전체 전송 대역이 20MHz 대역이라면 총 9개의 피드백 값을 AP에 보고하게 된다. 이때, STA은 9개의 피드백 값들을 모두 보고하거나, AP의 지시에 의해 일부 피드백 값만을 보고할 수도 있는데, 이와 관련하여서는 이하에서 상세히 후술한다.

[602] (3) 20MHz 서브 채널이 하나의 피드백 유닛으로 설정될 수 있다. 이 경우, 예를 들어, 피드백 프레임을 나르는 UL MU PPDU의 전체 전송 대역이 80MHz 대역이라면, 각 STA은 총 4개의 피드백 값을 AP에 보고하게 된다. 이 경우에도, STA은 4개의 피드백 값들을 모두 보고하거나, AP의 지시에 의해 일부 피드백 값만을 보고할 수도 있는데, 이와 관련하여서는 이하에서 상세히 후술한다.

[603]

[604] **DL 채널 측정 방법**

[605] 기존 시스템에서는 STA은 DL/UL PPDU의 전체 전송 대역의 HE-LTF를 측정해서 피드백했으나, 차세대 WLAN 시스템인 802.11ax에서는 OFDMA 기술이 도입되었으므로, AP는 STA들에게 일부 주파수 대역만 측정하여 보고할 것을 요청할 수 있다. 즉, 차세대 WLAN 시스템에서 AP는 주파수 전대역뿐만 아니라, 일부 대역을 측정해서 보고할 것을 STA에 지시할 수 있다. 즉, STA들이 보고할 측정 대역 자원은 주파수 전대역으로 전송되는 NDP 프레임의 주파수 자원 크기보다 같거나 작게 설정될 수 있다. 특히, 전대역으로 전송되는 NDP 프레임의 주파수 자원과 동일한 크기의 자원에 대한 빔포밍 피드백 행렬을 생성하여 전송하는 경우(또는 피드백 프레임을 통해 전송하는 경우) 그 오버헤드가 적지 않기 때문에, STA들이 보고할(또는 피드백할/빔포밍 피드백 행렬을 전송할) 측정 대역 자원은 NDP 프레임의 자원 크기와 같거나, 이보다 작게 설정될 수 있다.

[606] 예를 들어, AP는 80MHz 대역 중 특정 20MHz 대역만 채널 상태를 측정하여 보고할 것을 STA에 지시할 수 있다. 혹은 피드백 유닛이 26톤 자원 유닛을 기반으로 설정된다면, AP는 특정 피드백 유닛에 대한 채널 상태를 측정하여 보고할 것을 STA에 지시할 수도 있다. 예를 들어, 피드백 유닛을 구별하기 위해 각 26톤 자원 유닛에 인덱스가 할당된다면, AP는 STA이 보고/측정할 피드백 유닛의 인덱스를 STA에 전송해줌으로써, STA이 측정할 피드백 유닛을 지시할 수 있다.

[607] 다른 실시예로는, AP는 STA이 측정한 대역 중에 채널 상태가 좋은 대역에 대해서만 피드백할 것을 지시할 수도 있다. 이 경우, STA은 채널 상태가 좋은 대역에 대한 정보와 해당 대역의 피드백 값을 함께 전송할 수 있다. 예를 들어, 20MHz 채널에서 26톤 자원 유닛 기반의 피드백 유닛이 9개 설정되었다고 할 때, AP는 9개의 피드백 유닛들 중 채널 상태가 가장 좋은 피드백 유닛에 대해서만 보고하라고 STA에 지시할 수 있다. 이 경우, STA은 채널 상태가 가장 좋은 피드백 유닛에 대한 정보(예를 들어, 해당 피드백 유닛의 인덱스 또는 위치 정보)와 해당 피드백 유닛에 대해 측정한 피드백 값을 피드백 프레임에 실어 UL MU 전송할 수 있다.

[608]

[609] 도 34는 본 발명의 일 실시예에 따른 STA 장치의 사운딩 방법을 나타낸 순서도이다. 본 순서도와 관련하여 상술한 실시예들이 동일하게 적용될 수 있다. 따라서, 이하에서는 중복되는 설명은 생략하기로 한다.

[610] 도 34를 참조하면, 우선 STA은 NDP 프레임의 전송을 알리는 NDPA 프레임을 AP로부터 수신할 수 있다(S3410). 이때, STA에 수신되는 NDPA 프레임에는 사운딩 프로토콜에 관한 다양한 제어 정보가 포함되어 있을 수 있다. 예를 들어, NDPA 프레임에는 어떤 STA이, 어떤 DL 채널을, 어떠한 방식으로 측정할지 등에 관한 피드백 지시 정보(또는 사운딩 지시 정보)가 포함되어 있을 수 있다.

[611] 다음으로, STA은 NDP 프레임을 AP로부터 수신할 수 있다(S3420). 이때, STA에 수신되는 NDP 프레임에는 STA이 측정할 대상 DL 채널에 관한 정보를 지시하는 HE-STF/LTF가 포함되어 있을 수 있다(또는, DL 채널의 사운딩(또는 DL CSI(Channel State Information))을 위한 HE-STF/LTF가 포함되어 있을 수 있다). 또한, NDP 프레임에는 STA이 채널 상태를 보고할 공간 스트림의 개수와 같거나 보다 많은 수의 HE-LTF가 포함되어 있을 수 있다.

[612] 다음으로, STA은 트리거 프레임을 AP로부터 수신할 수 있다(S3430). 이때 STA에 수신되는 트리거 프레임에는, STA들이 DL 채널에 대한 채널 상태 정보를 UL MU 전송할 수 있도록 각 STA들에 할당된 UL MU 자원에 관한 자원 할당 정보가 포함되어 있을 수 있다.

[613] 다음으로, STA은 NDP 프레임에 포함된 트레이닝 필드를 기초로 채널 상태 정보를 생성할 수 있다(S3440). 보다 상세하게는, STA은 NDP 프레임에 포함된 HE-LTF를 기초로 측정 대상 DL 채널의 상태를 측정하고, 측정 결과가 포함된 채널 상태 정보를 생성할 수 있다. 이때, 만일 AP가 일부 주파수 대역에 대해서만 피드백할 것을 지시했던 경우에는(NDPA 프레임을 통해), STA은 해당 대역에 대한 채널 상태 정보만을 생성할 수 있다.

[614] 다음으로, STA은 생성한 채널 상태 정보가 포함된 피드백 프레임을 UL MU 전송할 수 있다(S3450). 이때, STA은 S3430 단계에서 수신한 트리거 프레임에 의해 지시받은 UL MU 자원을 이용하여 상기 피드백 프레임을 UL MU 전송할 수 있다.

[615] 본 순서도에서 NDPA 프레임, NDP 프레임 및 트리거 프레임은 일정한 시간 간격(예를 들어, SIFS)으로 순차적으로 STA에 수신되는 경우를 기준으로 설명하였으나(즉, 서로 다른 DL PPDU를 통해 STA에 수신), 이에 한정되는 것은 아니며, 오버헤드를 줄이기 위해 NDPA 프레임, NDP 프레임 및 트리거 프레임은 하나의 DL PPDU에 실려 STA들에 수신될 수 있음은 앞서 상술한 바와 같다. 이 경우, AP는 각 프레임에 존재하는 동일한 정보를 중복하여 전송하지 않도록, 이를 편집하여 전송할 수 있음은 앞서 상술한 바와 같다.

[616] 도 35는 본 발명의 일 실시예에 따른 각 STA 장치의 블록도이다.

[617] 도 35에서, STA 장치(3510)는 메모리(3512), 프로세서(3511) 및 RF 유닛(3513)을 포함할 수 있다. 그리고 상술한 바와 같이 STA 장치는 HE STA 장치로서, AP 또는 non-AP STA가 될 수 있다.

[618] RF 유닛(3513)은 프로세서(3511)와 연결되어 무선 신호를 송신/수신할 수 있다. RF 유닛(3513)은 프로세서(3511)로부터 수신된 데이터를 송수신 대역으로 업컨버팅하여 신호를 전송할 수 있다.

[619] 프로세서(3511)는 RF 유닛(3513)과 연결되어 IEEE 802.11 시스템에 따른 물리 계층 및/또는 MAC 계층을 구현할 수 있다. 프로세서(3511)는 상술한 도면 및 설명에 따른 본 발명의 다양한 실시예에 따른 동작을 수행하도록 구성될 수 있다. 또한, 상술한 본 발명의 다양한 실시예에 따른 STA(3510)의 동작을

구현하는 모듈이 메모리(3512)에 저장되고, 프로세서(3511)에 의하여 실행될 수 있다.

[620] 메모리(3512)는 프로세서(3511)와 연결되어, 프로세서(3511)를 구동하기 위한 다양한 정보를 저장한다. 메모리(3512)는 프로세서(3511)의 내부에 포함되거나 또는 프로세서(3511)의 외부에 설치되어 프로세서(3511)와 공지의 수단에 의해 연결될 수 있다.

[621] 또한, STA 장치(3510)는 한 개의 안테나(single antenna) 또는 다중 안테나(multiple antenna)를 포함할 수 있다.

[622] 도 35의 STA 장치(3510)의 구체적인 구성은, 전술한 본 발명의 다양한 실시예에서 설명한 사항들이 독립적으로 적용되거나 또는 2 이상의 실시예가 동시에 적용되도록 구현될 수 있다.

[623]

[624] 이상에서 설명된 실시예들은 본 발명의 구성요소들과 특징들이 소정 형태로 결합된 것들이다. 각 구성요소 또는 특징은 별도의 명시적 언급이 없는 한 선택적인 것으로 고려되어야 한다. 각 구성요소 또는 특징은 다른 구성요소나 특징과 결합되지 않은 형태로 실시될 수 있다. 또한, 일부 구성요소들 및/또는 특징들을 결합하여 본 발명의 실시예를 구성하는 것도 가능하다. 본 발명의 실시예들에서 설명되는 동작들의 순서는 변경될 수 있다. 어느 실시예의 일부 구성이나 특징은 다른 실시예에 포함될 수 있고, 또는 다른 실시예의 대응하는 구성 또는 특징과 교체될 수 있다. 특허청구범위에서 명시적인 인용 관계가 있지 않은 청구항들을 결합하여 실시예를 구성하거나 출원 후의 보정에 의해 새로운 청구항으로 포함시킬 수 있음은 자명하다.

[625] 본 발명에 따른 실시예는 다양한 수단, 예를 들어, 하드웨어, 펌웨어(firmware), 소프트웨어 또는 그것들의 결합 등에 의해 구현될 수 있다. 하드웨어에 의한 구현의 경우, 본 발명의 일 실시예는 하나 또는 그 이상의 ASICs(application specific integrated circuits), DSPs(digital signal processors), DSPDs(digital signal processing devices), PLDs(programmable logic devices), FPGAs(field programmable gate arrays), 프로세서, 콘트롤러, 마이크로 콘트롤러, 마이크로 프로세서 등에 의해 구현될 수 있다.

[626] 펌웨어나 소프트웨어에 의한 구현의 경우, 본 발명의 일 실시예는 이상에서 설명된 기능 또는 동작들을 수행하는 모듈, 절차, 함수 등의 형태로 구현될 수 있다. 소프트웨어 코드는 메모리에 저장되어 프로세서에 의해 구동될 수 있다. 상기 메모리는 상기 프로세서 내부 또는 외부에 위치하여, 이미 공지된 다양한 수단에 의해 상기 프로세서와 데이터를 주고 받을 수 있다.

[627] 본 발명은 본 발명의 필수적 특징을 벗어나지 않는 범위에서 다른 특정한 형태로 구체화될 수 있음은 당업자에게 자명하다. 따라서, 상술한 상세한 설명은 모든 면에서 제한적으로 해석되어서는 아니 되고 예시적인 것으로 고려되어야 한다. 본 발명의 범위는 첨부된 청구항의 합리적 해석에 의해 결정되어야 하고,

본 발명의 등가적 범위 내에서의 모든 변경은 본 발명의 범위에 포함된다.

발명의 실시를 위한 형태

[628] 본 발명에 관한 모든 실시예가 발명의 실시를 위한 최선의 형태에서 설명되었다.

산업상 이용가능성

[629] 본 발명의 무선 통신 시스템에서 프레임 전송 방안은 IEEE 802.11 시스템에 적용되는 예를 중심으로 설명하였으나, IEEE 802.11 시스템 이외에도 다양한 무선 통신 시스템에 적용하는 것이 가능하다.

청구범위

[청구항 1] WLAN(Wireless LAN) 시스템에서 하향링크(DL: Downlink) 채널 상태에 관한 피드백 정보를 전송하기 위한 STA(Station)의 사운딩 방법에 있어서,
NDP(Null data packet) 프레임의 전송을 알리는 NDPA(NDP announcement) 프레임을 수신하는 단계;
상기 NDP 프레임을 수신하는 단계;
상기 STA에 할당된 자원 할당 정보가 포함된 트리거 프레임을 수신하는 단계;
상기 NDP 프레임에 포함된 트레이닝 필드를 기초로 채널 상태 정보를 생성하는 단계; 및
상기 채널 상태 정보가 포함된 피드백 프레임을 상기 자원 할당 정보가 지시하는 주파수 자원을 이용하여 상향링크(UL: Uplink) 다중 사용자(MU: Multi-User) 전송하는 단계; 를 포함하는, STA 장치의 사운딩 방법.

[청구항 2] 제 1 항에 있어서,
상기 NDPA 프레임, 상기 NDP 프레임 및 상기 트리거 프레임은, 하나의 DL PPDU에 포함되어 수신되거나 서로 다른 DL PPDU들에 각각 포함되어 수신되는, STA 장치의 사운딩 방법.

[청구항 3] 제 1 항에 있어서,
상기 NDPA 프레임, 상기 NDP 프레임 및 상기 트리거 프레임이 상기 서로 다른 DL PPPDU들에 각각 포함되어 수신되는 경우,
상기 서로 다른 DL PPDU들은 SIFS(Short interframe space) 간격으로 상기 STA에 수신되는, STA 장치의 사운딩 방법.

[청구항 4] 제 1 항에 있어서,
상기 자원 할당 정보는 상기 피드백 프레임을 UL MU 전송하기 위해 상기 STA에 할당된 자원 유닛의 개수를 지시하는, STA 장치의 사운딩 방법.

[청구항 5] 제 4 항에 있어서,
상기 자원 유닛은 26개의 서브 캐리어들로 구성된 26톤 자원 유닛인, STA 장치의 사운딩 방법.

[청구항 6] 제 4 항에 있어서,
상기 자원 할당 정보의 비트 값은 상기 STA에 할당된 자원 유닛의 개수를 지시하는, STA 장치의 사운딩 방법.

[청구항 7] 제 4 항에 있어서,
상기 자원 할당 정보는 상기 피드백 프레임의 UL MU 전송을 위해 할당되는 자원 유닛들과 순차적으로 대응되는 복수의 비트들을 포함하며,
상기 복수의 비트들 각각의 비트 값은, 각 비트와 대응되는 자원 유닛이

할당되는 STA이 다른 STA으로 변경됨에 따라 이전 비트의 비트 값과 다른 비트 값으로 스위칭되는, STA 장치의 사운딩 방법.

[청구항 8] 제 4 항에 있어서,
상기 피드백 프레임의 UL MU 전송을 위해 할당되는 자원 유닛들에 각각 서로 다른 인덱스가 할당되는 경우,
상기 자원 할당 정보는 상기 STA에 할당된 자원 유닛의 인덱스 정보를 포함하는, STA 장치의 사운딩 방법.

[청구항 9] 제 1 항에 있어서,
상기 채널 상태 정보는 공간 스트림에 대해 기설정된 주파수 단위로 생성한 피드백 값을 포함하며,
상기 피드백 값은 상기 공간 스트림에 대한 상기 기설정된 주파수 단위의 SNR(Signal to Noise Ratio) 또는 빔포밍 피드백 행렬인, STA 장치의 사운딩 방법.

[청구항 10] 제 9 항에 있어서,
상기 기설정된 주파수 단위는 상기 NDP 프레임을 나르는 DL PPDU의 전체 전송 채널인, STA 장치의 사운딩 방법.

[청구항 11] 제 9 항에 있어서,
상기 기설정된 주파수 단위는 26톤 자원 유닛 또는 20MHz 채널인, STA 장치의 사운딩 방법.

[청구항 12] 제 1 항에 있어서,
상기 NDPA 프레임은 상기 STA이 측정해야 할 주파수 대역의 지시 정보를 포함하는, STA 장치의 사운딩 방법.

[청구항 13] 제 12 항에 있어서,
상기 채널 상태 정보를 생성하는 단계는,
상기 지시 정보가 지시하는 상기 주파수 대역에 대한 상기 채널 상태 정보를 생성하는 단계인, STA 장치의 사운딩 방법.

[청구항 14] 제 1 항에 있어서,
상기 채널 상태를 측정하는 단계는, 소정의 크기의 주파수 대역에 대한 상기 채널 상태 정보를 생성하는 단계이고,
상기 소정의 크기는 상기 NDP 프레임이 전송되는 데 사용되는 주파수 대역의 크기와 같거나 작은, STA 장치의 사운딩 방법.

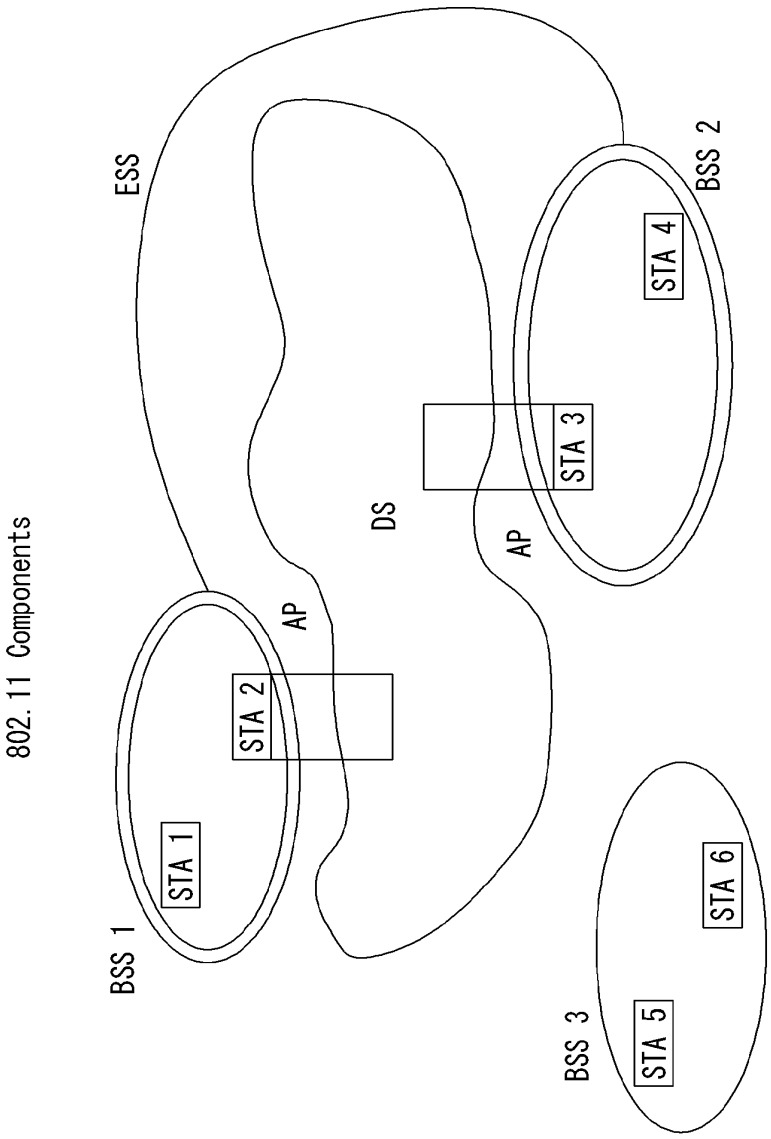
[청구항 15] 제 14 항에 있어서,
상기 생성된 채널 상태 정보는 상기 소정의 크기의 주파수 대역에 대한 빔포밍 피드백 행렬 정보인, STA 장치의 사운딩 방법.

[청구항 16] 제 1 항에 있어서,
상기 NDP 프레임의 상기 트레이닝 필드는 HE-LTF(High Efficiency-Long Training Field)인, STA 장치의 사운딩 방법.

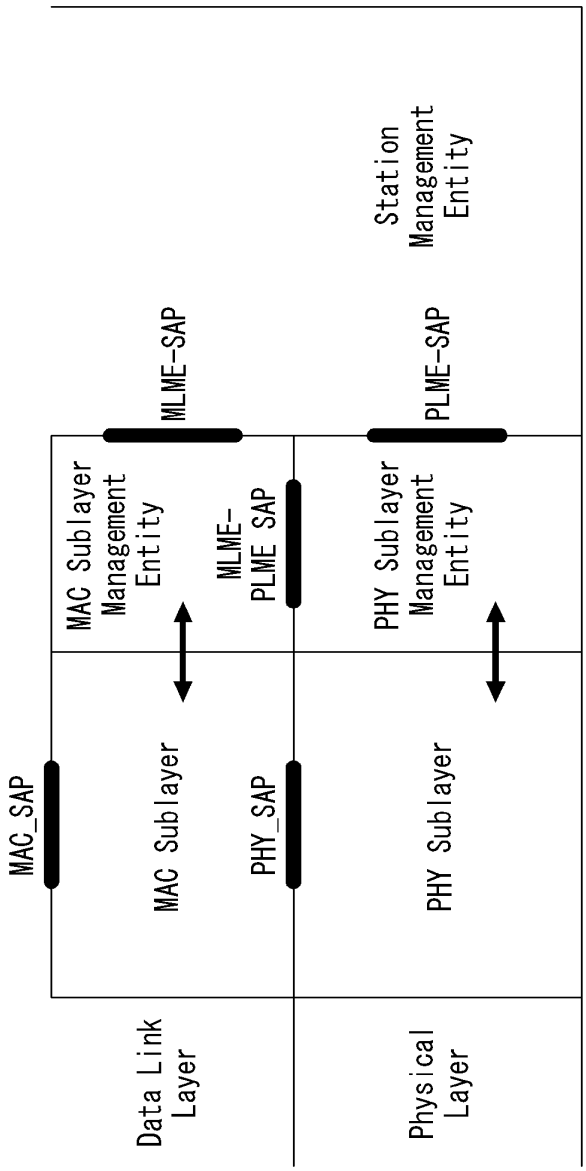
[청구항 17] WLAN(Wireless LAN) 시스템에서 STA(Station) 장치에 있어서,

무선 신호를 송수신하는, RF 유닛; 및
상기 RF 유닛을 제어하는, 프로세서; 를 포함하고,
상기 프로세서는,
NDP(Null data packet) 프레임의 전송을 알리는 NDPA(NDP announcement) 프레임을 수신하고,
상기 NDP 프레임을 수신하고,
상기 STA에 할당된 자원 할당 정보가 포함된 트리거 프레임을 수신하고,
상기 NDP 프레임에 포함된 트레이닝 필드를 기초로 채널 상태 정보를 생성하고, 및
상기 채널 상태 정보가 포함된 피드백 프레임을 상기 자원 할당 정보가 지시하는 주파수 자원을 이용하여 상향링크(UL: Uplink) 다중 사용자(MU: Multi-User) 전송하는, STA 장치.

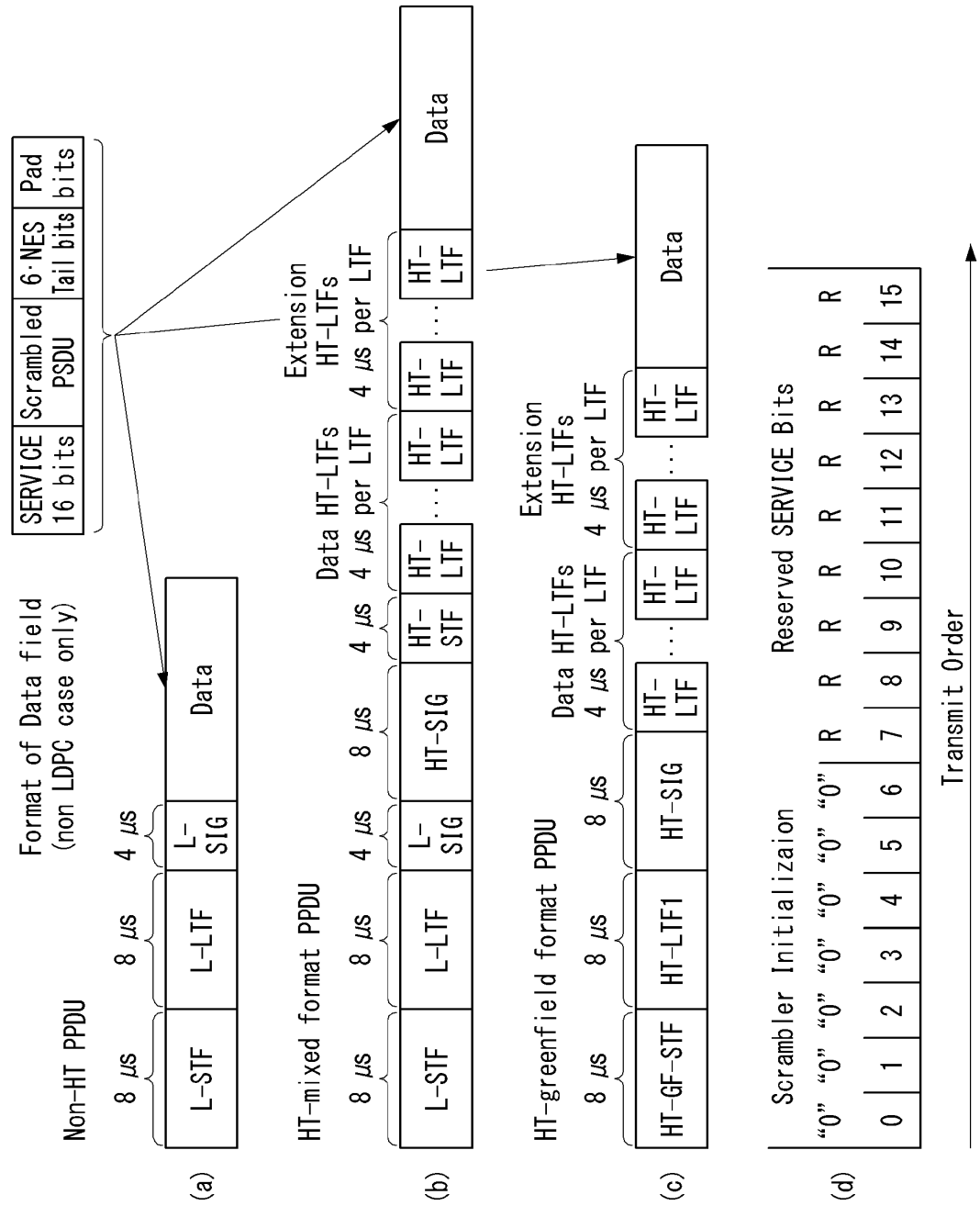
[도1]


802.11 Components
ESS
BSS 1
BSS 2
BSS 3
AP
AP
DS
STA 1
STA 2
STA 3
STA 4
STA 5
STA 6

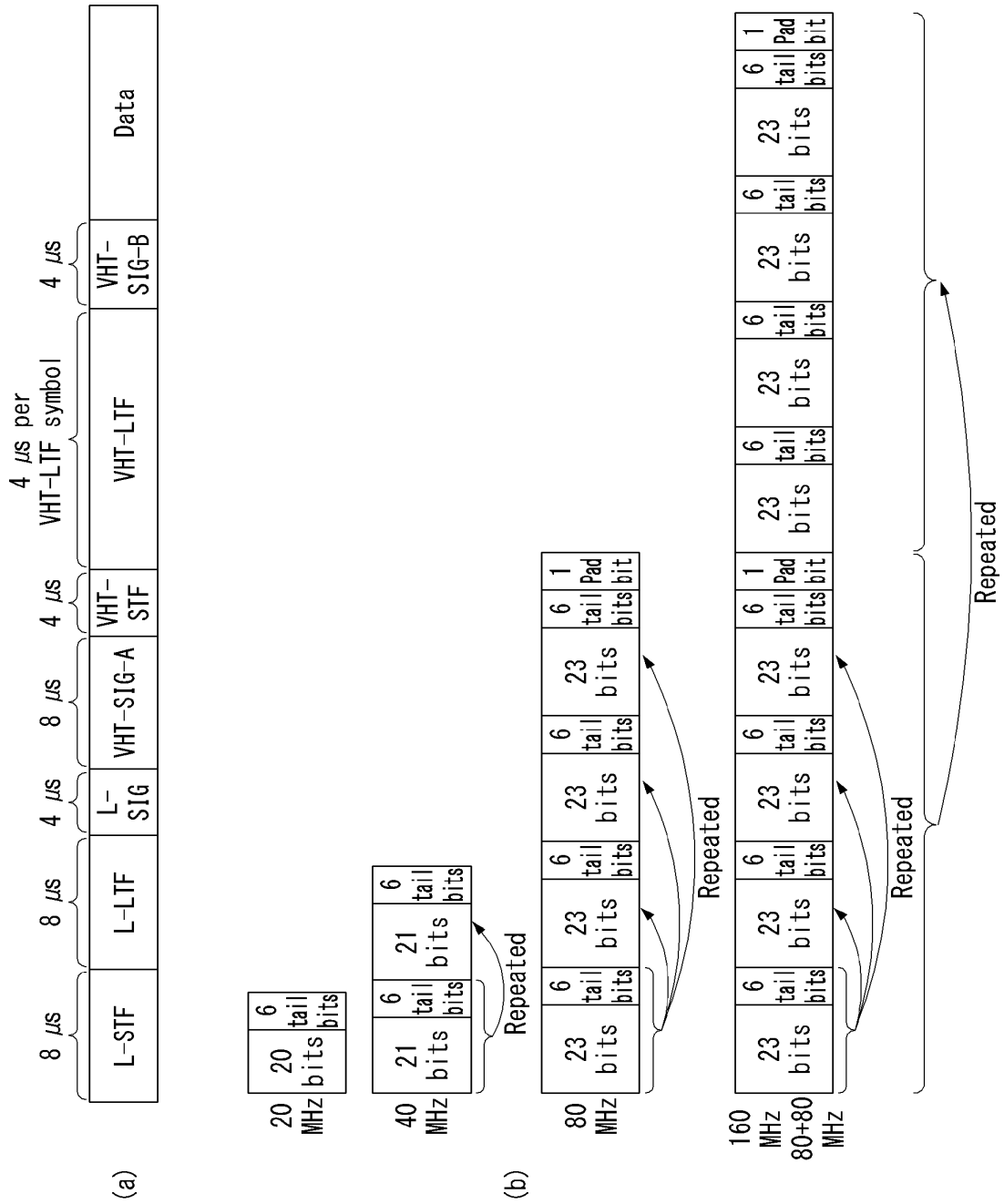
[도2]


Station Management Entity
MLME-SAP
PLME-SAP
MAC Sublayer Management Entity
MLME-PLME SAP
PHY Sublayer Management Entity
MAC_SAP
MAC Sublayer
PHY_SAP
PHY Sublayer
Data Link Layer
Physical Layer

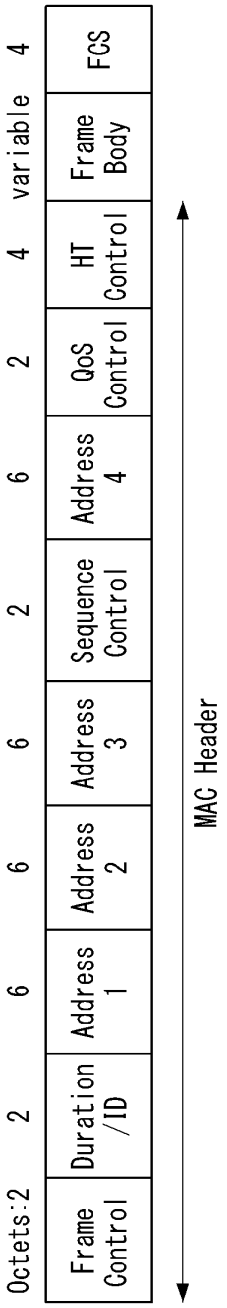
[도3]


Format of Data field
(non LDPC case only)
SERVICE
16 bits
Scrambled
PSDU
6·NES
Tail bits
Pad
bits
Non-HT PPDU
8 μs
8 μs
4 μs
L-STF
L-LTF
L-SIG
Data
(a)
HT-mixed format PPDU
8 μs
8 μs
4 μs
8 μs
4 μs
L-STF
L-LTF
L-SIG
HT-SIG
HT-STF
HT-LTF
...
HT-LTF
Data HT-LTFs
4 μs per LTF
Extension
HT-LTFs
4 μs per LTF
HT-LTF
...
HT-LTF
Data
(b)
HT-greenfield format PPDU
8 μs
8 μs
8 μs
HT-GF-STF
HT-LTF1
HT-SIG
HT-LTF
...
HT-LTF
Data HT-LTFs
4 μs per LTF
Extension
HT-LTFs
4 μs per LTF
HT-LTF
...
HT-LTF
Data
(c)
Scrambler Initializaion
Reserved SERVICE Bits
"0" "0" "0" "0" "0" "0" "0"
R R R R R R R R R
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Transmit Order
(d)

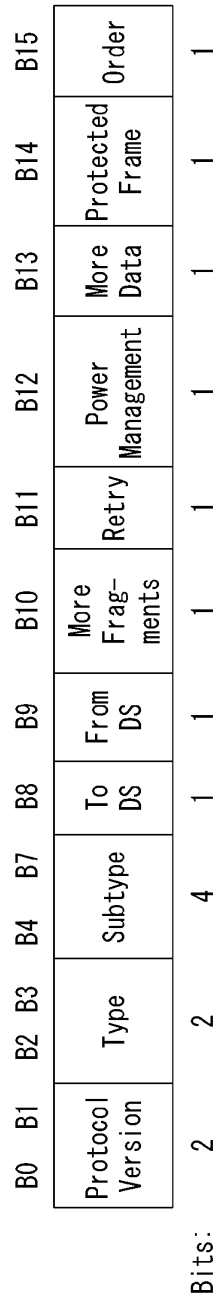
[도4]


(a)
8 μs
L-STF
8 μs
L-LTF
4 μs
L-SIG
8 μs
VHT-SIG-A
4 μs
VHT-STF
4 μs per VHT-LTF symbol
VHT-LTF
4 μs
VHT-SIG-B
Data
20 MHz
20 bits
6 tail bits
40 MHz
21 bits
6 tail bits
21 bits
6 tail bits
Repeated
(b)
80 MHz
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
1 Pad bit
Repeated
160 MHz
80+80 MHz
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
1 Pad bit
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
1 Pad bit
Repeated
Repeated

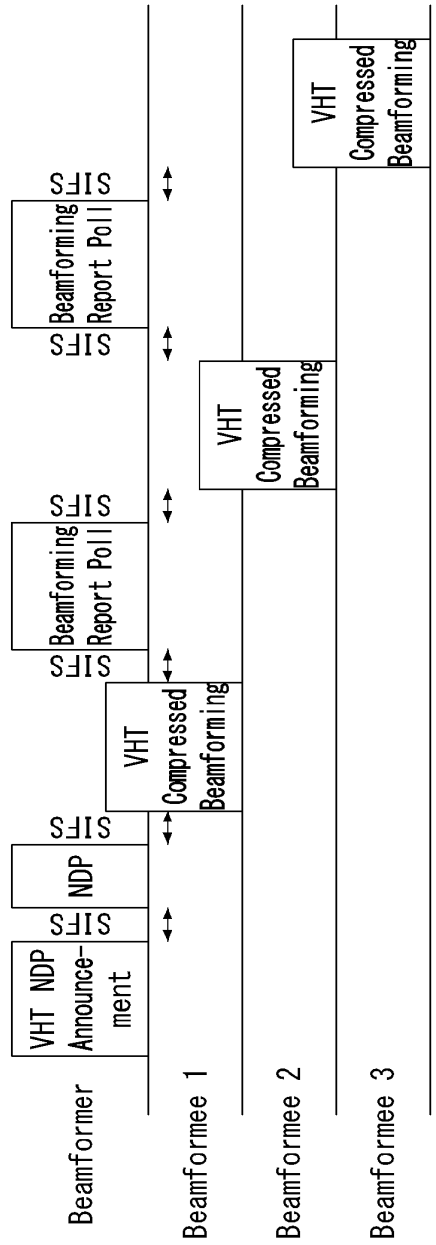
[도5]


Octets:2
2
6
6
6
2
6
2
4
variable
4
Frame Control
Duration /ID
Address 1
Address 2
Address 3
Sequence Control
Address 4
QoS Control
HT Control
Frame Body
FCS
MAC Header

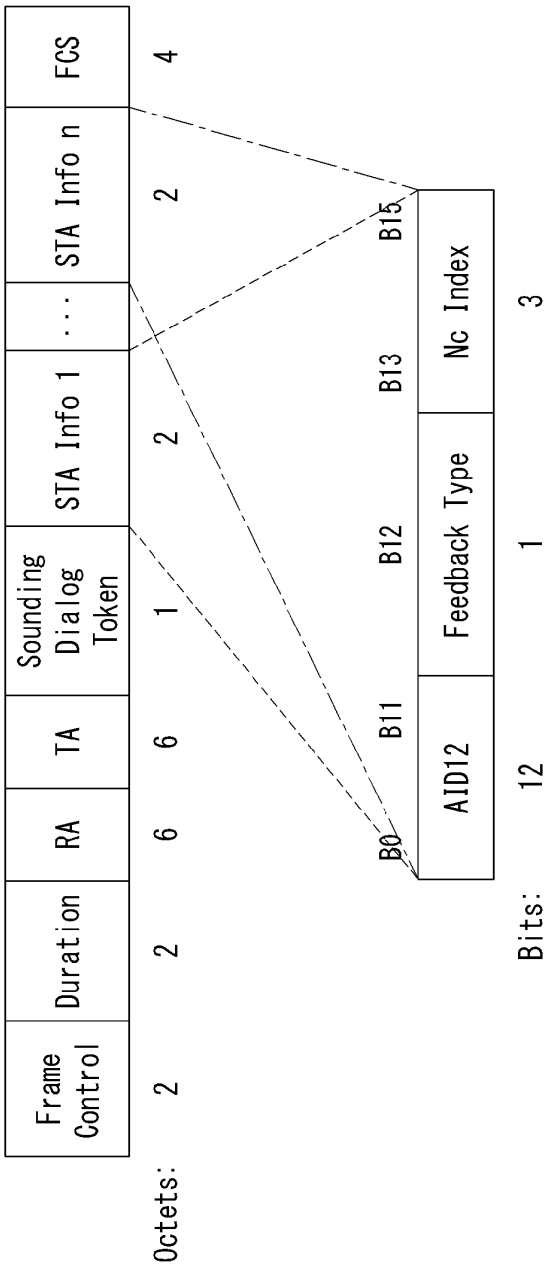
[도6]


B0 B1 B2 B3 B4 B7 B8 B9 B10 B11 B12 B13 B14 B15
Protocol Version
Type
Subtype
To DS
From DS
More Frag- ments
Retry
Power Management
More Data
Protected Frame
Order
Bits: 2 2 4 1 1 1 1 1 1 1 1

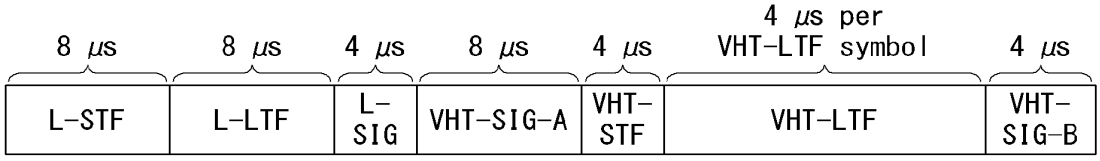
[도7]


Beamformer
Beamformee 1
Beamformee 2
Beamformee 3
VHT NDP Announce-ment
SIFS
NDP
SIFS
VHT Compressed Beamforming
SIFS
Beamforming Report Poll
SIFS
VHT Compressed Beamforming
SIFS
Beamforming Report Poll
SIFS
VHT Compressed Beamforming

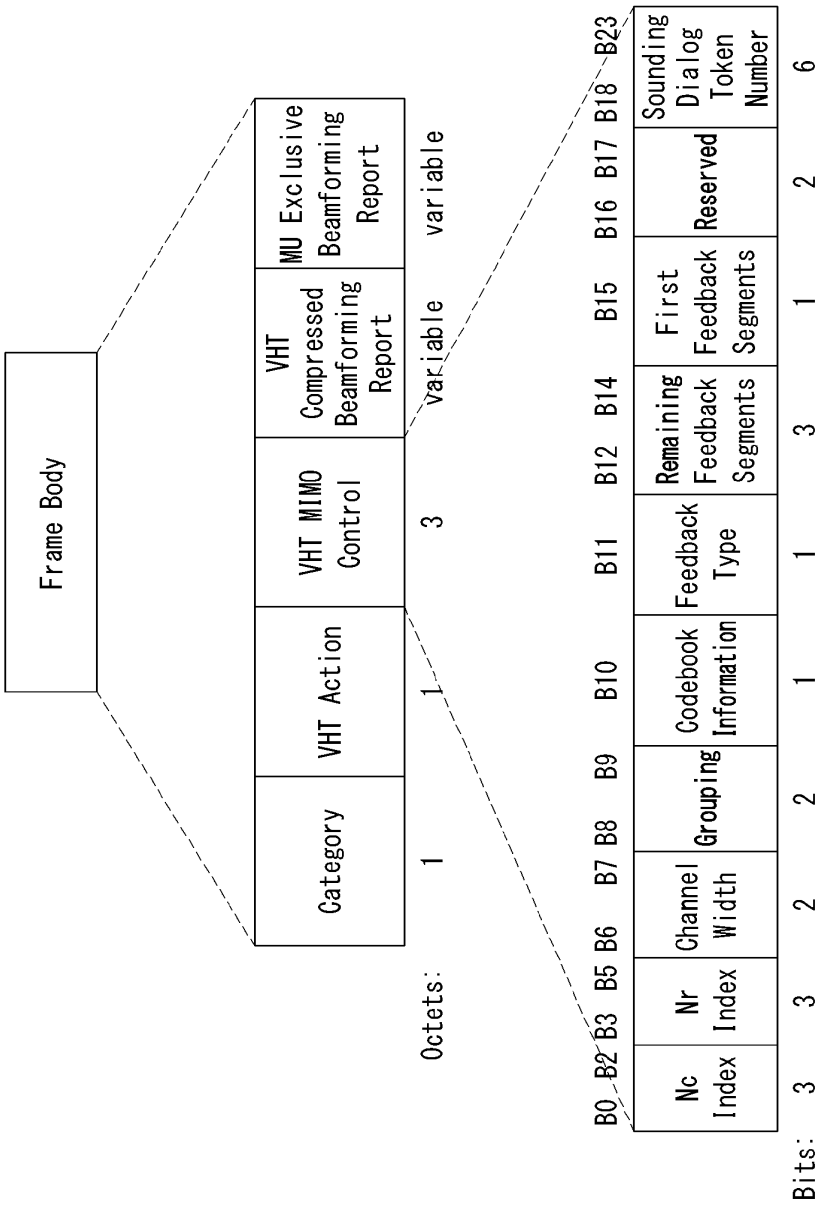
[도8]


Frame Control
Duration
RA
TA
Sounding Dialog Token
STA Info 1
...
STA Info n
FCS
Octets: 2 2 6 6 1 2 2 4
B0
B11
B12
B13
B15
AID12
Feedback Type
Nc Index
Bits: 12 1 3

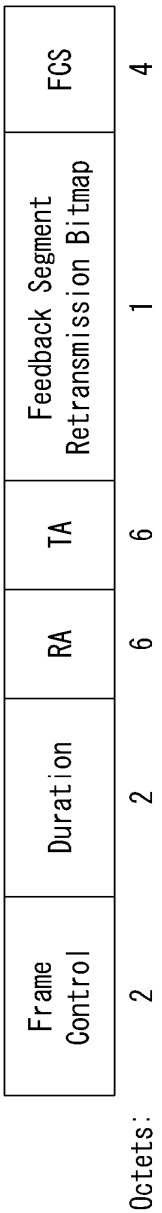
[도9]


8 μs
8 μs
4 μs
8 μs
4 μs
4 μs per VHT-LTF symbol
4 μs
L-STF
L-LTF
L-SIG
VHT-SIG-A
VHT-STF
VHT-LTF
VHT-SIG-B

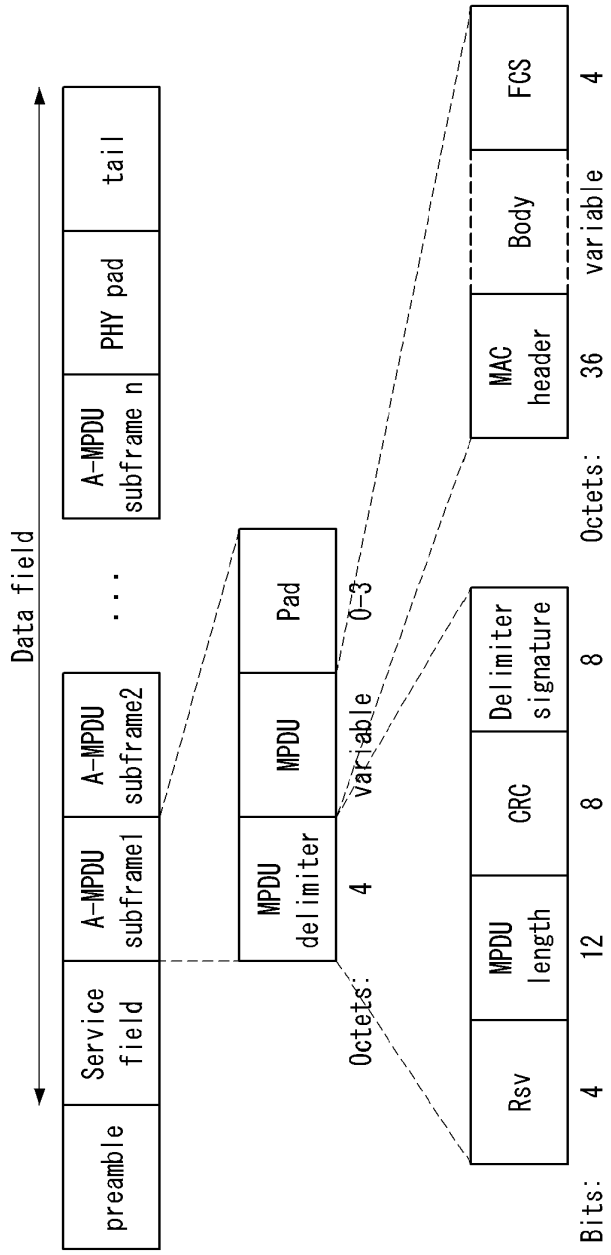
[도10]


Frame Body
Category
VHT Action
VHT MIMO Control
VHT Compressed Beamforming Report
MU Exclusive Beamforming Report
Octets: 1 1 3 variable variable
B0 B2 B3 B5 B6 B7 B8 B9 B10 B11 B12 B14 B15 B16 B17 B18 B23
Nc Index
Nr Index
Channel Width
Grouping
Codebook Information
Feedback Type
Remaining Feedback Segments
First Feedback Segments
Reserved
Sounding Dialog Token Number
Bits: 3 3 2 2 1 1 3 1 2 6

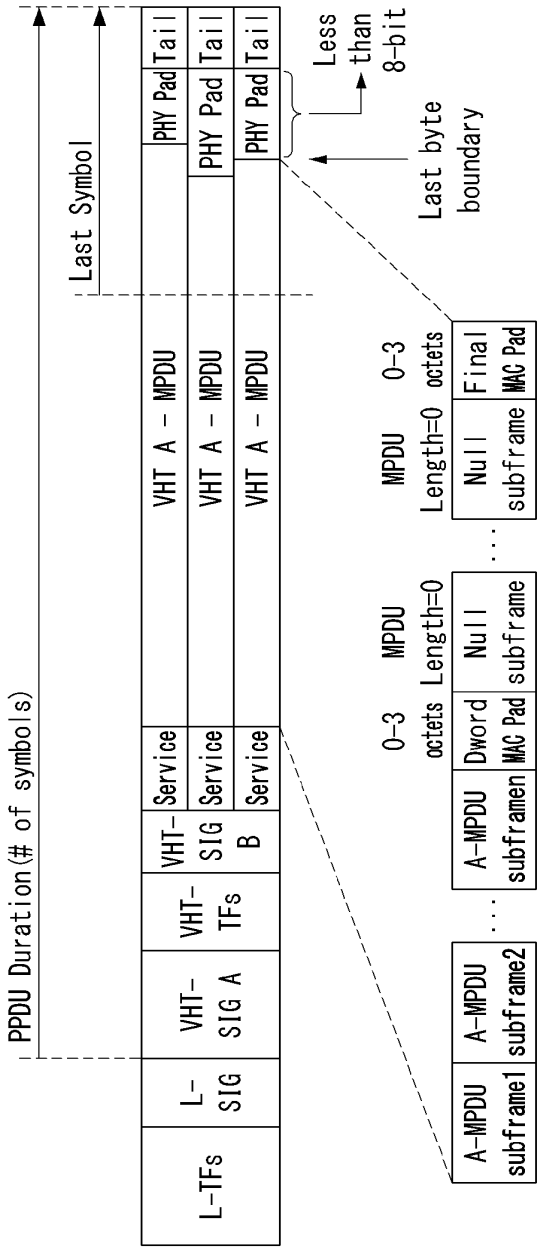
[도11]


Frame Control
Duration
RA
TA
Feedback Segment Retransmission Bitmap
FCS
Octets:
2
2
6
6
1
4

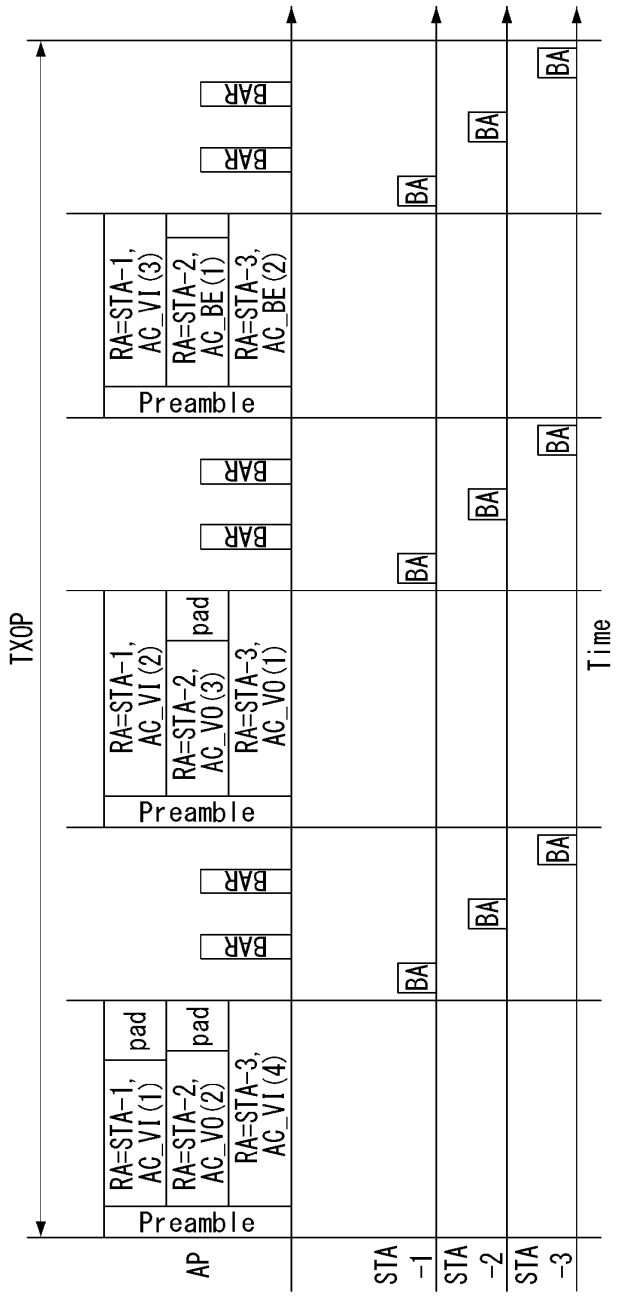
[도12]


Data field
preamble
Service field
A-MPDU subframe1
A-MPDU subframe2
...
A-MPDU subframe n
PHY pad
tail
MPDU delimiter
MPDU
Pad
Octets:
4
variable
0-3
Rsv
MPDU length
CRC
Delimiter signature
Bits:
4
12
8
8
MAC header
Body
FCS
Octets:
36
variable
4

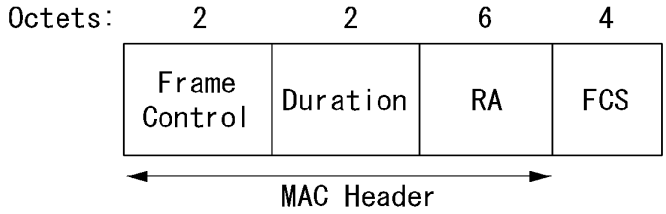
[도13]


PPDU Duration(# of symbols)
Last Symbol
L-TFs
L-SIG
VHT-SIG A
VHT-TFs
VHT-SIG B
Service
VHT A - MPDU
PHY Pad
Tail
Less than 8-bit
Last byte boundary
A-MPDU subframe1
A-MPDU subframe2
A-MPDU subframen
0-3 octets
Dword MAC Pad
MPDU Length=0
Null subframe
MPDU Length=0
0-3 octets
Final MAC Pad

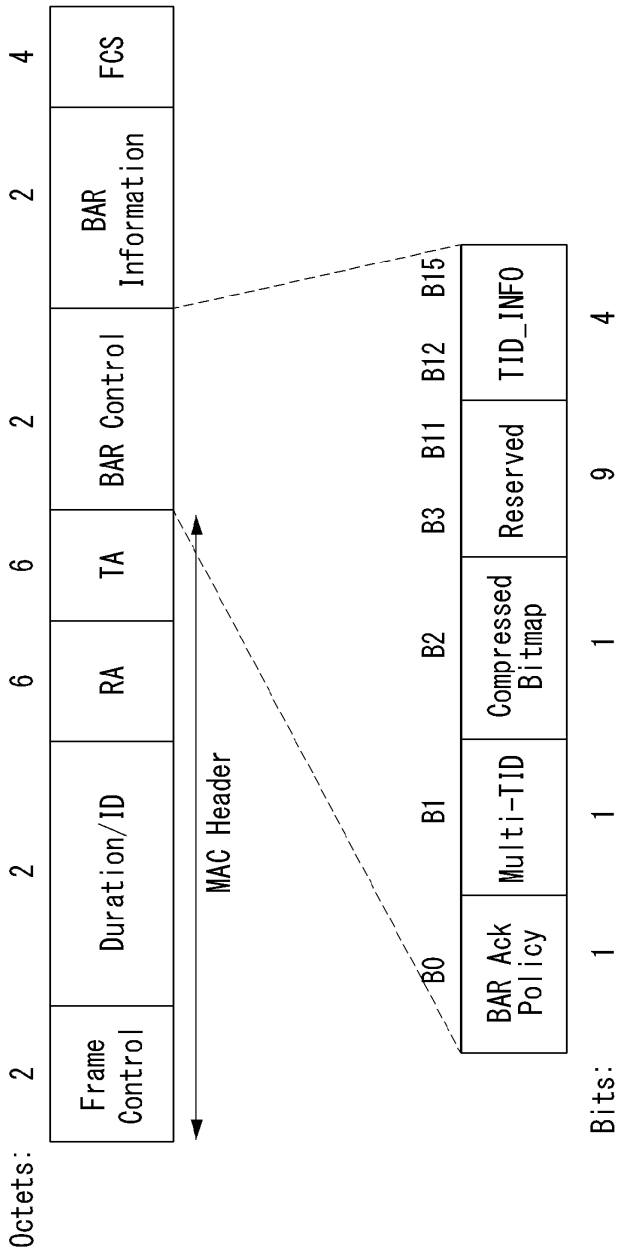
[도14]


TXOP
Time
AP
STA -1
STA -2
STA -3
Preamble
RA=STA-1, AC_VI(1)
pad
RA=STA-2, AC_VO(2)
pad
RA=STA-3, AC_VI(4)
BAR
BA
Preamble
RA=STA-1, AC_VI(2)
pad
RA=STA-2, AC_VO(3)
RA=STA-3, AC_VO(1)
Preamble
RA=STA-1, AC_VI(3)
RA=STA-2, AC_BE(1)
RA=STA-3, AC_BE(2)

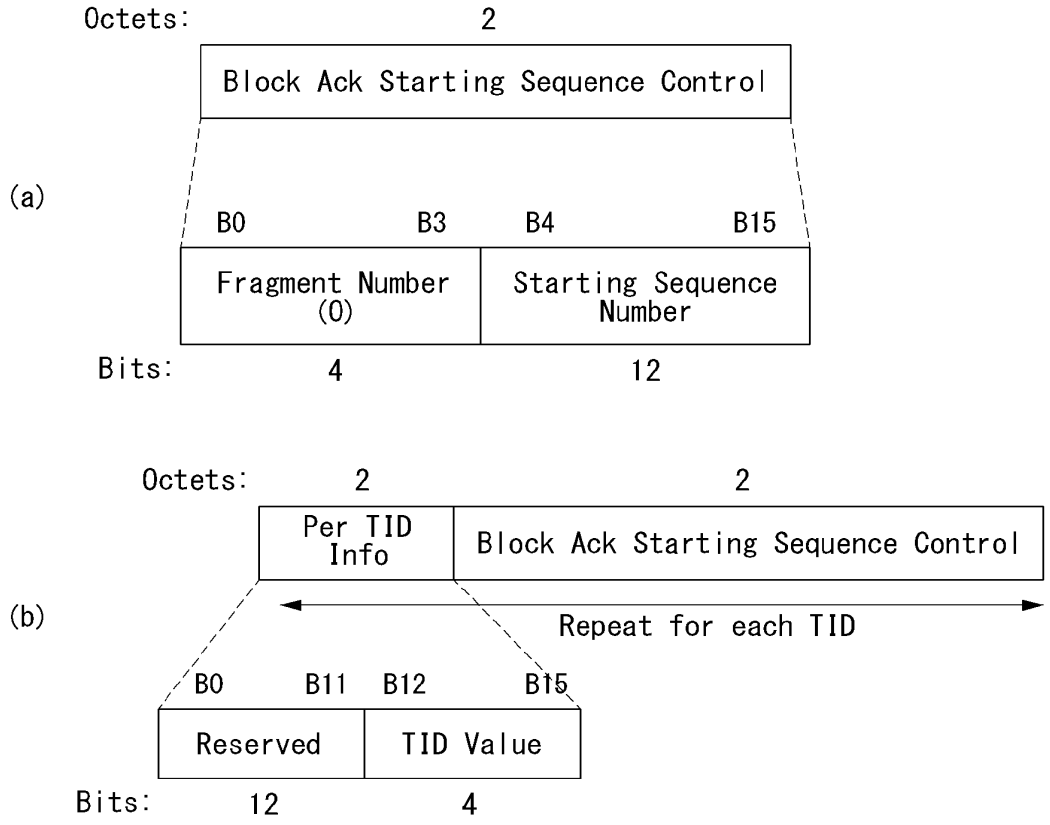
[도15]


Octets:
2
2
6
4
Frame Control
Duration
RA
FCS
MAC Header

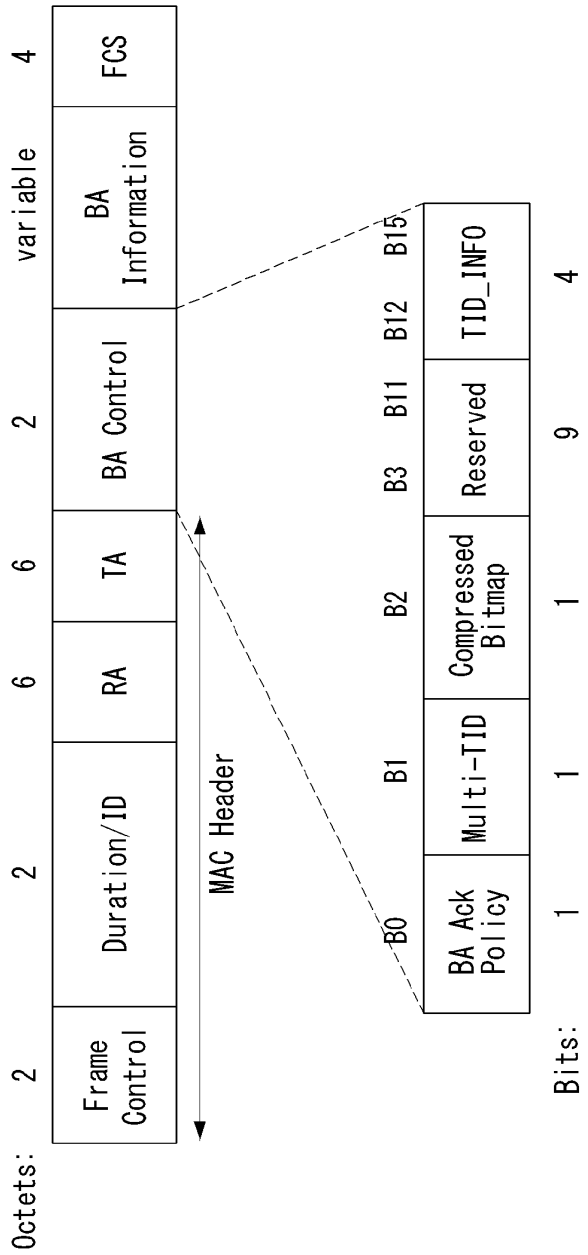
[도16]


Octets:
2
2
6
6
6
2
2
4
Frame Control
Duration/ID
RA
TA
BAR Control
BAR Information
FCS
MAC Header
Bits:
1
1
1
1
9
4
B0
B1
B2
B3
B11
B12
B15
BAR Ack Policy
Multi-TID
Compressed Bitmap
Reserved
TID_INFO

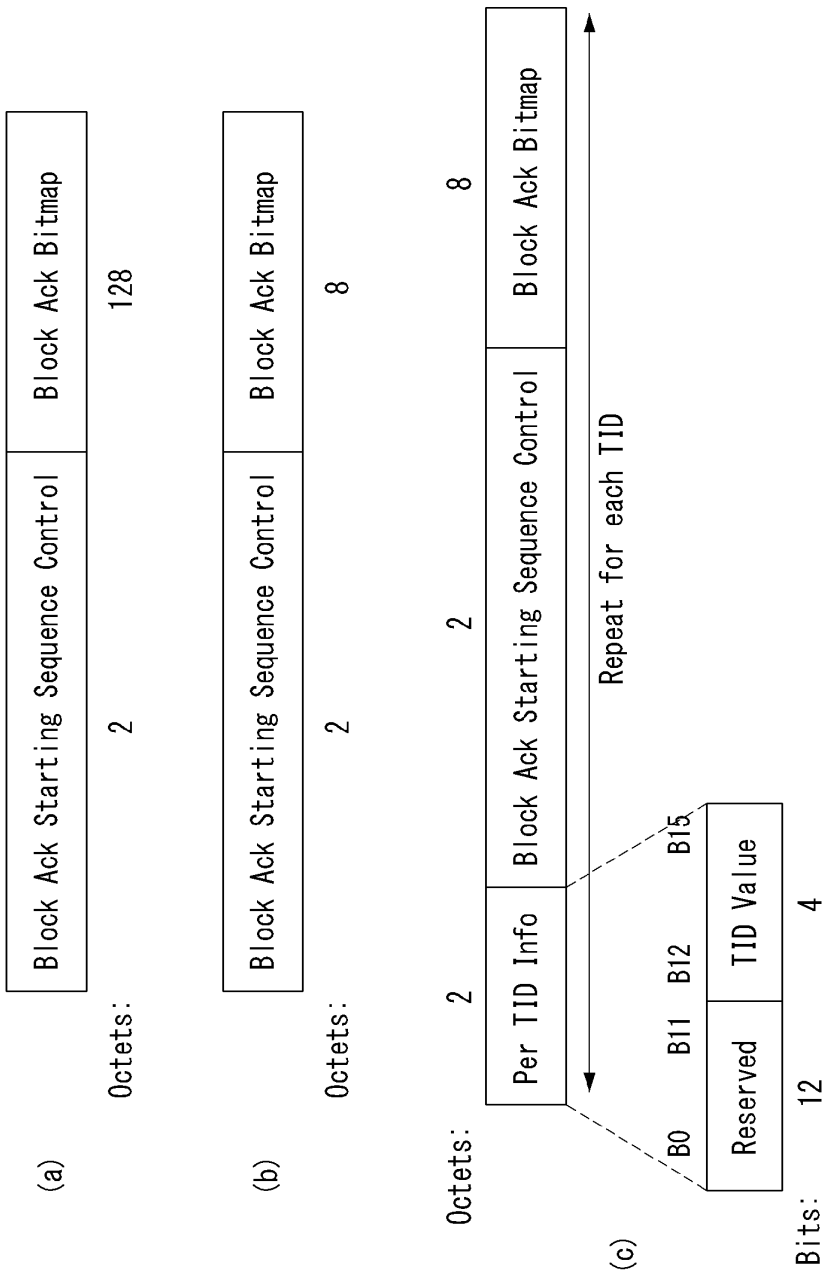
[도17]


Octets:
2
Block Ack Starting Sequence Control
(a)
B0
B3
B4
B15
Fragment Number (0)
Starting Sequence Number
Bits:
4
12
Octets:
2
2
Per TID Info
Block Ack Starting Sequence Control
(b)
Repeat for each TID
B0
B11
B12
B15
Reserved
TID Value
Bits:
12
4

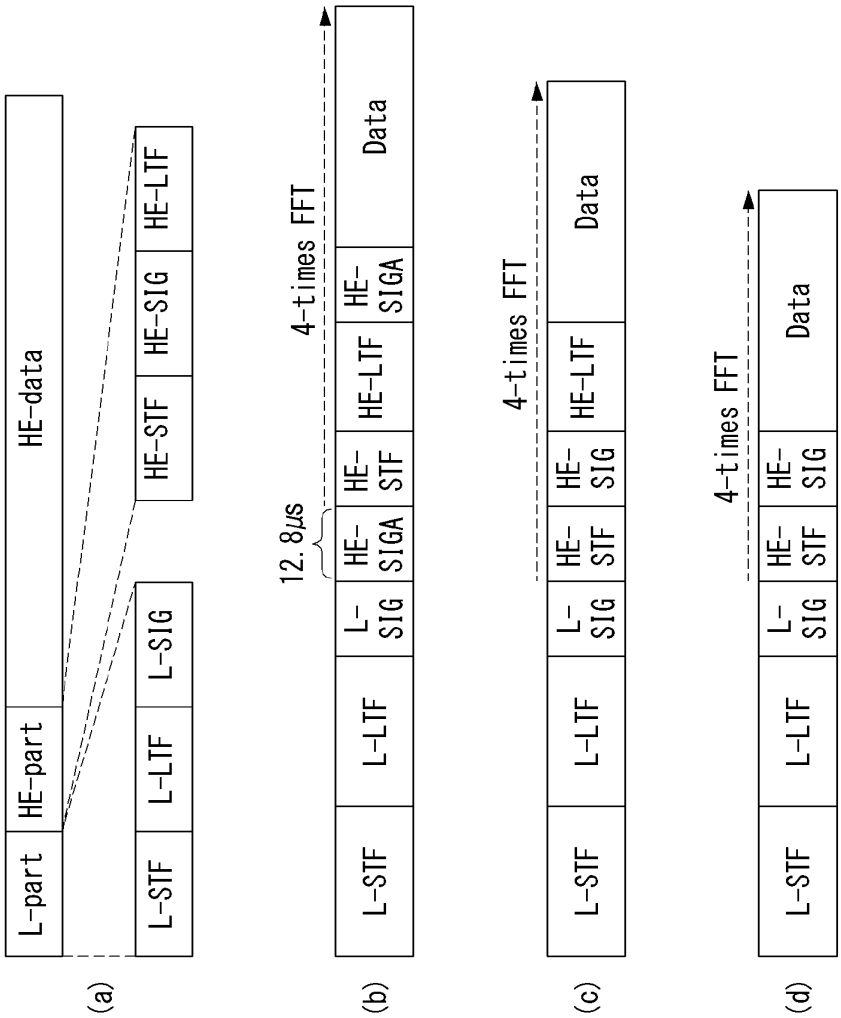
[도18]


Octets:
2
2
6
6
6
2
variable
4
Frame Control
Duration/ID
RA
TA
BA Control
BA Information
FCS
MAC Header
B0
B1
B2
B3
B11
B12
B15
BA Ack Policy
Multi-TID
Compressed Bitmap
Reserved
TID_INFO
Bits:
1
1
1
9
4

[도19]


(a)
Block Ack Starting Sequence Control
Block Ack Bitmap
Octets: 2 128
(b)
Block Ack Starting Sequence Control
Block Ack Bitmap
Octets: 2 8
Octets: 2 2 8
Per TID Info
Block Ack Starting Sequence Control
Block Ack Bitmap
Repeat for each TID
(c)
B0 B11 B12 B15
Reserved
TID Value
Bits: 12 4

[도20]



[도21]

L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data
L-STF	L-LTF	L-SIG	HE-SIG A				
L-STF	L-LTF	L-SIG	HE-SIG A				
L-STF	L-LTF	L-SIG	HE-SIG A				

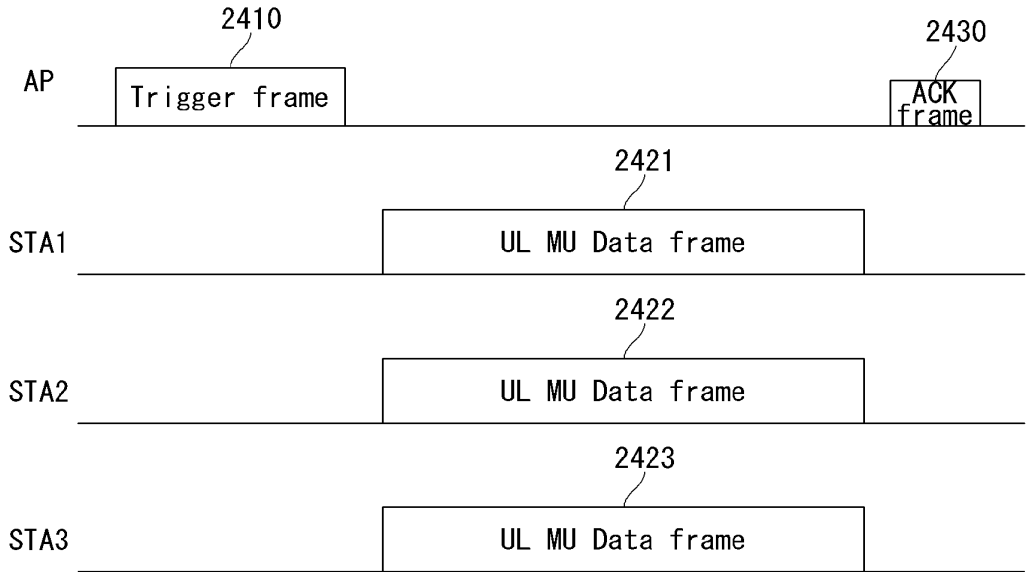
[도22]

<table>
<tr><td>L-STF</td><td>L-LTF</td><td>L-SIG</td><td>HE-SIG A</td><td rowspan="4">HE-SIG B</td><td>HE-STF</td><td>HE-LTF</td><td>Data for STA1</td></tr>
<tr><td>L-STF</td><td>L-LTF</td><td>L-SIG</td><td>HE-SIG A</td><td>HE-STF</td><td>HE-LTF</td><td>Data for STA2</td></tr>
<tr><td>L-STF</td><td>L-LTF</td><td>L-SIG</td><td>HE-SIG A</td><td>HE-STF</td><td>HE-LTF</td><td>Data for STA3</td></tr>
<tr><td>L-STF</td><td>L-LTF</td><td>L-SIG</td><td>HE-SIG A</td><td>HE-STF</td><td>HE-LTF</td><td>Data for STA4</td></tr>
</table>

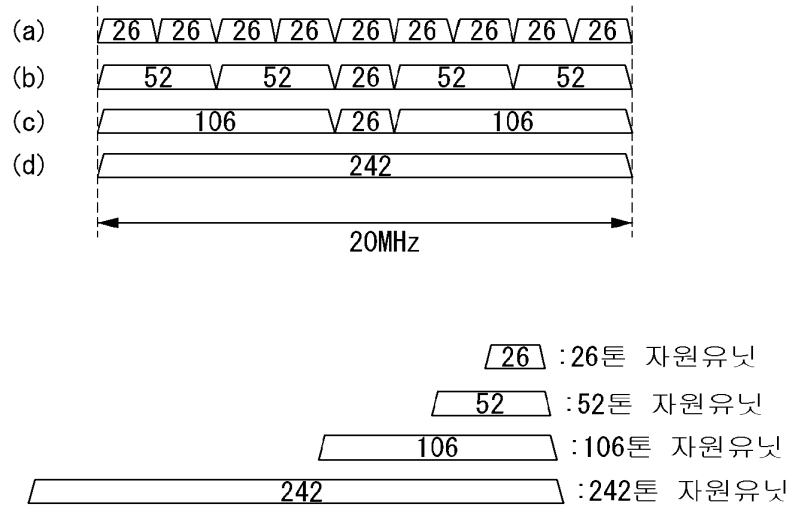
[도23]

L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA1
L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA2
L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA3
L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA4

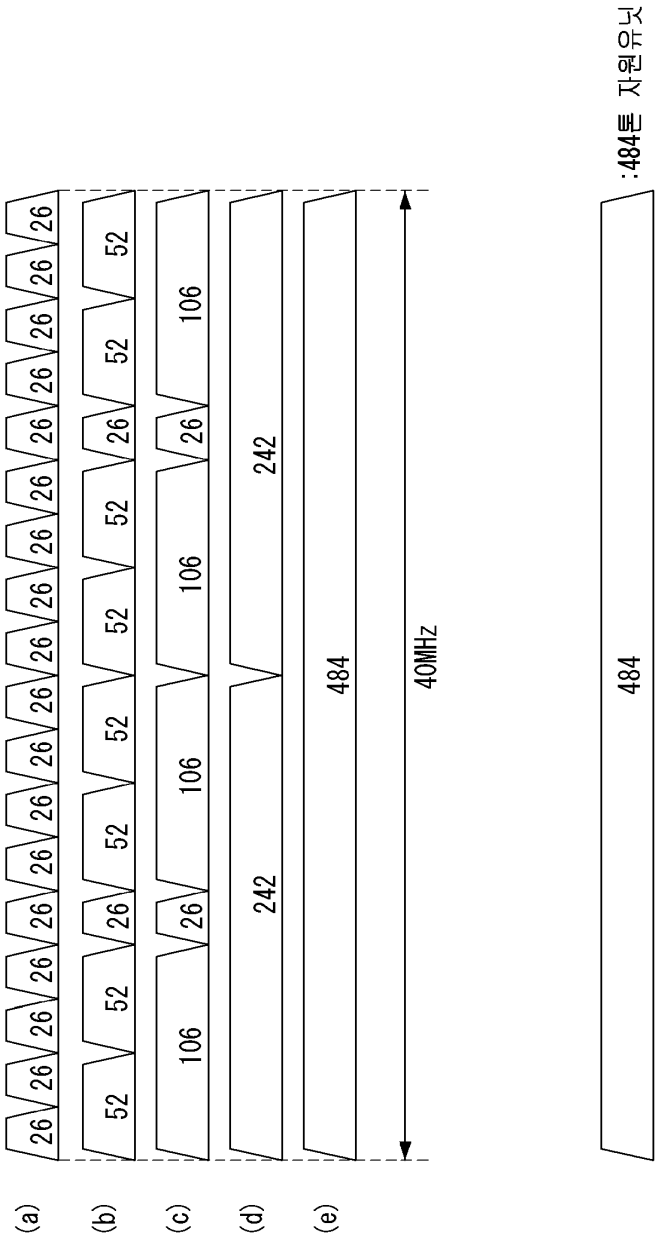
[도24]



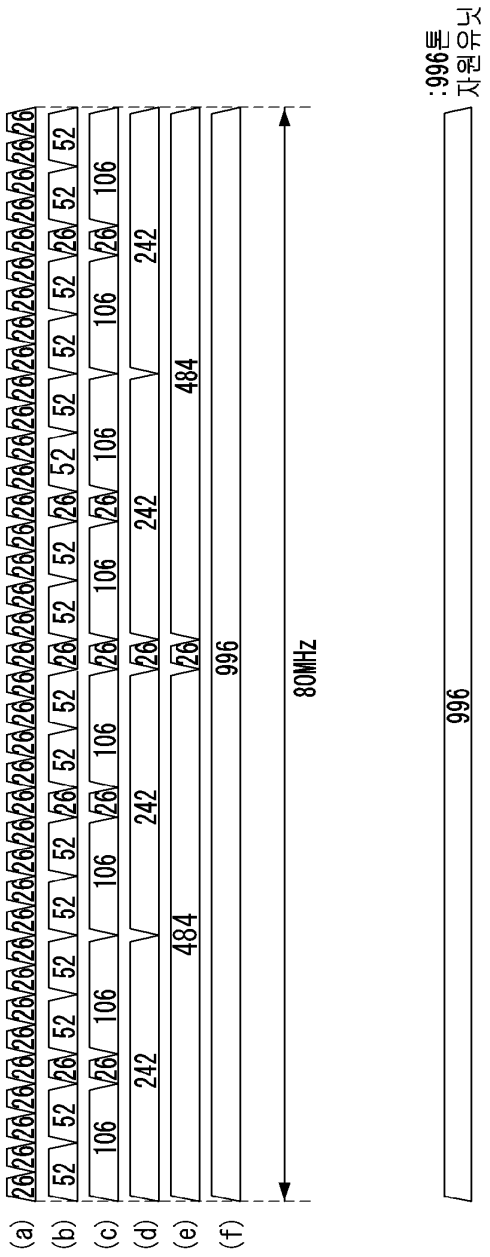
[도25]


(a)
26 26 26 26 26 26 26 26 26
(b)
52 52 26 52 52
(c)
106 26 106
(d)
242
20MHz
26 :26톤 자원유닛
52 :52톤 자원유닛
106 :106톤 자원유닛
242 :242톤 자원유닛

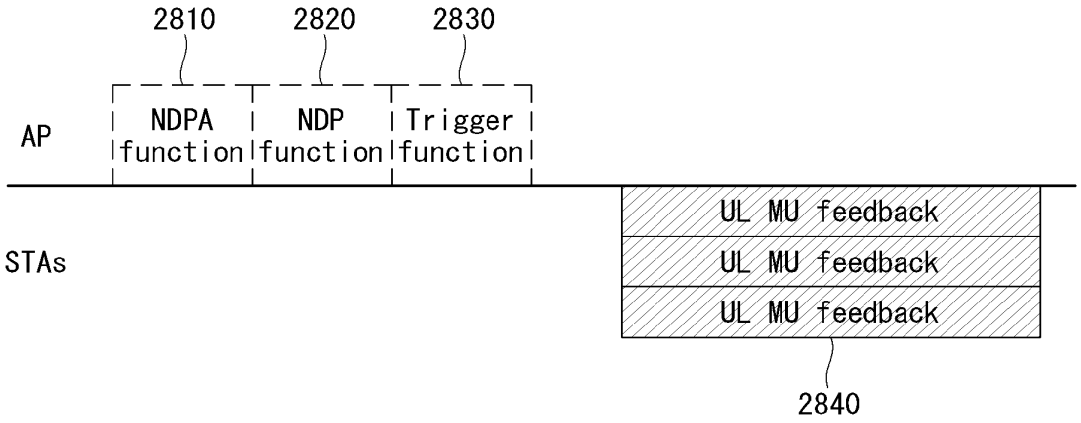
[도26]



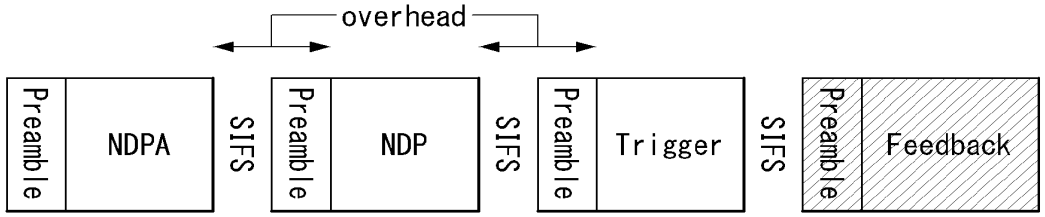
[도27]



[도28]

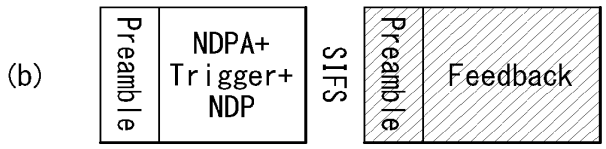


[도29]

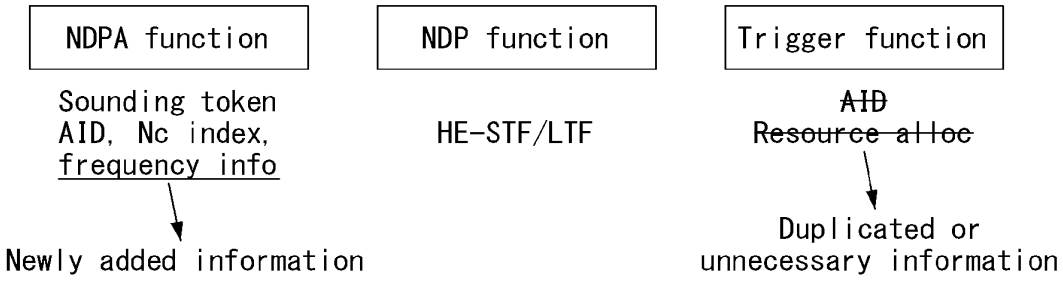


[도30]



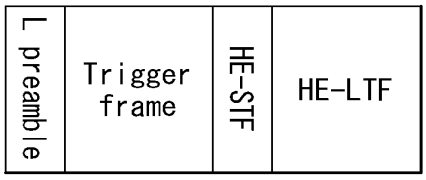


[도31]



[도32]

(a)

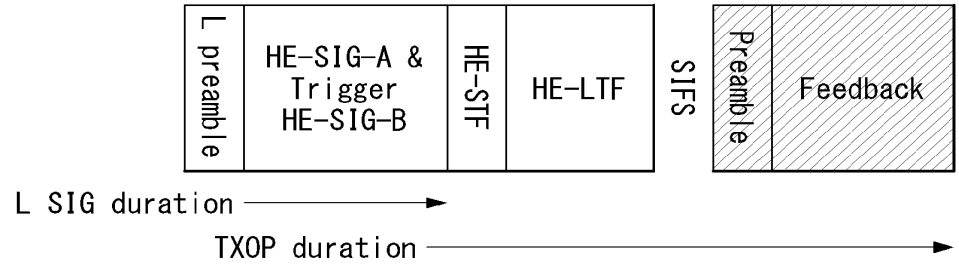

L preamble
Trigger frame
HE-STF
HE-LTF

(b)

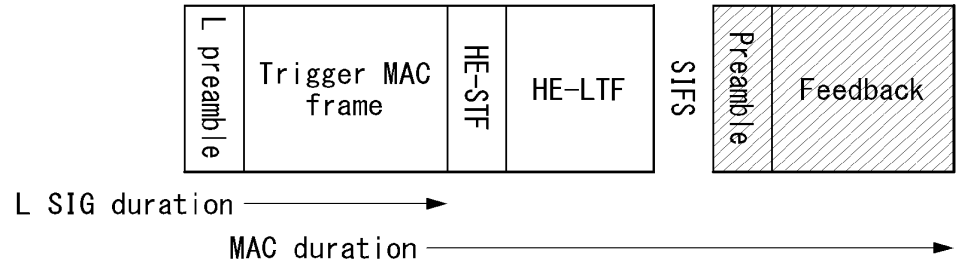

L preamble
HE-SIGs
HE-STF
HE-LTF
Trigger MAC frame

[도33]

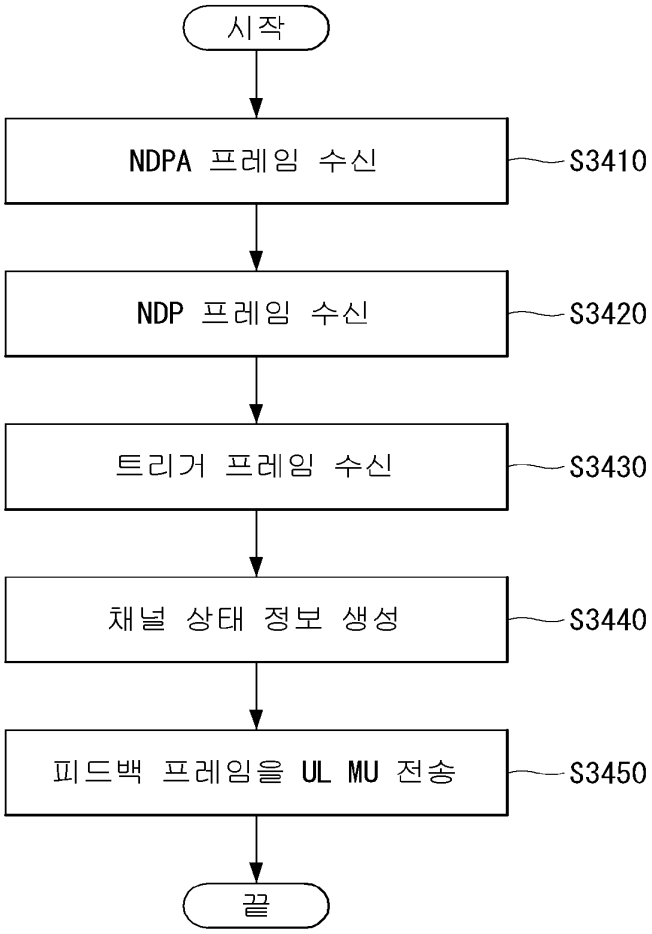
(a)


L preamble
HE-SIG-A & Trigger HE-SIG-B
HE-STF
HE-LTF
SIFS
Preamble
Feedback
L SIG duration
TXOP duration

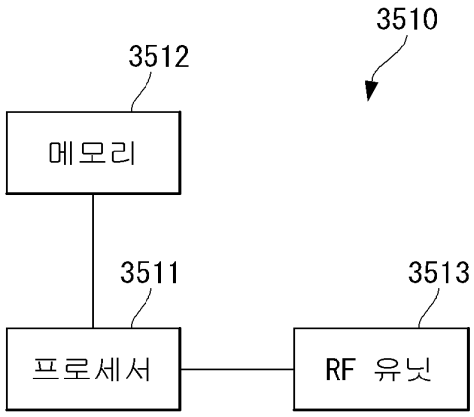
(b)


L preamble
Trigger MAC frame
HE-STF
HE-LTF
SIFS
Preamble
Feedback
L SIG duration
MAC duration

[도34]


시작
NDPA 프레임 수신
S3410
NDP 프레임 수신
S3420
트리거 프레임 수신
S3430
채널 상태 정보 생성
S3440
피드백 프레임을 UL MU 전송
S3450
끝

[도35]


3510
3512
메모리
3511
3513
프로세서
RF 유닛

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2016/003963

A. CLASSIFICATION OF SUBJECT MATTER

H04L 27/26(2006.01)i, H04L 5/00(2006.01)i, H04B 7/06(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)

H04L 27/26; H04W 74/08; H04B 7/06; H04W 72/02; H04W 72/04; H04B 7/04; H04W 24/08; H04W 84/12; H04L 5/00

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: WLAN, STA, Downlink, NDPA, NDP, sounding

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013-0250904 A1 (KANG, Byeong Woo et al.) 26 September 2013 See paragraphs [0079]-[0081], [0099], [0108], [0114], [0116], [0119] and figure 5.	1-6,8-17
A		7
Y	US 2014-0301240 A1 (LG ELECTRONICS INC.) 09 October 2014 See paragraphs [0015], [0025], [0032], [0035]-[0037] and figure 7.	1-6,8-17
Y	WO 2014-011006 A1 (LG ELECTRONICS INC.) 16 January 2014 See paragraph [0294] and figure 25.	3
Y	US 2014-0204891 A1 (PARK, Jong Hyun et al.) 24 July 2014 See paragraphs [0058], [0120] and figure 3.	4-6,8
A	US 2013-0229996 A1 (INTERDIGITAL PATENT HOLDINGS, INC.) 05 September 2013 See paragraphs [0110]-[0115] and figure 7.	1-17

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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
"P" document published prior to the international filing date but later than the priority date claimed
"T" 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
"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
"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 obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 JULY 2016 (28.07.2016)	**28 JULY 2016 (28.07.2016)**
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.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2016/003963

Patent document cited in search report	Publication date	Patent family member	Publication date
US 2013-0250904 A1	26/09/2013	US 9350428 B2	24/05/2016
		WO 2012-074316 A2	07/06/2012
		WO 2012-074316 A3	26/07/2012
US 2014-0301240 A1	09/10/2014	US 9332449 B2	03/05/2016
		WO 2013-077688 A1	30/05/2013
WO 2014-011006 A1	16/01/2014	CN 104429148 A	18/03/2015
		EP 2874459 A1	20/05/2015
		EP 2874459 A4	24/02/2016
		JP 2015-527790 A	17/09/2015
		KR 10-2015-0035721 A	07/04/2015
		US 2015-0208436 A1	23/07/2015
US 2014-0204891 A1	24/07/2014	AU 2012-295079 A1	06/03/2014
		AU 2012-295079 B2	17/09/2015
		CA 2844598 A1	14/02/2013
		CN 103828265 A	28/05/2014
		EP 2741431 A2	11/06/2014
		EP 2741431 A4	25/03/2015
		JP 2014-527751 A	16/10/2014
		KR 10-1558112 B1	06/10/2015
		KR 10-1607411 B1	29/03/2016
		KR 10-2014-0054034 A	08/05/2014
		RU 2014-105838 A	27/09/2015
		RU 2573579 C2	20/01/2016
		US 2015-0250003 A1	03/09/2015
		WO 2013-022253 A2	14/02/2013
		WO 2013-022254 A2	14/02/2013
		WO 2013-022254 A3	13/06/2013
US 2013-0229996 A1	05/09/2013	EP 2820909 A1	07/01/2015
		JP 2015-511077 A	13/04/2015
		TW 201349815 A	01/12/2013
		WO 2013-130793 A1	06/09/2013

국 제 조 사 보 고 서

국제출원번호
PCT/KR2016/003963

A. 발명이 속하는 기술분류(국제특허분류(IPC))

H04L 27/26(2006.01)i, H04L 5/00(2006.01)i, H04B 7/06(2006.01)i

B. 조사된 분야

조사된 최소문헌(국제특허분류를 기재)
H04L 27/26; H04W 74/08; H04B 7/06; H04W 72/02; H04W 72/04; H04B 7/04; H04W 24/08; H04W 84/12; H04L 5/00

조사된 기술분야에 속하는 최소문헌 이외의 문헌
한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC
일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC

국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우))
eKOMPASS(특허청 내부 검색시스템) & 키워드: WLAN, STA, Downlink, NDPA, NDP, sounding

C. 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
Y	US 2013-0250904 A1 (BYEONG WOO KANG 등) 2013.09.26 단락 [0079]-[0081], [0099], [0108], [0114], [0116], [0119] 및 도면 5 참조.	1-6,8-17
A		7
Y	US 2014-0301240 A1 (LG ELECTRONICS INC.) 2014.10.09 단락 [0015], [0025], [0032], [0035]-[0037] 및 도면 7 참조.	1-6,8-17
Y	WO 2014-011006 A1 (엘지전자 주식회사) 2014.01.16 단락 [0294] 및 도면 25 참조.	3
Y	US 2014-0204891 A1 (JONG HYUN PARK 등) 2014.07.24 단락 [0058], [0120] 및 도면 3 참조.	4-6,8
A	US 2013-0229996 A1 (INTERDIGITAL PATENT HOLDINGS, INC.) 2013.09.05 단락 [0110]-[0115] 및 도면 7 참조.	1-17

☐ 추가 문헌이 C(계속)에 기재되어 있습니다.

☒ 대응특허에 관한 별지를 참조하십시오.

* 인용된 문헌의 특별 카테고리:

"A" 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌

"E" 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌

"L" 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌

"O" 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌

"P" 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌

"T" 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌

"X" 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다.

"Y" 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다.

"&" 동일한 대응특허문헌에 속하는 문헌

국제조사의 실제 완료일	국제조사보고서 발송일
2016년 07월 28일 (28.07.2016)	2016년 07월 28일 (28.07.2016)

ISA/KR의 명칭 및 우편주소
대한민국 특허청
(35208) 대전광역시 서구 청사로 189,
4동 (둔산동, 정부대전청사)
팩스 번호 +82-42-481-8578

심사관
김도원
전화번호 +82-42-481-5560

서식 PCT/ISA/210 (두 번째 용지) (2015년 1월)

국 제 조 사 보 고 서
대응특허에 관한 정보

국제출원번호
PCT/KR2016/003963

국제조사보고서에서 인용된 특허문헌	공개일	대응특허문헌	공개일
US 2013-0250904 A1	2013/09/26	US 9350428 B2	2016/05/24
		WO 2012-074316 A2	2012/06/07
		WO 2012-074316 A3	2012/07/26
US 2014-0301240 A1	2014/10/09	US 9332449 B2	2016/05/03
		WO 2013-077688 A1	2013/05/30
WO 2014-011006 A1	2014/01/16	CN 104429148 A	2015/03/18
		EP 2874459 A1	2015/05/20
		EP 2874459 A4	2016/02/24
		JP 2015-527790 A	2015/09/17
		KR 10-2015-0035721 A	2015/04/07
		US 2015-0208436 A1	2015/07/23
US 2014-0204891 A1	2014/07/24	AU 2012-295079 A1	2014/03/06
		AU 2012-295079 B2	2015/09/17
		CA 2844598 A1	2013/02/14
		CN 103828265 A	2014/05/28
		EP 2741431 A2	2014/06/11
		EP 2741431 A4	2015/03/25
		JP 2014-527751 A	2014/10/16
		KR 10-1558112 B1	2015/10/06
		KR 10-1607411 B1	2016/03/29
		KR 10-2014-0054034 A	2014/05/08
		RU 2014-105838 A	2015/09/27
		RU 2573579 C2	2016/01/20
		US 2015-0250003 A1	2015/09/03
		WO 2013-022253 A2	2013/02/14
		WO 2013-022254 A2	2013/02/14
		WO 2013-022254 A3	2013/06/13
US 2013-0229996 A1	2013/09/05	EP 2820909 A1	2015/01/07
		JP 2015-511077 A	2015/04/13
		TW 201349815 A	2013/12/01
		WO 2013-130793 A1	2013/09/06

Electronic Acknowledgement Receipt

EFS ID:	46686380
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	24-SEP-2022
Filing Date:	25-JAN-2021
Time Stamp:	15:50:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2022-09-23_633016_IDS.pdf	244922 1cf5aab6899b3bf619b88dbd59d58f4f2a85e5f0	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Other reference-Patent/Application/ Search Documents	Ref1_CN2017800791550_NOA _6-29-22.pdf	405510 d67162e1f10442f34c4f87053702a169fb21 5e42	no	4
Warnings:					
Information:					
3	Other reference-Patent/Application/ Search Documents	Ref2_JP2021-071867_OA_7-4-2 2.pdf	170420 80ac915370f91230a836363d6d4ac90b17f7 d5cf	no	5
Warnings:					
Information:					
4	Non Patent Literature	Ref3_Content-Comment-Resolution_NPL.pdf	930053 e3875a7c81f9e10c9ecf70889685cee993df 8595	no	13
Warnings:					
Information:					
5	Foreign Reference	Ref4_WO2016-167608A1.pdf	8278672 e311c5f778c8853d85eed9ceb99546eb00fa cd51	no	149
Warnings:					
Information:					
6	Other reference-Patent/Application/ Search Documents	Ref5_EP221662257_ESSR_7-5-2 2.pdf	530477 f9bba3d52cbaaa15d345fefea6ade7c50237 31f7	no	9
Warnings:					
Information:					
7	Non Patent Literature	Ref6_IEEE80211151278r1_NPL. pdf	679074 c906269e0d024abbb0a231ad489f5a74c8d f09ab	no	13
Warnings:					

Information:					
8	Other reference-Patent/Application/ Search Documents	Ref8_US17157996_OA_8-30-22 .pdf	767585 c3725cee389c71b3260323654f7188f015a67892	no	13
Warnings:					
Information:					
9	Other reference-Patent/Application/ Search Documents	Ref7_CN2017800418480_NOA _8-3-22.pdf	346825 05c91b8642c5a7280786b64709134c769189502d	no	4
Warnings:					
Information:					
		Total Files Size (in bytes):	12353538		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Ton, Dang T
	Art Unit: 2476
Serial No.: 17/157,978	Conf. No.: 2451
Filing Date: January 25, 2021	Our Ref: B-10005CON1 633016-0
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Re: ***Information Disclosure Statement***
Date: September 23, 2022	

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[ ] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[ ] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

---

[x] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

- [ ] accompanied by the fee set forth in § 1.17(p), or
- [x] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

[ ] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

Additional Information

[x] Translations of the foreign-language documents are also enclosed as machine-translations, human-translations, or counterpart applications as noted. Machine translations were provided by the Japanese Patent Office, ESPACENET, Google Documents, Patent Fetcher® /ESPACENET, Google Translate or Google Translator Toolkit as noted and with OCR by Adobe Acrobat 9 or ABBYY PDF Transformer 3 if needed.

[x] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

September 23, 2022
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
Attorney for Applicant
Registration. No. 76,255
LADAS & PARRY LLP
4525 Wilshire Blvd., Suite 240
Los Angeles, CA 90010
(323) 934-2300 voice

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/157,978	01/25/2021	Woojin AHN	B-10005CON1 633016-0	2451

158747 7590 08/25/2022

LADAS & PARRY
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EXAMINER	
TON, DANG T	

ART UNIT	PAPER NUMBER
2476	

NOTIFICATION DATE	DELIVERY MODE
08/25/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

LA_MAIL@la.ladas.com
achinaryan@la.ladas.com
ykoo@la.ladas.com

Office Action Summary	Application No. 17/157,978	Applicant(s) AHN et al.	
	Examiner DANG T TON	Art Unit 2476	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 12/2/2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 17-30 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 17-30 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) -

706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

3. Claims 17-30 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 17-32 of copending Application No. 17/157,996. Although the claims at issue are not identical, they are not patentably distinct from each other because the claims 17-32 of copending Application No. 17/157,996 teaches a wireless communication terminal, the terminal comprising: a processor; and a communication unit, wherein the processor is configured to: transmit, through the communication unit, an aggregate MPDU(A-MPDU) consisting of one or more MAC protocol data units (MPDUs), wherein the A-MPDU includes at least one MPDU delimiter information and one or more traffic ID(TID) related to the one or more MPDUs, wherein each of the at least one MPDU delimiter information include an end of frame(EOF) field and a length field, and receive, through the communication unit, a

response frame of a specific format in response to the A-MPDU, wherein the specific format of the response frame is determined based on a number of at least one TID for successfully received MPDUs among the one or more TIDs and a combination of the EOF field and the length field, and wherein the at least one TID solicits an immediate response to the successfully received MPDUs;

wherein the specific format is determined by further considering whether the first MPDU delimiter information in which a value of the EOF field is 1 and a value of the length field is non-zero or the second MPDU delimiter information in which a value of the EOF field is 0 and a value of the length field is non-zero is included;

wherein the specific format of the response frame is determined as a format for an Ack frame when the one or more MPDUs include only one MPDU soliciting an immediate response, and the only one MPDU soliciting the immediate response follows the MPDU delimiter information with a value of the EOF field equal to 1 and a value of the length field is non-zero;

wherein the specific format of the response frame is determined as a format for a compressed BlockAck frame when the at least one TID is the same, and the at least one TID soliciting the immediate response follows the MPDU delimiter information with a value of the EOF field equal to 0;

wherein the specific format of the response frame is determined as a format for a multi-STA BlockAck frame when the one or more MPDUs include at least one MPDU of the at least one TID;

wherein the response frame is carried in a high efficiency single-user PHY protocol data unit (HE SU PPDU) when an MPDU in which an acknowledgment policy is set to HE TB PPDU (HTP) Ack is not present in the A-MPDU;

wherein the response frame is carried in a high efficiency trigger-based PHY protocol data unit (HE TB PPDU) when the A-MPDU contains a trigger frame or the A- MPDU contains a QoS data frame or a QoS null frame with an uplink multi-user response scheduling (UMRS) control field.

wherein an MPDU soliciting the immediate response and contained in the A- MPDU includes at least one of a QoS data frame in which an acknowledgment policy is set to HTP Ack and a QoS Null frame in which an acknowledgment policy is set to HTP Ack; and a

wireless communication method of a wireless communication terminal, the method comprising: transmitting, through the communication unit, an aggregate MPDU(A-MPDU) consisting of one or more MAC protocol data units (MPDUs), wherein the A-MPDU includes at least one MPDU delimiter information and one or more traffic ID(TID) related to the one or more MPDUs, and wherein each of the at least one MPDU delimiter information include an end of frame(EOF) field and a length field; and receiving, through the communication unit, a response frame of a specific format in response to the A-MPDU, wherein the specific format of the response frame is determined based on a number of at least one TID for successfully received MPDUs among the one or more TIDs and a combination of the EOF field and the length field, and wherein the at least one TID solicits an immediate response to the successfully received MPDUs.

Applicant's claims 17-30 broaden the scope of copending application of claims 17-32 by eliminating a combination of the EOF field and the length field, and wherein the at least one TID solicits an immediate response to the successfully received MPDUs from the claims. It has been held that the omission of an element and its function is an obvious expedient if the remaining elements perform the same function as before. In re karlson, 136 USPQ 184 (CCPA). Also note Ex Parte Raine, 168 USPQ 375 (bd. App. 1969); omission of a reference element whose function is not need would be obvious to one skilled in the art.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented.

4. The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 17-30 are rejected under 35 U.S.C. 103 as being unpatentable over ("Multi-TID A-MPDU in MU Transmission", Marvel et. al., JEEE 802.11-16/0069r0, Jan. 18, 2016) in view of "Block Ack generation and May 17, 2016 selection rules", Qualcomm, IEEE 802.11-16/0616r2.

For claims 17-30, ("Multi-TID A-MPDU in MU Transmission", Marvel et. al., JEEE 802.11-16/0069r0, Jan. 18, 2016) discloses a wireless communication terminal("Multi-TID A-MPDU in MU Transmission", Marvel et. al., JEEE 802.11-16/0069r0, Jan. 18, 2016) discloses Multi-TID A-MPDU in multiple user transmission and specifically the following technical features (see pages 11-12 of PPT): OFDMA A-MPDU Aggregation Rules MPDUs from multiple TIDs that need to acknowledged by Ack or BA can be aggregated in one A-MPDU (corresponding to receive an aggregate MPDU (A-MPDU) consisting of one or more MAC protocol data units (MPDUs). A STA doesn't need to do BA negotiation for each TID in order to aggregate MPDUs to A-MPDU. MPDUs in A-

MPDU should indicate whether Ack or BA is used to carry acknowledgement information. A. When EoF is 1, MPDU length is not 0 and Ack Policy of the MPDU is Normal Ack Request, the MPDU asks for acknowledgement by Ack SIFS after the OFDMA transmission. At most one such data MPDU for a TID is allowed in an A-MPDU. At most one such management MPDU is allowed in an A-MPDU. B. When EoF is 0 and MPDU length is not 0 and Ack Policy of the MPDU is Implicit Block Ack Request or related TID of the MPDU is indicated by Block Ack Request, the MPDU asks for acknowledgement by BA SIFS after the OFDMA transmission. C. When EoF is 0 and MPDU length is not 0, Ack Policy of the MPDU is Block Ack Request, and the related TID of the MPDU is not indicated by Block Ack Request, the MPDU asks for acknowledgement by BA in the future (no immediate response frame) (i.e. determine a format of a response frame for the received A-MPDU, and transmit, a response frame of the determined format; wherein the format of the response frame for the A-MPDU is determined based on MPDU delimiter information of the A-MPDU); When EoF is 1, MPDU length is not 0 and Ack Policy of the MPDU is Normal Ack Request, the MPDU asks for acknowledgement by Ack SIFS after the OFDMA transmission. At most one such data MPDU for a TID is allowed in an A-MPDU. At most one such management MPDU is allowed in an A-MPDU. B. When EoF is 0 and MPDU length is not 0 and Ack Policy of the MPDU is Implicit Block Ack Request or related TID of the MPDU is indicated by Block Ack Request, the MPDU asks for acknowledgement by BA SIFS after the OFDMA transmission. C. When EoF is 0 and MPDU length is not 0, Ack Policy of the MPDU is Block Ack Request,

and the related TID of the MPDU is not indicated by Block Ack Request, the MPDU asks for acknowledgement by BA in the future (no immediate response frame) (i.e. the MPDU delimiter information includes the presence or the number of MPDU delimiters with a value of an end of frame (EOF) field equal to 1 and a value of an MPDU length field not equal to 0); MPDU is Normal Ack Request, the MPDU asks for acknowledgement by Ack SIFS after the OFDMA transmission (corresponding to: the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an EOF field equal to 1 and a value of an MPDU length field not equal to 0, the response frame for the A-MPDU is determined to be an Ack frame; and when DL MU A-MPDU includes multiple TIDs, or when UL multi-TID MU A-MPDUs are acknowledged by DL OFDMA/MU PPDU. When Multi-STA M-BA is used for single user, RA is unicast MAC address AID field is TBD (i.e. when the successfully received MPDU(s) include MPDUs of a plurality of TIDs soliciting an immediate response or include MPDUs of one or more TIDs soliciting an immediate response and an Action frame, the response frame for the A-MPDU is determined to be a multi-STA BlockAck frame(see pages 11-12 of PPT).

For claims 17-30 , ("Multi-TID A-MPDU in MU Transmission", Marvel et. al., JEEE 802.11-16/0069r0, Jan. 18, 2016) discloses all the subject matter of the claimed invention with the exception of wherein a type of the response frame is determined according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information in a communications network. ("Block Ack generation and

selection rules", Qualcomm, JEFF 802. 11-16/0616r2. May 17, 2016) discloses a block Ack generation and selection rules and specifically the following technical feature (see pages 17-20 of PPT):

Action Ack frames do not have an Ack Policy field to differentiate between SU and MU (preferred) I.e., by default the response to DL Multi-TID A-MPDU frames containing this MPDU is in MU mode. The number of TIDs carried in multi-TID A-MPDU cannot exceed the # of TIDs specified by RX and the format of the response frame for the A-MPDU is also determined based on the number of TIDs soliciting an immediate response in MPDU(s) successfully received in the A-MPDU (see pages 17-20 of PPT). Thus, it would have been obvious to the person of ordinary skill in the art before the effective filling date of the invention to use wherein a type of the response frame is determined according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information as taught by ("Block Ack generation and selection rules", Qualcomm, JEFF 802. 11-16/0616r2. May 17, 2016) in the communication of ("Multi-TID A-MPDU in MU Transmission", Marvel et. al., JEEE 802.11-16/0069r0, Jan. 18, 2016) for the purpose of providing acknowledge response.

6. Seok et al. (2020/0259595) is cited to shows a system which is considered pertinent to the claimed invention.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DANG T TON whose telephone number is (571)272-3171. The examiner can normally be reached Monday to Friday 5:30 AM to 3:00 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ayaz Sheikh can be reached on 571-272-3795. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/DANG T TON/

Primary Examiner, Art Unit 2476

/D.T.T/

Primary Examiner, Art Unit 2476

Notice of References Cited	Application/Control No. 17/157,978	Applicant(s)/Patent Under Reexamination AHN et al.	
	Examiner DANG T TON	Art Unit 2476	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20200259595-A1	08-2020	Seok; Yongho	H04L1/1867	1/1
	B					
	C					
	D					
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	L					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
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	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
	Examiner	Art Unit
	DANG T TON	2476

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04L 12/28	07/18/2022	td

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
PE2E		07/18/2022	td
NPL		07/18/2022	td
IP.com		07/18/2022	td
Inventor searched		07/18/2022	td
CPC		07/18/2022	td

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
370/329	07/18/2022	td

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
370	329	07/18/2022	td

/DANG T TON/ Primary Examiner, Art Unit 2476	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/157,978	AHN et al.
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	DANG T TON	2476

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS										
☐ Claims renumbered in the same order as presented by applicant					☐ CPA		☐ T.D.		☐ R.1.47	
CLAIM		**DATE**								
Final	Original	07/18/2022								
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Main Concept Text
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The present invention relates to a method for transmitting an aggregate MPDU and a response frame thereto and a wireless communication terminal using the same, and more particularly, to a wireless communication method and a wireless communication terminal for setting various formats of the aggregate MPDU and the response frame thereto and performing an efficient data communication by using the same. To this end, provided are a wireless communication terminal including: a processor; and a communication unit, wherein the processor receives an aggregate MPDU (A-MPDU) consisting of one or more MAC protocol data units (MPDUs), determines a format of a response frame for the received A-MPDU, and transmits a response frame of the determined format, wherein the format of the response frame for the A-MPDU is determined based on at least one of the number of traffic IDs (TIDs) soliciting an immediate response in MPDU(s) successfully received in the A-MPDU and MPDU delimiter information of the A-MPDU and a wireless communication method using the same.

(No Concept Modifiers)
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(No Filters)
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Options
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De-dup: None
Cut-off: None
Sort: Relevance

Content: Patents + NPL (190)
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US Patents
US Designs
US Applications
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EPO Applications
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China Applications
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Other Literature: IBM Redbooks
Other Literature: PubMed Central
Other Literature: arXiv.org

Bibliographic Data

Application No: 17/157,978

Foreign Priority claimed: (•) Yes ( ) No

35 USC 119 (a-d) conditions met: [✓] Yes [ ] No [✓] Met After Allowance

Verified and Acknowledged: /DANG T TON/ (Examiner's Signature) D.T.T (Initials)

Title: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
01/25/2021	370	2476	
RULE			

APPLICANTS

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INVENTORS

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CONTINUING DATA

This application is a CON of 16449132 06/21/2019 PAT 10931396

16449132 is a CON of PCT/KR2017/015265 12/21/2017

FOREIGN APPLICATIONS

KOREA, REPUBLIC OF KR10-2016-0175999 12/21/2016

KOREA, REPUBLIC OF KR10-2017-0048145 04/13/2017

KOREA, REPUBLIC OF KR10-2017-0146357 11/04/2017

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02/04/2021

STATE OR COUNTRY

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$1,820

July 13, 2021

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE OR 371 (C) DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

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EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated April 19, 2021 for European Patent Application No. 17 824 568.4
	2.	Notice of Allowance dated April 20, 2021 for US Patent Application No. 16/596,674
	3.	Office Action dated June 1, 2021 for European Patent Application No. 17 884 228.2
	4.	Office Action dated June 14, 2021 for Japanese Patent Application No. 2020-125358 and its English translation provided by the Applicant's foreign counsel
	5.	Office Action dated June 14, 2021 for Japanese Patent Application No. 2020-125359 and its English translation provided by the Applicant's foreign counsel
	6.	Kiseon Ryu, "Ack Policy for UL MU Ack transmission", IEEE 802.11-15/1346r1, Internet URL:https://mentor.ieee.org/802.11/dcn/15/11-15-1346-01-00ax-ack-policy-for-ul-mu-ack-transmisssion.ppx, November 8, 2015
	7.	Po-Kai Huang (Intel), "Comment Resolution on Trigger Frame Format – MU-RTS Variant, IEEE 802.11-16/0808r0, Internet URL:https://mentor.ieee.org/802.11/dcn/16/11-16-0808-00-00ax-comment-resolution-on-triceer-frame-format-mu-rts-variant.docs, June 28, 2016.
	8.	Office Action dated June 22, 2021 for Korean Patent Application No. 10-2021-7016873 and its English translation provided by the Applicant's foreign counsel

EXAMINER	*DATE CONSIDERED*
/DANG T TON/	07/11/2022

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April 16, 2021

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
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U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	9,179,354	Nov. 3, 2015	Rubin et al.			

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EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	2.	Office Action dated February 19, 2021 for Indian Patent Application No. 201927025421.

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July 7, 2022

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	1.	Notice of Allowance dated May 10, 2022 for Korean Patent Application No. 10-2022-7001640 and its English translation provided by Applicant's foreign counsel.
	2.	Office Action dated May 7, 2022 for Chinese Patent Application No. 201780041848.0 and its English translation provided by Applicant's foreign counsel.
	3.	Notice of Allowance dated May 16, 2022 for Japanese Patent Application No. 2020-125358 and its English translation provided by Applicant's foreign counsel.
	4.	Notice of Allowance dated May 16, 2022 for Japanese Patent Application No. 2020-125359 and its English translation provided by Applicant's foreign counsel.
	5.	Corrected Notice of Allowance dated May 26, 2022 for US Patent Application No. 16/935,858.
	6.	Notice of Allowance dated October 15, 2021 for Korean Patent Application No. 10-2021-7016873 and its English translation provided by Applicant's foreign counsel.

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		GROUP NO. N/A

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	1.	2015/0124689	May 7, 2015	MERLIN et al.			
	2.	2011/0268094	Nov. 3, 2011	Gong et al.			
	3.	2015/0295680	Oct. 15, 2015	Othman et al.			
	4.	2016/0315681	Oct. 27, 2016	Moon et al.			
	5.	2016/0360442	Dec. 8, 2016	Stacey et al.			
	6.	2016/0182205	Jun. 23, 2016	Asterjadhi et al.			
	7.	2018/0254861	Sep. 6, 2018	CHERIAN et al.			
	8.	2017/0150493	May 25, 2017	SEOK			
	9.	2017/0257196	Sept. 7, 2017	Ghosh et al.			
	10.	2017/0310446	Oct. 26, 2017	ASTERJADHI et al.			
	11.	2016/0080115	Mar. 17, 2016	Joshiam et al.			
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	17.	10-2015-0111270	Oct. 5, 2015	KR			Espacenet/KIPRIS
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January 25, 2021

	19.	2016/043538	Mar. 24, 2016	WO			Espacenet
	20.	2018/117697	Jun. 28, 2018	WO			Espacenet
	21.	2013-536599	Sep. 19, 2013	JP			Espacenet
	22.	2011/159831	Dec. 22, 2011	WO			
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	26.	International Search Report for PCT/KR2017/015265 mailed on April 10, 2018 and its English translation from WIPO (now published as WO 2018/117697)
	27.	Written Opinion of the International Searching Authority for PCT/KR2017/015265 mailed on April 10, 2018 and its English translation from WIPO (now published as WO 2018/117697)
	28.	Robert Stacey et al.: "IEEE P802.11 Wireless LANs Submission doc.: IEEE 802.11-17/16822r0", Comments on TXax/D2.0, November 5, 2017 https://mentor.ieee.org/802.11/dcn/17/11-17-1682-00-00ax-comments-on-tgax-d2-0.xlsx
	29.	Notice of Allowance dated June 18, 2020 for Korean Patent Application No. 10-2020-7002361 and its English machine translation by Global Dossier
	30.	Notice of Allowance dated June 22, 2020 for Japanese Patent Application No. 2019-500497 and its English translation provided by Applicant's foreign counsel
	31.	Office Action dated July 13, 2020 for Japanese Patent Application No. 2019-533391 and its English translation provided by Applicant's foreign counsel
	32.	Liwen Chu: "IEEE P802.11 Wireless LANs Submission doc.: IEEE 802.11-16_1185r1", Comments on TGax D0.1, September 12, 2016
	33.	George Cherian et al.: "IEEE P802.11 Wireless LANs Submission doc.: IEEE 802.11-16_0024r3", Comments on TGax D0.1, April 17, 2016
	34.	Office Action dated July 28, 2020 for U.S. Patent Application 16/596,674
	35.	Extended European Search Report dated August 5, 2020 for European Patent Application No. 17884228.2
	36.	Liwen Chu et al.: "Multi TID A-MPDU in MU Transmission". January 18, 2016, doc: 801.11-16/0069r0, XP068104841.
	37.	Alfred Asterjadhi et al.: "Block Ack generation and selection rules". May 14, 2016, doc: IPEEE 802.11-16/0616r2; XP068119447.
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	39.	Notice of Allowance dated September 15, 2020 for Korean Patent Application No. 10-2020-7026125 and its English translation by provided by Applicant's foreign counsel
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	41.	Extended European Search Report dated February 10, 2020 for European Patent Application No. 17824568.4
	42.	Robert Stacey, Spec Framework, IEEE 802.11-15/0132r17, (IEEE 802.11-15/0132r15) URL https://mentor.ieee.org/802.11/dcn/15/11-15-0132-17-00ax-spec-framework.docs, May 2, 2016, pp. 1-61.

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	43.	Chittabrata Ghosh (INTEL): "Signaling of Multi-TID Aggregation Limit", IEEE Draft: 11-16-0667-00-00AX-SIGNALING-OF-MULTI-TID-AGGREGATION-LIMIT, IEEE-SA MENTOR, Piscataway, NJ USA, vol. 802.11-16/0667r0, URL https://mentor.ieee.org/802.11/dcn/16/11-16-0667-00-00ax-signaling-of-multi-tid-aggregation-limit.pptx, June 16, 2016, pp. 11-15.
	44.	Chittabrata Ghosh (INTEL): "Multi-TID Aggregation Limit", IEEE Draft: 11-16-0362-01-00AX-MULTI-TID-AGGREGATION-LIMIT, IEEE-SA MENTOR, Piscataway, NJ USA, vol. 802.11-16/0362r1, March 15, 2016, slides 1-16.
	45.	IEEE P802.11ax™/D0.2: "Draft Standard for Information technology-Tele-communications and information exchange between systems Local and metropolitan area networks-Specific requirements. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Amendment 6: Enhancements for high efficiency in frequency bands between 1GHz and 6GHz", LAN/MAN Standards Committee of the IEE Computer Society, IEEE Draft: P802.11ax/D0.2, June 8, 2016, pp. 20-23, pp. 36-38. URL: www.ieee802.org/11/private/Draft_Standards/11ax/DraftP802.11ax_D0.2.pdf
	46.	International Preliminary Report on Patentability (Chapter I) issued on June 25, 2019 for PCT/KR2017/015265 and its English translation from WIPO
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	49.	Oren Kedem (INTEL): "IEEE P802.11 Wireless LANs", IEEE 802.11-15/TBD, November 2015, pp 1-5
	50.	Notice of Allowance dated October 20, 2020 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)
	51.	Final Office Action dated May 1, 2020 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)
	52.	Office Action dated January 16, 2020 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)
	53.	Office Action dated September 16, 2019 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)

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March 15, 2022

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FOREIGN PATENT DOCUMENTS

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	1.	105432114	Mar. 23, 2016	CN			Espacenet
	2.	2016/111435	Jul. 14, 2016	WO			Espacenet
	3.	2016/032258	Mar. 3, 2016	WO			Espacenet

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EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	4.	Office Action dated January 26, 2022 for Chinese Patent Application No. 201780079155.0 and its English translation provided by Applicant's foreign counsel
	5.	Office Action dated February 24, 2022 for Korean Patent Application No. 10-2022-7001640 and its English translation provided by Applicant's foreign counsel

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December 1, 2021

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	1.	2018/0145801	May 24, 2018	WANG et al.			
	2.	2016/0302229	Oct. 13, 2016	HEDAYAT			

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	32080	PPDU	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:58 AM
L2	14208	1 AND MPDU	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:58 AM
L3	2070	2 AND subframes	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:58 AM
L4	648	3 AND (Ack adj1 policy)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/07/11 05:59 AM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L5	391	L4 AND eof	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 06:00 AM
L6	372	L5 AND (block adj1 ACK)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 06:01 AM
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			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
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PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

December 29, 2021

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	2.	Office Action dated November 22, 2021 for Japanese Patent Application No. 2020-125358 and its English translation provided by Applicant's foreign counsel

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L1	2251047	(control adj1 module)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:38 AM
L2	231375	1 AND (control adj1 operation)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:39 AM
L3	0	2 AND (reception adj1 strenght)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:39 AM
L4	389	2 AND (reception adj1 strength)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU,	OR	ON	ON	2022/07/11 05:40 AM

			CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L5	21	4 AND (state adj1 transition)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:41 AM
L6	19	5 AND active	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:41 AM
L7	849557	"61" AND H04L 12/28.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2022/07/11 05:42 AM

			VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L8	663	1 AND H04L12/18.cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:43 AM
L9	0	1 AND nagamatsu-tatsuo,in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2022/07/11 05:44 AM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

January 24, 2022

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. OPAP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	2014/0254552	Sep. 11, 2014	HAYES et al.			
	2.	2016/0127020	May 5, 2016	Abraham et al.			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	3.	104321995	Jan. 28, 2015	CN			Espacenet
	4.	103563457	Feb. 5, 2014	CN			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	5.	Office Action dated December 27, 2021 for Indian Patent Application No. 202128005900
	6.	Office Action dated December 9, 2021 for Chinese Patent Application No. 201780041848.0 and its English translation provided by Applicant's foreign counsel
	7.	Notice of Allowance dated December 13, 2021 for European Patent Application No. 17 824 568.4

EXAMINER	*DATE CONSIDERED*
/DANG T TON/	07/11/2022

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T.T/

May 27, 2021

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE OR 371 (C) DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated November 10, 2020 for Korean Patent Application No. 10-2019-7018255 and its English translation provided by Applicant's foreign counsel.
	2.	Jagit Singh Ashta et al.: "Performance improvement strategies for current and next generation Wi-Fi systems", June 13, 2012, pp. 1-151.

EXAMINER	*DATE CONSIDERED*
/DANG T TON/	07/11/2022

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T.T/

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. OPAP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Notice of Allowance dated May 10, 2022 for Korean Patent Application No. 10-2022-7001640 and its English translation provided by Applicant's foreign counsel.
	2.	Office Action dated May 7, 2022 for Chinese Patent Application No. 201780041848.0 and its English translation provided by Applicant's foreign counsel.
	3.	Notice of Allowance dated May 16, 2022 for Japanese Patent Application No. 2020-125358 and its English translation provided by Applicant's foreign counsel.
	4.	Notice of Allowance dated May 16, 2022 for Japanese Patent Application No. 2020-125359 and its English translation provided by Applicant's foreign counsel.
	5.	Corrected Notice of Allowance dated May 26, 2022 for US Patent Application No. 16/935,858.
	6.	Notice of Allowance dated October 15, 2021 for Korean Patent Application No. 10-2021-7016873 and its English translation provided by Applicant's foreign counsel.

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt	
EFS ID:	46141064
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	08-JUL-2022
Filing Date:	25-JAN-2021
Time Stamp:	01:38:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2022-07-07_633016_IDS.pdf	243182 b6978679f69ab6239bddb9cf189814f7c834b7be	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Other reference-Patent/Application/ Search Documents	Ref1_KR10-2022-7001640_NOA_5-10-22.pdf	322466 5a194391d27a667a78419b1e6b5edab2a39ec933	no	7
Warnings:					
Information:					
3	Other reference-Patent/Application/ Search Documents	Ref2_CN2017800418480_2ndOA_5-7-22.pdf	534916 fe6efbd9383f7f3149c3125e51ac5ded583d29b8	no	7
Warnings:					
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4	Other reference-Patent/Application/ Search Documents	Ref3_JP2020-125358_NOA_5-16-22.pdf	145010 c8d1a1ce1d230ea466ed92ecf68f981bc4b743af	no	5
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5	Other reference-Patent/Application/ Search Documents	Ref4_JP2020-125359_NOA_5-16-22.pdf	148142 d89601a6a97b5102aa0e2116cbd48730a4342428	no	6
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Information:					
6	Other reference-Patent/Application/ Search Documents	Ref5_US16935858_Corrected_NOA_5-26-22.pdf	177382 4f94da26af080c13eab6543f65309a2aee76f7c5	no	5
Warnings:					
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7	Other reference-Patent/Application/ Search Documents	Ref6_KR10-2021-7016873_NOA_10-15-2021.pdf	49664 ac3752c5b1ffe698439bc2e08516fa444d2697e2	no	4
Warnings:					

Information:	
Total Files Size (in bytes):	1620762

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Central, Docket
	Art Unit: OPAP
Serial No.: 17/157,978	Conf. No.: 2451
Filing Date: January 25, 2021	Our Ref: B-10005CON1 633016-0
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Re: ***Information Disclosure Statement***
Date: July 7, 2022	

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[ ] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[x] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

[ ] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

- [ ] accompanied by the fee set forth in § 1.17(p), or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

[ ] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

Additional Information

[x] Translations of the foreign-language documents are also enclosed as machine-translations, human-translations, or counterpart applications as noted. Machine translations were provided by the Japanese Patent Office, ESPACENET, Google Documents, Patent Fetcher® /ESPACENET, Google Translate or Google Translator Toolkit as noted and with OCR by Adobe Acrobat 9 or ABBYY PDF Transformer 3 if needed.

[x] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and May 28, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

July 7, 2022
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
Attorney for Applicant
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LADAS & PARRY LLP
4525 Wilshire Blvd., Suite 240
Los Angeles, CA 90010
(323) 934-2300 voice

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. OPAP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	1.	105432114	Mar. 23, 2016	CN			Espacenet
	2.	2016/111435	Jul. 14, 2016	WO			Espacenet
	3.	2016/032258	Mar. 3, 2016	WO			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	4.	Office Action dated January 26, 2022 for Chinese Patent Application No. 201780079155.0 and its English translation provided by Applicant's foreign counsel
	5.	Office Action dated February 24, 2022 for Korean Patent Application No. 10-2022-7001640 and its English translation provided by Applicant's foreign counsel

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	45236909
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	16-MAR-2022
Filing Date:	25-JAN-2021
Time Stamp:	01:55:30
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Other reference-Patent/Application/ Search Documents	Ref1_CN2017800791550_1stOA_1-26-22.pdf	1287875 69781a54787c409bf7d9e117ac16aec8ea6c9c58	no	24

Warnings:

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2	Other reference-Patent/Application/ Search Documents	Ref2_KR10-2022-7001640_1stOA_2-24-22.pdf	137266 859f61525d366635b22e16518beb910a55412ee7	no	5
Warnings:					
Information:					
3	Foreign Reference	Ref3_CN105432114A.pdf	4478456 3eb0fa6379fbc43cb02b4db08896d14d65c00a82	no	110
Warnings:					
Information:					
4	Foreign Reference	Ref4_WO2016-111435A1.pdf	2009254 fe43a692a90042a23b5395785e09f10f198397a3	no	56
Warnings:					
Information:					
5	Foreign Reference	Ref5_WO2016-032258A2.pdf	5588580 6f500e7e199b3872eb6d3a826090b91aa0e2bf05	no	178
Warnings:					
Information:					
6		2022-03-15_633016_IDS.pdf	241717 208a986c88091a41abafd28eb9391c6297f6cdc5	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	3
	Information Disclosure Statement (IDS) Form (SB08)	4	4

Warnings:	
Information:	
Total Files Size (in bytes):	13743148

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Espacenet

Bibliographic data: CN105432114 (A) — 2016-03-23

Systems and methods for communicating multi-destination traffic in a wireless network

Inventor(s): ASTERJADHI ALFRED; MERLIN SIMONE ± (ASTERJADHI ALFRED, ; MERLIN SIMONE)

Applicant(s): QUALCOMM INC ± (QUALCOMM, INCORPORATED)

Classification: **- international:** ***H04L1/12; H04W28/06***
- cooperative: **H04L1/1685 (EP, US); H04W28/065 (EP, US);** H04L1/12 (EP, US); H04W80/02 (EP, US)

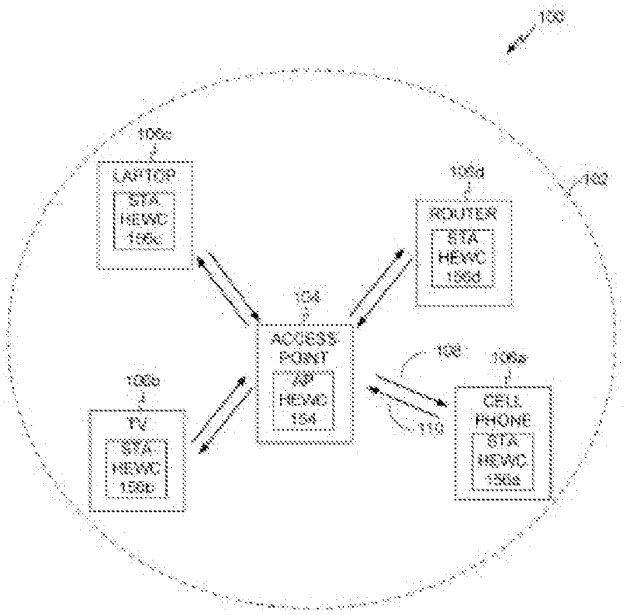
Application number: CN20148042745 20140730 Global Dossier

Priority number(s): WO2014US48920 20140730 ; US201361860227P 20130730 ; US201414446325 20140729

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Abstract of CN105432114 (A)

Systems, methods, and apparatuses for communicating multi-destination traffic are provided. One aspect of this disclosure provides a method of wireless communication. The method includes generating two media access control protocol data unit (MPDU) sub-frames, the A-MPDU sub-frames each comprising a different receiver address, generating an aggregated media access control protocol data unit (A-MPDU) frame comprising the two A-MPDU sub-frames, the A-MPDU signaling two different acknowledgement policies associated with the two different receiver addresses; and transmitting the A-MPDU frame.


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CLAIMS CN105432114A

1.

A wireless communication method, comprising:

A-MPDU frames comprising two or more aggregated medium access control protocol data unit (A-MPDU) subframes are generated by an apparatus, wherein each A-MPDU subframe includes a recipient address, and further wherein the A-MPDU frame includes at least one indication of one or more acknowledgment strategies associated with the recipient address of each A-MPDU subframe; and

The A-MPDU frame is output for transmission.

2.

The method of claim 1, wherein the one or more acknowledgment strategies are indicated in corresponding one or more control fields of the A-MPDU subframe.

3.

10. The method of claim 1, wherein at least one of the one or more acknowledgment strategies indicates that a control response frame is to be received after a subframe comprising the two or more A-MPDUs is received transmitted after the A-MPDU frame.

4.

4. The method of claim 3, wherein at least one of the one or more acknowledgment strategies further indicates that the control response frame is to include the two or more A- The A-MPDU frame of the MPDU subframe is transmitted after a short inter-frame space time.

5.

3. The method of claim 3, wherein at least one of the one or more acknowledgment strategies further indicates that the control response frame is to be in at least one of the one or more acknowledgment strategies Sent when one is set to a specific value.

6.

The method of claim 1, wherein at least one A-MPDU subframe of the two or more A-MPDU subframes includes a medium access control protocol data unit (MPDU) delimiter field , the MPDU delimiter field stores an indication that after receiving the at least one A-MPDU subframe of the two or more A-MPDU subframes and after transmitting a pair of the two or more A-MPDU

subframes The value of the time delay that elapses before acknowledgement of the at least one of the A-MPDU subframes.

7.

7. The method of claim 6, wherein the MPDU delimiter field of the at least one A-MPDU subframe of the two or more A-MPDU subframes indicates the The time delay is based on the backoff value also indicated in the MPDU Delimiter field.

8.

8. The method of claim 7, wherein the backoff value indicated in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value.

9.

The method of claim 1, wherein generating the A-MPDU frame comprises an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes or A request for acknowledgment of receipt is generated in at least one of the acknowledgment policy fields, wherein a value in the end of frame field or the acknowledgment policy field determines the type of request for acknowledgment of receipt.

10.

10. The method of claim 9, further comprising receiving a response to the two or more A-MPDUs after a delay greater than or equal to a short interframe space time after transmission of the A-MPDU frame Acknowledgement of receipt of the at least one A-MPDU subframe in the MPDU subframe.

11.

The method of claim 9, further comprising:

setting the value of the end-of-frame field in the at least one A-MPDU subframe of the two or more A-MPDU subframes to indicate that the two or more A-MPDU subframes The type of the request for acknowledgement of receipt of the at least one A-MPDU subframe in the frame is an acknowledgement frame.

12.

The method of claim 9, further comprising:

setting the value of the end-of-frame field in the at least one A-MPDU subframe of the two or more A-MPDU subframes to indicate that the two or more A-MPDU subframes The type of the request for acknowledgement of receipt of the at least one A-MPDU subframe in the frame is a block acknowledgement frame.

13.

An apparatus for wireless communication, comprising:

a processing system configured to generate an A-MPDU frame including two or more aggregated medium access control protocol data unit (A-MPDU) subframes, wherein each A-MPDU subframe includes a recipient address, and further wherein the A-MPDU frame includes at least one indication of one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe; and

An interface for outputting the A-MPDU frame for transmission.

14.

14. The apparatus of claim 13, wherein the processing system is further configured to indicate the one or more in corresponding one or more control fields of the two or more A-MPDU subframes Various confirmation strategies.

15.

14. The apparatus of claim 13, wherein at least one of the one or more acknowledgment strategies indicates that a control response frame is to be received after a subframe comprising the two or more A-MPDUs is received transmitted after the A-MPDU frame.

16.

16. The apparatus of claim 15, wherein at least one of the one or more acknowledgment strategies further indicates that the control response frame is to include the two or more A- The A-MPDU frame of the MPDU subframe is transmitted after a short inter-frame space time.

17.

16. The apparatus of claim 15, wherein the processing system is further configured to set the at least one of the one or more acknowledgment policies to a particular value to indicate the control response frame will be output for transmission.

18.

14. The apparatus of claim 13, wherein at least one A-MPDU subframe of the two or more A-MPDU subframes includes a medium access control protocol data unit (MPDU) delimiter field , wherein the processing system is configured to set the indication stored in the MPDU delimiter field after receiving the at least one A-MPDU subframe of the two or more A-MPDU subframes and The value of the time delay that elapses before an acknowledgment for the at least one A-MPDU subframe of the two or more A-MPDU subframes is output for transmission.

19.

19. The apparatus of claim 18, wherein the MPDU delimiter field of the at least one A-MPDU subframe of the two or more A-MPDU subframes indicates the The time delay is based on the backoff value also indicated in the MPDU Delimiter field.

20.

19. The apparatus of claim 19, wherein the backoff value indicated in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value.

21.

14. The apparatus of claim 13, wherein the processing system is further configured to include an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes or A request for acknowledgment of receipt is generated in at least one of the acknowledgment policy fields, wherein a value in the end of frame field or the acknowledgment policy field determines the type of request for acknowledgment of receipt.

22.

22. The apparatus of claim 21, wherein the processing system is further configured to process the two received after a delay greater than or equal to a short interframe space time after transmission of the A-MPDU frame The acknowledgment of receipt of the at least one A-MPDU subframe of the one or more A-MPDU subframes is decoded.

23.

21. The apparatus of claim 21, wherein the processing system is further configured to convert the at least one A-MPDU subframe in the at least one A-MPDU subframe of the two or more A-MPDU subframes The value of the frame end field is set to indicate that the type of request for acknowledgement of receipt of the at least one A-MPDU subframe of the two or more A-MPDU subframes is an acknowledgment frame, and that all A received acknowledgment frame decoding for the at least one of

the two or more A-MPDU subframes.

24.

21. The apparatus of claim 21, wherein the processing system is further configured to convert the at least one A-MPDU subframe in the at least one A-MPDU subframe of the two or more A-MPDU subframes The value of the frame end field is set to indicate that the type of request for acknowledgement of receipt of the at least one A-MPDU subframe of the two or more A-MPDU subframes is a block acknowledgment frame, and a The received block acknowledgment frame decoding for the at least one of the two or more A-MPDU subframes.

25.

A wireless node for wireless communication, comprising:

at least one antenna;

a processing system configured to generate an A-MPDU frame including two or more aggregated medium access control protocol data unit (A-MPDU) subframes, wherein each A-MPDU subframe includes a recipient address, and further wherein the A-MPDU frame includes at least one indication of one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe; and

A transmitter configured to transmit the A-MPDU frame using the at least one antenna.

26.

A device comprising:

means for generating an A-MPDU frame comprising two or more aggregated medium access control protocol data unit (A-MPDU) subframes, wherein each A-MPDU subframe includes a recipient address, and further wherein the A-MPDU frame includes at least one indication of one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe; and

means for transmitting the A-MPDU frame.

27.

27. The apparatus of claim 26, wherein the means for generating an A-MPDU frame is configured to indicate the one or more in corresponding one or more control fields of the A-MPDU subframe Various confirmation strategies.

28.

27. The apparatus of claim 26, wherein at least one of the one or more acknowledgment strategies indicates that a control response frame is to be received after a subframe comprising the two or more A-MPDUs is received transmitted after the A-MPDU frame.

29.

29. The apparatus of claim 28, wherein at least one of the one or more acknowledgment strategies further indicates that the control response frame is to include the two or more A- The A-MPDU frame of the MPDU subframe is transmitted after a short inter-frame space time.

30.

29. The apparatus of claim 28, wherein the means for generating an A-MPDU frame is configured to set the at least one of the one or more acknowledgment policies to a particular value to it is further indicated that the control response frame is to be output for transmission after receiving the A-MPDU frame.

31.

27. The apparatus of claim 26, wherein at least one A-MPDU subframe of the two or more A-MPDU subframes further comprises a medium access control protocol data unit (MPDU) delimiter field, wherein the means for generating an A-MPDU frame is configured to set the at least one stored in the MPDU delimiter field indicating that at least one of the two or more A-MPDU subframes is received The value of the time delay that elapses after an A-MPDU subframe and before the acknowledgment of the corresponding A-MPDU subframe is transmitted.

32.

31. The apparatus of claim 31, wherein the MPDU delimiter field of the at least one A-MPDU subframe of the two or more A-MPDU subframes indicates the The time delay is based on the backoff value also indicated in the MPDU Delimiter field.

33.

33. The apparatus of claim 32, wherein the backoff value indicated in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value.

34.

27. The apparatus of claim 26, wherein the means for generating the A-MPDU frame comprises at least one A-MPDU subframe in the two or more A-MPDU subframes A request for acknowledgment is generated in at least one of an end-of-frame field or an acknowledgment policy field in Types of.

35.

35. The apparatus of claim 34, further comprising means for processing the two or more received after a delay greater than or equal to a short interframe space time after transmission of the A-MPDU frame A device for decoding the reception acknowledgment of the at least one A-MPDU subframe in the multiple A-MPDU subframes.

36.

35. The apparatus of claim 34, further comprising means for setting the value of the end-of-frame field in at least one A-MPDU subframe of two or more A-MPDU subframes to means indicating that the type of request for an acknowledgement of receipt of the at least one A-MPDU subframe of the two or more A-MPDU subframes is an acknowledgement frame, and Means for acknowledging frame decoding for the at least one A-MPDU subframe of the two or more A-MPDU subframes.

37.

35. The apparatus of claim 34, further comprising means for setting the value of the end-of-frame field in at least one A-MPDU subframe of two or more A-MPDU subframes to means indicating that the type of request for an acknowledgement of receipt of the at least one A-MPDU subframe of the two or more A-MPDU subframes is a block acknowledgment frame, and means for acknowledging the received acknowledgement The apparatus for block acknowledgment frame decoding for the at least one A-MPDU subframe of the two or more A-MPDU subframes.

38.

A computer program product comprising a computer-readable medium having instructions encoded thereon that, when executed, cause an apparatus to perform a method of wireless communication, the method comprising:

generating an A-MPDU frame comprising two or more aggregated medium access control protocol data unit (A-MPDU) subframes, wherein each A-MPDU subframe includes a recipient address, and further wherein the A- The MPDU includes at least one indication of one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe; and

The A-MPDU frame is transmitted.

39.

A wireless communication method, comprising:

receiving, by a device, an aggregated medium access control protocol data unit (A-MPDU) frame;

decoding, by the apparatus, two or more A-MPDU subframes of the received A-MPDU frame;

decoding, by the apparatus, a recipient address corresponding to each of the two or more A-MPDU subframes; and

The two or more A's of the received A-MPDU frame are determined based on a recipient address decoded for each of the two or more A-MPDU subframes - At least one A-MPDU subframe of the MPDU subframes is addressed to the device.

40.

The method of claim 39, further comprising:

Based on at least one indication associated with the recipient address of each A-MPDU subframe in corresponding at least one field of each of the two or more A-MPDU subframes to decode one or more acknowledgment strategies corresponding to each of the two or more A-MPDU subframes of the received A-MPDU frame.

41.

41. The method of claim 40, further comprising, if the at least one field of each of the two or more A-MPDU subframes is set to a specific value , a frame is generated based on the specific value of the at least one field and the frame is output for transmission.

42.

41. The method of claim 41, further comprising, framing the at least one field in the at least one A-MPDU subframe of the two or more A-MPDU subframes The value in the end field is decoded, wherein if the value in the end of frame field is one, the frame generated and output for transmission is an acknowledgment frame.

43.

41. The method of claim 41, further comprising, framing the at least one field in the at least one A-MPDU subframe of the two or more A-MPDU subframes The value in the end field is decoded, wherein if the value in the end of frame field is zero, the frame generated and output for transmission is a block acknowledgment frame.

44.

The method of claim 40, further comprising:

decoding a value in an end-of-frame field in the at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating a relationship with the two or more A-MPDU subframes - the type of request for receipt of acknowledgement of one or more acknowledgment strategies corresponding to each A-MPDU subframe in the MPDU subframe;

generating an acknowledgment frame acknowledging receipt of the at least one A-MPDU subframe of the two or more A-MPDU subframes if the decoded value in the end of frame field is one; and

The acknowledgment frame is output for transmission.

45.

The method of claim 40, further comprising:

decoding a value in an end-of-frame field in the at least one A-MPDU subframe of the two or more A-MPDU subframes, the decoded value indicating a relationship between the two or more A-MPDU subframes The type of the request to receive acknowledgment of one or more acknowledgment strategies corresponding to each A-MPDU subframe in the A-MPDU

subframes;

generating a block acknowledgment frame acknowledging receipt of the at least one A-MPDU subframe of the two or more A-MPDU subframes if the decoded value in the end of frame field is zero ;as well as

The block ack frame is output for transmission.

46.

The method of claim 44, further comprising:

decoding a Media Access Control Protocol Data Unit (MPDU) delimiter field in the at least one A-MPDU subframe of the two or more A-MPDU subframes;

Determine from the value stored in the MPDU delimiter field the time delay that elapses after receiving the A-MPDU frame and before outputting the acknowledgment frame for transmission; and

The acknowledgment frame is output based on the one or more acknowledgment policies corresponding to each of the two or more A-MPDU subframes after the time delay has elapsed for delivery.

47.

The method of claim 46, wherein the value stored in the MPDU delimiter field is a backoff value.

48.

48. The method of claim 47, wherein the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value.

49.

41. The method of claim 40, further comprising generating an acknowledgement of receipt for at least one A-MPDU subframe of the two or more A-MPDU subframes, and Transmission of the A-MPDU frame is followed by a delay greater than or equal to a short interframe space time based on one or more A-MPDU subframes corresponding to each of the two or more A-MPDU subframes An acknowledgment strategy to output the received acknowledgment for transmission.

50.

An apparatus for wireless communication, comprising:

A processing system that is configured to:

receiving an aggregated medium access control protocol data unit (A-MPDU) frame;

decoding two or more A-MPDU subframes of the received A-MPDU frame; and

decoding a recipient address corresponding to each of the two or more A-MPDU subframes; and

The two or more A's of the received A-MPDU frame are determined based on a recipient address decoded for each of the two or more A-MPDU subframes - At least one A-MPDU subframe of the MPDU subframes is addressed to the device.

51.

The apparatus of claim 50, wherein the processing system is further configured to:

Based on at least one indication associated with the recipient address of each A-MPDU subframe in corresponding at least one field of each of the two or more A-MPDU subframes to decode an acknowledgement policy for each of the two or more A-MPDU subframes of the received A-MPDU frame addressed to the device.

52.

51. The apparatus of claim 51, wherein the processing system is further configured to, if the at least one field of each A-MPDU subframe of the two or more A-MPDU subframes is set to a specific value, a frame is generated based on the specific value of the at least one field and the frame is output for transmission.

53.

53. The apparatus of claim 52, wherein the processing system is further configured to process the two or more A-MPDU subframes of the received A-MPDU frame addressed to the apparatus Decoding the value in the end-of-frame field of the at least one field in the at least one A-MPDU subframe, wherein the processing system is further configured to, if the value in the end-of-frame field is one Frames for transmission are generated as acknowledgement frames.

54.

53. The apparatus of claim 52, wherein the processing system is further configured to process the two or more A-MPDU subframes of the received A-MPDU frame addressed to the apparatus Decoding the value in the end of frame field of the at least one field in the at least one A-MPDU subframe in the frame, wherein the processing system is further configured to, if the value in the end of frame field is zero Frames for transmission are generated as block ack frames.

55.

51. The apparatus of claim 51, wherein the processing system is further configured to end a frame in the at least one A-MPDU subframe of the two or more A-MPDU subframes decoding of a value in a field indicating the type of request for an acknowledgment of receipt for the acknowledgment policy for each of the two or more A-MPDU subframes, And the processing system is further configured to generate an acknowledgment frame for transmission if the value in the end of frame field is one.

56.

51. The apparatus of claim 51, wherein the processing system is further configured to end a frame in the at least one A-MPDU subframe of the two or more A-MPDU subframes decoding of a value in a field indicating the type of request for an acknowledgment of receipt for the acknowledgment policy for each of the two or more A-MPDU subframes, And the processing system is further configured to generate a block ack frame for transmission if the value in the end of frame field is zero.

57.

The apparatus of claim 55, wherein the processing system is further configured to:

decoding a Media Access Control Protocol Data Unit (MPDU) delimiter field in the at least one A-MPDU subframe of the two or more A-MPDU subframes; and

determining from the value stored in the MPDU delimiter field the time delay that elapses after receipt of the A-MPDU frame and before transmission of the acknowledgment frame; and

The acknowledgment frame is generated for transmission after the time delay has elapsed based on the acknowledgment policy for each of the two or more A-MPDU subframes.

58.

The apparatus of claim 57, wherein the value stored in the MPDU delimiter field is a backoff value.

59.

The apparatus of claim 58, wherein the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value.

60.

51. The apparatus of claim 51, wherein the processing system is further configured to be based on a comparison of the two or an acknowledgement policy corresponding to each of the more A-MPDU subframes to generate the two or more A-MPDU frames for the received A-MPDU frames addressed to the device The receipt of at least one of the A-MPDU subframes of the MPDU subframes is acknowledged for transmission.

61.

A wireless node for wireless communication, comprising:

at least one antenna;

a receiver configured to receive, via the antenna, aggregated medium access control protocol data unit (A-MPDU) frames;

a processing system configured to process two or more A-MPDU subframes of the received A-MPDU frame and each A-MPDU subframe corresponding to the two or more A-MPDU subframes Receiver address decoding of MPDU subframes; and

The two or more A's of the received A-MPDU frame are determined based on a recipient address decoded for each of the two or more A-MPDU subframes - At least one A-MPDU subframe of the MPDU subframes is addressed to the wireless node.

62.

A device for wireless communication, comprising:

means for receiving aggregated medium access control protocol data unit (A-MPDU) frames;

means for decoding two or more A-MPDU subframes based on the received A-MPDU frame;

means for decoding a recipient address corresponding to each of the two or more A-MPDU subframes;

for determining the two A-MPDU frames decoded from the received A-MPDU frame based on the recipient address decoded for each of the two or more A-MPDU subframes At least one A-MPDU subframe of the or more A-MPDU subframes is addressed to means of the apparatus.

63.

The apparatus of claim 62, further comprising:

for based on at least one of the corresponding at least one field of each of the two or more A-MPDU subframes associated with the recipient address of each A-MPDU subframe A means for indicating an acknowledgment policy for each of the two or more A-MPDU subframes.

64.

63. The apparatus of claim 63, further comprising, if the at least one field of each of the two or more A-MPDU subframes is set to a particular value , means for generating a frame based on the specific value of the at least one field and means for transmitting the frame.

65.

65. The apparatus of claim 64, wherein the means for decoding is further configured to parse the data in the at least one A-MPDU subframe of the two or more A-MPDU subframes decoding of a value in an end-of-frame field of the at least one field, wherein if the value in the end-of-frame field is one, the means for generating is configured to generate an acknowledgment frame and the means for transmitting The apparatus is further configured to transmit the acknowledgment frame.

66.

65. The apparatus of claim 64, wherein the means for decoding is further configured to parse the data in the at least one A-MPDU subframe of the two or more A-MPDU subframes decoding of a value in an end-of-frame field of the at least one field, wherein if the value in the end-of-frame field is zero, the means for generating is configured to generate an acknowledgment

frame and the means for transmitting The apparatus is further configured to transmit the block acknowledgment frame.

67.

The apparatus of claim 63, further comprising:

means for decoding a value in an end-of-frame field in the at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating information about the two or more A-MPDU subframes the type of the request to receive acknowledgment of the acknowledgment policy of each A-MPDU subframe in the multiple A-MPDU subframes;

means for generating an acknowledgment frame for the at least one A-MPDU subframe of the two or more A-MPDU subframes if the value in the end of frame field is one; and

means for transmitting the acknowledgment frame.

68.

The apparatus of claim 63, further comprising:

means for decoding a value in an end-of-frame field in the at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating information about the two or more A-MPDU subframes the type of the request to receive acknowledgment of the acknowledgment policy of each A-MPDU subframe in the multiple A-MPDU subframes;

means for generating a block acknowledgment frame for the at least one of the two or more A-MPDU subframes if the value in the end of frame field is zero; and

means for transmitting the block acknowledgment frame.

69.

The apparatus of claim 67, further comprising:

means for decoding a medium access control protocol data unit (MPDU) delimiter field in the at least one A-MPDU subframe of the two or more A-MPDU subframes;

means for determining, from a value stored in the MPDU delimiter field, a time delay that elapses after receipt of the A-MPDU frame and before transmission of the acknowledgment frame; and

Means for generating the acknowledgment frame based on the acknowledgment policy for each of the two or more A-MPDU subframes after the time delay has elapsed.

70.

69. The apparatus of claim 69, wherein the value in the MPDU Delimiter field is a backoff value.

71.

The apparatus of claim 70, wherein the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value.

72.

The apparatus of claim 63, further comprising, means for generating an acknowledgement of receipt for at least one A-MPDU subframe of the two or more A-MPDU subframes, and for if a block acknowledgment strategy is indicated with respect to the acknowledgment strategy for the at least one of the two or more A-MPDU subframes, then after transmission of the A-MPDU frame greater than or a delay equal to a short interframe space time to transmit the acknowledgement received.

73.

A computer program product comprising a computer-readable medium having instructions encoded thereon that, when executed, cause an apparatus to perform a method of wireless communication, the method comprising:

receiving an aggregated medium access control protocol data unit (A-MPDU) frame;

decoding two or more A-MPDU subframes of the received A-MPDU frame;

decoding a recipient address corresponding to each of the two or more A-MPDU subframes; and

It is determined that at least one A-MPDU subframe of the two or more A-MPDU subframes of the received A-MPDU frame is addressed to the apparatus.

74.

The method of claim 1, further comprising setting, by the apparatus, a transmitter address field of each A-MPDU subframe of the two or more A-MPDU subframes to A source transmitter address is indicated for each of the two or more A-MPDU subframes.

75.

14. The apparatus of claim 13, wherein the processing system is further configured to set a transmitter address field of each of the two or more A-MPDU subframes to a is a source transmitter address indicating each of the two or more A-MPDU subframes.

76.

27. The apparatus of claim 26, further comprising means for setting a transmitter address field of each of the two or more A-MPDU subframes to indicate the means for specifying the source transmitter address of each of the two or more A-MPDU subframes.

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DESCRIPTION CN105432114A

System and method for conveying multi-destination traffic in a wireless network

[0001]

background

[0002]

field

[0003]

The present application relates generally to wireless communications, and more particularly to systems, methods, and apparatus for conveying multi-destination traffic.

[0004]

background

[0005]

In many telecommunication systems, communication networks are used to exchange messages between several spatially separated interacting devices.

Networks can be classified according to geographic areas, which can be, for example, urban areas, local areas, or personal areas.

Such networks may be designated as a wide area network (WAN), metropolitan area network (MAN), local area network (LAN), wireless local area network (WLAN), or personal area network (PAN), respectively.

Networks are also based on the switching/routing techniques used to interconnect the various network nodes and devices (eg, circuit-switched vs. packet-switched), the type of physical medium used for transmission (eg, wired vs. wireless), and the type of Communication protocol sets (eg, Internet Protocol Suite, SONET (Synchronous Optical Networking), Ethernet, etc.) vary.

[0006]

Wireless networks are often preferred when the network elements are mobile and thus have dynamic connectivity requirements, or where the network architecture is formed in an adhoc topology rather than a fixed topology.

Wireless networks employ an invisible physical medium in an unguided propagation mode using electromagnetic waves in the radio, microwave, infrared, optical, etc. frequency bands.

Wireless networks advantageously facilitate user mobility and rapid field deployment when compared to fixed wired networks.

[0007]

However, multiple wireless networks may exist within the same building, within adjacent buildings, and/or within the same outdoor area.

The ubiquity of multiple wireless networks can cause interference, reduced throughput (eg, because each wireless network operates within the same area and/or frequency spectrum), and/or prevent certain devices from communicating. Accordingly, improved systems, methods and apparatus for communicating when wireless networks are densely populated are desired.

[0008]

Overview

[0009]

The systems, methods, and apparatuses of the present invention each have several aspects, no single one of which is solely responsible for its desirable attributes.

Without limiting the scope of the invention as expressed by the appended claims, some features will now be discussed briefly.

After considering this discussion, and especially after reading the section entitled "Detailed Description," it will be appreciated how the features of the present invention provide advantages including improved communication between access points and stations in a wireless network of.

[0010]

One aspect of the present disclosure provides a wireless communication method.

In one aspect, the method includes generating, by a wireless device, an A-MPDU frame including two or more aggregated medium access control protocol data unit (A-MPDU) subframes, wherein each A-MPDU subframe includes receiving party address, and further wherein the A-MPDU frame includes at least one indication of one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe; and the A-MPDU frame is output by the wireless device to for transmission.

[0011]

In some aspects, the one or more acknowledgment strategies are indicated in corresponding one or more control fields of the A-MPDU subframe.

In some aspects, at least one of the one or more acknowledgment strategies indicates that a control response frame should be transmitted after an A-MPDU is received. In some aspects, the one or more acknowledgment policies indicate that the acknowledgment should be transmitted SIFS time after the A-MPDU is received.

[0012]

In some aspects, at least one of the one or more acknowledgment strategies indicates that the control response frame should be set to a particular value (such as "normal acknowledgment") in at least one of the one or more acknowledgment strategies or implicit block ack request" value).

[0013]

In some aspects of the method, at least one of the two or more A-MPDU subframes includes an A-MPDU delimiter field, and the A-MPDU delimiter field indicates the corresponding A-MPDU subframe Time delay for frame acknowledgment.

In some aspects, the time delay is based on a backoff value also included in the A-MPDU Delimiter field.

In some aspects, the backoff value is based on at least one of a SIFS time or a constant value.

[0014]

In some aspects, the method further includes generating a request for an acknowledgment of receipt in a field in at least one of the two or more A-MPDU subframes, wherein the field includes an end-of-frame based field The value of at least one of the value of the acknowledgment policy field or the value of the acknowledgment policy field, and wherein the value in the field determines the type of request to acknowledge receipt.

In some of these aspects, the acknowledgment of receipt is received after a delay greater than or equal to the SIFS time after transmitting the A-MPDU.

[0015]

In some aspects, the method further includes setting a value of an end-of-frame (EOF) field in at least one of the two or more A-MPDU subframes in the A-MPDU frame to indicate that the two or more A-MPDU subframes The type of request for acknowledgement of receipt of at least one A-MPDU subframe of the one or more A-MPDU subframes is an acknowledgement frame.

In some aspects, the method further includes setting a value of an end-of-frame (EOF) field in at least one of the two or more A-MPDU subframes in the A-MPDU frame to indicate that the The type of request for acknowledgement of receipt of at least one A-MPDU subframe of the one or more A-MPDU subframes is a block acknowledgment frame.

[0016]

Another aspect disclosed is an apparatus for wireless communication.

The apparatus includes a processing system configured to generate an aggregated media access control protocol data unit (A-MPDU) frame including two or more media access control protocol data unit (MPDU) subframes, wherein each the A-MPDU subframes include the recipient address, and further wherein the A-MPDU frame includes at least one indication of one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe; and interface for outputting A-MPDU frames for transmission.

[0017]

In some aspects, the processing system is further configured to indicate one or more acknowledgment strategies in corresponding one or more control fields of the A-MPDU subframe.

In some aspects, one of the one or more acknowledgment strategies indicates that the control response frame should be transmitted after the A-MPDU frame is received. In some aspects, the acknowledgment policy indicates that the acknowledgment should be transmitted SIFS time after the A-MPDU frame is received.

[0018]

In some aspects, the processing system is configured to set at least one of the one or more acknowledgment policies to a particular value, such as a "normal acknowledgment or implicit block acknowledgment request" value.

In some aspects, at least one of the two or more A-MPDU subframes includes an A-MPDU delimiter field, and wherein the processing system is configured to set the A-MPDU delimiter field to Indicates the time delay for the acknowledgment of the corresponding A-MPDU subframe.

[0019]

In some aspects, the time delay is based on a backoff value also included in the A-MPDU delimiter field.

In some aspects, the backoff value is based on at least one of a SIFS time or a constant value. In some aspects, the processing

system is further configured to generate a request for acknowledgement of receipt in a field in at least one of the two or more A-MPDU subframes, wherein the field includes a frame-based The value of at least one of the value of the end field or the value of the acknowledgment policy field, and further wherein the value in the field determines the type of request to acknowledge receipt. In some aspects, the processing system is further configured to process at least one A-MPDU subframe of two or more A-MPDU subframes received after a delay greater than or equal to a SIFS time after transmission of the A-MPDU frame The frame's receipt acknowledgement is decoded. In some aspects, the processing system is further configured to:

[0020]

setting the value of the end-of-frame field in at least one of the two or more A-MPDU subframes to indicate that the The type of request for acknowledgment of subframes is an acknowledgment frame, and decoding of the received acknowledgment frame for at least one of the two or more A-MPDU subframes.

In some aspects, the processing system is further configured to: set a value of an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes to indicate that the two or more A-MPDU subframes The type of request for acknowledgement of receipt of at least one of the A-MPDU subframes is a block acknowledgment frame, and a request for a received acknowledgement of at least one of the two or more A-MPDU subframes A block acknowledgment frame decoding of an A-MPDU subframe.

[0021]

Another aspect disclosed is an access point.

The access point includes: at least one antenna; and a processing system configured to generate an aggregated media access control protocol data unit (A- MPDU) frame, wherein each A-MPDU subframe includes a recipient address, and further wherein the A-MPDU frame includes information about one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe at least one indication; and a transmitter configured to transmit the A-MPDU frame using the at least one antenna.

[0022]

Another aspect disclosed is an apparatus.

The apparatus includes means for generating an aggregated medium access control protocol data unit (A-MPDU) frame comprising two or more medium access control protocol data unit (MPDU) subframes, wherein each A- The MPDU subframe includes a recipient address, and further wherein the A-MPDU frame includes at least one indication of one or more acknowledgment policies associated with the recipient address of each A-MPDU subframe; and for transmitting A - Means of MPDU frame.

[0023]

In some aspects, the means for generating two or more medium access control protocol data unit (MPDU) subframes is a processing system.

In some aspects, a means for generating an A-MPDU frame comprising two or more aggregated medium access control protocol data unit (A-MPDU) subframes is a processing system. In some aspects, the means for transmitting A-MPDU frames is a transmitter.

[0024]

In some aspects, the means for generating two or more MPDU subframes is configured to indicate one or more acknowledgment strategies in corresponding one or more control fields of the A-MPDU subframe.

In some aspects, one of the one or more acknowledgment strategies indicates that the control response frame should be transmitted after the A-MPDU is received. In some aspects, the acknowledgment policy indicates that the acknowledgment should be delivered SIFS time after the A-MPDU is received. In some aspects, the means for generating two or more MPDU subframes is configured to set at least one of the one or more acknowledgment strategies to a particular value, such as "normal

acknowledgment or implicit block acknowledgment" receive request" value. In some aspects, at least one A-MPDU subframe of the two or more A-MPDU subframes includes an A-MPDU delimiter field, and wherein the means for generating the two or more MPDU subframes is Configured to set the A-MPDU delimiter field to indicate the time delay for the acknowledgment of the corresponding A-MPDU subframe. In some aspects, the time delay is based on a backoff value included in the A-MPDU delimiter field. In some aspects, the backoff value is based on at least one of a SIFS time or a constant value. In some aspects, the apparatus further includes means for generating an A-MPDU frame including two or more A-MPDU subframes, the generating an A-MPDU frame including in the two or more A-MPDU subframes A request for an acknowledgment is generated in at least one field in the A-MPDU subframe, wherein the field includes a value based on at least one of the value of the end of frame field or the value of the acknowledgment policy field, and further wherein where the value in this field determines the type of request to acknowledge receipt.

[0025]

In some aspects, the apparatus further comprises, for at least one of two or more A-MPDU subframes received after a delay greater than or equal to a short interframe space time after transmission of the A-MPDU frame A device for decoding an A-MPDU subframe upon acknowledgment of receipt.

In some aspects, the apparatus further includes means for decoding a block acknowledgment frame of one of the A-MPDU subframes when the end of frame (EOF) field of the A-MPDU subframe is zero. In some aspects, the apparatus further includes means for decoding an acknowledgment frame of an A-MPDU subframe when an end of frame (EOF) field of an A-MPDU subframe is set.

[0026]

Another disclosed aspect is a computer program product comprising a computer-readable medium having instructions encoded thereon that, when executed, cause an apparatus to perform a method of wireless communication, the method comprising: generating a method comprising two or A-MPDU frame of more aggregated medium access control protocol data unit (A-MPDU) subframes, wherein each A-MPDU subframe includes a recipient address, and further wherein the A-MPDU includes information related to each A-MPDU - at least one indication of one or more acknowledgment strategies associated with the recipient address of the MPDU subframe; and transmitting an A-MPDU frame.

[0027]

Another aspect disclosed is a wireless communication method.

The method includes: receiving, by a wireless device, an aggregated medium access control protocol data unit (A-MPDU) frame; decoding, by the wireless device, two or more A-MPDU subframes of the received A-MPDU frame ; decoding, by the apparatus, a recipient address corresponding to each of the two or more A-MPDU subframes; and A receiver address decoded from an A-MPDU subframe to determine that at least one of the two or more A-MPDU subframes of the received A-MPDU frame is addressed to the device.

[0028]

In some aspects, the method further includes a receiver address associated with each A-MPDU subframe based on a corresponding at least one field of each A-MPDU subframe of the two or more A-MPDU subframes to decode one or more acknowledgment strategies corresponding to each of the two or more A-MPDU subframes of the received A-MPDU frame.

In some aspects, the method further includes, if the field of each of the two or more A-MPDU subframes is set to a particular value, generating a frame based on the particular value of the field and output the frame for delivery.

In some aspects, the method further includes decoding a value in an end-of-frame field in at least one of the two or more A-MPDU subframes, wherein if the value in the end-of-frame field is one, The frame generated and output for transmission is then an acknowledgment frame. In some aspects, the method further includes decoding a value in an end-of-frame field in at least one of the two or more A-MPDU subframes, wherein if the value in the end-of-frame field is zero, The frame that is generated and output for transmission is then a block ack frame. In some aspects, the method further includes decoding a value in an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating a correlation between the two or more A-MPDU subframes The type of acknowledgment request for one or more acknowledgment strategies

corresponding to each A-MPDU subframe in the A-MPDU subframes; if the decoded value in the frame end field is one, then generate Acknowledging receipt of the at least one A-MPDU subframe of the two or more A-MPDU subframes; and outputting the acknowledgment frame for transmission.

[0029]

In some aspects, the method further includes decoding a value in an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating a correlation between the two or more A-MPDU subframes The type of the acknowledgment request for one or more acknowledgment strategies corresponding to each A-MPDU subframe in the A-MPDU subframes; if the decoded value in the frame end field is zero, then generate Acknowledging a received block acknowledgment frame for at least one of the two or more A-MPDU subframes; and outputting the block acknowledgment frame for transmission.

In some aspects, the method further comprises: decoding a medium access control protocol data unit (MPDU) delimiter field in at least one of the two or more A-MPDU subframes; The value stored in the delimiter field determines the time delay that elapses after the A-MPDU frame is received and before the acknowledgment frame is output for transmission; The decoded acknowledgment policy for each A-MPDU subframe in the subframe outputs an acknowledgment frame for transmission. In some aspects, the method further includes where the value stored in the MPDU delimiter field is a backoff value or where the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value. In some aspects, the method includes generating an acknowledgement of receipt for at least one A-MPDU subframe of the two or more A-MPDU subframes, and greater than or equal to a short frame after transmission of the A-MPDU frame The acknowledgment of receipt is output based on the decoded one or more acknowledgment policies corresponding to each of the two or more A-MPDU subframes after an inter-space-time delay, for transmission. In some aspects, the method further includes setting, by the apparatus, a transmitter address field of each of the two or more A-MPDU subframes to indicate the two or more A-MPDU subframes The source transmitter address of each A-MPDU subframe in the frame.

[0030]

Another aspect disclosed is an apparatus for wireless communication.

The apparatus includes: a receiver configured to receive aggregated media access control protocol data unit (A-MPDU) frames; and a processing system configured to respond to two or more of the received A-MPDU frames decoding multiple A-MPDU subframes, and decoding a recipient address corresponding to each of the two or more A-MPDU subframes, and - the decoded recipient address of each A-MPDU subframe in the MPDU subframe to determine at least one A-MPDU subframe out of two or more A-MPDU subframes of the received A-MPDU frame is addressed to this device. In some aspects of the apparatus, the processing system is further configured to based on a correlation between each A-MPDU subframe in the corresponding at least one field of each of the two or more A-MPDU subframes at least one indication associated with the address of the receiver to the acknowledgement policy for each of two or more A-MPDU subframes of the A-MPDU subframes received with respect to the A-MPDU frame addressed to the device decoding.

[0031]

Some aspects of the apparatus also include the processing system being further configured to generate a frame and to generate a frame if at least one field of each of the two or more A-MPDU subframes is set to a particular value Frames are output for transmission.

[0032]

In some aspects, the processing system is further configured to end a frame in at least one A-MPDU subframe of two or more A-MPDU subframes of the received A-MPDU frame addressed to the device The value in the field is decoded, wherein the processing system is further configured to generate the frame for transmission as an acknowledgment frame based on the particular value of the field if the value in the end of frame field is one.

In some aspects, the processing system is further configured to end a frame in at least one A-MPDU subframe of two or more A-MPDU subframes of the received A-MPDU frame addressed to the device The value in the field is decoded, wherein the processing system is further configured to generate the frame for transmission as a block acknowledgment frame if the value in

the end of frame field is zero.

In some aspects, the processing system is further configured to decode a value in an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating information about the two or more A-MPDU subframes the type of request for acknowledgement of receipt of the acknowledgment policy for each of the plurality of A-MPDU subframes, and the processing system is further configured to if the decoded value in the end of frame field is one, An acknowledgment frame is then generated for transmission. In some aspects, the processing system is further configured to decode a value in an end-of-frame field of at least one field in at least one of the two or more A-MPDU subframes, the value indicating information about the type of request for acknowledgement of receipt of the acknowledgement policy for each of the two or more A-MPDU subframes, and the processing system is further configured to A value of zero generates a block ack frame for transmission. In some aspects, the processing system is further configured to: decode a medium access control protocol data unit (MPDU) delimiter field in at least one A-MPDU subframe of the two or more A-MPDU subframes ; determine from the value stored in the delimiter field the time delay that elapses after the A-MPDU frame is received and before the transmission of the acknowledgment frame; and after the elapse of the time delay based on two or more A-MPDU sub- The decoded acknowledgment policy for each A-MPDU subframe in the frame generates an acknowledgment frame for transmission. In some aspects, the value stored in the MPDU delimiter field is a backoff value. In some aspects, the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value. In some aspects, the processing system is further configured to, after a delay greater than or equal to a short inter-frame space time after transmission of the A-MPDU frame, based on A-MPDU with each of the two or more A-MPDU subframes One or more acknowledgment strategies corresponding to the decoded MPDU subframes to generate at least one A-MPDU subframe of two or more A-MPDU subframes received for A-MPDU frames addressed to the device - Acknowledgement of receipt of MPDU subframes for transmission. In some aspects, the processing system is further configured to set the transmitter address field of each of the two or more A-MPDU subframes to indicate the two or more A-MPDU subframes The source transmitter address of each A-MPDU subframe in the frame.

[0033]

Another aspect disclosed is a station for wireless communication.

The station includes: at least one antenna; a receiver configured to receive, via the antenna, aggregated medium access control protocol data unit (A-MPDU) frames; and a processing system configured to process the received A-MPDUs two or more A-MPDU subframes of the frame, decoding the recipient address corresponding to each of the two or more A-MPDU subframes, and the decoded recipient address of each of the A-MPDU subframes or more A-MPDU subframes to determine at least one of the two or more A-MPDU subframes of the received A-MPDU subframe A-MPDU subframes are addressed to devices.

[0034]

Another disclosed aspect is an apparatus for wireless communication.

The apparatus comprises: means for receiving an aggregated medium access control protocol data unit (MPDU) frame; means for decoding two or more A-MPDU subframes of the received A-MPDU frame, and means for decoding a recipient address corresponding to each of the two or more A-MPDU subframes. In some aspects, the apparatus further includes means for determining, based on a recipient address decoded for each of the two or more A-MPDU subframes, that one of the two A-MPDU subframes is The device addressed to this device.

[0035]

Some aspects of the apparatus include for associating a recipient address with each A-MPDU subframe based on a corresponding at least one field of each of the two or more A-MPDU subframes Means for decoding an acknowledgment policy for each of the two or more A-MPDU subframes with at least one indication.

[0036]

Some aspects of the apparatus further include, if the at least one field of each of the two or more A-MPDU subframes is set to a particular value, for generating based on the particular value of the at least one field means for frames and means for transmitting frames.

In some aspects, the means for decoding is further configured to decode a value in an end-of-frame field of at least one field in at least one of the two or more A-MPDU subframes, wherein the The means for transmitting is further configured to transmit the acknowledgment frame as the frame if the value in the end of frame field is one.

In some aspects, the means for decoding is further configured to decode a value set in an end-of-frame field of at least one field in at least one of the two or more A-MPDU subframes, wherein The means for transmitting is further configured to transmit the block acknowledgment frame as the frame if the value in the end of frame field is zero.

[0037]

Some aspects of the apparatus further include: means for decoding a value in an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating a relationship with the two or more A-MPDU subframes Type of request for acknowledgment of receipt of the acknowledgment policy for each of the multiple A-MPDU subframes; used for two or more if the value in the end-of-frame field is one means for generating an acknowledgment frame in at least one of the A-MPDU subframes; and means for transmitting an acknowledgment frame.

In some aspects, the apparatus further includes means for decoding a value in an end-of-frame field in at least one of the two or more A-MPDU subframes, the value indicating a relationship with the two or more A-MPDU subframes. Type of request for acknowledgment of receipt of the acknowledgment policy for each of the multiple A-MPDU subframes; used for two or more if the value in the end of frame field is zero At least one of the A-MPDU subframes generates a block acknowledgment frame; and means for transmitting the block acknowledgment frame. In some aspects, the apparatus further includes means for decoding a medium access control protocol data unit (MPDU) delimiter field in at least one of the two or more A-MPDU subframes ; means for determining, from the value stored in the delimiter field, a time delay that elapses after the A-MPDU frame is received and before transmission of the acknowledgment frame; and for after the time delay has elapsed based on two or more A device for transmitting an acknowledgment frame with a decoded acknowledgment policy for each of the A-MPDU subframes. In some aspects, the value in the MPDU Delimiter field is a backoff value. In some aspects, the backoff value stored in the MPDU delimiter field is based on at least one of a short interframe space time or a constant value.

[0038]

In some aspects, the apparatus further includes means for generating an acknowledgement of receipt for at least one A-MPDU subframe of the two or more A-MPDU subframes, and for generating a receipt if the two or more A-MPDU subframes The acknowledgment strategy of at least one A-MPDU subframe in the A-MPDU subframe indicates the block acknowledgment strategy, then the acknowledgment is transmitted after a delay greater than or equal to a short interframe space time after the transmission of the A-MPDU frame. device.

[0039]

In some aspects, the means for receiving is a receiver.

In some aspects, the means for decoding two A-MPDU subframes is a processing system.

In some aspects, the means for decoding two different recipient addresses is a processing system. In some aspects, the means for determining is a processing system. In some aspects, the means for decoding an acknowledgment policy for an A-MPDU subframe is a processing system. In some aspects, the means for transmitting the control frame with the acknowledgment policy set to a particular value is a transmitter. In some aspects, the means for decoding an end-of-frame field in an A-MPDU subframe is a processing system. In some aspects, the means for determining the time delay for transmitting the control frame is a processing system. In some aspects, the means for receiving a request for an acknowledgment of an A-MPDU subframe is a receiver.

[0040]

In some aspects, the apparatus further comprises for setting a transmitter address field of each of the two or more A-MPDU subframes to indicate the two or more A-MPDU subframes A device for the source transmitter address of each A-MPDU subframe.

[0041]

Another disclosed aspect is a computer program product comprising a computer-readable medium having instructions encoded thereon that, when executed, cause an apparatus to perform a method of wireless communication, the method comprising: receiving an aggregated media interface. incoming control protocol data unit (MPDU) frames; decoding two or more A-MPDU subframes of the received A-MPDU frame; and decoding each of the two or more A-MPDU subframes The receiver address corresponding to an A-MPDU subframe is decoded.

[0042]

Brief Description of Drawings

[0043]

1 illustrates an exemplary wireless communication system in which aspects of the present disclosure may be employed.

[0044]

Figure 2A shows a wireless communication system in which multiple wireless communication networks exist.

[0045]

FIG. 2B shows another wireless communication system in which multiple wireless communication networks exist.

[0046]

Figure 3 illustrates a frequency reuse technique that may be employed within the wireless communication systems of Figures 1, 2A and 2B.

[0047]

4 illustrates a functional block diagram of an exemplary wireless device that may be employed within the wireless communication systems of FIGS. 1, 2A, 2B, and 3. FIG.

[0048]

5A illustrates a plurality of messages communicated by an access point to three stations in the wireless communication system of FIGS. 1, 2A, 2B, and 3. FIG.

[0049]

5B illustrates a single A-MPDU transmitted by an access point to three stations in the wireless communication systems of FIGS. 1, 2A, 2B, and 3. FIG.

[0050]

FIG. 6 shows an exemplary structure of a medium access control protocol data unit (MPDU) subframe.

[0051]

FIG. 7 shows an exemplary structure of a quality of service (QoS) control (qc) field.

[0052]

FIG. 8 shows an exemplary structure of an aggregated MPDU (A-MPDU) frame.

[0053]

Figure 9A shows an embodiment of the MPDU delimiter field.

[0054]

Figure 9B shows an alternate embodiment of the MPDU delimiter field.

[0055]

FIG. 9C shows an A-MPDU frame including three A-MPDU subframes.

[0056]

9D illustrates example wireless communications between an access point and three stations.

[0057]

9E illustrates an embodiment of an A-MPDU frame including three A-MPDU subframes.

[0058]

9F illustrates example wireless communication between an access point and three stations.

[0059]

10A illustrates an embodiment of an A-MPDU.

[0060]

10B shows example wireless communications between an access point and three stations.

[0061]

10C illustrates an embodiment of an A-MPDU.

[0062]

10D illustrates example wireless communications between an access point and three stations.

[0063]

11A is a flowchart of an exemplary wireless communication method.

[0064]

11B is a functional block diagram of an exemplary wireless device that may be employed within a wireless communication system.

[0065]

12A is a flowchart of an exemplary wireless communication method.

[0066]

12B is a functional block diagram of an exemplary wireless device that may be employed within a wireless communication system.

[0067]

13A is a flowchart of an exemplary wireless communication method.

[0068]

13B is a functional block diagram of an exemplary wireless device that may be employed within a wireless communication system.

[0069]

A detailed description

[0070]

Various aspects of the present novel systems, apparatus and methods are described more fully below with reference to the accompanying drawings.

This disclosure may, however, be embodied in many different forms and should not be construed as limited to any specific structure or function presented throughout this disclosure.

Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art.

Based on the teachings herein, those skilled in the art should appreciate that the scope of the present disclosure is intended to cover any aspect of these novel systems, devices, and methods disclosed herein, whether implemented independently or in conjunction with any other aspects of the present invention. Aspects are combined.

For example, an apparatus may be implemented or a method of practice may be implemented using any number of the aspects set forth herein.

In addition, the scope of the invention is intended to cover apparatus or methods that are practiced using other structure, functionality, or structure and functionality in addition to or other than the various aspects of the invention set forth herein.

It should be understood that any aspect disclosed herein may be embodied by one or more elements of a claim.

[0071]

Although certain aspects are described herein, numerous variations and permutations of these aspects fall within the scope of this disclosure.

Although some benefits and advantages of preferred aspects are mentioned, the scope of the present disclosure is not intended to be limited to particular benefits, uses, or objectives.

Rather, aspects of the present disclosure are intended to be broadly applicable to different wireless technologies, system configurations, networks, and transmission protocols, some of which are illustrated by way of example in the accompanying drawings and the following description of the preferred aspects.

The detailed description and drawings merely illustrate rather than limit the disclosure, the scope of which is defined by the appended claims and their equivalents.

[0072]

Popular wireless network technologies may include various types of wireless local area networks (WLANs).

WLAN can be used to interconnect nearby devices together using widely used networking protocols.

The various aspects described herein are applicable to any communication standard, such as a wireless protocol.

[0073]

In some aspects, Orthogonal Frequency Division Multiplexing (OFDM), Direct Sequence Spread Spectrum (DSSS) communications, a combination of OFDM and DSSS communications, or other schemes may be used to transmit wireless signals according to the high-efficiency 802.11 protocol.

Implementations of the high-efficiency 802.11 protocol can be used for Internet access, sensors, metering, smart grids, or other wireless applications.

Advantageously, aspects of certain devices implementing efficient 802.11 protocols using the techniques disclosed herein may include allowing for increased peer-to-peer services (eg, Miracast, WiFi Direct services, social WiFi, etc.) within the same area, support for increased minimum throughput requirements per user, support more users, provide improved outdoor coverage and robustness, and/or consume less power than devices implementing other wireless protocols.

[0074]

In some implementations, a WLAN includes various devices as components for accessing a wireless network.

For example, there may be two types of devices: access points ("APs") and clients (also known as stations, or "STAs").

In general, an AP can be used as a hub or base station of a WLAN, and a STA can be used as a user of the WLAN.

For example, the STA may be a laptop computer, a personal digital assistant (PDA), a mobile phone, or the like.

In one example, the STA connects to the AP via a WiFi compliant (e.g., IEEE 802.11 protocol) wireless link for general connectivity to the Internet or to other wide area networks.

In some implementations, STAs may also be used as APs.

[0075]

Another aspect disclosed is a wireless node for wireless communication.

The wireless node includes: an antenna; a processing system configured to generate a message indicating a start time of a window during which one or more devices are permitted to communicate with the device, the start time being based on an absolute time reference; and a transmitter that The antenna is configured to transmit the generated message using the antenna.

[0076]

An access point ("AP") may also include, be implemented as, or be referred to as a Node B, a radio network controller ("RNC"), an evolved Node B, a base station controller ("BSC"), a base transceiver station ("BTS"), base station ("BS"), transceiver function ("TF"), radio router, radio transceiver, or some other term.

[0077]

A station ("STA") may also include, be implemented as, or be referred to as an access terminal ("AT"), subscriber station, subscriber unit, mobile station, remote station, remote terminal, user terminal, user agent, user equipment , user equipment, or some other term.

In some implementations, access terminals may include cellular telephones, cordless telephones, Session Initiation Protocol ("SIP") telephones, wireless local loop ("WLL") stations, personal digital assistants ("PDAs"), wireless connectivity capable , or some other suitable processing device connected to the wireless modem.

Accordingly, one or more aspects taught herein may be incorporated into telephones (eg, cellular phones or smart phones), computers (eg, laptop devices), portable communication devices, handsets, portable computing devices (eg, personal data assistants), entertainment devices (eg, music or video devices, or satellite radios), gaming devices or systems, global positioning system devices, or any other suitable device configured to communicate via a wireless medium.

[0078]

As discussed above, certain devices described herein may implement, for example, the high-efficiency 802.11 standard.

Such devices, whether used as STAs or APs or other devices, can be used for smart metering or in smart grids.

Such devices can provide sensor applications or be used in home automation.

These devices may alternatively or additionally be used in a healthcare environment, such as for personal healthcare.

These devices may also be used for supervision to enable extended range Internet connectivity (eg, for use with hotspots), or to enable machine-to-machine communication.

Although various systems, methods, and apparatus are described herein with respect to the high-efficiency 802.11 standard, for example, those skilled in the art will appreciate that the present disclosure is applicable to other wireless communication standards, such as, for example, 802.11ah.

[0079]

1 illustrates an exemplary wireless communication system 100 in which aspects of the present disclosure may be employed.

The wireless communication system 100 may operate in accordance with a wireless standard, such as the High Efficiency 802.11 standard.

Wireless communication system 100 may include AP 104 that communicates with STAs 106 (generally referred to as STAs 106A-106D).

[0080]

Various procedures and methods may be used for transmissions between APs 104 and STAs 106 in wireless communication system 100.

For example, signals may be sent and received between AP 104 and STA 106 according to OFDM/OFDMA techniques.

If this is the case, the wireless communication system 100 may be referred to as an OFDM/OFDMA system.

Alternatively, signals may be sent and received between AP 104 and STA 106 according to code division multiple access (CDMA) techniques.

If this is the case, the wireless communication system 100 may be referred to as a CDMA system.

[0081]

The communication link that facilitates transmissions from the AP 104 to the one or more STAs 106 may be referred to as the downlink (DL) 108, and the communication link that facilitates transmissions from the one or more STAs 106 to the AP 104 may be referred to as the uplink (UL)110.

Alternatively, downlink 108 may be referred to as a forward link or forward channel, and uplink 110 may be referred to as a reverse link or reverse channel.

[0082]

AP 104 may act as a base station and provide wireless communication coverage in Basic Service Area (BSA) 102 .

An AP 104, together with the STAs 106 associated with the AP 104 and communicating using the AP 104, may be referred to as a Basic Service Set (BSS).

It should be noted that the wireless communication system 100 may not have a central AP 104, but may function as a peer-to-peer network between the STAs 106.

Accordingly, the functions of AP 104 described herein may alternatively be performed by one or more STAs 106 .

[0083]

In some aspects, a STA 106 may be required to associate with an AP 104 to send communications to and/or receive communications from the AP 104.

In one aspect, the information for the association is included in the broadcast made by the AP 104 .

To receive such broadcasts, for example, the STA 106 may perform a wide coverage search on the coverage area.

The search may also be performed by the STA 106 by sweeping the coverage area in a beacon fashion, for example.

After receiving the information for association, the STA 106 may transmit a reference signal, such as an association probe or request, to the AP 104.

In some aspects, AP 104 may use backhaul services, for example, to communicate with a larger network, such as the Internet or the public switched telephone network (PSTN).

[0084]

In one embodiment, AP 104 includes AP High Efficiency Wireless Component (HEWC) 154 .

APHEWC 154 may perform some or all of the operations described herein to enable communication between AP 104 and STA 106 using the high-efficiency 802.11 protocol.

The functionality of APHEWC154 is described in more detail below with respect to Figures 2B, 3, 4 and 5-11.

[0085]

Alternatively or additionally, STA 106 may include STAHEWC 156 .

The STAHEWC 156 may perform some or all of the operations described herein to enable communication between the STA 106 and the AP 104 using the high frequency 802.11 protocol.

The functionality of STAHEWC156 is described in more detail below with respect to Figures 2B, 3, 4 and 5-11.

[0086]

In some environments, a BSA may be located near other BSAs.

For example, Figure 2A shows a wireless communication system 200 in which multiple wireless communication networks exist.

As illustrated in Figure 2A, BSAs 202A, 202B, and 202C may be physically adjacent to each other. Although the BSAs 202A-202C are in close proximity, the APs 204A-204C and/or the STAs 206A-206H may each communicate using the same spectrum. Therefore, if a device in BSA 202C (eg, AP 204C) is transmitting data, a device outside BSA 202C (eg, AP 204A-204B or STA 206A-206F) can hear the communication on the medium.

[0087]

In general, wireless networks using conventional 802.11 protocols (eg, 802.11a, 802.11b, 802.11g, 802.11n, etc.) operate under a Carrier Sense Multiple Access (CSMA) mechanism for medium access.

According to CSMA, a device listens to the medium and transmits only when the medium is heard to be idle. Therefore, if APs 204A-204C and/or STAs 206A-206H are operating according to CSMA mechanisms and a device in BSA 202C (eg, AP 204C) is transmitting data, APs 204A-204B and/or STAs 206A-206F outside of BSA 202C may not be on the medium make transfers, even if they are part of a different BSA.

[0088]

Figure 2A illustrates this scenario.

As shown in Figure 2A, the AP204C is transmitting on the medium. The transmission is heard by STA 206G in the same BSA

202C as AP 204C and by STA 206A in a different BSA from AP 204C. While the transmission may be addressed to STA 206G and/or only STAs in BSA 202C, STA 206A may not be able to transmit or receive communications (eg, to or from the AP) until AP 204C (and any other device) is no longer transmitting on the medium. 204A). Although not shown, the same may apply to STAs 206D-206F in BSA 202B and/or STAs 206B-206C in BSA 202A (eg, if AP 204C makes a stronger transmission to enable other STAs to hear the transmission on the medium)).

[0089]

The use of the CSMA mechanism then creates inefficiencies, since some APs or STAs outside a BSA may be able to transmit data without interfering with transmissions by APs or STAs in the BSA.

As the number of active wireless devices continues to grow, such inefficiencies can begin to significantly impact network latency and throughput. For example, significant network latency issues may arise in apartment buildings, where each apartment unit may include an access point and associated station. In fact, each apartment unit can include multiple access points, as a resident can have wireless routers, video game consoles with wireless media center capabilities, televisions with wireless media center capabilities, Cellular phones, and/or the like. Correcting the inefficiencies of the CSMA mechanism would then be critical to avoid latency and throughput issues and overall user dissatisfaction.

[0090]

Such latency and throughput issues may not even be limited to residential areas.

For example, multiple access points may be located at airports, subway stations, and/or other crowded public spaces. Currently, WiFi access can be provided in these public spaces for a fee. If the inefficiencies created by the CSMA mechanism are not corrected, operators of wireless networks may lose customers as charges and lower quality of service begin to outweigh any benefits.

[0091]

Accordingly, the high-efficiency 802.11 protocol described herein may allow devices to operate under modified mechanisms that minimize these inefficiencies and increase network throughput.

Such a mechanism is described below with respect to FIGS. 2B , 3 and 4 . Additional aspects of the high-efficiency 802.11 protocol are described below with respect to Figures 5-11.

[0092]

FIG. 2B shows a wireless communication system 250 in which multiple wireless communication networks exist.

Unlike the wireless communication system 200 of Figure 2A, the wireless communication system 250 may operate in accordance with the high-efficiency 802.11 standard discussed herein. Wireless communication system 250 may include AP 254A, AP 254B, and AP 254C. AP254A can communicate with STA256A-256C, AP254B can communicate with STA256D-256F, and AP254C can communicate with STA256G-256H.

[0093]

Various processes and methods may be used for transmission in wireless communication system 250 between APs 254A-254C and STAs 256A-256H.

For example, signals may be transmitted and received between the APs 254A-254C and the STAs 256A-256H according to OFDM/OFDMA techniques or CDMA techniques.

[0094]

The AP254A can act as a base station and provide wireless communication coverage in the BSA252A.

The AP254B acts as a base station and provides wireless communication coverage in the BSA252B. The AP254C can act as a base station and provide wireless communication coverage in the BSA 252C. It should be noted that each BSA 252A, 252B,

and/or 252C may not have a central AP 254A, 254B, or 254C, but may allow peer-to-peer communication between one or more of the STAs 256A-256H. Accordingly, the functions of the APs 254A-254C described herein may alternatively be performed by one or more of the STAs 256A-256H.

[0095]

In one embodiment, APs 254A-254C and/or STAs 256A-256H include high-efficiency wireless components.

As described herein, the high-efficiency wireless components can enable the use of high-efficiency 802.11 protocols to communicate between APs and STAs. In particular, the high-efficiency wireless components may enable the APs 254A-254C and/or the STAs 256A-256H to use modified mechanisms that minimize inefficiencies of the CSMA mechanism (eg, enabling the for concurrent communication). The high-efficiency wireless components are described in more detail below with reference to FIG. 4 .

[0096]

As illustrated in Figure 2B, the BSAs 252A-252C are located physically adjacent to each other.

When, for example, AP 254A and STA 256B are communicating with each other, the communication can be heard by other devices in BSAs 252B-252C. However, this communication may only interfere with certain devices, such as STA 256F and/or STA 256G. Under CSMA, AP 254B is not allowed to communicate with STA 256E, even if such communication does not interfere with communication between AP 254A and STA 256B. Thus, the high-efficiency 802.11 protocol operates under a modified mechanism that distinguishes between devices that can communicate concurrently and devices that cannot. Such device classification may be performed by the high-efficiency wireless components in the AP254A-254C and/or the STA256A-256H.

[0097]

In one embodiment, the determination of whether a device can communicate concurrently with other devices is based on the location of the device.

For example, a STA located near the edge of a BSA may be in a state or condition that prevents the STA from concurrently communicating with other devices. As illustrated in Figure 2B, STAs 206A, 206F, and 206G may be devices that are in a state or condition in which they are unable to communicate concurrently with other devices. Likewise, a STA located near the center of the BSA may be in a state or condition that enables the STA to communicate with other devices. As illustrated in FIG. 2, STAs 206B, 206C, 206D, 206E, and 206H may be devices that are in states or conditions in which they can communicate concurrently with other devices. Note that device classifications are not permanent. A device may transition between being in a state or condition that enables it to communicate concurrently and being in a state or condition that enables it not to communicate concurrently (eg, the device may be in motion, when associating with a new AP, change state or condition when disassociating, etc.).

[0098]

Additionally, devices may be configured to behave differently based on whether they are devices in a state or condition that is concurrently communicating with other devices.

For example, devices in states or conditions that enable them to communicate concurrently may communicate within the same frequency spectrum. However, devices in states or conditions that prevent them from communicating concurrently may employ certain techniques, such as spatial multiplexing or frequency domain multiplexing, to communicate over the medium. Control of device behavior can be performed by the high-efficiency wireless components in the AP254A-254C and/or STA256A-256H.

[0099]

In one embodiment, devices in states or conditions that prevent them from communicating concurrently use spatial multiplexing techniques to communicate over the medium.

For example, power and/or other information may be embedded within the preamble of a packet transmitted by another device.

A device in a state or condition that prevents it from communicating concurrently can analyze the preamble when it hears a packet on the medium and decide whether to transmit based on a set of rules.

[0100]

In another embodiment, devices in states or conditions that prevent them from communicating concurrently use frequency domain multiplexing techniques to communicate over the medium.

3 illustrates a frequency reuse technique that may be employed within the wireless communication system 100 of FIG. 1 and the wireless communication system 250 of FIG. 2B. As illustrated in FIG. 3, APs 304A, 304B, 304C, and 304D may exist within wireless communication system 300. Each of APs 304A, 304B, 304C, and 304D may be associated with a different BSA and include the high-efficiency wireless components described herein.

[0101]

As an example, the bandwidth of the communication medium may be 80 MHz.

Under conventional 802.11 protocols, each of APs 304A, 304B, 304C, and 304D and the STAs associated with each respective AP attempt to use the entire bandwidth for communication, which can reduce throughput. However, under the highly efficient 802.11 protocol using frequency domain multiplexing, the bandwidth can be divided into four 20 MHz segments 308, 310, 312 and 314 (e.g., channels), as illustrated in FIG. AP 304A may be associated with segment 308, AP 304B may be associated with segment 310, AP 304C may be associated with segment 312, and AP 304D may be associated with segment 314.

[0102]

In one embodiment, when APs 304A-304D and those STAs in states or conditions that enable STAs to communicate concurrently with other devices (eg, STAs near the center of the BSA) are communicating with each other, then each AP 304A-304D and each of these STAs may communicate using some or all of the 80MHz medium.

However, when APs 304A-304D and those STAs in states or conditions that prevent STAs from communicating concurrently with other devices (eg, STAs near the edge of the BSA) are communicating with each other, AP 304A and its STAs use the 20MHz segment 308 to To communicate, AP 304B and its STAs use the 20MHz segment 310 to communicate, AP 304C and its STAs use the 20MHz segment 312 to communicate, and AP 304D and its STAs use the 20MHz segment 314 to communicate. Because segments 308, 310, 312, and 314 are distinct parts of the communication medium, a first transmission using the first segment does not interfere with a second transmission using the second segment.

[0103]

Thus, APs and/or STAs that include highly efficient wireless components, even those APs and/or STAs that are in states or conditions that prevent them from concurrently communicating with other devices, can communicate concurrently with other APs and STAs without interference.

Therefore, the throughput of the wireless communication system 300 can be increased. In the case of apartment buildings or crowded public spaces, APs and/or STAs using high-efficiency wireless components may experience reduced latency and increased network throughput even as the number of active wireless devices increases, thereby improving user experience.

[0104]

4 illustrates an exemplary functional block diagram of a wireless device 402 that may be employed within the wireless communication systems 100, 250 and/or 300 of FIGS. 1, 2B and 3.

Wireless device 402 is an example of a device that may be configured to implement the various methods described herein. For example, wireless device 402 may include one of AP 104, one of STA 106, one of AP 254, one of STA 256, and/or one of AP 304.

[0105]

The wireless device 402 may include a processor 404 that controls the operation of the wireless device 402 .

Processor 404 may also be referred to as a central processing unit (CPU). Memory 406, which may include both read only memory (ROM) and random access memory (RAM), may provide instructions and data to processor 404. A portion of memory 406 may also include non-volatile random access memory (NVRAM). The processor 404 typically performs logical and arithmetic operations based on program instructions stored within the memory 406 . The instructions in memory 406 may be executable to implement the methods described herein.

[0106]

Processor 404 may comprise or be a component of a processing system implemented with one or more processors.

The one or more processors can be implemented as general-purpose microprocessors, microcontrollers, digital signal processors (DSPs), field programmable gate arrays (FPGAs), programmable logic devices (PLDs), controllers, state machines, selectors implemented through any combination of logic, discrete hardware components, dedicated hardware finite state machines, or any other suitable entity capable of performing calculations or other manipulations of information.

[0107]

The processing system may also include a machine-readable medium for storing software.

Software should be construed broadly to mean any type of instructions, whether referred to as software, firmware, middleware, microcode, hardware description language, or otherwise. Instructions may include code (eg, in source code format, binary code format, executable code format, or any other suitable code format). These instructions, when executed by the one or more processors, cause the processing system to perform various functions described herein.

[0108]

The wireless device 402 may also include a housing 408, which may include a transmitter 410 and/or a receiver 412 to allow transmission and reception of data between the wireless device 402 and a remote location.

Transmitter 410 and receiver 412 may be combined into transceiver 414. Antenna 416 may be attached to housing 408 and electrically coupled to transceiver 414. Wireless device 402 may also include (not shown) multiple transmitters, multiple receivers, multiple transceivers, and/or multiple antennas.

[0109]

The transmitter 410 may be configured to wirelessly transmit what may be referred to as a "paging message" configured to indicate to the wireless device whether the wireless device needs to wake up from a doze state and enter an awake state, as follows discussed.

For example, transmitter 410 may be configured to transmit the paging messages generated by processor 404 discussed above. When wireless device 402 is implemented or used as STA 106, processor 404 may be configured to process paging messages. When wireless device 402 is implemented or used as AP 104, processor 404 may also be configured to generate paging messages.

[0110]

Receiver 412 may be configured to wirelessly receive paging messages.

When wireless device 402 is implemented or used as STA 106, transmitter 410 may be configured to transmit a request for data in response to a paging message. For example, wireless device 402 may be configured to transmit a power save poll (PS-Poll), as will be described herein with reference to FIG. 4 . When wireless device 402 is implemented or used as AP 104, transmitter 410 may be further configured to transmit data to one or more STAs 106. When wireless device 402 is implemented or used as STA 106, transmitter 410 may be configured to transmit acknowledgments for data received from AP 104.

[0111]

The wireless device 402 may also include a signal detector 418 that may be used in an attempt to detect and quantify the signal level received by the transceiver 414.

Signal detector 418 may detect signals such as total energy, energy per symbol per subcarrier, power spectral density, and other signals. Wireless device 402 may also include a digital signal processor (DSP) 420 for processing signals. DSP 420 may be configured to generate packets for transmission. In some aspects, packets may include physical layer data units (PPDUs).

[0112]

In some aspects, the wireless device 402 may further include a user interface 422 .

User interface 422 may include a keypad, a microphone, a speaker, and/or a display. User interface 422 may include any element or component that communicates information to and/or receives input from a user of wireless device 402.

[0113]

In some aspects, the wireless device 402 can further include a high-efficiency wireless component 424 .

High efficiency wireless assembly 424 may include a classifier unit 428 and a transport control unit 430. As described herein, the high-efficiency wireless component 424 can enable APs and/or STAs to use modified mechanisms that minimize inefficiencies of CSMA mechanisms (eg, enable operations on the medium without interference concurrent communication).

[0114]

The modified mechanism may be implemented by classifier unit 428 and transfer control unit 430 .

In one embodiment, the classifier unit 428 determines which devices are in states or conditions that enable them to communicate concurrently with other devices, and which devices are in states or conditions that prevent them from concurrently communicating with other devices. In one embodiment, the transport control unit 430 controls the behavior of the device. For example, transmit control unit 430 may allow certain devices to transmit concurrently on the same medium, and allow other devices to transmit using spatial multiplexing or frequency domain multiplexing techniques. Transport control unit 430 may control the behavior of the device based on the determinations made by classifier unit 428 .

[0115]

Various components of wireless device 402 may be coupled together by bus system 426 .

The bus system 426 may include, for example, a data bus, as well as a power bus, a control signal bus, and a status signal bus in addition to the data bus. Those skilled in the art will appreciate that the various components of wireless device 402 may be coupled together or use some other mechanism to accept or provide input to each other.

[0116]

Although several separate components are illustrated in Figure 4, those skilled in the art will recognize that one or more of these components may be combined or implemented collectively.

For example, processor 404 may be used to implement not only the functionality described above with respect to processor 404, but also the functionality described above with respect to signal detector 418 and/or DSP 420. Additionally, each component illustrated in Figure 4 may be implemented using multiple separate elements.

[0117]

Wireless device 402 may include AP 104, STA 106, AP 254, STA 256, and/or AP 304, and may be used to transmit and/or receive communications.

That is, any of AP104, STA106, AP254, STA256, or AP304 may function as a transmitter or receiver device. Certain aspects contemplate that signal detector 418 is used by software running on memory 406 and processor 404 to detect the presence of a transmitter or receiver.

[0118]

Referring again to FIG. 1, the STA 106 may have various modes of operation.

For example, the STA 106 may have a first mode of operation called an active mode. In the active mode, the STA 106 may always be in a "awake" state and actively transmit/receive data to/from the AP 104. Additionally, the STA 106 may have a second mode of operation known as a power save mode. In the power saving mode, the STA 106 may be in an "awake" state or a "doze" or "sleep" state in which the STA 106 is not actively transmitting/receiving data to/from the AP 104. For example, receiver 412 of STA 106 and possibly DSP 420 and signal detector 418 may operate with reduced power consumption in a doze state. Additionally, in the power save mode, the STA 106 may enter an awake state from time to time to listen for messages from the AP 104 (eg, paging messages) that indicate to the STA 106 whether the STA 106 needs to "wake up" (eg, go awake) at a certain time status) to be able to transmit/receive data to/from AP 104.

[0119]

Thus, in some wireless communication systems 100, the AP 104 may transmit paging messages to multiple STAs 106 in the power save mode in the same network as the AP 104, indicating whether there is data buffered at the AP 104 for the STAs 106.

The STAs 106 can also use this information to determine whether they need to be awake or doze. For example, if the STA 106 determines that it is not being paged, the STA 106 may enter a doze state. Alternatively, if the STA 106 determines that it may be paged, the STA 106 may enter an awake state for a period of time to receive the page and further determine when to be in the awake state based on the page. Additionally, the STA 106 may stay in the awake state for a certain period of time after receiving the page. In another example, the STA 106 may be configured to function when paged or not in other ways consistent with this disclosure.

[0120]

In some aspects, the paging message may include a bitmap (not shown in this figure), such as a traffic identification map (TIM).

In some such aspects, the bitmap may include several bits. These paging messages may be sent from AP 104 to STA 106 in beacons or TIM frames. Each bit in the bitmap may correspond to a particular STA 106 of the plurality of STAs 106, and the value of each bit (eg, 0 or 1) may indicate the buffer unit the corresponding STA 106 should be in to be able to receive the AP 104 with respect to that particular STA state (e.g., dozing or awake). Thus, the size of the bitmap may be proportional to the number of STAs 106 in the wireless communication system 100 . Thus, a larger number of STAs 106 in the wireless communication system 100 may result in a larger bitmap.

[0121]

In some aspects, a STA 106 that has been dormant for an extended period of time may not wake up to read any TIM messages.

For example, the STA 106 may decide to sleep in one or more TIM messages in an extended sleep mode. In this case, the STA 106 may inform the AP 104 that the STA 106 may not read any TIM messages. Accordingly, AP 104 may not include the corresponding identifier in the TIM message. In various embodiments, each STA 106 may notify the AP 104 immediately during association that they may not wake up during one or more TIM messages (i.e., they operate in the aforementioned power saving mode) using a control message or immediately.

[0122]

For STAs 106 that have notified AP 104 in this manner, AP 104 may not include the identifier in the TIM message, even when AP 104 has BUs intended for these STAs 106.

STAs 106 may assert their BUs by sending a PS-Poll to AP 104 at any time. In one embodiment, AP 104 may send buffer units (BUs) immediately in response to PS-Poll. In another embodiment, AP 104 may respond to PS-Poll with an acknowledgement (ACK) and deliver the BU at a later time. In yet another embodiment, AP 104 may not immediately respond to PS-Poll (neither ACK nor BU). The AP 104 may instead reply with a cumulative ACK frame sent after the given scheduled time after the TIM message.

[0123]

In various embodiments, the STA 106 may specify the latency to deliver the BU via PS-Poll (for dynamic indication), association request, probe request, and/or another management frame to the AP (for static indication) .

In other embodiments, AP 104 may specify delivery of BUs via ACK frames, TIM elements (for dynamic indications), beacons, association responses, probe responses, and/or other management frames to STAs 106 (for static indications) waiting time. The STA 106 may go to sleep for the waiting duration. The STA 106 may acknowledge correct receipt of the BU by sending an ACK. STA 106 may then go back to sleep.

[0124]

5A illustrates a plurality of wireless messages 502 communicated by AP 104 to STA 106 in wireless communication system 100 of FIG.

As shown, time increases horizontally across the pages on the timeline 504 . In various embodiments, AP 104 may receive and/or store buffer units including multiple frames 510A-510N addressed to several destination STAs 106. If the AP 104 has a buffer to transmit, it may transmit multiple wireless messages 502 to multiple STAs 106 .

[0125]

In various embodiments, frames 510A-510B may be small or short frames 510A-510N and may include about 1 byte to about 100 bytes, about 10 bytes to about 50 bytes, and more specifically about 20 bytes .

Small frames may be generated by applications such as, for example, push notifications (eg, emails, advertisements, etc.), short messaging applications (eg, Facebook™ posts, Twitter™ posts, text messages, etc.), upper layer protocol overhead (For example, Transmission Control Protocol (TCP) acknowledgments, keep-alive messages, etc.), and similar applications. Accordingly, a large number of relatively small frames may generate many wireless messages, which may result in one or more STAs 106 competing to transmit requests to the AP 104 over the medium.

[0126]

5B illustrates a single A-MPDU wireless message 502 communicated by AP 104 to STA 106 in wireless communication system 100 of FIG.

As shown, time increases horizontally across the pages on the timeline 504 . As discussed above with respect to FIG. 5A, the AP 104 may receive and/or store buffer units, including multiple frames 510A-510N addressed to several destination STAs 106. If the AP 104 has a buffer to transmit, instead of transmitting multiple wireless messages 502 as shown in FIG. 5A, the AP may transmit a single aggregated MPDU message 504. A-MPDU 504 may include multiple A-MPDU subframes 505a-c. One or more of the multiple A-MPDU subframes 505a-c included in the A-MPDU 504 may be addressed to different recipients.

[0127]

Since the A-MPDU subframes 505a-c of the wireless message 504 can be addressed to multiple recipients, there arises a question about how each recipient will determine any A-MPDU subframes 505a-c addressed to that recipient. question.

In order to coordinate acknowledgments from each recipient, one or more of the A-MPDU subframes 505a-c may include one or more fields that define an acknowledgment policy for that A-MPDU subframe. For example, the acknowledgment policy may, for example, indicate whether an acknowledgment for the A-MPDU subframe should be transmitted by the addressed recipient, the type of acknowledgment that should be transmitted (eg, should an acknowledgment or a block acknowledgment be transmitted), and/or The delay period between the time A-MPDU wireless message 504 is received and the time acknowledgments for any MPDU subframes included in message 504 are transmitted. The indicated acknowledgment policy for each A-MPDU subframe 505a-c is used to coordinate the acknowledgment of each of the MPDU subframes 505a-c so that in the event that each of the MPDU subframes 505a-c is acknowledged Reduce the probability of conflict.

[0128]

FIG. 6 shows an exemplary structure of a medium access control protocol data unit (MPDU) frame 600 .

As shown, MPDU frame 600 includes 11 different fields: frame control (fc) field 610, duration/identification (dur) field 625, receiver address (a1) field 630, transmitter address (a2) field 635, destination ground address (a3) field 640, sequence control (sc) field 645, fourth address (a4) field 650, quality of service (QoS) control (qc) field 655, high throughput (HT) control field 660, frame body 665 , and a Frame Check Sequence (FCS) field 670 . Some or all of the fields 610-660 make up the MAC header 602.

[0129]

Each of the fields of the medium access control frame may be considered a medium access control parameter.

Additionally, each field may include one or more subfields or fields. For example, the frame control field 610 of the medium access control header 602 may include a number of subfields, such as a protocol version, a type field, a subtype field, and other fields. Each of these subfields or fields may also be considered a medium access control parameter. In some embodiments, the individual bits of the medium access control frame may be considered as medium access control parameters.

[0130]

Each of the a1, a2, a3, and a4 fields 630, 635, 640, and 650 may include the full MAC address of the device, which is a 48-bit (6 octet) value.

In some aspects, any of these fields may include an AID based on the short MAC header format. Figure 6 further indicates the size in octets of each of the fields 610-670. The frame body field 665 includes a variable number of octets, and different types of MPDU frames may include only a portion of the fields shown in FIG. 6 . For example, if the MPDU frame is a control frame, the MAC header of the MPDU frame may not include the QoS control field 655 or the HT control field 660. Additionally, depending on the type, MPDU frame 600 may include additional fields. However, in some cases, regardless of type, MPDU frame 600 may include frame control field 610.

[0131]

FIG. 7 shows an exemplary structure of the quality of service (QoS) control (qc) field 655.

As shown, QoS control field 655 includes five (5) distinct fields: Traffic Indicator (TID) field 710, End of Service Period field 720, Acknowledgement Policy field 730, Aggregated MSDU Presence field 740, and " Change" field 750. In some aspects, the acknowledgment strategy field 730 may indicate one of four acknowledgment strategies. In some aspects, the four acknowledgment strategies may include "normal acknowledgment or implicit block acknowledgment request", "no acknowledgment", "no acknowledgment or power saving multiple polling (PSMP) acknowledgment", and " block acknowledgement". In some aspects, acknowledgement policy (ACK policy) field 730 and traffic indicator (TID) field 710 may be located elsewhere in the MAC header. For example, the acknowledgement policy field and/or the TID field may be located in the frame control field 610 of the MAC header 602 .

[0132]

The "change" field 750 may be a variety of different fields depending on the embodiment of the QoS control field 655.

For example, in some aspects, the "change" field 750 may be a TXOP limit field, an access point PS buffer status field, a requested TXOP duration field, or a queue size field.

[0133]

In some aspects, if the Acknowledgement Policy field 730 indicates a specific value (such as "Normal Acknowledgement or Implicit Block Acknowledgement Request") and the MPDU frame 600 is included as part of an A-MPDU frame, then the MPDU 600 is transmitted individually or When transmitted as part of an A-MPDU, the addressed recipient of the MPDU frame may transmit an acknowledgment frame or a block acknowledgment frame.

The transmission of an acknowledgment or block acknowledgment may begin after the PPDU carrying the MPDU frame 600 for a too short interframe space (SIFS) period. In some aspects, if the acknowledgment policy field 730 indicates "no

acknowledgment," the addressed recipient of the MPDU frame takes no action upon receipt of the MPDU subframe. In some aspects, if the acknowledgment policy field 730 indicates "block ack," the addressed recipient of the MPDU frame takes no action upon receipt of the frame other than logging the status. The receiver can expect future block acknowledgment request frames for which it will respond.

[0134]

FIG. 8 shows an example structure of an aggregated MPDU (A-MPDU) frame 800 .

As shown, A-MPDU frame 800 includes a variable number (n) of A-MPDU subframes, shown as 805a, 805b, and 805n. In some aspects, each of A-MPDU subframes 805a, 805b, and 805n may include MPDU delimiter field 810a, MPDU frame 600a, and zero or more padding bytes. In some aspects, MPDU frame 600a may substantially follow MPDU frame 600 illustrated in FIG. 6 .

[0135]

Each MPDU delimiter field (e.g., MPDU delimiter field 810a) may include an end of frame (EOF) field 812a, a reserved field 814a, an MPDU length field 816a, a CRC field 818a, and a delimiter signature field 820a.

[0136]

In some aspects, if A-MPDU subframe 805a is the only A-MPDU subfield with MPDU Length field 816a having a non-zero value, end of frame field 812 may be set to one (1) in A-MPDU subframe 805a .

In some aspects, for each A-MPDU subframe 805 in the A-MPDU frame 800 that has a non-zero MPDU length field 816a and is not an A-MPDU only subframe with a non-zero MPDU length field, the end of frame field 812a may be Set to zero (0).

[0137]

Figure 9A shows an embodiment of the MPDU delimiter field 810b.

In some aspects, MPDU delimiter field 810b may replace MPDU delimiter field 810a illustrated in FIG. 8 .

For example, A-MPDU 900a, discussed below with respect to Figure 9C, may utilize MPDU delimiter field 810b. MPDU delimiter field 810b includes four fields: delay indicator field 814b, MPDU length field 816b, CRC field 818b, and delimiter signature field 820b. In some aspects, if the MPDU delimiter field 810b is included in each of the A-MPDU subframes 905a-c discussed below with respect to FIG. 9C, then in each of the A-MPDU subframes 905a-c A separate copy of the delay indicator field 814b may indicate a delay indicator value 814m-o.

[0138]

Figure 9B shows an embodiment of the MPDU delimiter field 810c.

In some aspects, MPDU delimiter field 810c may replace MPDU delimiter field 810a illustrated in FIG. 8 . For example, A-MPDU 900a may utilize MPDU delimiter field 810c. MPDU delimiter field 810c includes five fields: end of frame indicator field 812c, delay indicator field 814c, MPDU length field 816c, CRC field 818c, and delimiter signature field 820c. In some aspects, if the MPDU delimiter field 810c is included in each of the A-MPDU subframes 905a-c, a separate copy of the delay indicator field 814c may indicate the delay indicator value illustrated in FIG. 9C below 814m-o.

[0139]

Figure 9C shows an A-MPDU frame 900a including at least three A-MPDU subframes 905a-c.

The first A-MPDU subframe 905a indicates the recipient address equivalent to the station address of the STA 106a. Similarly, the second A-MPDU subframe 905b indicates a recipient address equivalent to the station address of the STA 106b. The third A-MPDU subframe 905c indicates the recipient address equivalent to the station address of the STA 106c. In some other non-illustration aspects, A-MPDU 900a may include more than three A-MPDU subframes. For example, an A-MPDU may include four, five, six, seven, eight, nine, ten, or more subframes. In some aspects, some or all of any additional subframes in A-MPDU

900a may indicate recipient addresses of STAs 106a-c or any of other stations, access points, or relay stations.

[0140]

As discussed above with respect to MPDU 600 and QoS control field 655, each A-MPDU subframe 905a-c of A-MPDU 900a shown in Figure 9A may include a QoS control field or some other field that includes an acknowledgement policy indication.

For example, each A-MPDU subframe 905a-c may follow the format of MPDU 600, which includes the QoS control fields shown in FIG.

[0141]

In the illustrated implementation, the three A-MPDU subframes 905a-c included in the A-MPDU 900a include three distinct recipient addresses, eg, in a recipient address field (such as that described in the MPDU frame 600 of FIG. 6). Three different recipient addresses are included in the illustrated address 1 field 630).

The three A-MPDU subframes included in A-MPDU 900a also include three different acknowledgment policies associated with three different recipient address fields.

[0142]

The acknowledgment procedure in the illustrated aspect is derived from one or more fields in the MPDU delimiter and the Ack Policy field included in the MPDU to which the MPDU delimiter is associated: delay indicator field 814m-o, EOF field (if present)), and acknowledgement policy fields 730a-c.

In some aspects, delay indicator fields 814m-o substantially follow the format of delay indicator field 814 shown in Figure 9A. In some aspects, the acknowledgement policy fields 730a-c substantially follow the format of the acknowledgement policy field 730 of FIG.

[0143]

As shown in Figure 9C, all three A-MPDU subframes 905a-c include an acknowledgment policy set to "normal acknowledgment".

In some wireless standards (eg, the 802.11ah standard), this may correspond to a specific value, such as "normal acknowledgment or implicit block acknowledgment request". Each of the A-MPDU subframes 905a-c has a different delay indicator value.

[0144]

Based on the values of the acknowledgment policy fields 730a-c and delay indicator fields 814m-o, the A-MPDU 900a indicates that the STA 106a should acknowledge the correct receipt of the MPDU 905a first.

In some aspects, the A-MPDU subframe 905a should be acknowledged SIFS time after completion of the transmission/reception of the A-MPDU 900a because the delay indicator is set to a zero value. Note that, in general, one or more MPDUs may be addressed to any of the STAs 106a-c. In such an embodiment, if a single MPDU is addressed to a given recipient, it can determine whether to use an ACK frame response with the EOF field set to 1 or a block acknowledgment response otherwise. In general, in some aspects, the amount of delay can be determined based on equation (1):

[0145]

delay = SIFS + (delay indicator * (SIFS + K)) (1)

[0146]

where K is equal to the time duration required by the receiver to transmit the control response to the transmitter.

In some aspects, the transmitter device may require one or more receivers to follow precise rules for the transmission of

response frames so that the duration K is deterministic and equal for all receivers.

Examples of such rules may include precise MCS and bandwidth selection rules and may also require all receivers to respond with the same response frame (eg, by including an address to each receiver indicating that an acknowledgment should be in the A-MPDU The transmitted A-MPDU subframe, the transmitter instructs the receiver to respond with an ACK frame for the corresponding A-MPDU subframe). Similar rules can be applied to only request block ack frames in response (in this case, the duration of K may be longer).

[0147]

Within a particular A-MPDU frame, each delay indicator field may be set to a unique value, at least for any A-MPDU subframe for which the transmitter requests an acknowledgment from the receiver device.

In some aspects, if the A-MPDU subframe is addressed to a group of STAs, the transmitter sets the ACK policy to "no acknowledgement," indicating that no response is expected. In some aspects, the delay indicator may be a value used for another MPDU subframe. In some aspects, the delay indicator for the A-MPDU subframe that indicates the "no ack" acknowledgment policy may be a random or uninitialized value.

[0148]

In some aspects, after the delay determined by Equation 1 has elapsed, the transmission of A-MPDU subframe acknowledgments may be performed if the A-MPDU subframe acknowledgment policy is set to "normal acknowledgment or implicit block acknowledgment" .

In Figure 9C, all three subframes 905a-c can be acknowledged in this manner.

[0149]

Since the delay indicator 814n for the A-MPDU subframe 905b is zero (0), the STA 106b should acknowledge the A-MPDU subframe 905b SIFS time after the transmission of the A-MPDU 900a.

In some aspects, the A-MPDU 900a further indicates that the STA 106a should acknowledge the transmission of the MPDU subframe 905a SIFS+1*(SIFS+K)=2SIFS+constant time after the transmission of the A-MPDU 900a because the acknowledgement delay indicator field 814m is Set to one (1). Similarly, A-MPDU 900a indicates that STA 106c should acknowledge the transmission of MPDU subframe 905c 3SIFS+2K after the transmission of A-MPDU 900a, since acknowledgement delay indicator value field 814o is set to two (2).

[0150]

By including different acknowledgment policies for the two or more (in this case, three) recipient addresses indicated by A-MPDU 900a, AP 104 can efficiently manage the traffic generated by the three recipient addresses corresponding to the three recipient addresses. Receipt of an acknowledgment response by one of the devices (STAs 106a-c) SIFS time after the transmission of the A-MPDU 900a.

In this embodiment, some STAs (eg, 106a and 106c) wait a period of time before transmitting their acknowledgments based on the indication in the A-MPDU subframe delimiter field. In some aspects, this reduces the probability of a collision between at least two acknowledgments for at least two A-MPDU subframes included in A-MPDU 900a over a SIFS time after transmission of A-MPDU 900a. Although three A-MPDU subframes are illustrated in A-MPDU frame 900a in Figure 9C, in some aspects two or more recipient addresses may be indicated by A-MPDU 900a. For example, A-MPDU 900a may include A-MPDU subframes addressed to two or four or more devices. Such A-MPDUs will also include at least two different acknowledgment strategies, corresponding to at least two of the recipient addresses indicated by the A-MPDU subframes included in A-MPDU 900a. Note that, in some aspects, the AP may request different acknowledgment policies based on a traffic identifier (TID) and/or on a per-MPDU basis. Those skilled in the art will appreciate that the acknowledgement procedures described herein can be easily extended to these embodiments.

[0151]

In addition to having multiple recipient addresses in the A-MPDU (wherein one or more A-MPDU subframes have different recipient addresses, as discussed above), one or more A-MPDU subframes may have different Transmitter address, which means that one or more A-MPDU subframes can be received by the transmitter from one or more different source devices.

For example, a transmitter of an A-MPDU that includes two or more MPDUs may set the A2 field 635 (i.e., transmitter address) in the MAC header of each MPDU to a different MAC address, which helps reduce overhead. The transmitter may implement an embodiment in which different transmitter addresses are set. Embodiments may include where the transmitter is an AP with multiple BSSIDs (each BSSID identifies the BSS with which the AP is associated) and the AP needs to send messages to any of the BSSs associated with the AP. When the associated STA transmits multiple MPDUs. Additional embodiments may exist where the transmitting party provides relay or mesh functionality and operates to forward frames that need to be exchanged between multiple STAs that may not be within their respective transmission range; accordingly, the transmitting party may - Aggregate multiple MPDUs received from different STAs in an MPDU and transmit the A-MPDUs to one or more destinations, where each MPDU has an A2 address indicating the source address of the MPDU (ie, the STA that generated the frame). For example, in some embodiments, a transmitter may aggregate: one or more MPDUs with a common A1 address (receiver) and A2 address (transmitter); a different A1 address (receiver) and a commnon A2 address (transmitter)) (multiple receivers - single transmitter); one or more MPDUs with a shared A1 address (receiver) and different A2 addresses (transmitter) (single receiver - multiple transmitters) ; or one or more MPDUs with different A1 addresses (receiver) and different A2 addresses (transmitters) (multiple receivers - multiple transmitters). Such aggregation reduces overhead and improves media efficiency.

[0152]

9D illustrates exemplary wireless communications between AP 104 and three stations, STA 106a, STA 106b, and STA 106c.

The wireless communication begins with AP 104 transmitting an A-MPDU packet 900a. In some aspects, A-MPDU 900a may be broadcast. In some other aspects, A-MPDU 900a may be multicast to a multicast group including stations STA 106a, STA 106b, and STA 106c. In some aspects, the format of A-MPDU 900a shown in FIG. 9D may substantially follow the format of A-MPDU 900a illustrated in FIG. 9C and/or the format of A-MPDU 800 shown in FIG. 8 .

[0153]

Figure 9D shows that the STA 106b transmits an acknowledgment packet 955 SIFS time after the completion of the transmission of the A-MPDU 900a.

STA 106b transmits acknowledgment packet 955 at the illustrated time based on acknowledgment policy 730b and acknowledgment delay indicator value 814n (illustrated in Figure 9C) in A-MPDU subframe 905b. Next, the STA 106a transmits the acknowledgment packet 960 over 2SIFS + constant K after the transmission of the A-MPDU 900a is completed. The time at which the STA 106a transmits the acknowledgment 960 is based on the acknowledgment policy 730a and acknowledgment delay indicator value 814m indicated by the A-MPDU subframe 905a, as illustrated in Figure 9C. Although the constant K is shown as being equal to the time necessary to transmit the acknowledgment 955, in some other aspects the constant time K may be greater than the time necessary to transmit the acknowledgment 955.

[0154]

In certain aspects, the AP may only instruct the recipient STA to acknowledge receipt of the MPDU if the MPDU is a unicast transmission (i.e., the recipient STA's address is a unicast address).

However, in some embodiments where a multicast (broadcast) frame is included in the A-MPDU, the AP may selectively request the single STA by including a null MPDU in the A-MPDU addressed to a STA in the group The STA sends an acknowledgment response. The acknowledgment policy for this null MPDU may be set to a specific value, such as "normal acknowledgment or implicit block acknowledgment request". This procedure may help to allow a transmitter to estimate whether a multicast packet was at least partially received by a receiver. As will be appreciated by those skilled in the art, this procedure of selecting a recipient from a group of devices to confirm correct receipt of an MPDU within an A-MPDU can be accomplished by enabling the transmitting device to identify whether the A-MPDU has potentially communicated with other networks. service collisions to increase the reliability of multicast transmissions. The selection of the responding device may be based on one or more metrics, which may allow for maximizing the reliability of the acknowledgement.

[0155]

Next, the STA 106c transmits the acknowledgment packet 965 at 3SIFS+2*constant K after the transmission of the A-MPDU 900a is completed.

The time at which the STA 106c transmits the acknowledgment 965 is based on the acknowledgment policy 730c and the acknowledgment delay indicator value 814o indicated by the A-MPDU subframe 905c, as illustrated in Figure 9C. Although the constant K is shown in FIG. 9D as being equal to the time necessary to transmit the acknowledgment 960, in some other aspects the constant time K may be greater than the time necessary to transmit the acknowledgment 955.

[0156]

9E illustrates an embodiment of an A-MPDU 900b.

A-MPDU 900b includes at least three A-MPDU subframes 905d-f. Each of the three A-MPDU subframes 905d-f is addressed to one of the STAs 106a-c, respectively. The format of A-MPDU 900b may substantially follow the format of A-MPDU 800 . In some aspects, MPDU delimiter field format 810b may be used in A-MPDU 900b in place of MPDU delimiter 810a. In some aspects, MPDU delimiter field format 810c may be used in A-MPDU 900b in place of 810a or 810b.

[0157]

Similar to the A-MPDU subframes 905a-c of Figure 9C, the A-MPDU subframes 905d-f each provide an acknowledgement delay indicator field value 814d-f and an acknowledgement policy field 730d-f.

The format of the delay indicator fields 814d-f may substantially follow the delay indicator field 814b of the MPDU delimiter 810b shown in Figure 9A. In some aspects, the format of the delay indicator fields 814d-f may substantially follow the delay indicator field 814c of the MPDU delimiter 810c shown in Figure 9B. The format of the acknowledgement policy fields 730d-f may substantially follow the acknowledgement policy field 730 of FIG.

[0158]

Similar to the A-MPDU 900a of Figure 9C, the first A-MPDU subframe 905d of the A-MPDU 900b has an acknowledgment policy field 730d set to the value of a normal acknowledgment.

Since the delay indicator value 814d of the A-MPDU subframe 905d is set to zero (0), the STA 106a will acknowledge the A-MPDU subframe 905d SIFS time after the transmission of the A-MPDU 900b. Each of the A-MPDU subframes 905e-f indicates an acknowledgement policy field 730e-f that is set to "no acknowledgement". Therefore, MPDUs 905e-f will not be acknowledged by STAs 106b-c, respectively. Since the policy fields 730e-f are set to "no ack," in some aspects, each of the STAs 106b and 106c may not decode or act on the value of the delay indicator fields 814e-f.

[0159]

9F illustrates example wireless communications between AP 104 and three STAs 106a-c.

The wireless communication begins with AP 104 transmitting an A-MPDU packet 900b. In some aspects, A-MPDU 900b may be broadcast. In some other aspects, A-MPDU 900b may be multicast to a multicast group including stations STA 106a, STA 106b, and STA 106c. In some aspects, the format of the A-MPDU 900b shown in FIG. 9F may substantially follow the A-MPDU 800 illustrated in FIG. 8 . In some aspects, A-MPDU 900b may include three A-MPDU subframes. One aspect of A-MPDU 900b is shown above in Figure 9E.

[0160]

Next, the STA 106a transmits an acknowledgment packet 970 SIFS time after the transmission of the A-MPDU 900b is completed.

The STA 106a transmits the acknowledgment packet 970 at the illustrated time based on the acknowledgment policy 730d and the acknowledgment delay indicator value 814d indicated by the A-MPDU subframe 905d illustrated in Figure 9E. Since the delay indicator value 814d of the A-MPDU subframe 905d is set to zero, the STA 106a will acknowledge the A-MPDU subframe

905 SIFS time after the transmission of the A-MPDU 900b.

[0161]

Unlike Figure 9D where STAs 106b-c each transmit acknowledgments back to AP 104 for A-MPDUs 905b-c, Figure 9F illustrates that STAs 106b-c do not acknowledge A-MPDUs 905e-f of A-MPDU 900b shown in Figure 9E.

STAs 106b-c do not acknowledge A-MPDUs 905e-f based on the acknowledgment policy field 730e-f being set to the "no ack" value (as shown in Figure 9D).

[0162]

10A illustrates an embodiment of an A-MPDU 900c.

A-MPDU 900c includes at least three A-MPDU subframes 905g-i. Similar to the A-MPDU subframes 905a-f of Figures 9E-F, the A-MPDU subframes 905g-i each indicate an acknowledgement delay indicator field value 814g-i and an acknowledgement policy field 730g-i value. In some aspects, each of the A-MPDU subframes 905g-i may substantially follow the format of the A-MPDU 800 of FIG. 8 . In some aspects, MPDU delimiter field 810b may replace MPDU delimiter field 810a of A-MPDU 800 . In some aspects, MPDU delimiter field 810c may replace MPDU delimiter field 810a of A-MPDU 800 .

[0163]

The first A-MPDU subframe 905g of the A-MPDU 900c indicates the block acknowledgment acknowledgment policy field 730g.

This value indicates that the recipient of the A-MPDU 905g should not acknowledge the A-MPDU 905g SIFS time after the A-MPDU 905c was transmitted/received. Instead, the acknowledgment policy field 730g indicates to the STA 106a receiving the A-MPDU 905g that it should wait for an explicit acknowledgment request before acknowledging the A-MPDU 905g. Similarly, A-MPDU subframe 905h acknowledgment policy field 730h also indicates block acknowledgment. Therefore, the A-MPDU 905h indicates that the STA 106b should wait for an explicit block ack request before acknowledging the A-MPDU 905h. The A-MPDU 905i Acknowledgement Policy field 730i indicates that the STA 106c receiving the A-MPDU 905i should acknowledge the A-MPDU 905i SIFS time after the transmission of the A-MPDU 900c is complete, because the MPDU 905i Acknowledgement Delay Indicator field 814i is set to zero (0), as above

[0164]

159179

discussed. Since both acknowledgment policy fields 730g-h are set to block acknowledgments, the values of delay indicator fields 814g-h may be ignored by STAs 106a-b in some aspects.

[0165]

10B illustrates example wireless communications between AP 104 and three STAs 106a-c.

First, AP 104 transmits A-MPDU 900c. In some aspects, A-MPDU 900c provides field values equivalent to those shown in A-MPDU 900c of Figure 10A. As discussed above with respect to Figure 10A, the A-MPDU subframe 905i shown in Figure 10A addressed to STA 106c indicates an acknowledgment policy for normal acknowledgments. Therefore, since the delay indicator field 814i is zero, the STA 106c acknowledges the A-MPDU subframe 905i SIFS time after the transmission of the A-MPDU frame 900c is completed. This is shown by the transmission of block ack frame 1005.

[0166]

Since each of the A-MPDU subframes 905g-h indicates a "block ack" acknowledgment policy, the STAs 106a-b will not acknowledge the A-MPDU subframe 905g without an explicit block ack request -h.

Accordingly, as shown in Figure 10B, AP 104 transmits a block ack request 1010 to STA 106b. In response, the STA 106b transmits a block acknowledgment 1015 for the A-MPDU 905h SIFS time after receiving the block acknowledgment request 1010. Similarly, AP 104 transmits a block ack request 1020 to STA 106a. In response, the STA 106a transmits a block

acknowledgment message 1025 for the A-MPDU 905g to the AP 104 SIFS time after receiving the block acknowledgment request 1020.

[0167]

10C illustrates an embodiment of an A-MPDU 900d.

A-MPDU 900d includes at least three A-MPDU subframes 905j-1. A-MPDU 900d may follow the frame field format described above with respect to A-MPDU 800. For example, each A-MPDU subframe may include an MPDU delimiter field and an MPDU field (neither of which are explicitly shown). As shown in the example MPDU delimiter field 810c shown in FIG. 9B, the MPDU delimiter field of the A-MPDU subframe 905j-1 may include the EOF field 812j-1, the delay indicator field 814j-1, and the MPDU Length fields 816j-l. The control field of each MPDU subframe 905j-1 includes an acknowledgement policy field 730j-1.

[0168]

In some aspects, the EOF field 812 of the MPDU delimiter may indicate whether the A-MPDU subframe should be acknowledged using an acknowledgment frame or a block acknowledgment frame.

For example, in some aspects, if the end of frame field 812j-1 is empty (zero), a block acknowledgment should be transmitted in response to receipt of the corresponding A-MPDU subframe. If the EOF field 812j-1 is set (one), the acknowledgment frame shall be transmitted in response to receipt of the corresponding A-MPDU subframe. The block acknowledgment and regular acknowledgment of A-MPDU subframes illustrated in Figure 10C may operate similarly to previously disclosed embodiments such as Figures 9C-10B. For example, each A-MPDU subframe 905g-i may specify an acknowledgment policy in field 730j-1, which is similar to the previously discussed acknowledgment policy fields (such as any of the acknowledgment policy fields 730a-i)) to operate. Delay indicator fields 802j-1 may also operate similarly to either of delay indicator fields 802a-i or m-o discussed previously.

[0169]

10D illustrates example wireless communications between AP 104 and three STAs 106a-c.

First, AP 104 transmits A-MPDU 900d. In some aspects, A-MPDU 900d indicates the field values indicated in A-MPDU 900d of Figure 10C.

[0170]

Since the delay indicator field 8141 of the A-MPDU subframe 905l includes a zero delay value, the STA 106c acknowledges the A-MPDU (905l) addressed to it SIFS time after the transmission of the A-MPDU 900d.

Since the EOF field 8121 of the A-MPDU subframe 905l is empty (zero), the STA 106c acknowledges the A-MPDU subframe with a block acknowledgment frame 1055.

[0171]

Next, based on the delay indicator value 814j, the STA 106a transmits an acknowledgment frame 1060 at a time according to equation (1) above.

The acknowledgment frame is transmitted by the STA 106a because the EOF field 812j is set to one. STA 106b then transmits an acknowledgment for A-MPDU subframe 905k based on delay indicator field 814k. Since the EOF field 812k is set, the acknowledgment frame 1065 is transmitted in place of the block acknowledgment frame.

[0172]

11A is a flowchart of an exemplary wireless communication method.

In some aspects, process 1100 may be performed by wireless device 202 shown above with respect to FIG. 2 . In some aspects, process 1100 may be performed by AP 104 .

[0173]

At block 1105, an aggregated medium access control protocol data unit (A-MPDU) frame is generated by the wireless device.

The A-MPDU frame includes two or more A-MPDU subframes generated in block 1105. Each A-MPDU subframe includes the recipient address. The A-MPDU frame includes at least one indication of one or more acknowledgment strategies associated with each recipient address of each A-MPDU subframe. Each of the two or more A-MPDU subframes includes a control field indicating one or more acknowledgment strategies for each corresponding A-MPDU subframe. In some aspects, more than two A-MPDU subframes are generated at block 1105. In some aspects, the A-MPDU subframe generated at block 1105 indicates more than two different acknowledgment strategies. In some aspects, two or more A-MPDU subframes within an A-MPDU frame may be generated with the same recipient address. In some embodiments, these acknowledgment strategies may be indicated by a control field, a delimiter field, or a combination of control and delimiter fields in each A-MPDU subframe.

[0174]

In some aspects, the control field indicating the acknowledgment policy is the acknowledgment policy control field in the QoS control field of each A-MPDU subframe.

In some aspects, the format of the QoS control field for each A-MPDU subframe may substantially follow the QoS control field 655 illustrated in FIG.

[0175]

In some aspects, the acknowledgment policy field of the QoS control frame may be set to a specific value, such as "normal acknowledgment or implicit block acknowledgment".

In some aspects, this value corresponds to 0b00. If set to a specific value, the acknowledgment policy indicates that the acknowledgment for the corresponding A-MPDU subframe should be transmitted by the receiver of that A-MPDU subframe after a time delay. In some aspects, the time delay is the SIFS time after the transmission/reception of the A-MPDU frame including the A-MPDU subframe. In order to reduce collisions for acknowledgment of A-MPDU subframe transmissions, in some aspects only one acknowledgment policy for the generated A-MPDU subframe will be set to a specific value, such as "normal acknowledgment or implicit block acknowledgment" receive".

[0176]

The acknowledgment policy field 730 in some A-MPDU subframes may be set to "no acknowledgment".

If set to "unacknowledged", the receiver shall not acknowledge the corresponding A-MPDU subframe. In some aspects, the value of "no acknowledgement" corresponds to 0b10. In some aspects, the Acknowledgement Policy field may be set to a value of "Block Acknowledgement". In some aspects, this value corresponds to 0b11. If set to "Block Acknowledgement", the Acknowledgement Policy field indicates that the recipient of the corresponding A-MPDU subframe may receive a request for a Block Acknowledgement message at a later time, and the corresponding A-MPDU subframe is included in the The acknowledgment for the corresponding A-MPDU subframe shall not be transmitted after the SIFS time after the reception of the A-MPDU is completed.

[0177]

In some aspects, the acknowledgment policy is further indicated by a delay indicator field in the control field.

In some aspects, the delay indicator field may be included in the MPDU delimiter field. For example, the delay indicator field may be shown by the delay indicator field 814b of the MPDU delimiter field 810b of Figure 9A. In some other aspects, the delay indicator field may be shown by delay indicator field 814a of MPDU delimiter field 810a of FIG. 8 . In some other aspects, the delay indicator field may be shown by the delay indicator field 814c of the MPDU delimiter field 810c of Figure 9B.

[0178]

The delay indicator field may indicate the delay that should elapse before the corresponding A-MPDU subframe is

acknowledged.

In some aspects, the delay indicator field may indicate a backoff counter. In some aspects, the delay indicator may represent a multiple of SIFS time or a SIFS time plus a counter value. The device receiving the corresponding A-MPDU subframe shall delay the acknowledged transmission by the determined delay value. In some aspects, if the Acknowledgement Policy field is set to a specific value, such as "Normal Acknowledgement or Implicit Block Acknowledgment" discussed above, the Delay Indicator field indicates the reception/reception of an A-MPDU subframe or A-MPDU frame. Delay between delivery and delivery time for frame acknowledgment.

[0179]

In some aspects, the acknowledgment policy is indicated by an end of frame (EOF) field.

For example, in some aspects, the A-MPDU subfield may include a MPDU delimiter field substantially in accordance with the format of MPDU delimiter field 810a. In these aspects, the acknowledgment policy may be indicated by the EOF field 812a of the MPDU delimiter 810a. In some other aspects, the acknowledgment policy may be indicated by the EOF field 812c of the MPDU delimiter field 810c.

[0180]

At block 1110, the A-MPDU frame is transmitted by the wireless device.

When executed by a wireless device that includes one or more antennas, the A-MPDU frame may be transmitted using the one or more antennas.

[0181]

In some aspects, the method further includes transmitting, by the wireless device, a request for an acknowledgment to a recipient address indicated by one of the A-MPDU subframes.

In some aspects, the request is a block acknowledgement request. A request for acknowledgment may be transmitted if the acknowledgment strategy indicated by the A-MPDU subframe indicates a block acknowledgment strategy. The request for acknowledgment may be transmitted after a delay greater than the SIFS period after transmission of the A-MPDU in block 1115. This delay may provide an opportunity for one A-MPDU subframe in the transmitted A-MPDU frame to be acknowledged. A-MPDU subframes with the acknowledgment policy set to a certain value (such as "normal acknowledgment or implicit block acknowledgment") may be acknowledged during this delay.

[0182]

In some aspects, the method further includes receiving, by the wireless device, one or more acknowledgments for one or more of the A-MPDU subframes included in the transmitted A-MPDU frame.

In some aspects, one of these acknowledgments is received SIFS time after completion of transmission of the A-MPDU frame in block 1115. For example, A-MPDU frames with an acknowledgment policy set to a specific value (such as "normal acknowledgment or implicit block acknowledgment"), or A-MPDU frames with an end-of-frame indication set, may be acknowledged during this time.

[0183]

Some aspects may further base the timing of A-MPDU subframe acknowledgments on a delay indicator field, as discussed above.

For example, in some aspects A-MPDU subframes with an acknowledgment policy set to a specific value (such as "normal acknowledgment or implicit block acknowledgment" as appropriate for the 802.11 standard) will also need to have a delay set to zero or minimum value of the Delay Indicator field so that this A-MPDU subframe is acknowledged SIFS time after the completion of transmission of the A-MPDU frame in block 1115.

[0184]

Other frames may be acknowledged in response to an explicit acknowledgment request (such as a block acknowledgment request, described above) transmitted by the wireless device.

[0185]

11B is a functional block diagram of an exemplary wireless device 1150 that may be employed within the wireless communication system 100.

Apparatus 1150 includes A-MPDU frame generation circuitry 1155 and A-MPDU transmission circuitry 1160.

A-MPDU frame generation circuit 1155 may be configured to perform one or more of the functions discussed above with respect to block 1105 illustrated in FIG. 11A. A-MPDU frame generation circuit 1155 may correspond to one or more of processor 404 and/or DSP 420, and/or processing system. Apparatus 1150 further includes A-MPDU frame transfer circuitry 1160. In some aspects, A-MPDU frame transmission circuitry 1160 may be configured to perform one or more of the functions discussed above with respect to block 1110. In some aspects, A-MPDU frame transmission circuitry 1160 may include transmitter 410 . In some aspects, the frame transmission circuitry may be further configured to transmit a request for an acknowledgment to the recipient address indicated by one of the A-MPDU subframes. In some implementations, means for generating an A-MPDU frame comprising two or more aggregated medium access control protocol data unit (A-MPDU) subframes and/or for generating two or more subframes The means of A-MPDU subframing may include an A-MPDU generation frame circuit 1155 . In some implementations, the means for transmitting A-MPDU frames can include A-MPDU transmission circuitry.

[0186]

In some aspects, device 1150 further includes decoding circuitry.

The decoding circuit may be configured to decode a block acknowledgment for an A-MPDU subframe generated by the A-MPDU frame generation circuit 1155 if the end of frame (EOF) field of the A-MPDU subframe is set to zero. In some aspects, the decoding circuitry may correspond to one or more of the processor 404 and/or the DSP 420, and/or the processing system. In some aspects, the decoding circuit may be further configured to decode an acknowledgment for an A-MPDU subframe generated by the A-MPDU frame generation circuit 1155 if the end of frame (EOF) field of the A-MPDU subframe is set. In some aspects, device 1150 further includes decoding circuitry. The decoding circuitry may respond to reception of at least one A-MPDU subframe of two or more A-MPDU subframes received after a delay greater than or equal to a short interframe space time following transmission of the A-MPDU frame Acknowledgment to decode. In some aspects, decoding circuitry may correspond to processor 404 and/or DSP 420, and/or processing system. In some implementations, the means for decoding the acknowledgment received may include decoding circuitry. In some aspects, device 1150 further includes a value setting circuit. The setup circuit may be configured to set the value in the end of frame field to indicate a frame to be sent upon receipt according to the A-MPDU subframe acknowledgment policy. In some aspects, the setup circuit may correspond to the processor 404 and/or the DSP 420, and/or the processing system. In some implementations, the means for setting the value of the end-of-frame field includes a setting circuit.

[0187]

12A is a flowchart of an exemplary wireless communication method.

In some aspects, process 1200 may be performed by wireless device 202 shown above with respect to FIG. 2 . In some aspects, process 1200 may be performed by STA 106 .

[0188]

At block 1205, an aggregated medium access control protocol data unit (A-MPDU) frame is received by the wireless device.

The A-MPDU frame includes two or more A-MPDU subframes. In some aspects, these A-MPDU subframes substantially follow the format of one of the frames 900a-d discussed above.

[0189]

At block 1210, the A-MPDU frame is decoded by the wireless device.

In some aspects, the recipient device identifies one or more of the A-MPDU subframes included in the A-MPDU frame addressed to the device. In some aspects, this may be accomplished by comparing the recipient address specified in each of these A-MPDU subframes to the wireless device's local device address. In some aspects, the recipient address specified in one or more of the A-MPDU subframes is a broadcast or multicast address. In this case, the recipient device may determine whether it is included in the multicast group indicated by the multicast address of the A-MPDU subframe.

[0190]

Once the recipient device has identified the A-MPDU subframes addressed to the recipient, the recipient device can determine the receipt policy for each A-MPDU subframe addressed to the recipient.

In some aspects, if the Acknowledgement Policy field of the QoS Control field of the A-MPDU subframe is set to "No Acknowledgement", the recipient device will not transmit an acknowledgment for that particular A-MPDU subframe. If the acknowledgment policy field is set to "block ack", the receipt of the A-MPDU subframe may be stored, but the device will not transmit acknowledgment until a subsequent acknowledgment request is received. In some aspects, the acknowledgment request received will be a block acknowledgment request.

[0191]

If the Acknowledgement Policy field of the QoS Control field is set to a specific value (such as a value corresponding to "Normal Acknowledgement or Implicit Block Acknowledgement" as appropriate for the 802.11 standard), the recipient device may After completion, the acknowledgment is sent after SIFS time.

In some aspects, the acknowledged delivery time will be further based on the delay indicator field. In some aspects, the delay indicator field is provided in the MPDU delimiter field of the A-MPDU subframe. For example, in some aspects, the MPDU delimiter field may substantially follow the format of the MPDU delimiter field 810b shown in Figure 9B. In some aspects, the delay indicator field may indicate a backoff value. For example, the delay indicator field may indicate a multiple of SIFS time or a multiple of SIFS time + a constant value that the receiver should wait before acknowledging the corresponding A-MPDU subframe.

[0192]

In some aspects, determining the acknowledgment policy for an A-MPDU subframe may be based on an end-of-frame field.

In some aspects, the end of frame field is included in the MPDU delimiter field, as shown in MPDU delimiter field 810a or 810c. In some aspects, if the end of frame field is set, the acknowledgment of the A-MPDU is transmitted SIFS time after receipt of the A-MPDU frame. In some aspects, if the end of frame field is empty (zero), acknowledgments for the A-MPDU subframe may not be transmitted SIFS time after receipt of the A-MPDU frame.

[0193]

Some aspects further include receiving an acknowledgement request for one or more of the A-MPDU subframes included in the A-MPDU frame.

For example, if the A-MPDU subframe indicates a "block ack" acknowledgment policy, the receiver will not acknowledge the A-MPDU subframe until an explicit acknowledgment request is received. When an acknowledgment request for the A-MPDU subframe is received, the acknowledgment for the A-MPDU subframe may be transmitted based at least on whether the A-MPDU subframe is received.

[0194]

12B is a functional block diagram of an exemplary wireless device 1250 that may be employed within the wireless communication system 100.

Apparatus 1250 includes A-MPDU frame reception circuitry 1255 and A-MPDU frame decoding circuitry 1260. A-MPDU frame reception circuitry 1255 may be configured to perform one or more of the functions discussed above with reference to block

1205 illustrated in Figure 12A. A-MPDU frame reception circuitry 1255 may correspond to one or more receivers 412. Apparatus 1250 further includes A-MPDU frame decoding circuitry 1260. A-MPDU frame decoding circuit 1260 may be configured to perform one or more of the functions discussed above with reference to block 1210 illustrated in Figure 12A. In some aspects, A-MPDU frame decoding circuit 1260 may correspond to processor 404 . In some implementations, means for receiving aggregated medium access control protocol data unit (A-MPDU) frames can include A-MPDU receive frame circuitry 1255. In some implementations, means for decoding two or more A-MPDU subframes based on a received A-MPDU frame, for decoding each of the two or more A-MPDU subframes Means for decoding a recipient address corresponding to an A-MPDU subframe, or for decoding based on an A-MPDU for each of two or more A-MPDU subframes decoded from a received A-MPDU frame The means for subframe decoding the recipient address to determine that at least one of the two or more A-MPDU subframes is addressed to the apparatus may include A-MPDU decoding circuitry 1260 .

[0195]

In some aspects, device 1250 further includes decoding circuitry.

The decoding circuit may be configured to decode the A-MPDU subframes based on the received A-MPDU frame. The decoding circuit may be configured to decode the A-MPDU subframes based on the received A-MPDU frame. The decoding circuit may be configured to decode the recipient address corresponding to each of the two or more A-MPDU subframes. The decoding circuit may be configured to decode the MPDU delimiter field in at least one of the two or more A-MPDU subframes. In some aspects, decoding circuitry may correspond to processor 404, DSP 420, and/or a processing system. In some implementations, the means for decoding the A-MPDU subframe and the means for decoding the recipient address may include decoding circuitry.

[0196]

In some aspects, device 1250 further includes determination circuitry.

The determination circuit may be configured to determine the two A-MPDU frames decoded from the received A-MPDU frame based on the recipient address decoded for each of the two or more A-MPDU subframes. At least one A-MPDU subframe of the or more A-MPDU subframes is addressed to the device. The determination circuit may also be configured to determine, from the value stored in the MPDU delimiter field, a time delay that elapses after the receipt of the A-MPDU frame and before transmission of the acknowledgment frame. In some aspects, the determination circuit may correspond to the processor 404, the DSP 420, and/or the processing system. In some implementations, the means for determining may include the determining circuit.

[0197]

In some aspects, apparatus 1250 further includes acknowledgement policy decoding circuitry.

The acknowledgment policy decoding circuit may be configured based on the corresponding one or more fields of each of the two or more A-MPDU subframes and the recipient of each A-MPDU subframe. The address is associated with at least one indication to decode the acknowledgment policy for each of the two or more A-MPDU subframes. In some aspects, the acknowledgment decoding circuit may correspond to the processor 404 . In some implementations, the means for decoding the acknowledgment policy can include acknowledgment decoding circuitry.

[0198]

In some aspects, apparatus 1250 further includes end-of-frame field decoding circuitry.

The end-of-frame field decoding circuitry may be configured to decode a value in an end-of-frame field in at least one A-MPDU subframe of the two or more A-MPDU subframes, the value indicating information about the two or more A-MPDU subframes The type of request for acknowledgement of receipt of the acknowledgement policy for each A-MPDU subframe in the A-MPDU subframe. In some aspects, the end-of-frame field decoding circuitry may correspond to processor 404, DSP 420, and/or processing system. In some implementations, the means for decoding the end-of-frame field can include end-of-frame field decoding circuitry.

[0199]

In some aspects, device 1250 further includes frame generation circuitry.

The frame generation circuit may generate an acknowledgment frame or a block acknowledgment frame for at least one of the two or more A-MPDU subframes based on the value in the end of frame field. In some aspects, the end-of-frame generation circuit may correspond to the processor 404, the DSP 420, and/or the processing system. In some implementations, the means for generating an acknowledgment frame can include frame generation circuitry.

[0200]

13A is a flowchart of an exemplary wireless communication method.

In some aspects, process 1300 may be performed by wireless device 202 shown above with respect to FIG. 2 . In some aspects, process 1300 may be performed by STA 106 .

[0201]

At block 1305, an aggregated medium access control protocol data unit (A-MPDU) frame is received by the wireless device.

At block 1310, two or more A-MPDU subframes of the received A-MPDU frame are decoded by the wireless device. In some aspects, the decoded A-MPDU subframes substantially follow the format of one of the frames 900a-d discussed above.

[0202]

At block 1315, the recipient address corresponding to each of the two or more A-MPDU subframes is decoded by the wireless device.

In some aspects, the recipient address specified in one or more of the A-MPDU subframes is a broadcast or multicast address. In this case, the recipient device may determine whether it is included in the multicast group indicated by the multicast address of the A-MPDU subframe.

[0203]

In some aspects, a device performing process 1300 can compare each of the decoded recipient addresses to the local address of the decoding device.

If the recipient address in one or more of these A-MPDU subframes matches the local recipient address, the recipient device may then further decode the received A-MPDU subframe.

[0204]

Once the recipient device has identified the A-MPDU subframes addressed to the recipient device, the recipient device can determine the receipt policy for each A-MPDU subframe addressed to the recipient device.

For example, in some aspects, the recipient device may decode the acknowledgment policy indicated by the recipient A-MPDU subframe. In some aspects, the acknowledgement policy may be indicated by one or more of: the acknowledgement policy field in the control field, the delay indicator field in the MPDU delimiter field, and/or the end of frame included in the MPDU delimiter field field.

[0205]

In some aspects, if the Acknowledgement Policy field of the QoS Control field of the A-MPDU subframe is set to a value corresponding to "no acknowledgement", the recipient device will not transmit an acknowledgement for that particular A-MPDU subframe.

If the acknowledgment policy field is set to "block acknowledgment", the receipt of the A-MPDU subframe may be stored, but the acknowledgment will not be transmitted until a subsequent acknowledgment request is received. In some aspects, the received ack request will be a block ack request.

[0206]

If the acknowledgment policy field of the QoS control field is set to a specific value (in some aspects, the specific value corresponds to a "normal acknowledgment or implicit block acknowledgment" value as defined by the appropriate 802.11 standard), the recipient device The acknowledgment may be transmitted SIFS time after the reception of the A-MPDU frame is completed.

In some aspects, the acknowledged delivery time will be further based on the delay indicator field. In some aspects, the delay indicator field is provided in the MPDU delimiter field of the A-MPDU subframe. For example, in some aspects, the MPDU delimiter field may substantially follow the format of the MPDU delimiter field 810b shown in Figure 9B. In some aspects, the delay indicator field may indicate a backoff value. For example, the delay indicator field may indicate a multiple of SIFS time or a multiple of SIFS time + constant value that the receiver should wait before acknowledging the corresponding A-MPDU subframe.

[0207]

In some aspects, determining the acknowledgment policy for an A-MPDU subframe may be based on an end-of-frame field.

In some aspects, the end of frame field is included in the MPDU delimiter field, as shown in MPDU delimiter field 810a or 810c. In some aspects, if the end of frame field is set, the acknowledgment of the A-MPDU is transmitted SIFS time after receipt of the A-MPDU frame. In some aspects, if the end-of-frame field is empty (zero), a block acknowledgment for an A-MPDU subframe may be transmitted SIFS time after receipt of the A-MPDU frame. In some other aspects, if the end-of-frame field is empty (zero), no acknowledgment is transmitted SIFS time after receipt of the A-MPDU frame.

[0208]

Some aspects further include receiving an acknowledgement request for one or more of the A-MPDU subframes included in the A-MPDU frame.

For example, in some aspects, if the A-MPDU subframe indicates a "block ack" acknowledgment policy, the receiver will not acknowledge the A-MPDU subframe until an explicit block ack request is received. When an acknowledgment request for the A-MPDU subframe is received, the acknowledgment for the A-MPDU subframe may be transmitted based at least on whether the A-MPDU subframe is received.

[0209]

13B is a functional block diagram of an exemplary wireless device 1350 that may be employed within the wireless communication system 100.

Apparatus 1350 includes A-MPDU frame reception circuitry 1355 , A-MPDU subframe decoding circuitry 1360 , and recipient address decoding circuitry 1365 . A-MPDU frame reception circuitry 1355 may be configured to perform one or more of the functions discussed above with respect to block 1305 illustrated in Figure 13A. A-MPDU frame reception circuitry 1355 may correspond to one or more receivers 412. Apparatus 1350 further includes A-MPDU subframe decoding circuitry 1360. A-MPDU subframe decoding circuitry 1360 may be configured to perform one or more of the functions discussed above with respect to block 1310 illustrated in Figure 13A. In some aspects, the A-MPDU subframe decoding circuit 1360 may be configured to decode the acknowledgment policy for an A-MPDU subframe. In some aspects, the A-MPDU subframe decoding circuit 1360 may be further configured to decode the end-of-frame field of the A-MPDU subframe. In some aspects, A-MPDU subframe decoding circuitry 1360 may correspond to processor 404 and/or DSP 420, and/or processing system. Apparatus 1350 further includes recipient address decoding circuitry 1365. The recipient address decoding circuit 1365 may be configured to perform one or more of the functions discussed above with respect to block 1315 illustrated in Figure 13A. In some aspects, recipient address decoding circuitry 1365 may correspond to processor 404 and/or DSP 420, and/or processing system.

[0210]

In some aspects, apparatus 1350 may further include determination circuitry. .

In some aspects, the determination circuit may be further configured to determine a time delay for transmitting the control frame.

The determination circuit may be configured to determine the time delay for transmitting the control frame based on the A-MPDU delimiter field of the A-MPDU subframe. In some aspects, the determination circuit may correspond to the processor 404 and/or the DSP 420, and/or the processing system.

[0211]

Some aspects of apparatus 1350 may further include transmit circuitry.

The transmit circuit may be configured to transmit the control frame if the acknowledgment policy is set to a specific value. In some aspects, the transmit circuit may correspond to the transmitter 410.

[0212]

In some aspects, apparatus 1350 may further include receive circuitry.

The receiving circuit may be configured to receive a request for an acknowledgment for an A-MPDU subframe. In some aspects, the receive circuit may correspond to the receiver 412.

[0213]

As used herein, the term "determining" encompasses a wide variety of actions.

For example, "determining" may include calculating, calculating, processing, deriving, studying, looking up (e.g., looking up in a table, database, or other data structure), probing, and the like. Also, "determining" may include receiving (eg, receiving information), accessing (eg, accessing data in memory), and the like. Moreover, "determining" may also include parsing, selecting, choosing, establishing, and the like. Additionally, "channel width" as used herein may encompass or may also be referred to as bandwidth in certain aspects.

[0214]

As used herein, a phrase referring to "at least one" of a list of items refers to any combination of those items, including individual members.

As an example, "at least one of a, b, or c" is intended to encompass: a, b, c, a-b, a-c, b-c, and a-b-c.

[0215]

The various operations of the methods described above may be performed by any suitable apparatus capable of performing the operations, such as various hardware and/or software components, circuits, and/or modules.

Generally, any operations illustrated in the figures can be performed by corresponding functional means capable of performing the operations.

[0216]

As used herein, the term "interface" may refer to hardware or software configured to connect two or more devices together.

For example, an interface may be part of a processor or bus and may be configured to allow communication of information or data between devices. The interface can be integrated into a chip or other device. For example, in some embodiments, an interface may include a receiver configured to receive information or communications at one device from another device. An interface (e.g., of a processor or bus) may receive information or data processed by the front end or another device or may process the received information. In some embodiments, the interface may include a transmitter configured to transmit or communicate information or data to another device. Thus, an interface may communicate information or data or may prepare information or data for communication (e.g., via a bus).

[0217]

The various illustrative logical blocks, modules, and circuits described in connection with this disclosure may be used with

general purpose processors, digital signal processors (DSPs), application specific integrated circuits (ASICs), field programmable gate arrays designed to perform the functions described herein signal (FPGA) or other programmable logic device (PLD), discrete gate or transistor logic, discrete hardware components, or any combination thereof.

A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any commercially available processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, such as a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0218]

In one or more aspects, the functions described may be implemented in hardware, software, firmware, or any combination thereof.

If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage medium can be any available medium that can be accessed by a computer. By way of example and not limitation, such computer-readable media may include RAM, ROM, EEPROM, CD-ROM, or other optical disk storage, magnetic disk storage, or other magnetic storage devices, or desired devices that can be used to carry or store instructions or data structures in the form of Program code and any other medium that can be accessed by a computer. Any connection is also properly termed a computer-readable medium. For example, if the software is transmitted from a web site, server, or other remote source using coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave , then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc as used herein includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc, where disks are often reproduced magnetically Data and discs optically reproduce data using laser light. Thus, in some aspects computer-readable media may include non-transitory computer-readable media (e.g., tangible media). Additionally, in some aspects, computer-readable media may include transitory computer-readable media (e.g., signals). Combinations of the above should also be included within the scope of computer-readable media.

[0219]

Accordingly, some aspects may include a computer program product for performing the operations presented herein.

For example, such a computer program product may include a computer-readable medium having stored (and/or encoded) thereon instructions executable by one or more processors to perform the operations described herein. For some aspects, the computer program product may include packaging materials.

[0220]

The methods disclosed herein include one or more steps or actions for implementing the described methods.

The method steps and/or actions may be interchanged with each other without departing from the scope of the claims. In other words, unless a specific order of steps or actions is specified, the order and/or use of specific steps and/or actions may be modified without departing from the scope of the claims.

[0221]

The software or instructions may also be transmitted over a transmission medium.

For example, if the software is transmitted from a web site, server, or other remote source using coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then The coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of transmission medium.

[0222]

Furthermore, it should be appreciated that modules and/or other suitable means for performing the methods and techniques described herein can be downloaded and/or otherwise obtained by user terminals and/or base stations, where applicable.

For example, such a device can be coupled to a server to facilitate the transfer of means for performing the methods described herein. Alternatively, the various methods described herein can be provided via a storage device (eg, RAM, ROM, physical storage medium such as a compact disc (CD) or floppy disk, etc.) such that once the storage device is coupled to or provided to User terminal and/or base station, the device can obtain various methods. In addition, any other suitable technology suitable for providing the methods and techniques described herein to a device may be utilized.

[0223]

It is to be understood that the claims are not limited to the precise arrangements and components described above.

Various changes, substitutions and alterations may be made in the arrangement, operation and details of the methods and apparatus described above without departing from the scope of the claims.

[0224]

While the foregoing has been directed to various aspects of the present disclosure, other and further aspects of the present disclosure may be devised without departing from its essential scope, which is to be determined by the appended claims.

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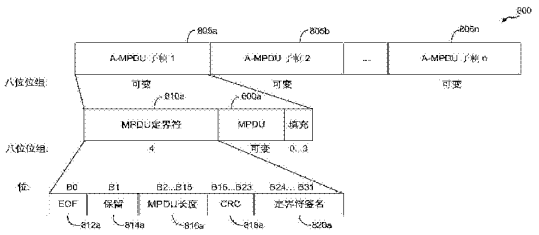
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(54)发明名称

用于在无线网络中传达多目的地话务的系统和方法

(57)摘要

提供用于传达多目的地话务的系统、方法和装置。本公开的一个方面提供了一种无线通信方法。该方法包括：生成两个媒体接入控制协议数据单元(MPDU)子帧，该A-MPDU子帧各自包括不同接收方地址，生成包括该两个经聚集媒体接入控制协议数据单元(A-MPDU)子帧的A-MPDU帧，该A-MPDU信令通知与该两个不同接收方地址相关联的两种不同确收策略；以及传送该A-MPDU帧。



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1.一种无线通信方法，包括：

由一装置生成包括两个或更多个经聚集媒体接入控制协议数据单元(A-MPDU)子帧的A-MPDU帧，其中每个A-MPDU子帧包括接收方地址，并且进一步其中所述A-MPDU帧包括关于与每个A-MPDU子帧的所述接收方地址相关联的一种或多种确收策略的至少一个指示；以及

输出所述A-MPDU帧以供传送。

2.如权利要求1所述的方法，其特征在于，所述一种或多种确收策略在所述A-MPDU子帧的对应一个或多个控制字段中指示。

3.如权利要求1所述的方法，其特征在于，所述一种或多种确收策略中的至少一者指示控制响应帧将在接收到包括所述两个或更多个A-MPDU子帧的所述A-MPDU帧之后传送。

4.如权利要求3所述的方法，其特征在于，所述一种或多种确收策略中的至少一者进一步指示所述控制响应帧将在接收到包括所述两个或更多个A-MPDU子帧的所述A-MPDU帧之后过一短帧间空间时间传送。

5.如权利要求3所述的方法，其特征在于，所述一种或多种确收策略中的至少一者进一步指示所述控制响应帧将在所述一种或多种确收策略中的至少一者被设为特定值的情况下被传送。

6.如权利要求1所述的方法，其特征在于，所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧包括媒体接入控制协议数据单元(MPDU)定界符字段，所述MPDU定界符字段存储指示在接收到所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧之后和在传送对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的确收之前逝去的时间延迟的值。

7.如权利要求6所述的方法，其特征在于，所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的所述MPDU定界符字段所指示的所述时间延迟基于也在所述MPDU定界符字段中指示的退避值。

8.如权利要求7所述的方法，其特征在于，所述MPDU定界符字段中指示的所述退避值基于短帧间空间时间或常数值中的至少一者。

9.如权利要求1所述的方法，其特征在于，生成所述A-MPDU帧包括在所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧中的帧结束字段或确收策略字段中的至少一者中生成对收到确收的请求，其中所述帧结束字段或所述确收策略字段中的值决定对收到确收的请求的类型。

10.如权利要求9所述的方法，其特征在于，进一步包括，在所述A-MPDU帧的传送之后大于或等于一短帧间空间时间的延迟之后接收对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的收到确收。

11.如权利要求9所述的方法，其特征在于，进一步包括：

将所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的所述帧结束字段的值设为指示对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的收到确收的请求的类型是确收帧。

12.如权利要求9所述的方法，其特征在于，进一步包括：

将所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的所述帧结束字段

的值设为指示对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的收到确收的请求的类型是块确收帧。

13.一种用于无线通信的装置，包括：

处理系统，其被配置成生成包括两个或更多个经聚集媒体接入控制协议数据单元(A-MPDU)子帧的A-MPDU帧，其中每个A-MPDU子帧包括接收方地址，并且进一步其中所述A-MPDU帧包括关于与每个A-MPDU子帧的所述接收方地址相关联的一种或多种确收策略的至少一个指示；以及

用于输出所述A-MPDU帧以供传送的接口。

14.如权利要求13所述的装置，其特征在于，所述处理系统被进一步配置成在所述两个或更多个A-MPDU子帧的对应一个或多个控制字段中指示所述一种或多种确收策略。

15.如权利要求13所述的装置，其特征在于，所述一种或多种确收策略中的至少一者指示控制响应帧将在接收到包括所述两个或更多个A-MPDU子帧的所述A-MPDU帧之后传送。

16.如权利要求15所述的装置，其特征在于，所述一种或多种确收策略中的至少一者进一步指示所述控制响应帧将在接收到包括所述两个或更多个A-MPDU子帧的所述A-MPDU帧之后过一短帧间空间时间传送。

17.如权利要求15所述的装置，其特征在于，所述处理系统被进一步配置成将所述一种或多种确收策略中的所述至少一者设为特定值以指示所述控制响应帧将被输出以供传送。

18.如权利要求13所述的装置，其特征在于，所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧包括媒体接入控制协议数据单元(MPDU)定界符字段，其中所述处理系统被配置成设置所述MPDU定界符字段中存储的指示在接收到所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧之后和在对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的确收被输出以供传送之前逝去的时间延迟的值。

19.如权利要求18所述的装置，其特征在于，所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的所述MPDU定界符字段所指示的所述时间延迟基于也在所述MPDU定界符字段中指示的退避值。

20.如权利要求19所述的装置，其特征在于，所述MPDU定界符字段中指示的所述退避值基于短帧间空间时间或常数值中的至少一者。

21.如权利要求13所述的装置，其特征在于，所述处理系统被进一步配置成在所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧中的帧结束字段或确收策略字段中的至少一者中生成对收到确收的请求，其中所述帧结束字段或所述确收策略字段中的值决定对收到确收的请求的类型。

22.如权利要求21所述的装置，其特征在于，所述处理系统被进一步配置成对在所述A-MPDU帧的传送之后大于或等于一短帧间空间时间的延迟之后接收到的所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的收到确收进行解码。

23.如权利要求21所述的装置，其特征在于，所述处理系统被进一步配置成将所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的所述帧结束字段的值设为指示对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的收到确收的请求的

类型是确收帧，以及对所接收到的针对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的确收帧解码。

24. 如权利要求 21 所述的装置，其特征在于，所述处理系统被进一步配置成将所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的所述帧结束字段的值设为指示对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的收到确收的请求的类型是块确收帧，以及对所接收到的针对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的块确收帧解码。

25. 一种用于无线通信的无线节点，包括 ：

至少一个天线 ；

处理系统，其被配置成生成包括两个或更多个经聚集媒体接入控制协议数据单元 (A-MPDU) 子帧的 A-MPDU 帧，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中所述 A-MPDU 帧包括关于与每个 A-MPDU 子帧的所述接收方地址相关联的一种或多种确收策略的至少一个指示 ；以及

发射机，其被配置成使用所述至少一个天线来传送所述 A-MPDU 帧。

26. 一种设备，包括 ：

用于生成包括两个或更多个经聚集媒体接入控制协议数据单元 (A-MPDU) 子帧的 A-MPDU 帧的装置，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中所述 A-MPDU 帧包括关于与每个 A-MPDU 子帧的所述接收方地址相关联的一种或多种确收策略的至少一个指示 ；以及

用于传送所述 A-MPDU 帧的装置。

27. 如权利要求 26 所述的设备，其特征在于，所述用于生成 A-MPDU 帧的装置被配置成在所述 A-MPDU 子帧的对应一个或多个控制字段中指示所述一种或多种确收策略。

28. 如权利要求 26 所述的设备，其特征在于，所述一种或多种确收策略中的至少一者指示控制响应帧将在接收到包括所述两个或更多个 A-MPDU 子帧的所述 A-MPDU 帧之后传送。

29. 如权利要求 28 所述的设备，其特征在于，所述一种或多种确收策略中的至少一者进一步指示所述控制响应帧将在接收到包括所述两个或更多个 A-MPDU 子帧的所述 A-MPDU 帧之后过一短帧间空间时间传送。

30. 如权利要求 28 所述的设备，其特征在于，所述用于生成 A-MPDU 帧的装置被配置成将所述一种或多种确收策略中的所述至少一者设为特定值以进一步指示所述控制响应帧将在接收到所述 A-MPDU 帧之后被输出以供传送。

31. 如权利要求 26 所述的设备，其特征在于，所述两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧进一步包括媒体接入控制协议数据单元 (MPDU) 定界符字段，其中所述用于生成 A-MPDU 帧的装置被配置成设置所述 MPDU 定界符字段中存储的指示在接收到所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧之后和在对应 A-MPDU 子帧的确收被传送之前逝去的时间延迟的值。

32. 如权利要求 31 所述的设备，其特征在于，所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的所述 MPDU 定界符字段所指示的所述时间延迟基于也在所述 MPDU 定界符字段中指示的退避值。

33. 如权利要求 32 所述的设备，其特征在于，所述 MPDU 定界符字段中指示的所述退避值基于短帧间空间时间或常数值中的至少一者。

34. 如权利要求 26 所述的设备，其特征在于，所述用于生成所述 A-MPDU 帧的装置包括在所述两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段或确收策略字段中的至少一者中生成对收到确收的请求，其中所述帧结束字段或所述确收策略字段中的值决定对收到确收的请求的类型。

35. 如权利要求 34 所述的设备，其特征在于，进一步包括，用于对在所述 A-MPDU 帧的传送之后大于或等于一短帧间空间时间的延迟之后接收到的所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的收到确收进行解码的装置。

36. 如权利要求 34 所述的设备，其特征在于，进一步包括，用于将两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的所述帧结束字段的值设为指示对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的收到确收的请求的类型是确收帧的装置，以及用于对所接收到的针对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的确收帧解码的装置。

37. 如权利要求 34 所述的设备，其特征在于，进一步包括，用于将两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的所述帧结束字段的值设为指示对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的收到确收的请求的类型是块确收帧的装置，以及用于对所接收到的针对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的块确收帧解码的装置。

38. 一种包括其上编码有指令的计算机可读介质的计算机程序产品，所述指令在被执行时使一装置执行一种无线通信方法，所述方法包括 ：

生成包括两个或更多个经聚集媒体接入控制协议数据单元 (A-MPDU) 子帧的 A-MPDU 帧，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中所述 A-MPDU 包括关于与每个 A-MPDU 子帧的所述接收方地址相关联的一种或多种确收策略的至少一个指示 ；以及

传送所述 A-MPDU 帧。

39. 一种无线通信方法，包括 ：

由一装置接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧 ；

由所述装置对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码 ；

由所述装置对与所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码 ；以及

基于关于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定所接收到的 A-MPDU 帧的所述两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧被定址到所述装置。

40. 如权利要求 39 所述的方法，其特征在于，进一步包括 ：

基于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的对应至少一个字段中的与每个 A-MPDU 子帧的所述接收方地址相关联的至少一个指示来对与所接收到的 A-MPDU 帧的所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的一种或多种确收策略解码。

41. 如权利要求 40 所述的方法，其特征在于，进一步包括，如果所述两个或更多个

A-MPDU 子帧中的每一个 A-MPDU 子帧的所述至少一个字段被设为特定值，则基于所述至少一个字段的所述特定值来生成帧并输出所述帧以供传送。

42. 如权利要求 41 所述的方法，其特征在于，进一步包括，对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的所述至少一个字段的帧结束字段中的值解码，其中如果所述帧结束字段中的值为一，则所生成并输出以供传送的所述帧是确收帧。

43. 如权利要求 41 所述的方法，其特征在于，进一步包括，对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的所述至少一个字段的帧结束字段中的值解码，其中如果所述帧结束字段中的值为零，则所生成并输出以供传送的所述帧是块确收帧。

44. 如权利要求 40 所述的方法，其特征在于，进一步包括 ：

对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的帧结束字段中的值解码，所述值指示关于与所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的一种或多种确收策略的对收到确收的请求的类型 ；

如果所述帧结束字段中解码出的值为一，则生成确收所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的收到的确收帧 ；以及

输出所述确收帧以供传送。

45. 如权利要求 40 所述的方法，其特征在于，进一步包括 ：

对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的帧结束字段中的值解码，所解码出的值指示关于与所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的一种或多种确收策略的对收到确收的请求的类型 ；

如果所述帧结束字段中解码出的值为零，则生成确收所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧的收到的块确收帧 ；以及

输出所述块确收帧以供传送。

46. 如权利要求 44 所述的方法，其特征在于，进一步包括 ：

对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的媒体接入控制协议数据单元 (MPDU) 定界符字段解码 ；

从所述 MPDU 定界符字段中存储的值确定在接收到所述 A-MPDU 帧之后和在输出所述确收帧以供传送之前逝去的时间延迟 ；以及

在所述时间延迟逝去之后基于对应于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的所述一种或多种确收策略来输出所述确收帧以供传送。

47. 如权利要求 46 所述的方法，其特征在于，所述 MPDU 定界符字段中存储的值是退避值。

48. 如权利要求 47 所述的方法，其特征在于，所述 MPDU 定界符字段中存储的所述退避值基于短帧间空间时间或常数值中的至少一者。

49. 如权利要求 40 所述的方法，其特征在于，进一步包括，生成对所述两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收，以及在所述 A-MPDU 帧的传送之后大于或等于一短帧间空间时间的延迟之后基于与所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的一种或多种确收策略来输出所述收到确收以供传送。

50. 一种用于无线通信的装置，包括 ：

处理系统，其被配置成 ：

接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧 ;

对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码 ;以及

对与所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码 ;以及

基于关于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定所接收到的 A-MPDU 帧的所述两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧被定址到所述装置。

51. 如权利要求 50 所述的装置,其特征在于,所述处理系统被进一步配置成 :

基于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的对应至少一个字段中的与每个 A-MPDU 子帧的所述接收方地址相关联的至少一个指示来对关于所接收到的定址到所述装置的 A-MPDU 帧的所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略解码。

52. 如权利要求 51 所述的装置,其特征在于,所述处理系统被进一步配置成如果所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的所述至少一个字段被设为特定值,则基于所述至少一个字段的所述特定值来生成帧并输出所述帧以供传送。

53. 如权利要求 52 所述的装置,其特征在于,所述处理系统被进一步配置成对所接收到的定址到所述装置的 A-MPDU 帧的所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的所述至少一个字段的帧结束字段中的值解码,其中所述处理系统被进一步配置成如果所述帧结束字段中的值为一,则将用于传送的帧生成为确收帧。

54. 如权利要求 52 所述的装置,其特征在于,所述处理系统被进一步配置成对所接收到的定址到所述装置的 A-MPDU 帧的所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的所述至少一个字段的帧结束字段中的值解码,其中所述处理系统被进一步配置成如果所述帧结束字段中的值为零,则将用于传送的帧生成为块确收帧。

55. 如权利要求 51 所述的装置,其特征在于,所述处理系统被进一步配置成对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的帧结束字段中的值解码,所述值指示关于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的所述确收策略的对收到确收的请求的类型,并且所述处理系统被进一步配置成如果所述帧结束字段中的值为一,则生成确收帧以供传送。

56. 如权利要求 51 所述的装置,其特征在于,所述处理系统被进一步配置成对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的帧结束字段中的值解码,所述值指示关于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的所述确收策略的对收到确收的请求的类型,并且所述处理系统被进一步配置成如果所述帧结束字段中的值为零,则生成块确收帧以供传送。

57. 如权利要求 55 所述的装置,其特征在于,所述处理系统被进一步配置成 :

对所述两个或更多个 A-MPDU 子帧中的所述至少一个 A-MPDU 子帧中的媒体接入控制协议数据单元 (MPDU) 定界符字段解码 ;以及

从所述 MPDU 定界符字段中存储的值确定在接收到所述 A-MPDU 帧之后和在所述确收帧的传送之前逝去的时间延迟 ;以及

在所述时间延迟逝去之后基于所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧

的所述确收策略来生成所述确收帧以供传送。

58.如权利要求57所述的装置，其特征在于，所述MPDU定界符字段中存储的值是退避值。

59.如权利要求58所述的装置，其特征在于，所述MPDU定界符字段中存储的所述退避值基于短帧间空间时间或常数值中的至少一者。

60.如权利要求51所述的装置，其特征在于，所述处理系统被进一步配置成在所述A-MPDU帧的传送之后大于或等于一短帧间空间时间的延迟之后基于与所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧相对应的确收策略来生成对所接收到的定址到所述装置的A-MPDU帧的所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧的收到确收以供传送。

61.一种用于无线通信的无线节点，包括：

至少一个天线；

接收机，其被配置成经由所述天线接收经聚集媒体接入控制协议数据单元(A-MPDU)帧；

处理系统，其被配置成对所接收到的A-MPDU帧的两个或更多个A-MPDU子帧以及对应于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧的接收方地址解码；以及

基于关于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧解码出的接收方地址来确定所接收到的A-MPDU帧的所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧被定址到所述无线节点。

62.一种用于无线通信的设备，包括：

用于接收经聚集媒体接入控制协议数据单元(A-MPDU)帧的装置；

用于基于所接收到的A-MPDU帧对两个或更多个A-MPDU子帧解码的装置；

用于对与所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧相对应的接收方地址解码的装置；

用于基于关于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧解码出的接收方地址来确定从所接收到的A-MPDU帧解码出的所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧被定址到所述设备的装置。

63.如权利要求62所述的设备，其特征在于，进一步包括：

用于基于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧的对应至少一个字段中的与每个A-MPDU子帧的所述接收方地址相关联的至少一个指示来对关于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧的确收策略解码的装置。

64.如权利要求63所述的设备，其特征在于，进一步包括，如果所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧的所述至少一个字段被设为特定值，用于基于所述至少一个字段的所述特定值来生成帧的装置以及用于传送所述帧的装置。

65.如权利要求64所述的设备，其特征在于，所述用于解码的装置被进一步配置成对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的所述至少一个字段的帧结束字段中的值解码，其中如果所述帧结束字段中的值为一，则所述用于生成的装置被配置成生成确收帧并且所述用于传送的装置被进一步配置成传送所述确收帧。

66.如权利要求64所述的设备，其特征在于，所述用于解码的装置被进一步配置成对

所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的所述至少一个字段的帧结束字段中的值解码，其中如果所述帧结束字段中的值为零，则所述用于生成的装置被配置成生成确收帧并且所述用于传送的装置被进一步配置成传送块确收帧。

67.如权利要求63所述的设备，其特征在于，进一步包括：

用于对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的帧结束字段中的值解码的装置，所述值指示关于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧的确收策略的对收到确收的请求的类型；

用于如果所述帧结束字段中的值为一，则为所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧生成确收帧的装置；以及

用于传送所述确收帧的装置。

68.如权利要求63所述的设备，其特征在于，进一步包括：

用于对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的帧结束字段中的值解码的装置，所述值指示关于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧的确收策略的对收到确收的请求的类型；

用于如果所述帧结束字段中的值为零，则为所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧生成块确收帧的装置；以及

用于传送所述块确收帧的装置。

69.如权利要求67所述的设备，其特征在于，进一步包括：

用于对所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧中的媒体接入控制协议数据单元(MPDU)定界符字段解码的装置；

用于从所述MPDU定界符字段中存储的值确定在接收到所述A-MPDU帧之后和在所述确收帧的传送之前逝去的时间延迟的装置；以及

用于在所述时间延迟逝去之后基于所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧的所述确收策略来生成所述确收帧的装置。

70.如权利要求69所述的设备，其特征在于，所述MPDU定界符字段中的值是退避值。

71.如权利要求70所述的设备，其特征在于，所述MPDU定界符字段中存储的所述退避值基于短帧间空间时间或常数值中的至少一者。

72.如权利要求63所述的设备，其特征在于，进一步包括，用于生成对所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子帧的收到确收的装置，以及用于如果关于所述两个或更多个A-MPDU子帧中的所述至少一个A-MPDU子帧的确收策略指示块确收策略，则在所述A-MPDU帧的传送之后大于或等于一短帧间空间时间的延迟之后传送所述收到确收的装置。

73.一种包括其上编码有指令的计算机可读介质的计算机程序产品，所述指令在被执行时使一装置执行一种无线通信方法，所述方法包括：

接收经聚集媒体接入控制协议数据单元(A-MPDU)帧；

对所接收到的A-MPDU帧的两个或更多个A-MPDU子帧解码；

对与所述两个或更多个A-MPDU子帧中的每一个A-MPDU子帧相对应的接收方地址解码；以及

确定所接收到的A-MPDU帧的所述两个或更多个A-MPDU子帧中的至少一个A-MPDU子

帧被定址到所述装置。

74.如权利要求 1 所述的方法，其特征在于，进一步包括，由所述装置将所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的传送方地址字段设为指示所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的源传送方地址。

75.如权利要求 13 所述的装置，其特征在于，所述处理系统被进一步配置成将所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的传送方地址字段设为指示所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的源传送方地址。

76.如权利要求 26 所述的设备，其特征在于，进一步包括，用于将所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的传送方地址字段设为指示所述两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的源传送方地址的装置。

用于在无线网络中传达多目的地话务的系统和方法

[0001] 背景

[0002] 领域

[0003] 本申请一般涉及无线通信，尤其涉及用于传达多目的地话务的系统、方法和设备。

[0004] 背景

[0005] 在许多电信系统中，通信网络被用于在若干个空间上分开的交互设备之间交换消息。网络可根据地理范围来分类，该地理范围可以例如是城市区域、局部区域、或者个人区域。此类网络可分别被指定为广域网 (WAN)、城域网 (MAN)、局域网 (LAN)、无线局域网 (WLAN)、或个域网 (PAN)。网络还根据用于互连各种网络节点和设备的交换 / 路由技术（例如，电路交换相对于分组交换）、用于传输的物理介质的类型（例如，有线相对于无线）、和所使用的通信协议集（例如，网际协议套集、SONET（同步光学联网）、以太网等）而有所不同。

[0006] 当网络元件是移动的并由此具有动态连通性需求时，或者在网络架构以自组织 (ad hoc) 拓扑结构而非固定拓扑结构来形成的情况下，无线网络往往是优选的。无线网络使用无线电、微波、红外、光等频带中的电磁波以非制导传播模式来采用无形的物理介质。在与固定的有线网络相比较时，无线网络有利地促成用户移动性和快速的现场部署。

[0007] 然而，多个无线网络可存在于同一建筑物内、近旁建筑物内和 / 或同一室外区域内。多个无线网络的普遍存在可导致干扰、降低的吞吐量（例如，因为每个无线网络都在同一区域和 / 或频谱内操作）和 / 或阻碍某些设备进行通信。因此，用于在无线网络密布时进行通信的改进型系统、方法和设备是期望的。

[0008] 概述

[0009] 本发明的系统、方法和设备各自具有若干方面，其中并非仅靠任何单一方面来负责其期望属性。在不限制如由所附权利要求所表达的本发明的范围的情况下，现在将简要地讨论一些特征。在考虑此讨论后，并且尤其是在阅读题为“详细描述”的章节之后，将理解本发明的特征是如何提供包括无线网络中的接入点和站之间的改进的通信在内的优点的。

[0010] 本公开的一个方面提供了一种无线通信方法。在一个方面，该方法包括由无线设备生成包括两个或更多个经聚集媒体接入控制协议数据单元 (A-MPDU) 子帧的 A-MPDU 帧，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中 A-MPDU 帧包括关于与每个 A-MPDU 子帧的接收方地址相关联的一种或多种确收策略的至少一个指示；以及由无线设备输出 A-MPDU 帧以供传送。

[0011] 在一些方面，该一种或多种确收策略在 A-MPDU 子帧的对应一个或多个控制字段中指示。在一些方面，该一种或多种确收策略中的至少一者指示控制响应帧应当在接收到 A-MPDU 之后传送。在一些方面，该一种或多种确收策略指示确收应当在接收到 A-MPDU 之后过 SIFS 时间传送。

[0012] 在一些方面，该一种或多种确收策略中的至少一者指示控制响应帧应当在该一种或多种确收策略中的至少一者被设为特定值（诸如，“正常确收或隐式块确收请求”值）时被传送。

[0013] 在该方法的一些方面，两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧包括 A-MPDU 定界符字段，并且 A-MPDU 定界符字段指示对应 A-MPDU 子帧的确收的时间延迟。在一些方面，该时间延迟基于也包括在 A-MPDU 定界符字段中的退避值。在一些方面，该退避值基于 SIFS 时间或常数值中的至少一者。

[0014] 在一些方面，该方法还包括在两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的字段中生成对收到确收的请求，其中该字段包括基于帧结束字段的值或确收策略字段的值中的至少一者的值，并且其中该字段中的值决定对收到确收的请求的类型。在这些方面中的一些方面，收到确收在传送 A-MPDU 之后大于或等于 SIFS 时间的延迟之后接收。

[0015] 在一些方面，该方法还包括将 A-MPDU 帧中的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束 (EOF) 字段的值设为指示对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收的请求的类型是确收帧。在一些方面，该方法还包括将 A-MPDU 帧中的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束 (EOF) 字段的值设为指示对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收的请求的类型是块确收帧。

[0016] 所公开的另一方面是一种用于无线通信的装置。该装置包括 ：处理系统，其被配置成生成包括两个或更多个媒体接入控制协议数据单元 (MPDU) 子帧的经聚集媒体接入控制协议数据单元 (A-MPDU) 帧，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中 A-MPDU 帧包括关于与每个 A-MPDU 子帧的接收方地址相关联的一种或多种确收策略的至少一个指示 ；以及用于输出 A-MPDU 帧以供传送的接口。

[0017] 在一些方面，该处理系统被进一步配置成在 A-MPDU 子帧的对应一个或多个控制字段中指示一种或多种确收策略。在一些方面，该一种或多种确收策略之一指示控制响应帧应当在接收到 A-MPDU 帧之后传送。在一些方面，该确收策略指示确收应当在接收到 A-MPDU 帧之后过 SIFS 时间传送。

[0018] 在一些方面，处理系统被配置成将一种或多种确收策略中的至少一者设为特定值，诸如“正常确收或隐式块确收请求”值。在一些方面，两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧包括 A-MPDU 定界符字段，并且其中处理系统被配置成将 A-MPDU 定界符字段设为指示对应 A-MPDU 子帧的确收的时间延迟。

[0019] 在一些方面，该时间延迟基于也包括在 A-MPDU 定界符字段中的退避值。在一些方面，该退避值基于 SIFS 时间或常数值中的至少一者。在一些方面，处理系统被进一步配置成在两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的字段中生成对收到确收的请求，其中该字段包括基于帧结束字段的值或确收策略字段的值中的至少一者的值，并且进一步其中该字段中的值决定对收到确收的请求的类型。在一些方面，该处理系统被进一步配置成对在 A-MPDU 帧的传送之后大于或等于 SIFS 时间的延迟之后接收到的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收进行解码。在一些方面，该处理系统被进一步配置成 ：

[0020] 将两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段的值设为指示对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收的请求的类型是确收帧，以及对所接收到的对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的确收帧解码。在一些方面，该处理系统被进一步配置成 ：将两个或更多个 A-MPDU 子帧中的至少

一个 A-MPDU 子帧中的帧结束字段的值设为指示对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收的请求的类型是块确收帧，以及对所接收到的对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的块确收帧解码。

[0021] 所公开的另一方面是一种接入点。该接入点包括：至少一个天线；处理系统，其被配置成生成包括两个或更多个媒体接入控制协议数据单元 (MPDU) 子帧的经聚集媒体接入控制协议数据单元 (A-MPDU) 帧，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中 A-MPDU 帧包括关于与每个 A-MPDU 子帧的接收方地址相关联的一种或多种确收策略的至少一个指示；以及发射机，其被配置成使用至少一个天线来传送 A-MPDU 帧。

[0022] 所公开的另一方面是一种设备。该设备包括：用于生成包括两个或更多个媒体接入控制协议数据单元 (MPDU) 子帧的经聚集媒体接入控制协议数据单元 (A-MPDU) 帧的装置，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中 A-MPDU 帧包括关于与每个 A-MPDU 子帧的接收方地址相关联的一种或多种确收策略的至少一个指示；以及用于传送 A-MPDU 帧的装置。

[0023] 在一些方面，用于生成两个或更多个媒体接入控制协议数据单元 (MPDU) 子帧的装置是处理系统。在一些方面，用于生成包括两个或更多个经聚集媒体接入控制协议数据单元 (A-MPDU) 子帧的 A-MPDU 帧的装置是处理系统。在一些方面，用于传送 A-MPDU 帧的装置是发射机。

[0024] 在一些方面，用于生成两个或更多个 MPDU 子帧的装置被配置成在 A-MPDU 子帧的对应一个或多个控制字段中指示一种或多种确收策略。在一些方面，该一种或多种确收策略之一指示控制响应帧应当在接收到 A-MPDU 之后传送。在一些方面，该确收策略指示确收应当在接收到 A-MPDU 之后过 SIFS 时间传送。在一些方面，用于生成两个或更多个 MPDU 子帧的装置被配置成将一种或多种确收策略中的至少一者设为特定值，诸如“正常确收或隐式块确收请求”值。在一些方面，两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧包括 A-MPDU 定界符字段，并且其中用于生成两个或更多个 MPDU 子帧的装置被配置成将 A-MPDU 定界符字段设为指示对应 A-MPDU 子帧的确收的时间延迟。在一些方面，该时间延迟基于包括在 A-MPDU 定界符字段中的退避值。在一些方面，该退避值基于 SIFS 时间或常数值中的至少一者。在一些方面，该设备还包括用于生成包括两个或更多个 A-MPDU 子帧的 A-MPDU 帧的装置，该生成 A-MPDU 帧包括在两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的字段中生成对收到确收的请求，其中该字段包括基于帧结束字段的值或确收策略字段的值中的至少一者的值，并且进一步其中其中该字段中的值决定对收到确收的请求的类型。

[0025] 在一些方面，该设备进一步包括，用于对在 A-MPDU 帧的传送之后大于或等于一短帧间空间时间的延迟之后接收到的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收进行解码的装置。在一些方面，该设备还包括用于在 A-MPDU 子帧的帧结束 (EOF) 字段为零时对 A-MPDU 子帧之一的块确收帧解码的装置。在一些方面，该设备还包括用于在一个 A-MPDU 子帧的帧结束 (EOF) 字段被置位时对一个 A-MPDU 子帧的确收帧解码的装置。

[0026] 所公开的另一方面是一种包括其上编码有指令的计算机可读介质的计算机程序产品，这些指令在被执行时使一装置执行一种无线通信方法，该方法包括：生成包括两个或更多个经聚集媒体接入控制协议数据单元 (A-MPDU) 子帧的 A-MPDU 帧，其中每个 A-MPDU 子帧包括接收方地址，并且进一步其中 A-MPDU 包括关于与每个 A-MPDU 子帧的接收方地址相

关联的一种或多种确收策略的至少一个指示；以及传送 A-MPDU 帧。

[0027] 所公开的另一方面是一种无线通信方法。该方法包括：由一无线设备接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧；由无线设备对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码；由装置对与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码；以及基于关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧被定址到该装置。

[0028] 在一些方面，该方法还包括基于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的对应至少一个字段中的与每个 A-MPDU 子帧的接收方地址相关联的至少一个指示来对与所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的一种或多种确收策略解码。在一些方面，该方法还包括，如果两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的该字段被设为特定值，则基于该字段的该特定值来生成帧并输出帧以供传送。在一些方面，该方法还包括对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码，其中如果帧结束字段中的值为一，则所生成并输出以供传送的帧是确收帧。在一些方面，该方法还包括对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码，其中如果帧结束字段中的值为零，则所生成并输出以供传送的帧是块确收帧。在一些方面，该方法还包括：对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码，该值指示关于与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的一种或多种确收策略的收到确收的请求的类型；如果帧结束字段中解码出的值为一，则生成确收两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到的确收帧；以及输出确收帧以供传送。

[0029] 在一些方面，该方法还包括：对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码，该值指示关于与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的一种或多种确收策略的收到确收的请求的类型；如果帧结束字段中解码出的值为零，则生成确收两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到的块确收帧；以及输出块确收帧以供传送。在一些方面，该方法进一步包括：对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的媒体接入控制协议数据单元 (MPDU) 定界符字段解码；从定界符字段中存储的值确定在接收到 A-MPDU 帧之后和在输出确收帧以供传送之前逝去的时间延迟；以及在该时间延迟逝去之后基于对应于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的所解码出的确收策略来输出确收帧以供传送。在一些方面，该方法进一步包括 MPDU 定界符字段中存储的值是退避值的情况或者 MPDU 定界符字段中存储的退避值基于短帧间空间时间或常数值中的至少一者的情况。在一些方面，该方法包括生成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收，以及在 A-MPDU 帧的传送之后大于或等于一短帧间空间时间的延迟之后基于与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的所解码出的一种或多种确收策略来输出收到确收以供传送。在一些方面，该方法进一步包括由该装置将两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的传送方地址字段设为指示两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的源传送方地址。

[0030] 所公开的另一方面是一种用于无线通信的装置。该装置包括：接收机，其被配置

成接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧 ;以及处理系统,其被配置成对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码,以及对与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码,以及基于关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧被定址到该装置。在该装置的一些方面,该处理系统被进一步配置成基于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的对应至少一个字段中的与每个 A-MPDU 子帧的接收方地址相关联的至少一个指示来对关于所接收到的定址到该装置的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略解码。

[0031] 该装置的一些方面还包括,该处理系统被进一步配置成如果两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的至少一个字段被设为特定值,则生成帧并输出帧以供传送。

[0032] 在一些方面,该处理系统被进一步配置成对所接收到的定址到该装置的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码,其中该处理系统被进一步配置成如果帧结束字段中的值为一,则基于该字段的特定值将用于传送的帧生成为确收帧。在一些方面,该处理系统被进一步配置成对所接收到的定址到该装置的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码,其中该处理系统被进一步配置成如果帧结束字段中的值为零,则将用于传送的帧生成为块确收帧。在一些方面,该处理系统被进一步配置成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码,该值指示关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略的对收到确收的请求的类型,并且该处理系统被进一步配置成如果帧结束字段中的经解码值为一,则生成确收帧以供传送。在一些方面,该处理系统被进一步配置成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的至少一个字段的帧结束字段中的值解码,该值指示关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略的对收到确收的请求的类型,并且该处理系统被进一步配置成如果帧结束字段中的经解码值为零,则生成块确收帧以供传送。在一些方面,该处理系统被进一步配置成 :对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的媒体接入控制协议数据单元 (MPDU) 定界符字段解码 ;从定界符字段中存储的值确定在接收到 A-MPDU 帧之后和在确收帧的传送之前逝去的时间延迟 ;以及在该时间延迟逝去之后基于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的所解码出的确收策略来生成确收帧以供传送。在一些方面,MPDU 定界符字段中存储的值是退避值。在一些方面,MPDU 定界符字段中存储的退避值基于短帧间空间时间或常数值中的至少一者。在一些方面,该处理系统被进一步配置成在 A-MPDU 帧的传送之后大于或等于一短帧间空间时间的延迟之后基于与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的解码出的一种或多种确收策略来生成对所接收到的定址到该装置的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收以供传送。在一些方面,该处理系统被进一步配置成将两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的传送方地址字段设为指示两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的源传送方地址。

[0033] 所公开的另一方面是一种用于无线通信的站。该站包括 :至少一个天线 ;接收机,其被配置成经由天线接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧 ;以及处理系统,

其被配置成对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码，对与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码，以及基于关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧被定址到装置。

[0034] 所公开的另一方面是一种用于无线通信的设备。该设备包括：用于接收经聚集媒体接入控制协议数据单元 (MPDU) 帧的装置；用于对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码的装置，以及用于对与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码的装置。在一些方面，该设备还包括用于基于关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定两个 A-MPDU 子帧之一被定址到该设备的装置。

[0035] 该设备的一些方面包括用于基于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的对应至少一个字段中的与每个 A-MPDU 子帧的接收方地址相关联的至少一个指示来对关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略解码的装置。

[0036] 该设备的一些方面还包括，如果两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的至少一个字段被设为特定值，用于基于至少一个字段的特定值来生成帧的装置以及用于传送帧的装置。在一些方面，用于解码的装置被进一步配置成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的至少一个字段的帧结束字段中的值解码，其中用于传送的装置被进一步配置成如果帧结束字段中的值为一，则传送确收帧作为该帧。在一些方面，用于解码的装置被进一步配置成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的至少一个字段的帧结束字段中设置的值解码，其中用于传送的装置被进一步配置成如果帧结束字段中的值为零，则传送块确收帧作为该帧。

[0037] 该设备的一些方面进一步包括：用于对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码的装置，值指示关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略的对收到确收的请求的类型；用于如果帧结束字段中的值为一，则为两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧生成确收帧的装置；以及用于传送确收帧的装置。在一些方面，该设备还包括用于对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码的装置，值指示关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略的对收到确收的请求的类型；用于如果帧结束字段中的值为零，则为两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧生成块确收帧的装置；以及用于传送块确收帧的装置。在一些方面，该设备还包括用于对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的媒体接入控制协议数据单元 (MPDU) 定界符字段解码的装置；用于从定界符字段中存储的值确定在接收到 A-MPDU 帧之后和在确收帧的传送之前逝去的时间延迟的装置；以及用于在时间延迟逝去之后基于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的所解码出的确收策略来传送确收帧的装置。在一些方面，MPDU 定界符字段中的值是退避值。在一些方面，MPDU 定界符字段中存储的退避值基于短帧间空间时间或常数值中的至少一者。

[0038] 在一些方面，该设备还包括用于生成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收的装置，以及用于如果两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的确收策略指示块确收策略，则在 A-MPDU 帧的传输之后大于或等于一短帧间

空间时间的延迟之后传送收到确收的装置。

[0039] 在一些方面，用于接收的装置是接收机。在一些方面，用于解码两个 A-MPDU 子帧的装置是处理系统。在一些方面，用于解码两个不同接收方地址的装置是处理系统。在一些方面，用于确定的装置是处理系统。在一些方面，用于解码一个 A-MPDU 子帧的确收策略的装置是处理系统。在一些方面，用于在确收策略被设为特定值的情况下传送控制帧的装置是发射机。在一些方面，用于解码 A-MPDU 子帧中的帧结束字段的装置是处理系统。在一些方面，用于确定传送控制帧的时间延迟的装置是处理系统。在一些方面，用于接收对 A-MPDU 子帧的确收的请求的装置是接收机。

[0040] 在一些方面，该设备进一步包括用于将两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的传送方地址字段设为指示两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的源传送方地址的装置。

[0041] 所公开的另一方面是一种包括其上编码有指令的计算机可读介质的计算机程序产品，这些指令在被执行时使一装置执行一种无线通信方法，该方法包括：接收经聚集媒体接入控制协议数据单元 (MPDU) 帧；对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码；以及对与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码。

[0042] 附图简述

[0043] 图 1 示出了其中可采用本公开的各方面的示例性无线通信系统。

[0044] 图 2A 示出了其中存在多个无线通信网络的无线通信系统。

[0045] 图 2B 示出了其中存在多个无线通信网络的另一无线通信系统。

[0046] 图 3 示出了可以在图 1、2A 和 2B 的无线通信系统内采用的频率复用技术。

[0047] 图 4 示出了可在图 1、2A、2B 和 3 的无线通信系统内采用的示例性无线设备的功能框图。

[0048] 图 5A 解说了在图 1、2A、2B 和 3 的无线通信系统中由接入点传送给三个站的多个消息。

[0049] 图 5B 解说了在图 1、2A、2B 和 3 的无线通信系统中由接入点传送给三个站的单个 A-MPDU。

[0050] 图 6 示出了媒体接入控制协议数据单元 (MPDU) 子帧的示例性结构。

[0051] 图 7 示出了服务质量 (QoS) 控制 (qc) 字段的示例性结构。

[0052] 图 8 示出了经聚集 MPDU(A-MPDU) 帧的示例性结构。

[0053] 图 9A 示出了 MPDU 定界符字段的实施例。

[0054] 图 9B 示出了 MPDU 定界符字段的替换实施例。

[0055] 图 9C 示出了包括三个 A-MPDU 子帧的 A-MPDU 帧。

[0056] 图 9D 解说了接入点与三个站之间的示例性无线通信。

[0057] 图 9E 解说了包括三个 A-MPDU 子帧的 A-MPDU 帧的实施例。

[0058] 图 9F 解说了接入点与三个站之间的示例性无线通信。

[0059] 图 10A 解说了 A-MPDU 的实施例。

[0060] 图 10B 示出了接入点与三个站之间的示例性无线通信。

[0061] 图 10C 解说了 A-MPDU 的实施例。

[0062] 图 10D 示出了接入点与三个站之间的示例性无线通信。

[0063] 图 11A 是一种示例性无线通信方法的流程图。

[0064] 图 11B 是可在无线通信系统内采用的示例性无线设备的功能框图。

[0065] 图 12A 是一种示例性无线通信方法的流程图。

[0066] 图 12B 是可在无线通信系统内采用的示例性无线设备的功能框图。

[0067] 图 13A 是一种示例性无线通信方法的流程图。

[0068] 图 13B 是可在无线通信系统内采用的示例性无线设备的功能框图。

[0069] 详细描述

[0070] 以下参照附图更全面地描述本新颖系统、装置和方法的各种方面。然而，本教义公开可用许多不同的形式来实施并且不应被解释为被限定于本公开通篇所给出的任何特定结构或功能。确切而言，提供这些方面是为了使本公开将是透彻和完整的，并且其将向本领域技术人员完全传达本公开的范围。基于本文中的教导，本领域技术人员应领会到，本公开的范围旨在覆盖本文中公开的这些新颖的系统、设备和方法的任何方面，不论其是独立实现的还是与本发明的任何其他方面组合实现的。例如，可以使用本文所阐述的任何数目的方面来实现装置或实践方法。另外，本发明的范围旨在覆盖使用作为本文中所阐述的本发明各种方面的补充或者与之不同的其他结构、功能性、或者结构及功能性来实践的装置或方法。应当理解，本文披露的任何方面可以由权利要求的一个或多个要素来实施。

[0071] 尽管本文描述了特定方面，但这些方面的众多变体和置换落在本公开的范围之内。尽管提到了优选方面的一些益处和优点，但本公开的范围并非旨在被限定于特定益处、用途或目标。相反，本公开的各方面旨在宽泛地适用于不同的无线技术、系统配置、网络、和传输协议，其中一些藉由示例在附图和以下对优选方面的描述中解说。详细描述和附图仅仅解说本公开而非限定本公开，本公开的范围由所附权利要求及其等效技术方案来定义。

[0072] 流行的无线网络技术可包括各种类型的无线局域网 (WLAN)。WLAN 可被用于采用广泛使用的联网协议来将近旁设备互连在一起。本文中所描述的各个方面可应用于任何通信标准，诸如无线协议。

[0073] 在一些方面，可使用正交频分复用 (OFDM)、直接序列扩频 (DSSS) 通信、OFDM 与 DSSS 通信的组合、或其他方案来根据高效率 802.11 协议传送无线信号。高效率 802.11 协议的实现可用于因特网接入、传感器、计量、智能电网或其他无线应用。有利地，使用本文所公开的技术来实现高效率 802.11 协议的某些设备的各方面可包括允许在同一区域内增加的对等服务（例如，Miracast、WiFi 直连服务、社交 WiFi 等）、支持增加的每用户最低吞吐量要求、支持更多用户、提供改善的室外覆盖和稳健性、和 / 或消耗比实现其他无线协议的设备更少的功率。

[0074] 在一些实现中，WLAN 包括作为接入无线网络的组件的各种设备。例如，可以有两种类型的设备 :接入点（“AP”）和客户端（亦称为站，或“STA”）。一般而言，AP 可用作 WLAN 的中枢或基站，而 STA 用作 WLAN 的用户。例如，STA 可以是膝上型计算机、个人数字助理 (PDA)、移动电话等。在一示例中，STA 经由遵循 WiFi（例如，IEEE 802.11 协议）的无线链路连接到 AP 以获得到因特网或到其他广域网的一般连通性。在一些实现中，STA 也可被用作 AP。

[0075] 所公开的另一方面是用于无线通信的无线节点。该无线节点包括 :天线 ;处理系统，其被配置成生成消息，该消息指示其间一个或多个设备被准许与装置通信的窗口的开

始时间，该开始时间基于绝对时间基准；以及发射机，其被配置成使用该天线来传送所生成的消息。

[0076] 接入点（“AP”）还可包括、被实现为或被称为B节点、无线电网络控制器（“RNC”）、演进型B节点、基站控制器（“BSC”）、基收发机站（“BTS”）、基站（“BS”）、收发机功能（“TF”）、无线电路由器、无线电收发机或其他某个术语。

[0077] 站（“STA”）还可包括、被实现为、或被称为接入终端（“AT”）、订户站、订户单元、移动站、远程站、远程终端、用户终端、用户代理、用户设备、用户装备或其他某个术语。在一些实现中，接入终端可包括蜂窝电话、无绳电话、会话发起协议（“SIP”）话机、无线本地环路（“WLL”）站、个人数字助理（“PDA”）、具有无线连接能力的手持式设备、或连接至无线调制解调器的其他某种合适的处理设备。因此，本文所教导的一个或多个方面可被纳入到电话（例如，蜂窝电话或智能电话）、计算机（例如，膝上型设备）、便携式通信设备、手持机、便携式计算设备（例如，个人数据助理）、娱乐设备（例如，音乐或视频设备、或卫星无线电）、游戏设备或系统、全球定位系统设备、或被配置成经由无线介质通信的任何其他合适的设备中。

[0078] 如以上所讨论的，本文所描述的某些设备可实现例如高效率802.11标准。此类设备（无论是用作STA还是AP还是其他设备）可被用于智能计量或者用在智能电网中。此类设备可提供传感器应用或者用在家庭自动化中。这些设备可取而代之或者附加地用在健康护理环境中，例如用于个人健康护理。这些设备也可被用于监督以启用扩展范围的因特网连通性（例如，供与热点联用）、或者实现机器对机器通信。尽管各种系统、方法和装置在本文中是关于高效率802.11标准来描述的，但是例如本领域技术人员将领会本公开可适用于其它无线通信标准，诸如举例而言802.11ah。

[0079] 图1示出了其中可采用本公开的各方面的示例性无线通信系统100。无线通信系统100可按照无线标准（例如高效率802.11标准）来操作。无线通信系统100可包括AP 104，其与STA 106（一般指代STA 106A－106D）通信。

[0080] 可以将各种过程和方法用于无线通信系统100中在AP 104与STA 106之间的传输。例如，可以根据OFDM/OFDMA技术在AP 104与STA 106之间发送和接收信号。如果是这种情形，则无线通信系统100可以被称为OFDM/OFDMA系统。替换地，可以根据码分多址(CDMA)技术在AP 104与STA 106之间发送和接收信号。如果是这种情形，则无线通信系统100可被称为CDMA系统。

[0081] 促成从AP 104至一个或多个STA 106的传输的通信链路可被称为下行链路(DL)108，而促成从一个或多个STA 106至AP 104的传输的通信链路可被称为上行链路(UL)110。替换地，下行链路108可被称为前向链路或前向信道，而上行链路110可被称为反向链路或反向信道。

[0082] AP 104可充当基站并提供基本服务区域(BSA)102中的无线通信覆盖。AP 104连同与该AP 104相关联并使用该AP 104来通信的诸STA 106一起可被称为基本服务集(BSS)。应注意，无线通信系统100可以不具有中央AP 104，而是可以作为STA 106之间的对等网络起作用。相应地，本文中所描述的AP104的功能可替换地由一个或多个STA 106来执行。

[0083] 在一些方面，STA 106可能被要求与AP 104进行关联以向该AP 104发送通信和/

或从该 AP 104 接收通信。在一个方面，用于关联的信息被包括在由 AP104 作出的广播中。为了接收此种广播，例如，STA 106 可在覆盖区划上执行宽覆盖搜索。举例而言，搜索还可由 STA 106 通过以灯塔方式扫过覆盖区划来执行。在接收到用于关联的信息之后，STA 106 可向 AP 104 传送参考信号，诸如关联探测或请求。在一些方面，AP 104 可使用回程服务例如以与更大的网络（诸如因特网或公共交换电话网 (PSTN)）通信。

[0084] 在一实施例中，AP 104 包括 AP 高效率无线组件 (HEWC)154。AP HEWC154 可执行本文所描述的操作中的部分或全部以使得能够使用高效率 802.11 协议来在 AP 104 和 STA 106 之间进行通信。AP HEWC 154 的功能性在以下关于图 2B、3、4 和 5 - 11 来更详细地描述。

[0085] 替换地或补充地，STA 106 可包括 STA HEWC 156。STA HEWC 156 可执行本文所描述的操作中的部分或全部以使得能够使用高频率 802.11 协议来在 STA 106 和 AP 104 之间进行通信。STA HEWC 156 的功能性在以下关于图 2B、3、4 和 5 - 11 来更详细地描述。

[0086] 在某些环境中，一 BSA 可位于其他 BSA 附近。例如，图 2A 示出了其中存在多个无线通信网络的无线通信系统 200。如图 2A 中所解说的，BSA 202A、202B 和 202C 可以物理地彼此邻近。尽管 BSA 202A - 202C 紧邻，但是 AP204A - 204C 和 / 或 STA 206A - 206H 可以各自使用相同的频谱来通信。因此，如果 BSA 202C 中的设备（例如，AP 204C）正在传送数据，则在 BSA 202C 以外的设备（例如，AP 204A - 204B 或 STA 206A - 206F）可以侦听到介质上的通信。

[0087] 一般而言，使用常规 802.11 协议（例如，802.11a、802.11b、802.11g、802.11n 等）的无线网络在用于介质接入的载波侦听多址 (CSMA) 机制下操作。根据 CSMA，设备侦听介质并且只在介质被侦听到为空闲时进行传送。因此，如果 AP 204A-204C 和 / 或 STA 206A-206H 正根据 CSMA 机制来操作并且 BSA 202C 中的设备（例如，AP 204C）正在传送数据，则在 BSA 202C 以外的 AP 204A-204B 和 / 或 STA 206A-206F 不可在介质上进行传输，即使它们是不同 BSA 的一部分。

[0088] 图 2A 解说了这一场景。如图 2A 所示，AP 204C 正在介质上进行传输。该传输被与 AP 204C 在相同 BSA 202C 中的 STA 206G 侦听到、并被与 AP 204C 在不同的 BSA 中的 STA 206A 侦听到。虽然该传输可被定址到 STA 206G 和 / 或仅仅 BSA 202C 中的 STA，但 STA 206A 却可能直到 AP 204C（以及任何其他设备）不再在介质上进行传送才能够传送或接收通信（例如，去往或来自 AP204A）。尽管未示出，但同样情况也可适用于 BSA 202B 中的 STA 206D-206F 和 / 或 BSA 202A 中的 STA 206B-206C（例如，如果 AP 204C 进行的传输更强以使得其他 STA 能够侦听到介质上的该传输）。

[0089] 于是对 CSMA 机制的使用造成低效，因为在一 BSA 以外的一些 AP 或 STA 可能能够传送数据而不会干扰由该 BSA 中的 AP 或 STA 进行的传输。随着活跃无线设备的数量持续增长，这类低效可能开始显著地影响网络等待时间和吞吐量。例如，显著的网络等待时间问题可能出现在公寓楼内，其中每个公寓单元都可包括接入点及相关联的站。事实上，每个公寓单元都可包括多个接入点，因为住户可拥有无线路由器、具有无线媒体中心能力的视频游戏控制台、具有无线媒体中心能力的电视机、能够像个人热点那样工作的蜂窝电话、和 / 或类似物。于是纠正 CSMA 机制的低效对于避免等待时间和吞吐量问题和总体用户不满而言会是至关重要的。

[0090] 此类等待时间和吞吐量问题甚至可能不限于居住区域。例如，多个接入点可位于

机场、地铁站、和/或其他人群密集的公共空间。当前，可以在这些公共空间中提供WiFi接入，但要收费。如果不纠正由CSMA机制造成的低效，则无线网络的运营商可能随着收费和较低的服务质量开始超过任何益处而失去客户。

[0091] 因此，本文所描述的高效率802.11协议可允许设备在使这些低效得以最小化并增加网络吞吐量的经修改机制下操作。此种机制在以下关于图2B、3和4来描述。高效率802.11协议的附加方面在以下关于图5-11来描述。

[0092] 图2B示出了其中存在多个无线通信网络的无线通信系统250。不像图2A的无线通信系统200，无线通信系统250可以按照本文讨论的高效率802.11标准来操作。无线通信系统250可包括AP 254A、AP 254B和AP 254C。AP 254A可以与STA 256A-256C进行通信，AP 254B可以与STA 256D-256F进行通信，而AP 254C可以与STA 256G-256H进行通信。

[0093] 可以将各种过程和方法用于无线通信系统250中在AP 254A-254C与STA256A-256H之间的传输。例如，可以根据OFDM/OFDMA技术或CDMA技术来在AP 254A-254C和STA 256A-256H之间发送和接收信号。

[0094] AP 254A可充当基站并提供BSA 252A中的无线通信覆盖。AP 254B可充当基站并提供BSA 252B中的无线通信覆盖。AP 254C可充当基站并提供BSA252C中的无线通信覆盖。应当注意，每个BSA 252A、252B和/或252C可以不具有中央AP 254A、254B或254C，而是可允许STA 256A-256H中的一个或多个之间的对等通信。因此，本文所描述的AP 254A-254C的功能可替换地由STA256A-256H中的一个或多个来执行。

[0095] 在一实施例中，AP 254A-254C和/或STA 256A-256H包括高效率无线组件。如本文所描述的，高效率无线组件可使得能够使用高效率802.11协议来在AP和STA之间进行通信。具体而言，高效率无线组件可使得AP 254A-254C和/或STA 256A-256H能够使用使CSMA机制的低效得以最小化的经修改的机制（例如，使得能够在不会发生干扰的情况下在介质上进行并发通信）。高效率无线组件以下参考图4来更详细地描述。

[0096] 如图2B中所解说的，BSA 252A-252C物理地位于彼此邻近。当例如AP254A和STA 256B正在彼此通信时，该通信可被BSA 252B-252C中的其他设备侦听到。然而，该通信可能只干扰某些设备，诸如STA 256F和/或STA 256G。在CSMA下，AP 254B不会被允许与STA 256E进行通信，即使这种通信不会干扰AP 254A与STA 256B之间的通信亦然。由此，高效率802.11协议在经修改机制下操作，该经修改机制在能够并发地通信的设备和不能并发地通信的设备之间进行区分。此类设备归类可由AP 254A-254C和/或STA 256A-256H中的高效率无线组件来执行。

[0097] 在一实施例中，对设备是否能够与其他设备并发地通信的判断基于该设备的位置。例如，位于BSA边缘附近的STA可能处在使得该STA无法与其他设备并发地通信的状态或状况中。如图2B中所解说的，STA 206A、206F和206G可以是处在其中它们无法与其他设备并发地通信的状态或状况中的设备。同样，位于BSA中心附近的STA可能处在使得该STA能够与其他设备进行通信的状态或状况中。如图2中所解说的，STA 206B、206C、206D、206E和206H可以是处在其中它们能够与其他设备并发地通信的状态或状况中的设备。注意，设备分类不是永久的。设备可以在处在使其能够并发地通信的状态或状况与处在使其不能够并发地通信的状态或状况之间转变（例如，设备可以在运动中时、在与新AP进行关联时、在解除关联时等改变状态或状况）。

[0098] 此外，设备可被配置成基于它们是否是处在与其他设备并发地通信的状态或状况中的设备而有不同的行为。例如，处在使其能够并发地通信的状态或状况中的设备可以在相同的频谱内通信。然而，处在使其不能并发地通信的状态或状况中的设备可采用某些技术（诸如空间复用或频域复用）来在该介质上通信。对设备行为的控制可由 AP 254A-254C 和 / 或 STA 256A-256H 中的高效率无线组件来执行。

[0099] 在一实施例中，处在使其不能并发地通信的状态或状况中的设备使用空间复用技术来在介质上通信。例如，功率和 / 或其他信息可以被嵌入在由另一设备传送的分组的前置码内。处在使其不能并发地通信的状态或状况中的设备当在介质上侦听到分组时可以分析前置码，并基于规则集来决定是否要进行传送。

[0100] 在另一实施例中，处在使其不能并发地通信的状态或状况的设备使用频域复用技术来在介质上通信。图 3 示出了可以在图 1 的无线通信系统 100 和图 2B 的无线通信系统 250 内采用的频率复用技术。如图 3 中所解说的，在无线通信系统 300 内可以存在 AP 304A、304B、304C 和 304D。AP 304A、304B、304C 和 304D 中的每一个都可以与不同的 BSA 相关联并且包括本文描述的高效率无线组件。

[0101] 作为示例，通信介质的带宽可以是 80MHz。在常规 802.11 协议下，AP304A、304B、304C 和 304D 中的每一个以及与每一个相应 AP 相关联的 STA 尝试使用整个带宽来进行通信，这可减少吞吐量。然而，在使用频域复用的高效率 802.11 协议下，带宽可被划分成四个 20MHz 段 308、310、312 和 314（例如，信道），如图 3 所解说的。AP 304A 可以与段 308 相关联，AP 304B 可以与段 310 相关联，AP 304C 可以与段 312 相关联，而 AP 304D 可以与段 314 相关联。

[0102] 在一实施例中，当 AP 304A-304D 以及处在使得 STA 能与其它设备并发地通信的状态或状况的这些 STA（例如，在 BSA 的中心附近的 STA）正在彼此通信时，则每个 AP 304A-304D 以及这些 STA 中的每一个 STA 都可使用 80MHz 介质中的部分或全部来进行通信。然而，当 AP 304A-304D 以及处在使得 STA 不能与其它设备并发地通信的状态或状况的这些 STA（例如，在 BSA 的边缘附近的 STA）正在彼此通信时，AP 304A 及其 STA 使用 20MHz 段 308 来进行通信，AP 304B 及其 STA 使用 20MHz 段 310 来进行通信，AP 304C 及其 STA 使用 20MHz 段 312 来进行通信，而 AP 304D 及其 STA 使用 20MHz 段 314 来进行通信。因为段 308、310、312 和 314 是通信介质的不同部分，所以使用第一段的第一传输不会干扰使用第二段的第二传输。

[0103] 因此，包括高效率无线组件的 AP 和 / 或 STA，甚至处于使得它们不能与其它设备并发通信的状态或状况的那些 AP 和 / 或 STA，可与其它 AP 和 STA 并发地通信而不产生干扰。因此，无线通信系统 300 的吞吐量可以增加。在公寓楼或人群密集的公共空间的情况下，使用高效率无线组件的 AP 和 / 或 STA 甚至可以在活跃无线设备的数量增加时经历减少的等待时间和增加的网络吞吐量，由此改善用户体验。

[0104] 图 4 示出了可在图 1、2B 和 3 的无线通信系统 100、250 和 / 或 300 内采用的无线设备 402 的示例性功能框图。无线设备 402 是可被配置成实现本文描述的各种方法的设备的示例。例如，无线设备 402 可包括 AP 104、STA 106 之一、AP 254 之一、STA 256 之一和 / 或 AP 304 之一。

[0105] 无线设备 402 可包括控制无线设备 402 的操作的处理器 404。处理器 404 也可被

称为中央处理单元 (CPU)。可包括只读存储器 (ROM) 和随机存取存储器 (RAM) 两者的存储器 406 可以向处理器 404 提供指令和数据。存储器 406 的一部分还可包括非易失性随机存取存储器 (NVRAM)。处理器 404 通常基于存储器 406 内存储的程序指令来执行逻辑和算术运算。存储器 406 中的指令可以是可执行的以实现本文描述的方法。

[0106] 处理器 404 可包括用一个或多个处理器实现的处理系统或者可以是其组件。这一个或多个处理器可以用通用微处理器、微控制器、数字信号处理器 (DSP)、现场可编程门阵列 (FPGA)、可编程逻辑器件 (PLD)、控制器、状态机、选通逻辑、分立硬件组件、专用硬件有限状态机、或能够对信息执行演算或其他操纵的任何其他合适实体的任何组合来实现。

[0107] 处理系统还可包括用于存储软件的机器可读介质。软件应当被宽泛地解释成意指任何类型的指令，无论其被称作软件、固件、中间件、微代码、硬件描述语言、或是其他。指令可包括代码（例如，呈源代码格式、二进制代码格式、可执行代码格式、或任何其他合适的代码格式）。这些指令在由该一个或多个处理器执行时使处理系统执行本文描述的各种功能。

[0108] 无线设备 402 还可包括外壳 408，该外壳 408 可包括发射机 410 和 / 或接收机 412 以允许在无线设备 402 与远程位置之间进行数据的传送和接收。发射机 410 和接收机 412 可被组合成收发机 414。天线 416 可被附连至外壳 408 并且电耦合至收发机 414。无线设备 402 还可包括（未示出）多个发射机、多个接收机、多个收发机、和 / 或多个天线。

[0109] 发射机 410 可被配置成无线地传送可被称为“寻呼消息”的消息，该“寻呼消息”被配置成向无线设备指示无线设备是否需要从打盹状态苏醒并且进入苏醒状态，如以下所讨论的。例如，发射机 410 可被配置成传送以上讨论的由处理器 404 生成的寻呼消息。当无线设备 402 被实现为或者被用作 STA 106 时，处理器 404 可被配置成处理寻呼消息。当无线设备 402 被实现为或者被用作 AP104 时，处理器 404 还可被配置成生成寻呼消息。

[0110] 接收机 412 可被配置成无线地接收寻呼消息。当无线设备 402 被实现为或者被用作 STA 106 时，发射机 410 可被配置成响应于寻呼消息而传送对数据的请求。例如，无线设备 402 可被配置成传送功率节省轮询 (PS-Poll)，如本文将参照图 4 描述的。当无线设备 402 被实现为或者被用作 AP 104 时，发射机 410 可进一步被配置成向一个或多个 STA 106 传送数据。当无线设备 402 被实现为或者被用作 STA 106 时，发射机 410 可被配置成传送对接收自 AP 104 的数据的确收。

[0111] 无线设备 402 还可包括可被用于力图检测和量化由收发机 414 接收到的信号电平的信号检测器 418。信号检测器 418 可检测诸如总能量、每副载波每码元能量、功率谱密度之类的信号以及其它信号。无线设备 402 还可包括用于处理信号的数字信号处理器 (DSP)420。DSP 420 可被配置成生成分组以供传输。在一些方面，分组可包括物理层数据单元 (PPDU)。

[0112] 在一些方面，无线设备 402 可进一步包括用户接口 422。用户接口 422 可包括按键板、话筒、扬声器、和 / 或显示器。用户接口 422 可包括向无线设备 402 的用户传达信息和 / 或从该用户接收输入的任何元件或组件。

[0113] 在一些方面，无线设备 402 可进一步包括高效率无线组件 424。高效率无线组件 424 可包括分类器单元 428 和传送控制单元 430。如本文所描述的，高效率无线组件 424 可使得 AP 和 / 或 STA 能够使用使 CSMA 机制的低效得以最小化的经修改机制（例如，使得能

够在不会发生干扰的境况下在介质上进行并发通信）。

[0114] 经修改机制可由分类器单元 428 和传送控制单元 430 来实现。在一实施例中，分类器单元 428 确定哪些设备处在使得它们能够与其他设备并发地通信的状态或状况中、以及哪些设备处在使得它们不能与其他设备并发地通信的状态或状况中。在一实施例中，传送控制单元 430 控制设备的行为。例如，传送控制单元 430 可允许某些设备在相同介质上并发地传送，并且允许其他设备使用空间复用或频域复用技术来传送。传送控制单元 430 可基于由分类器单元 428 作出的确定来控制设备的行为。

[0115] 无线设备 402 的各种组件可由总线系统 426 耦合在一起。总线系统 426 可包括例如数据总线，以及除了数据总线之外还有电源总线、控制信号总线、和状态信号总线。本领域技术人员将领会，无线设备 402 的各组件可耦合在一起或者使用某种其他机制来接受或提供彼此的输入。

[0116] 尽管图 4 中解说了数个分开的组件，但本领域技术人员将认识到，这些组件中的一个或多个组件可被组合或者共同地实现。例如，处理器 404 可被用于不仅实现以上关于处理器 404 描述的功能性，而且还实现以上关于信号检测器 418 和 / 或 DSP 420 描述的功能性。另外，图 4 中解说的每个组件可使用多个分开的元件来实现。

[0117] 无线设备 402 可包括 AP 104、STA 106、AP 254、STA 256 和 / 或 AP 304，并且可用于传送和 / 或接收通信。即，AP 104、STA 106、AP 254、STA 256 或 AP 304 中的任一者可用作发射机或接收机设备。某些方面构想了信号检测器 418 由在存储器 406 和处理器 404 上运行的软件用来检测发射机或接收机的存在。

[0118] 再次参照图 1，STA 106 可以具有多种操作模式。例如，STA 106 可具有被称为活跃模式的第一操作模式。在活跃模式中，STA 106 可以始终处于“苏醒”状态并且活跃地向 AP 104 传送数据 / 从其接收数据。此外，STA 106 可具有被称为功率节省模式的第二操作模式。在功率节省模式中，STA 106 可以处于“苏醒”状态或者其中 STA 106 不活跃地向 AP 104 传送数据 / 从其接收数据的“打盹”或“休眠”状态。例如，STA 106 的接收机 412 以及可能还有 DSP 420 和信号检测器 418 可以在打盹状态中使用降低的功耗来操作。此外，在功率节省模式中，STA 106 可以不时地进入苏醒状态以监听来自 AP 104 的消息（例如，寻呼消息），该消息向 STA 106 指示 STA 106 是否需要在某个时间处“唤醒”（例如，进入苏醒状态）以便能够向 AP 104 传送数据 / 从其接收数据。

[0119] 因此，在某些无线通信系统 100 中，AP 104 可以向处于功率节省模式中、与 AP 104 处于相同的网络中的多个 STA 106 传送寻呼消息，从而指示在 AP 104 处是否存在缓冲用于 STA 106 的数据。诸 STA 106 还可以使用此信息来确定它们是需要处于苏醒状态还是需要处于打盹状态。例如，如果 STA 106 确定其未被寻呼，则 STA 106 可以进入打盹状态。替换地，如果 STA 106 确定其可能被寻呼，则 STA 106 可进入苏醒状态达某个时间段以接收该寻呼并且基于该寻呼来进一步确定何时处于苏醒状态。此外，STA 106 可以在接收到寻呼之后停留在苏醒状态中达某个时间段。在另一示例中，STA 106 可被配置成在被寻呼或不被寻呼时以与本公开一致的其他方式起作用。

[0120] 在一些方面，寻呼消息可包括位映射（该图中未示出），诸如话务标识映射 (TIM)。在某些此类方面，位映射可包括数个位。这些寻呼消息可以在信标或 TIM 帧中从 AP 104 发送给 STA 106。位映射中的每一位可以对应于多个 STA 106 中的特定 STA 106，并且每一位

的值（例如，0 或 1）可以指示相应的 STA 106 应当处于的能够接收 AP 104 关于该特定 STA 具有的缓冲单位的状态（例如，打盹状态或苏醒状态）。因此，位映射的大小可以与无线通信系统 100 中的 STA 106 的数目成正比。因此，无线通信系统 100 中较大数目的 STA 106 可导致较大的位映射。

[0121] 在一些方面，休眠达较长时间的 STA 106 可能不会苏醒来读取任何 TIM 消息。例如，STA 106 可决定在延长休眠模式中在一个或多个 TIM 消息中休眠。在此情形中，STA 106 可向 AP 104 通告 STA 106 可能不会读取任何 TIM 消息。相应地，AP 104 可在 TIM 消息中不包括对应的标识符。在各种实施例中，各 STA 106 可使用控制消息或者在关联期间立即向 AP 104 通知它们可能不会在一个或多个 TIM 消息期间苏醒（即，它们以前述功率节省模式操作）。

[0122] 对于已按此方式通知 AP 104 的 STA 106 而言，AP 104 可以不在 TIM 消息中包括标识符，即使在 AP 104 具有旨在发往这些 STA 106 的 BU 时也如此。STA 106 可通过在任何时间向 AP 104 发送 PS-Poll 来主张它们的 BU。在一实施例中，AP 104 可响应于 PS-Poll 而立即发送缓冲单元 (BU)。在另一实施例中，AP 104 可使用确收 (ACK) 对 PS-Poll 作出响应，并在稍后时间递送该 BU。在又一实施例中，AP 104 可以不立即对 PS-Poll 作出响应（既不用 ACK，也不用 BU）。AP 104 可改为用在 TIM 消息之后的给定调度时间后发送的累积 ACK 帧来回复。

[0123] 在各种实施例中，STA 106 可经由 PS-Poll（用于动态指示）、关联请求、探测请求、和 / 或发往 AP 的另一管理帧（用于静态指示）来指定递送 BU 的等待时间。在其他实施例中，AP 104 可经由 ACK 帧、TIM 元素（用于动态指示）、信标、关联响应、探测响应、和 / 或发往 STA 106 的其他管理帧（用于静态指示）来指定递送 BU 的等待时间。STA 106 可进入休眠达等待持续时间。STA 106 可通过发送 ACK 来确收 BU 的正确接收。STA 106 随后可返回休眠。

[0124] 图 5A 解说了在图 1 的无线通信系统 100 中由 AP 104 传送给 STA 106 的多个无线消息 502。如图所示，时间在时间轴 504 上跨页面地水平增加。在各个实施例中，AP 104 可接收和 / 或存储缓冲单元，包括定址到若干目的地 STA 106 的多个帧 510A - 510N。如果 AP 104 具有要发送的缓冲单元，则它可向多个 STA106 传送多个无线消息 502。

[0125] 在各个实施例中，帧 510A - 510B 可以是小或短帧 510A - 510N 并且可包括约 1 字节到约 100 字节、约 10 字节到约 50 字节、并且更具体地约 20 字节。小帧可由应用生成，该应用诸如举例而言，推送通知（例如，电子邮件、广告等）、短消息接发应用（例如，Facebook™ 帖子、Twitter™ 帖子、文本消息等）、上层协议开销（例如，传输控制协议 (TCP) 确收、保持存活消息等）、以及类似应用。相应地，大数目的相对较小的帧可生成许多无线消息，这可导致一个或多个 STA 106 竞争在介质上向 AP 104 传送请求。

[0126] 图 5B 解说了在图 1 的无线通信系统 100 中由 AP 104 传送给 STA 106 的单个 A-MPDU 无线消息 502。如图所示，时间在时间轴 504 上跨页面地水平增加。如以上关于图 5A 讨论的，AP 104 可接收和 / 或存储缓冲单元，包括定址到若干目的地 STA 106 的多个帧 510A - 510N。如果 AP 104 具有要发送的缓冲单元，则代替如图 5A 中所示的传送多个无线消息 502，该 AP 可传送单个经聚集 MPDU 消息 504。A-MPDU 504 可包括多个 A-MPDU 子帧 505a-c。A-MPDU 504 中所包括的多个 A-MPDU 子帧 505a-c 中的一个或更多个 A-MPDU 子帧

可被定址到不同接收方。

[0127] 由于无线消息 504 的 A-MPDU 子帧 505a-c 可被定址到多个接收方，因此产生了关于每个接收方将如何确收定址到该接收方的任何 A-MPDU 子帧 505a-c 的问题。为了协调来自每个接收方的确收，一个或多个 A-MPDU 子帧 505a-c 可包括定义针对该 A-MPDU 子帧的确收策略的一个或多个字段。例如，该确收策略可例如指示针对该 A-MPDU 子帧的确收是否应当由被定址的接收方传送、应当传送的确收的类型（例如，应当传送确收还是块确收）、和 / 或 A-MPDU 无线消息 504 被接收到的时间与针对消息 504 中所包括的任何 MPDU 子帧的确收被传送的时间之间的延迟时间段。每个 A-MPDU 子帧 505a-c 的所指示确收策略用来协调 MPDU 子帧 505a-c 中的每一个的确收，从而在 MPDU 子帧 505a-c 中的每一个被确收的情况下降低冲突发生的概率。

[0128] 图 6 示出了媒体接入控制协议数据单元 (MPDU) 帧 600 的示例性结构。如图所示，MPDU 帧 600 包括 11 个不同字段 :帧控制 (fc) 字段 610、历时 / 标识 (dur) 字段 625、接收方地址 (a1) 字段 630、发射机地址 (a2) 字段 635、目的地地址 (a3) 字段 640、序列控制 (sc) 字段 645、第四地址 (a4) 字段 650、服务质量 (QoS) 控制 (qc) 字段 655、高吞吐量 (HT) 控制字段 660、帧主体 665、以及帧校验序列 (FCS) 字段 670。字段 610-660 中的一些或全部构成 MAC 报头 602。

[0129] 媒体接入控制帧的各字段中的每一个可以被认为是媒体接入控制参数。另外，每一字段可包括一个或多个子字段或字段。例如，媒体接入控制报头 602 的帧控制字段 610 可以包括多个子字段，诸如协议版本、类型字段、子类型字段、以及其它字段。这些子字段或字段中的每一个也可被认为是媒体接入控制参数。在一些实施例中，媒体接入控制帧的个体位可以被认为是媒体接入控制参数。

[0130] a1、a2、a3 和 a4 字段 630、635、640 和 650 中的每一者可包括设备的完整 MAC 地址，其是 48 位 (6 个八位位组）值。在一些方面，这些字段中的任何字段可包括基于短 MAC 报头格式的 AID。图 6 进一步指示了字段 610-670 中的每一个的以八位位组为单位的大小。帧主体字段 665 包括可变数目的八位位组，不同类型的 MPDU 帧可仅包括图 6 中所示的字段的一部分。例如，如果 MPDU 帧是控制帧，则 MPDU 帧的 MAC 报头可以不包括 QoS 控制字段 655 或 HT 控制字段 660。另外，取决于类型，MPDU 帧 600 可包括附加字段。然而，在一些情形中，不论类型如何，MPDU 帧 600 可包括帧控制字段 610。

[0131] 图 7 示出了服务质量 (QoS) 控制 (qc) 字段 655 的示例性结构。如图所示，QoS 控制字段 655 包括五 (5) 个不同的字段 :话务指示符 (TID) 字段 710、服务时段结束字段 720、确收策略字段 730、经聚集 MSDU 存在字段 740、以及“变化”字段 750。在一些方面，确收策略字段 730 可指示四种确收策略之一。在一些方面，这四种确收策略可包括“正常确收或隐式块确收请求”、“无确收”、“无确收或功率节省多轮询 (PSMP) 确收”、以及“块确收”。在一些方面，确收策略 (ACK 策略）字段 730 和话务指示符 (TID) 字段 710 可位于 MAC 报头中的其它地方。例如，确收策略字段和 / 或 TID 字段可位于 MAC 报头 602 的帧控制字段 610 中。

[0132] “变化”字段 750 取决于 QoS 控制字段 655 的实施例可以是各种不同的字段。例如，在一些方面，“变化”字段 750 可以是 TXOP 限制字段、接入点 PS 缓冲状态字段、所请求 TXOP 历时字段、或者队列大小字段。

[0133] 在一些方面，如果确收策略字段 730 指示特定值（诸如，“正常确收或隐式块确收

请求”）并且MPDU帧600作为A-MPDU帧的一部分来包括，则在MPDU 600个体地传送或作为A-MPDU的一部分传送的情况下，该MPDU帧的被定址接收方可传送确收帧或块确收帧。确收或块确收的传输可在携带MPDU帧600的PPDU之后过短帧间空间（SIFS）时间段开始。在一些方面，如果确收策略字段730指示“无确收”，则MPDU帧的被定址接收方在收到该MPDU子帧之际不采取任何动作。在一些方面，如果确收策略字段730指示“块确收”，则MPDU帧的被定址接收方在收到该帧之际除记录状态以外不采取任何动作。接收方可期望将来它将响应的块确收请求帧。

[0134] 图8示出了经聚集MPDU(A-MPDU)帧800的示例性结构。如图所示，A-MPDU帧800包括可变数目（n）的A-MPDU子帧，如805a、805b和805n所示。在一些方面，A-MPDU子帧805a、805b和805n中的每一者可以包括MPDU定界符字段810a、MPDU帧600a以及零个或更多个填充字节。在一些方面，MPDU帧600a可以基本上遵循图6中解说的MPDU帧600。

[0135] 每一个MPDU定界符字段（例如，MPDU定界符字段810a）可以包括帧结束（EOF）字段812a、保留字段814a、MPDU长度字段816a、CRC字段818a、以及定界符签名字段820a。

[0136] 在一些方面，如果A-MPDU子帧805a是MPDU长度字段816a具有非零值的仅有A-MPDU子字段，则在A-MPDU子帧805a中帧结束字段812可被设为一（1）。在一些方面，对于A-MPDU帧800中具有非零MPDU长度字段816a、不是具有非零MPDU长度字段的仅有A-MPDU子帧的每一个A-MPDU子帧805，帧结束字段812a可被设为零（0）。

[0137] 图9A示出了MPDU定界符字段810b的实施例。在一些方面，MPDU定界符字段810b可代替图8所解说的MPDU定界符字段810a。例如，以下关于图9C讨论的A-MPDU 900a可利用MPDU定界符字段810b。MPDU定界符字段810b包括四个字段：延迟指示符字段814b、MPDU长度字段816b、CRC字段818b、以及定界符签名字段820b。在一些方面，如果MPDU定界符字段810b被包括在以下关于图9C讨论的A-MPDU子帧905a-c中的每一者中，则A-MPDU子帧905a-c中的每一者中的延迟指示符字段814b的分开副本可指示延迟指示符值814m-o。

[0138] 图9B示出了MPDU定界符字段810c的实施例。在一些方面，MPDU定界符字段810c可代替图8所解说的MPDU定界符字段810a。例如，A-MPDU900a可利用MPDU定界符字段810c。MPDU定界符字段810c包括五个字段：帧结束指示符字段812c、延迟指示符字段814c、MPDU长度字段816c、CRC字段818c、以及定界符签名字段820c。在一些方面，如果MPDU定界符字段810c被包括在A-MPDU子帧905a-c中的每一者中，则延迟指示符字段814c的分开副本可指示以下图9C所解说的延迟指示符值814m-o。

[0139] 图9C示出了包括至少三个A-MPDU子帧905a-c的A-MPDU帧900a。第一A-MPDU子帧905a指示等同于STA 106a的站地址的接收方地址。类似地，第二A-MPDU子帧905b指示等同于STA 106b的站地址的接收方地址。第三A-MPDU子帧905c指示等同于STA 106c的站地址的接收方地址。在一些其它非解说方面，A-MPDU 900a可包括三个以上A-MPDU子帧。例如，A-MPDU可包括四个、五个、六个、七个、八个、九个、十个或更多个子帧。在一些方面，A-MPDU 900a中的任何附加子帧的一些或全部可指示STA 106a-c或其它站、接入点或中继站中的任一者的接收方地址。

[0140] 如以上关于MPDU 600和QoS控制字段655所讨论的，图9A中所示的A-MPDU 900a的每一个A-MPDU子帧905a-c可包括QoS控制字段或者包括确收策略指示的某一其它字段。例如，每一个A-MPDU子帧905a-c可遵循MPDU600的格式，MPDU 600包括图7中所示

的 QoS 控制字段。

[0141] 在所解说的实现中，A-MPDU 900a 中所包括的三个 A-MPDU 子帧 905a-c 包括三个不同的接收方地址，例如在接收方地址字段（诸如，图 6 的 MPDU 帧 600 中所解说的地址 1 字段 630）中包括三个不同的接收方地址。A-MPDU 900a 中所包括的三个 A-MPDU 子帧还包括与三个不同的接收方地址字段相关联的三种不同的确收策略。

[0142] 所解说方面中的确收规程从 MPDU 定界符中的一个或多个字段以及 MPDU 定界符所关联的 MPDU 中包括的 Ack 策略字段推导出：延迟指示符字段 814m-o、EOF 字段（若存在）、以及确收策略字段 730a-c。在一些方面，延迟指示符字段 814m-o 基本上遵循图 9A 中所示的延迟指示符字段 814 的格式。在一些方面，确收策略字段 730a-c 基本上遵循图 7 的确收策略字段 730 的格式。

[0143] 如图 9C 所示，所有三个 A-MPDU 子帧 905a-c 都包括被设为“正常确收”的确收策略。在一些无线标准（例如 802.11ah 标准）中，这可对应于特定值，诸如“正常确收或隐式块确收请求”。A-MPDU 子帧 905a-c 中的每一者具有不同的延迟指示符值。

[0144] 基于确收策略字段 730a-c 和延迟指示符字段 814m-o 的值，A-MPDU 900a 指示 STA 106a 应当首先确收 MPDU 905a 的正确接收。在一些方面，A-MPDU 子帧 905a 应当在完成 A-MPDU 900a 的传送 / 接收之后过 SIFS 时间确收，因为延迟指示符被设为零值。注意，一般而言，一个或多个 MPDU 可被定址到 STA106a-c 中的任一者。在此类实施例中，如果单个 MPDU 被定址到给定接收方，则它可确定是否要在 EOF 字段被设为 1 的情况下使用 ACK 帧响应或者否则的话使用块确收响应。一般而言，在一些方面，延迟量可基于式 (1) 来确定：

[0145] 延迟 = SIFS+（延迟指示符 *(SIFS+K)） (1)

[0146] 其中 K 等于接收方向传送方传送控制响应所需的时间历时。在一些方面，传送方设备可要求一个或多个接收方遵循用于响应帧的传输的精确规则，以使得历时 K 是确定性的并且对于所有接收方均相等。这些规则的示例可包括精确的 MCS 和带宽选择规则并且还可要求所有接收方使用相同响应帧来进行响应（例如，通过包括被定址到每个接收方的、指示确收应当在 A-MPDU 中发送的 A-MPDU 子帧，传送方指令接收方使用针对相应 A-MPDU 子帧的 ACK 帧来进行响应）。类似规则可应用于仅请求块确收帧作为响应（在此情形中，K 的历时可以更长）。

[0147] 在特定 A-MPDU 帧内，每个延迟指示符字段可被设为唯一性值，至少对于传送方请求来自接收方设备的确收的任何 A-MPDU 子帧而言。在一些方面，如果 A-MPDU 子帧被定址到一群 STA，则传送方将 ACK 策略设为“无确收”，这指示不期望响应。在一些方面，延迟指示符可以是另一 MPDU 子帧所使用的值。在一些方面，指示“无确收”的确收策略的用于 A-MPDU 子帧的延迟指示符可以是随机或未初始化值。

[0148] 在一些方面，在式 1 所确定的延迟逝去之后，如果 A-MPDU 子帧的确收策略被设为“正常确收或隐式块确收”，则可执行 A-MPDU 子帧的确收的传输。在图 9C 中，所有三个子帧 905a-c 均可按此方式确收。

[0149] 由于用于 A-MPDU 子帧 905b 的延迟指示符 814n 为零 (0)，因此 STA 106b 应当在 A-MPDU 900a 的传输之后过 SIFS 时间确收 A-MPDU 子帧 905b。在一些方面，A-MPDU 900a 进一步指示 STA 106a 应当在 A-MPDU 900a 的传输之后过 SIFS+1*(SIFS+K) = 2SIFS+ 常数时间确收 MPDU 子帧 905a 的传输，因为确收延迟指示符字段 814m 被设为一 (1)。类似地，

A-MPDU 900a 指示 STA 106c 应当在 A-MPDU 900a 的传输之后过 3SIFS+2K 确收 MPDU 子帧 905c 的传输，因为确收延迟指示符值字段 814o 被设为二 (2)。

[0150] 通过包括用于 A-MPDU 900a 所指示的两个或更多个（在此情形中为三个）接收方地址的不同确收策略，AP 104 可高效地管理由对应于这三个接收方地址的三个设备 (STA 106a-c) 之一在 A-MPDU 900a 的传输之后过 SIFS 时间作出的一个确收响应的接收。在此实施例中，一些 STA（例如 106a 和 106c) 基于 A-MPDU 子帧定界符字段中的指示在传送它们的确收之前等待一时间段。在一些方面，这降低了在 A-MPDU 900a 的传输之后过 SIFS 时间针对 A-MPDU 900a 中所包括的至少两个 A-MPDU 子帧的至少两个确收之间的冲突的概率。尽管在图 9C 中的 A-MPDU 帧 900a 中解说了三个 A-MPDU 子帧，但在一些方面，两个或三个以上接收方地址可被 A-MPDU 900a 指示。例如，A-MPDU 900a 可包括定址到两个或四个或更多设备的 A-MPDU 子帧。此类 A-MPDU 还将包括至少两种不同的确收策略，对应于 A-MPDU 900a 中包括的 A-MPDU 子帧所指示的接收方地址中的至少两个接收方地址。注意，在一些方面，AP 可基于话务标识符 (TID) 和 / 或以每 MPDU 为基础来请求不同的确收策略。本领域技术人员可领会本文所描述的确收规程可容易地扩展到这些实施例。

[0151] 除在 A-MPDU 中具有多个接收方地址（其中一个或多个 A-MPDU 子帧具有不同的接收方地址，如以上所讨论的）以外，一个或多个 A-MPDU 子帧可具有不同传送方地址，这意味着一个或多个 A-MPDU 子帧可由来自一个或多个不同源设备的传送方接收。例如，包括两个或更多个 MPDU 的 A-MPDU 的传送方可将每个 MPDU 的 MAC 报头中的 A2 字段 635（即，传送方地址）设为不同 MAC 地址，这有助于减少开销。传送方可实现设置不同传送方地址的实施例可包括在传送方为具有多个 BSSID 的 AP（每个 BSSID 标识 AP 与其关联的 BSS) 并且 AP 需要向与该 AP 所关联的 BSS 中的任一者相关联的 STA 传送多个 MPDU 时。在传送方提供中继或网状功能性并且操作以转发需要在可能不在它们相应传输范围内的多个 STA 之间交换的帧的情况下可存在附加实施例；相应地，传送方可在 A-MPDU 中聚集接收自不同 STA 的多个 MPDU 并且将 A-MPDU 传送给一个或多个目的地，其中每个 MPDU 具有指示 MPDU 的源地址的 A2 地址（即，生成该帧的 STA)。例如，在一些实施例中，传送方可聚集：具有共用 A1 地址（接收方）和 A2 地址（传送方）的一个或多个 MPDU；具有不同 A1 地址（接收方）和共用 A2 地址（传送方）（多个接收方－单个传送方）的一个或多个 MPDU；具有共用 A1 地址（接收方）和不同 A2 地址（传送方）（单个接收方－多个传送方）的一个或多个 MPDU；或者具有不同 A1 地址（接收方）和不同 A2 地址（传送方）（多个接收方－多个传送方）的一个或多个 MPDU。此类聚集可减少开销并提高介质效率。

[0152] 图 9D 解说了 AP 104 与三个站 STA 106a、STA 106b 和 STA 106c 之间的示例性无线通信。该无线通信始于 AP 104 传送 A-MPDU 分组 900a。在一些方面，A-MPDU 900a 可以被广播。在一些其它方面，A-MPDU 900a 可以被多播到包括站 STA 106a、STA 106b 和 STA 106c 的多播群。在一些方面，图 9D 中所示的 A-MPDU 900a 的格式可基本上遵循图 9C 所解说的 A-MPDU 900a 和 / 或图 8 中所示的 A-MPDU 800 的格式。

[0153] 图 9D 示出 STA 106b 在 A-MPDU 900a 的传输完成之后过 SIFS 时间传送确收分组 955。STA 106b 在基于 A-MPDU 子帧 905b 中的确收策略 730b 和确收延迟指示符值 814n（其在图 9C 中解说）的所解说时间处传送确收分组 955。接着，STA 106a 在 A-MPDU 900a 的传输完成之后过 2SIFS+ 常数 K 传送确收分组 960。STA 106a 传送确收 960 的时间基于 A-MPDU

子帧 905a 所指示的确收策略 730a 和确收延迟指示符值 814m，如图 9C 所解说的。尽管常数 K 被示为等同于传送确收 955 所必需的时间，但在一些其它方面，常数时间 K 可以大于传送确收 955 所必需的时间。

[0154] 在某些方面，如果 MPDU 是单播传输（即，接收方 STA 的地址是单播地址），则 AP 可以仅指令接收方 STA 确收 MPDU 的接收。然而，在 A-MPDU 中包括群播（广播）帧的某些实施例中，AP 可以通过在定址到该群组中的一个 STA 的 A-MPDU 中包括空元 MPDU 来选择性地请求该单个 STA 发送确收响应。该空元 MPDU 的确收策略可被设为特定值，诸如“正常确收或隐式块确收请求”。此规程可有助于允许传送方估计群播分组是否至少部分地被一个接收方接收。本领域技术人员可领会，从一群设备中选择接收方来确收 A-MPDU 内的 MPDU 的正确接收的此规程可通过使得传送方设备能够标识出该 A-MPDU 是否已潜在地与其它网络话务冲突来增大多播传输的可靠性。响应设备的选择可以基于一个或多个度量，这可允许最大化确收的可靠性。

[0155] 接着，STA 106c 在 A-MPDU 900a 的传输完成之后过 3SIFS+2* 常数 K 传送确收分组 965。STA 106c 传送确收 965 的时间基于 A-MPDU 子帧 905c 所指示的确收策略 730c 和确收延迟指示符值 814o，如图 9C 所解说的。尽管常数 K 在图 9D 中被示为等同于传送确收 960 所必需的时间，但在一些其它方面，常数时间 K 可以大于传送确收 955 所必需的时间。

[0156] 图 9E 解说了 A-MPDU 900b 的实施例。A-MPDU 900b 包括至少三个 A-MPDU 子帧 905d-f。这三个 A-MPDU 子帧 905d-f 中的每一个被分别定址到 STA 106a-c 之一。A-MPDU 900b 的格式可基本上遵循 A-MPDU 800 的格式。在一些方面，MPDU 定界符字段格式 810b 可代替 MPDU 定界符 810a 用在 A-MPDU 900b 中。在一些方面，MPDU 定界符字段格式 810c 可代替 810a 或 810b 用在 A-MPDU 900b 中。

[0157] 类似于图 9C 的 A-MPDU 子帧 905a-c，A-MPDU 子帧 905d-f 各自提供确收延迟指示符字段值 814d-f 和确收策略字段 730d-f。延迟指示符字段 814d-f 的格式可基本上遵循图 9A 中所示的 MPDU 定界符 810b 的延迟指示符字段 814b。在一些方面，延迟指示符字段 814d-f 的格式可基本上遵循图 9B 中所示的 MPDU 定界符 810c 的延迟指示符字段 814c。确收策略字段 730d-f 的格式可基本上遵循图 7 的确收策略字段 730。

[0158] 类似于图 9C 的 A-MPDU 900a，A-MPDU 900b 的第一个 A-MPDU 子帧 905d 具有被设为正常确收的值的确收策略字段 730d。由于 A-MPDU 子帧 905d 的延迟指示符值 814d 被设为零 (0)，因此 STA 106a 将在 A-MPDU 900b 的传输之后过 SIFS 时间确收 A-MPDU 子帧 905d。A-MPDU 子帧 905e-f 中的每一个指示被设为“无确收”的确收策略字段 730e-f。因此，MPDU 905e-f 将不分别被 STA106b-c 确收。由于策略字段 730e-f 被设为“无确收”，因此在一些方面，STA106b 和 106c 中的每一个可以不对延迟指示符字段 814e-f 的值解码或起作用。

[0159] 图 9F 解说了 AP 104 与三个 STA 106a-c 之间的示例性无线通信。该无线通信始于 AP 104 传送 A-MPDU 分组 900b。在一些方面，A-MPDU 900b 可以被广播。在一些其它方面，A-MPDU 900b 可以被多播至包括站 STA 106a、STA106b 和 STA 106c 的多播群。在一些方面，图 9F 中所示的 A-MPDU 900b 的格式可基本上遵循图 8 所解说的 A-MPDU 800。在一些方面，A-MPDU 900b 可包括三个 A-MPDU 子帧。A-MPDU 900b 的一个方面在以上图 9E 中示出。

[0160] 接着，STA 106a 在 A-MPDU 900b 的传输完成之后过 SIFS 时间传送确收分组 970。

STA 106a 在基于图 9E 中解说的 A-MPDU 子帧 905d 所指示的确收策略 730d 和确收延迟指示符值 814d 的所解说时间处传送确收分组 970。由于 A-MPDU 子帧 905d 的延迟指示符值 814d 被设为零，因此 STA 106a 将在 A-MPDU 900b 的传输之后过 SIFS 时间确收 A-MPDU 子帧 905。

[0161] 不同于图 9D 中 STA 106b-c 各自向 AP 104 传送回对 A-MPDU 905b-c 的确收，图 9F 解说了 STA 106b-c 不对图 9E 中示出的 A-MPDU 900b 的 A-MPDU905e-f 进行确收。STAs 106b－c 基于确收策略字段 730e-f 被设为“无确收”的值（如图 9D 中所示）而不确收 A-MPDU 905e-f。

[0162] 图 10A 解说了 A-MPDU 900c 的实施例。A-MPDU 900c 包括至少三个 A-MPDU 子帧 905g-i。类似于图 9E-F 的 A-MPDU 子帧 905a-f，A-MPDU 子帧 905g-i 各自指示确收延迟指示符字段值 814g-i 和确收策略字段 730g-i 值。在一些方面，A-MPDU 子帧 905g-i 中的每一者可基本上遵循图 8 的 A-MPDU 800 的格式。在一些方面，MPDU 定界符字段 810b 可代替 A-MPDU 800 的 MPDU 定界符字段 810a。在一些方面，MPDU 定界符字段 810c 可代替 A-MPDU 800 的 MPDU 定界符字段 810a。

[0163] A-MPDU 900c 的第一个 A-MPDU 子帧 905g 指示块确收的确收策略字段 730g。此值指示 A-MPDU 905g 的接收方应当不在 A-MPDU 905c 被传送／接收之后过 SIFS 时间确收 A-MPDU 905g。代替地，确收策略字段 730g 向接收 A-MPDU 905g 的 STA 106a 指示它应当在确收 A-MPDU 905g 之前等待显式的确收请求。类似地，A-MPDU 子帧 905h 的确收策略字段 730h 也指示块确收。因此，A-MPDU 905h 指示 STA 106b 应当在确收 A-MPDU 905h 之前等待显式的块确收请求。A-MPDU 子帧 905i 的确收策略字段 730i 指示接收 A-MPDU 905i 的 STA 106c 应当在 A-MPDU 900c 的传输完成之后过 SIFS 时间确收 A-MPDU905i，因为 MPDU 905i 的确收延迟指示符字段 814i 被设为零 (0)，如以上所

[0164] 159179 讨论的。由于确收策略字段 730g-h 两者均被设为块确收，因此在一些方面延迟指示符字段 814g-h 的值可被 STA 106a-b 忽略。

[0165] 图 10B 解说了 AP 104 与三个 STA 106a-c 之间的示例性无线通信。首先，AP 104 传送 A-MPDU 900c。在一些方面，A-MPDU 900c 提供等同于图 10A 的 A-MPDU 900c 中所示的那些字段值的字段值。如以上关于图 10A 所讨论的，图 10A 中所示的定址到 STA 106c 的 A-MPDU 子帧 905i 指示正常确收的确收策略。因此，由于延迟指示符字段 814i 为零，因此 STA 106c 在 A-MPDU 帧 900c 的传输完成之后过 SIFS 时间确收 A-MPDU 子帧 905i。这通过块确收帧 1005 的传输示出。

[0166] 由于 A-MPDU 子帧 905g-h 中的每一者指示“块确收”的确收策略，因此 STA 106a-b 在没有显式的块确收请求的情况下将不确收 A-MPDU 子帧 905g-h。因此，如图 10B 中所示，AP 104 向 STA 106b 传送块确收请求 1010。作为响应，STA 106b 在接收到块确收请求 1010 之后过 SIFS 时间传送对 A-MPDU 905h 的块确收 1015。类似地，AP 104 向 STA 106a 传送块确收请求 1020。作为响应，STA 106a 在接收到块确收请求 1020 之后过 SIFS 时间向 AP 104 传送针对 A-MPDU 905g 的块确收消息 1025。

[0167] 图 10C 解说了 A-MPDU 900d 的实施例。A-MPDU 900d 包括至少三个 A-MPDU 子帧 905j-l。A-MPDU 900d 可遵循以上关于 A-MPDU 800 描述的帧字段格式。例如，每个 A-MPDU 子帧可包括 MPDU 定界符字段和 MPDU 字段（两者均未显式示出）。如图 9B 中所示的示例

MPDU 定界符字段 810c 中所示，A-MPDU 子帧 905j-1 的 MPDU 定界符字段可包括 EOF 字段 812j-1、延迟指示符字段 814j-1、以及 MPDU 长度字段 816j-1。每个 MPDU 子帧 905j-1 的控制字段包括确收策略字段 730j-1。

[0168] 在一些方面，MPDU 定界符的 EOF 字段 812 可指示 A-MPDU 子帧应当使用确收帧还是块确收帧来确收。例如，在一些方面，如果帧结束字段 812j-1 为空（零），则块确收应当响应于对应 A-MPDU 子帧的接收而传送。如果 EOF 字段 812j-1 被设置（一），则确收帧应当响应于对应 A-MPDU 子帧的接收而传送。图 10C 中所解说的对 A-MPDU 子帧的块确收和常规确收可类似于先前公开的例如图 9C – 10B 的实施例来操作。例如，每个 A-MPDU 子帧 905g-i 可在字段 730j-1 中指定确收策略，字段 730j-1 类似于先前讨论的确收策略字段（诸如，确收策略字段 730a-i 中的任一者）来操作。延迟指示符字段 802j-1 还可按类似于先前讨论的延迟指示符字段 802a-i 或 m-o 中的任一者来操作。

[0169] 图 10D 解说了 AP 104 与三个 STA 106a-c 之间的示例性无线通信。首先，AP 104 传送 A-MPDU 900d. 在一些方面，A-MPDU 900d 指示图 10C 的 A-MPDU900d 中所指示的字段值。

[0170] 由于 A-MPDU 子帧 905i 的延迟指示符字段 8141 包括零延迟值，因此 STA106c 在 A-MPDU 900d 的传输之后过 SIFS 时间对定址到它的 A-MPDU(905i) 确收。由于 A-MPDU 子帧 905i 的 EOF 字段 8121 为空（零），因此 STA 106c 用块确收帧 1055 来确收 A-MPDU 子帧。

[0171] 接着，基于延迟指示符值 814j，STA 106a 在根据以上式 (1) 的时间传送确收帧 1060。确收帧被 STA 106a 传送，因为 EOF 字段 812j 被设为一。STA 106b 随后基于延迟指示符字段 814k 传送对 A-MPDU 子帧 905k 的确收。由于 EOF 字段 812k 被置位，因此确收帧 1065 代替块确收帧来传送。

[0172] 图 11A 是一种示例性无线通信方法的流程图。在一些方面，过程 1100 可以由以上关于图 2 示出的无线设备 202 执行。在一些方面，过程 1100 可由 AP104 执行。

[0173] 在框 1105，由无线设备生成经聚集媒体接入控制协议数据单元 (A-MPDU) 帧。A-MPDU 帧包括两个或更多个在框 1105 中生成的 A-MPDU 子帧。每一个 A-MPDU 子帧包括接收方地址。A-MPDU 帧包括关于与每一个 A-MPDU 子帧的每一个接收方地址相关联的一种或多种确收策略的至少一个指示。该两个或更多个 A-MPDU 子帧中的每一个包括控制字段，该控制字段指示用于每个对应 A-MPDU 子帧的一种或多种确收策略。在一些方面，在框 1105 生成两个以上 A-MPDU 子帧。在一些方面，在框 1105 生成的 A-MPDU 子帧指示两种以上不同的确收策略。在一些方面，A-MPDU 帧内的两个或更多个 A-MPDU 子帧可被生成为具有相同接收方地址。在一些实施例中，这些确收策略可在每一个 A-MPDU 子帧中被控制字段、定界符字段、或者控制字段和定界符字段的组合来指示。

[0174] 在一些方面，指示确收策略的控制字段是每一个 A-MPDU 子帧的 QoS 控制字段中的确收策略控制字段。在一些方面，每一个 A-MPDU 子帧的 QoS 控制字段的格式可基本上遵循图 7 所解说的 QoS 控制字段 655。

[0175] 在一些方面，QoS 控制帧的确收策略字段可被设为特定值，诸如“正常确收或隐式块确收”。在一些方面，该值对应于 0b00。如果被设为特定值，则确收策略指示针对相应 A-MPDU 子帧的确收应当由该 A-MPDU 子帧的接收方在一时间延迟之后传送。在一些方面，该时间延迟是包括 A-MPDU 子帧的 A-MPDU 帧的传送 / 接收之后的 SIFS 时间。为了减少针对

A-MPDU 子帧传送的确收的冲突，在一些方面，所生成的 A-MPDU 子帧的仅一种确收策略将被设为特定值，诸如“正常确收或隐式块确收”。

[0176] 一些 A-MPDU 子帧中的确收策略字段 730 可被设为“无确收”。如果被设为“无确收”，则接收方应当不确收对应 A-MPDU 子帧。在一些方面，“无确收”的值对应于 0b10。在一些方面，确收策略字段可可被设为“块确收”的值。在一些方面，该值对应于 0b11。如果被设为“块确收”，则确收策略字段指示对应 A-MPDU 子帧的接收方可在稍后时间接收到对块确收消息的请求，并且在对包括对应 A-MPDU 子帧的 A-MPDU 的接收完成之后过 SIFS 时间不应当传送针对对应 A-MPDU 子帧的确收。

[0177] 在一些方面，确收策略进一步由控制字段中的延迟指示符字段指示。在一些方面，延迟指示符字段可被包括在 MPDU 定界符字段中。例如，延迟指示符字段可由图 9A 的 MPDU 定界符字段 810b 的延迟指示符字段 814b 示出。在一些其它方面，延迟指示符字段可由图 8 的 MPDU 定界符字段 810a 的延迟指示符字段 814a 示出。在一些其它方面，延迟指示符字段可由图 9B 的 MPDU 定界符字段 810c 的延迟指示符字段 814c 示出。

[0178] 延迟指示符字段可指示在确收对应 A-MPDU 子帧之前应当逝去的延迟。在一些方面，延迟指示符字段可指示退避计数器。在一些方面，延迟指示符可代表 SIFS 时间的倍数或 SIFS 时间加计数器值。接收到对应 A-MPDU 子帧的设备应当将确收的传送延迟所确定的延迟值。在一些方面，如果确收策略字段被设为特定值，诸如以上讨论的“正常确收或隐式块确收”，则延迟指示符字段指示 A-MPDU 子帧或 A-MPDU 帧的接收 / 传送与对帧的确收的传送时间之间的延迟。

[0179] 在一些方面，确收策略由帧结束 (EOF) 字段指示。例如，在一些方面，A-MPDU 子字段可包括基本上根据 MPDU 定界符字段 810a 的格式的 MPDU 定界符字段。在这些方面，确收策略可由 MPDU 定界符 810a 的 EOF 字段 812a 指示。在一些其它方面，确收策略可由 MPDU 定界符字段 810c 的 EOF 字段 812c 指示。

[0180] 在框 1110，由无线设备传送该 A-MPDU 帧。在由包括一个或多个天线的无线设备执行时，A-MPDU 帧可使用该一个或多个天线来传送。

[0181] 在一些方面，该方法进一步包括由无线设备向 A-MPDU 子帧之一所指示的接收方地址传送对确收的请求。在一些方面，该请求是块确收请求。如果 A-MPDU 子帧所指示的确收策略指示块确收策略，则可传送对确收的请求。对确收的请求可在框 1115A-MPDU 的传输之后大于 SIFS 时间段的延迟之后传送。此延迟可为所传送的 A-MPDU 帧中的一个 A-MPDU 子帧提供被确收的时机。确收策略被设为特定值（诸如“正常确收或隐式块确收”）的 A-MPDU 子帧可在此延迟期间被确收。

[0182] 在一些方面，该方法进一步包括由无线设备接收针对所传送的 A-MPDU 帧中包括的 A-MPDU 子帧中的一个或多个 A-MPDU 子帧的一个或多个确收。在一些方面，这些确收之一在框 1115A-MPDU 帧的传送完成之后过 SIFS 时间接收。例如，确收策略被设为特定值（诸如“正常确收或隐式块确收”）的 A-MPDU 帧、或者帧结束指示被设置的 A-MPDU 帧可在此时间期间被确收。

[0183] 一些方面可进一步使 A-MPDU 子帧确收的定时以延迟指示符字段为基础，如以上所讨论的。例如，在一些方面，确收策略被设为特定值（诸如恰适 802.11 标准的“正常确收或隐式块确收”）的 A-MPDU 子帧还将需要具有被设为零或最小延迟值的延迟指示符字段以

便使该 A-MPDU 子帧在框 1115A-MPDU 帧的传送完成之后过 SIFS 时间确收。

[0184] 其它帧可响应于由无线设备传送的显式确收请求（诸如，块确收请求，如上所述）而被确收。

[0185] 图 11B 是可在无线通信系统 100 内采用的示例性无线设备 1150 的功能框图。设备 1150 包括 A-MPDU 帧生成电路 1155 和 A-MPDU 传送电路 1160。A-MPDU 帧生成电路 1155 可被配置成执行以上关于图 11A 中解说的框 1105 讨论的一个或多个功能。A-MPDU 帧生成电路 1155 可对应于处理器 404 和 / 或 DSP 420、和 / 或处理系统中的一者或多者。设备 1150 进一步包括 A-MPDU 帧传送电路 1160。在一些方面，A-MPDU 帧传送电路 1160 可被配置成执行以上关于框 1110 讨论的一个或多个功能。在一些方面，A-MPDU 帧传送电路 1160 可包括发射机 410。在一些方面，帧传送电路可被进一步配置成向 A-MPDU 子帧之一所指示的接收方地址传送对确收的请求。在一些实现中，用于生成包括两个或更多个经聚集媒体接入控制协议数据单元 (A-MPDU) 子帧的 A-MPDU 帧的装置和 / 或用于生成两个或更多个 A-MPDU 子帧的装置可包括 A-MPDU 生成帧电路 1155。在一些实现中，用于传送 A-MPDU 帧的装置可包括 A-MPDU 传送电路。

[0186] 在一些方面，设备 1150 进一步包括解码电路。解码电路可被配置成如果由 A-MPDU 帧生成电路 1155 生成的 A-MPDU 子帧的帧结束 (EOF) 字段被设为零，则解码针对该 A-MPDU 子帧的块确收。在一些方面，解码电路可对应于处理器 404 和 / 或 DSP 420、和 / 或处理系统中的一者或多者。在一些方面，解码电路可被进一步配置成如果由 A-MPDU 帧生成电路 1155 生成的 A-MPDU 子帧的帧结束 (EOF) 字段被设置，则解码针对该 A-MPDU 子帧的确收。在一些方面，设备 1150 进一步包括解码电路。解码电路可对在 A-MPDU 帧的传输之后大于或等于一短帧间空间时间的延迟之后接收到的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的收到确收进行解码。在一些方面，解码电路可对应于处理器 404 和 / 或 DSP 420、和 / 或处理系统。在一些实现中，用于解码收到确收的装置可包括解码电路。在一些方面，设备 1150 进一步包括值设置电路。该设置电路可被配置成根据 A-MPDU 子帧的确收策略将帧结束字段中的值设为指示在收到时要发送的帧。在一些方面，设置电路可对应于处理器 404 和 / 或 DSP 420、和 / 或处理系统。在一些实现中，用于设置帧结束字段的值的装置包括设置电路。

[0187] 图 12A 是一种示例性无线通信方法的流程图。在一些方面，过程 1200 可以由以上关于图 2 示出的无线设备 202 执行。在一些方面，过程 1200 可由 STA106 执行。

[0188] 在框 1205，由无线设备接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧。该 A-MPDU 帧包括两个或更多个 A-MPDU 子帧。在一些方面，这些 A-MPDU 子帧基本上遵循以上讨论的帧 900a-d 之一的格式。

[0189] 在框 1210，由无线设备对该 A-MPDU 帧解码。在一些方面，接收方设备标识定址到该设备的 A-MPDU 帧中所包括的 A-MPDU 子帧中的一者或多者。在一些方面，这可通过将这些 A-MPDU 子帧中的每一者中指定的接收方地址与无线设备的本地设备地址进行比较来完成。在一些方面，这些 A-MPDU 子帧中的一个或多个 A-MPDU 子帧中指定的接收方地址是广播或多播地址。在此情形中，接收方设备可确定它是否被包括在 A-MPDU 子帧的多播地址所指示的多播群中。

[0190] 一旦接收方设备已标识出定址到该接收方的 A-MPDU 子帧，接收方设备就可确定

定址到该接收方的每一个 A-MPDU 子帧的确收策略。在一些方面，如果 A-MPDU 子帧的 QoS 控制字段的确收策略字段被设为“无确收”，则接收方设备将不传送对该特定 A-MPDU 子帧的确收。如果确收策略字段被设为“块确收”，则可存储 A-MPDU 子帧的收到，但设备直至接收到后续确收请求才将传送确收。在一些方面，所接收到的确收请求将为块确收请求。

[0191] 如果 QoS 控制字段的确收策略字段被设为特定值（诸如，对应于恰适 802.11 标准的“正常确收或隐式块确收”的值），则接收方设备可在 A-MPDU 帧的接收完成之后过 SIFS 时间传送确收。在一些方面，确收的传送时间将进一步基于延迟指示符字段。在一些方面，延迟指示符字段在 A-MPDU 子帧的 MPDU 定界符字段中提供。例如，在一些方面，MPDU 定界符字段可基本上遵循图 9B 中所示的 MPDU 定界符字段 810b 的格式。在一些方面，延迟指示符字段可指示退避值。例如，延迟指示符字段可指示接收方在确收对应 A-MPDU 子帧之前应当等待的 SIFS 时间的倍数或者 SIFS 时间的倍数 + 常数值。

[0192] 在一些方面，确定 A-MPDU 子帧的确收策略可以基于帧结束字段。在一些方面，帧结束字段被包括在 MPDU 定界符字段中，如 MPDU 定界符字段 810a 或 810c 中所示。在一些方面，如果帧结束字段被置位，则对 A-MPDU 的确收在 A-MPDU 帧的接收之后过 SIFS 时间传送。在一些方面，如果帧结束字段为空（零），则在 A-MPDU 帧的接收之后过 SIFS 时间处可不传送对 A-MPDU 子帧的确收。

[0193] 一些方面进一步包括接收对 A-MPDU 帧中所包括的 A-MPDU 子帧中的一者或多者的确收请求。例如，如果 A-MPDU 子帧指示“块确收”的确收策略，则接收方将直至接收到显式的确收请求才确收 A-MPDU 子帧。在接收到对 A-MPDU 子帧的确收请求时，可至少基于是否接收到 A-MPDU 子帧来传送对 A-MPDU 子帧的确收。

[0194] 图 12B 是可在无线通信系统 100 内采用的示例性无线设备 1250 的功能框图。设备 1250 包括 A-MPDU 帧接收电路 1255 和 A-MPDU 帧解码电路 1260。A-MPDU 帧接收电路 1255 可被配置成执行以上参照图 12A 中解说的框 1205 讨论的一个或多个功能。A-MPDU 帧接收电路 1255 可对应于一个或多个接收机 412。设备 1250 进一步包括 A-MPDU 帧解码电路 1260。A-MPDU 帧解码电路 1260 可被配置成执行以上参照图 12A 中解说的框 1210 讨论的一个或多个功能。在一些方面，A-MPDU 帧解码电路 1260 可对应于处理器 404。在一些实现中，用于接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧的装置可包括 A-MPDU 接收帧电路 1255。在一些实现中，用于基于所接收到的 A-MPDU 帧解码两个或更多个 A-MPDU 子帧的装置、用于对与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码的装置、或者用于基于针对从所接收到的 A-MPDU 帧解码出的两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定该两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧被定址到该设备的装置可包括 A-MPDU 解码电路 1260。

[0195] 在一些方面，设备 1250 进一步包括解码电路。解码电路可被配置成基于所接收到的 A-MPDU 帧对 A-MPDU 子帧解码。解码电路可被配置成基于所接收到的 A-MPDU 帧对 A-MPDU 子帧解码。解码电路可被配置成对与两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码。解码电路可被配置成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的 MPDU 定界符字段解码。在一些方面，解码电路可对应于处理器 404、DSP 420 和 / 或处理系统。在一些实现中，用于解码 A-MPDU 子帧的装置和用于解码接收方地址的装置可包括解码电路。

[0196] 在一些方面，设备 1250 进一步包括确定电路。确定电路可被配置成基于关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧解码出的接收方地址来确定从所接收到的 A-MPDU 帧解码出的两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧被定址到该设备。确定电路还可被配置成从 MPDU 定界符字段中存储的值确定在接收到 A-MPDU 帧之后和在确收帧的传送之前逝去的时间延迟。在一些方面，确定电路可对应于处理器 404、DSP 420 和 / 或处理系统。在一些实现中，用于确定的装置可包括该确定电路。

[0197] 在一些方面，设备 1250 进一步包括确收策略解码电路。确收策略解码电路可被配置成基于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的对应一个或多个字段中的与每个 A-MPDU 子帧的接收方地址相关联的至少一个指示来对关于该两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略解码。在一些方面，确收解码电路可对应于处理器 404。在一些实现中，用于解码确收策略的装置可包括确收解码电路。

[0198] 在一些方面，设备 1250 进一步包括帧结束字段解码电路。帧结束字段解码电路可被配置成对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧中的帧结束字段中的值解码，该值指示关于两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧的确收策略的对收到确收的请求的类型。在一些方面，帧结束字段解码电路可对应于处理器 404、DSP 420、和 / 或处理系统。在一些实现中，用于解码帧结束字段的装置可包括帧结束字段解码电路。

[0199] 在一些方面，设备 1250 进一步包括帧生成电路。帧生成电路可基于帧结束字段中的值来生成针对两个或更多个 A-MPDU 子帧中的至少一个 A-MPDU 子帧的确收帧或块确收帧。在一些方面，帧结束生成电路可对应于处理器 404、DSP 420、和 / 或处理系统。在一些实现中，用于生成确收帧的装置可包括帧生成电路。

[0200] 图 13A 是一种示例性无线通信方法的流程图。在一些方面，过程 1300 可以由以上关于图 2 示出的无线设备 202 执行。在一些方面，过程 1300 可由 STA106 执行。

[0201] 在框 1305，由无线设备接收经聚集媒体接入控制协议数据单元 (A-MPDU) 帧。在框 1310，由无线设备对所接收到的 A-MPDU 帧的两个或更多个 A-MPDU 子帧解码。在一些方面，解码出的 A-MPDU 子帧基本上遵循以上讨论的帧 900a-d 之一的格式。

[0202] 在框 1315，由无线设备对与该两个或更多个 A-MPDU 子帧中的每一个 A-MPDU 子帧相对应的接收方地址解码。在一些方面，这些 A-MPDU 子帧中的一个或多个 A-MPDU 子帧中指定的接收方地址是广播或多播地址。在此情形中，接收方设备可确定它是否被包括在 A-MPDU 子帧的多播地址所指示的多播群中。

[0203] 在一些方面，执行过程 1300 的设备可将解码出的接收方地址中的每一者与解码设备的本地地址进行比较。如果这些 A-MPDU 子帧中的一者或多者中的接收方地址与本地接收方地址相匹配，则接收方设备随后可进一步对所接收到的 A-MPDU 子帧进行解码。

[0204] 一旦接收方设备已标识出定址到该接收方设备的 A-MPDU 子帧，接收方设备就可确定定址到该接收方的每一个 A-MPDU 子帧的确收策略。例如，在一些方面，接收方设备可对接收方 A-MPDU 子帧所指示的确收策略解码。在一些方面，确收策略可由以下一者或多者指示 ：控制字段中的确收策略字段、MPDU 定界符字段中的延迟指示符字段、和 / 或 MPDU 定界符字段中所包括的帧结束字段。

[0205] 在一些方面，如果 A-MPDU 子帧的 QoS 控制字段的确收策略字段被设为对应于“无确收”的值，则接收方设备将不传送对该特定 A-MPDU 子帧的确收。如果确收策略字段被设

为“块确收”，则可存储 A-MPDU 子帧的收到，但确收将直至接收到后续确收请求才被传送。在一些方面，所接收到的确收请求将是块确收请求。

[0206] 如果 QoS 控制字段的确收策略字段被设为特定值（在一些方面，该特定值对应于如由恰适 802.11 标准定义的“正常确收或隐式块确收”的值），则接收方设备可在 A-MPDU 帧的接收完成之后过 SIFS 时间传送确收。在一些方面，确收的传送时间将进一步基于延迟指示符字段。在一些方面，延迟指示符字段在 A-MPDU 子帧的 MPDU 定界符字段中提供。例如，在一些方面，MPDU 定界符字段可基本上遵循图 9B 中所示的 MPDU 定界符字段 810b 的格式。在一些方面，延迟指示符字段可指示退避值。例如，延迟指示符字段可指示接收方在确收对应 A-MPDU 子帧之前应当等待的 SIFS 时间的倍数或者 SIFS 时间的倍数 + 常数值。

[0207] 在一些方面，确定 A-MPDU 子帧的确收策略可以基于帧结束字段。在一些方面，帧结束字段被包括在 MPDU 定界符字段中，如 MPDU 定界符字段 810a 或 810c 中所示。在一些方面，如果帧结束字段被置位，则对 A-MPDU 的确收在 A-MPDU 帧的接收之后过 SIFS 时间传送。在一些方面，如果帧结束字段为空（零），则对 A-MPDU 子帧的块确收可在 A-MPDU 帧的接收之后过 SIFS 时间处传送。在一些其它方面，如果帧结束字段为空（零），则在 A-MPDU 帧的接收之后过 SIFS 时间不传送确收。

[0208] 一些方面进一步包括接收对 A-MPDU 帧中所包括的 A-MPDU 子帧中的一个或多个 A-MPDU 子帧的确收请求。例如，在一些方面，如果 A-MPDU 子帧指示“块确收”的确收策略，则接收方将直至接收到显式的块确收请求才确收 A-MPDU 子帧。在接收到对 A-MPDU 子帧的确收请求时，可至少基于是否接收到 A-MPDU 子帧来传送对 A-MPDU 子帧的确收。

[0209] 图 13B 是可在无线通信系统 100 内采用的示例性无线设备 1350 的功能框图。设备 1350 包括 A-MPDU 帧接收电路 1355、A-MPDU 子帧解码电路 1360、以及接收方地址解码电路 1365。A-MPDU 帧接收电路 1355 可被配置成执行以上关于图 13A 中解说的框 1305 讨论的一个或多个功能。A-MPDU 帧接收电路 1355 可对应于一个或多个接收机 412。设备 1350 进一步包括 A-MPDU 子帧解码电路 1360。A-MPDU 子帧解码电路 1360 可被配置成执行以上关于图 13A 中解说的框 1310 讨论的一个或多个功能。在一些方面，A-MPDU 子帧解码电路 1360 可被配置成对一个 A-MPDU 子帧的确收策略解码。在一些方面，A-MPDU 子帧解码电路 1360 可被进一步配置成对 A-MPDU 子帧的帧结束字段解码。在一些方面，A-MPDU 子帧解码电路 1360 可对应于处理器 404 和 / 或 DSP 420、和 / 或处理系统。设备 1350 进一步包括接收方地址解码电路 1365。接收方地址解码电路 1365 可被配置成执行以上关于图 13A 中解说的框 1315 所讨论的一个或多个功能。在一些方面，接收方地址解码电路 1365 可对应于处理器 404 和 / 或 DSP 420、和 / 或处理系统。

[0210] 在一些方面，设备 1350 可进一步包括确定电路。. 在一些方面，确定电路可被进一步配置成确定用于传送控制帧的时间延迟。确定电路可被配置成基于 A-MPDU 子帧的 A-MPDU 定界符字段来确定用于传送控制帧的时间延迟。在一些方面，确定电路可对应于处理器 404 和 / 或 DSP 420、和 / 或处理系统。

[0211] 设备 1350 的一些方面可进一步包括传送电路。传送电路可被配置成在确收策略被设为特定值的情况下传送控制帧。在一些方面，传送电路可对应于发射机 410。

[0212] 在一些方面，设备 1350 可进一步包括接收电路。接收电路可被配置成接收对于针对 A-MPDU 子帧的确收的请求。在一些方面，接收电路可对应于接收机 412。

[0213] 如本文所使用的，术语“确定”涵盖各种各样的动作。例如，“确定”可包括演算、计算、处理、推导、研究、查找（例如，在表、数据库或其他数据结构中查找）、探知及诸如此类。而且，“确定”可包括接收（例如，接收信息）、访问（例如，访问存储器中的数据）及诸如此类。而且，“确定”还可包括解析、选择、选取、确立及类似动作。另外，如本文中所使用的“信道宽度”可在某些方面涵盖或者还可称为带宽。

[0214] 如本文所使用的，引述一列项目中的“至少一个”的短语是指这些项目的任何组合，包括单个成员。作为示例，“a、b 或 c 中的至少一个”旨在涵盖 :a、b、c、a-b、a-c、b-c、以及 a-b-c。

[0215] 上面描述的方法的各种操作可由能够执行这些操作的任何合适的装置来执行，诸如各种硬件和 / 或软件组件、电路、和 / 或模块。一般而言，在附图中所解说的任何操作可由能够执行这些操作的相对应的功能性装置来执行。

[0216] 如本文所使用的，术语“接口”可指代被配置成将两个或更多个设备连接在一起的硬件或软件。例如，接口可以是处理器或总线的一部分并且可被配置成允许设备之间的信息或数据的通信。接口可被集成到芯片或其它设备中。例如，在一些实施例中，接口可包括被配置成在一设备处接收来自另一设备的信息或通信的接收机。接口（例如，处理器或总线的接口）可接收由前端或另一设备处理的信息或数据或者可处理所接收到的信息。在一些实施例中，接口可包括被配置成向另一设备传送或传达信息或数据的发射机。因此，接口可传送信息或数据或者可准备用于传送（例如，经由总线传送）的信息或数据。

[0217] 结合本公开所描述的各种解说性逻辑框、模块、以及电路可用设计成执行本文所描述功能的通用处理器、数字信号处理器 (DSP)、专用集成电路 (ASIC)、现场可编程门阵列信号 (FPGA) 或其他可编程逻辑器件 (PLD)、分立的门或晶体管逻辑、分立的硬件组件或其任何组合来实现或执行。通用处理器可以是微处理器，但在替换方案中，该处理器可以是任何市售的处理器、控制器、微控制器或状态机。处理器还可以被实现为计算设备的组合，例如 DSP 与微处理器的组合、多个微处理器、与 DSP 核心协同的一个或多个微处理器、或任何其它此类配置。

[0218] 在一个或多个方面中，所描述的功能可在硬件、软件、固件或其任何组合中实现。如果在软件中实现，则各功能可以作为一条或多条指令或代码存储在计算机可读介质上或藉其进行传送。计算机可读介质包括计算机存储介质和通信介质两者，包括促成计算机程序从一地向另一地转移的任何介质。存储介质可以是能被计算机访问的任何可用介质。作为示例而非限定，这样的计算机可读介质可包括 RAM、ROM、EEPROM、CD-ROM 或其他光盘存储、磁盘存储或其他磁存储设备、或能用于携带或存储指令或数据结构形式的期望程序代码且能被计算机访问的任何其他介质。任何连接也被正当地称为计算机可读介质。例如，如果软件是使用同轴电缆、光纤电缆、双绞线、数字订户线 (DSL)、或诸如红外、无线电、以及微波之类的无线技术从 web 网站、服务器、或其他远程源传送而来，则该同轴电缆、光纤电缆、双绞线、DSL、或诸如红外、无线电、以及微波之类的无线技术就被包括在介质的定义之中。如本文中所使用的盘 (disk) 和碟 (disc) 包括压缩碟 (CD)、激光碟、光碟、数字通用碟 (DVD)、软盘和蓝光碟，其中盘 (disk) 往往以磁的方式再现数据而碟 (disc) 利用激光以光学方式再现数据。因此，在一些方面，计算机可读介质可包括非暂态计算机可读介质（例如，有形介质）。另外，在一些方面，计算机可读介质可包括暂态计算机可读介质（例如，信

号）。上述的组合应当也被包括在计算机可读介质的范围内。

[0219] 因此，一些方面可包括用于执行本文中给出的操作的计算机程序产品。例如，此种计算机程序产品可包括其上存储（和/或编码）有指令的计算机可读介质，这些指令能由一个或多个处理器执行以执行本文中所描述的操作。对于一些方面，计算机程序产品可包括包装材料。

[0220] 本文所公开的方法包括用于实现所描述的方法的一个或多个步骤或动作。这些方法步骤和/或动作可以彼此互换而不会脱离权利要求的范围。换言之，除非指定了步骤或动作的特定次序，否则具体步骤和/或动作的次序和/或使用可以改动而不会脱离权利要求的范围。

[0221] 软件或指令还可以在传输介质上传送。例如，如果软件是使用同轴电缆、光纤电缆、双绞线、数字订户线(DSL)、或诸如红外、无线电、以及微波等无线技术从web站点、服务器或其他远程源传送而来的，则该同轴电缆、光纤电缆、双绞线、DSL、或诸如红外、无线电以及微波等无线技术就被包括在传输介质的定义里。

[0222] 此外，应当领会，用于执行本文中所描述的方法和技术的模块和/或其它恰适装置能由用户终端和/或基站在适用的场合下载和/或以其他方式获得。例如，此类设备能被耦合至服务器以促成用于执行本文中所描述的方法的装置的转移。替换地，本文所述的各种方法能经由存储装置（例如，RAM、ROM、诸如压缩碟(CD)或软盘等物理存储介质等）来提供，以使得一旦将该存储装置耦合至或提供给用户终端和/或基站，该设备就能获得各种方法。此外，可利用适于向设备提供本文中所描述的方法和技术的任何其他合适的技术。

[0223] 将理解，权利要求并不被限定于以上所解说的精确配置和组件。可在以上所描述的方法和装置的布局、操作和细节上作出各种改动、更换和变形而不会脱离权利要求的范围。

[0224] 尽管上述内容针对本公开的各方面，然而可设计出本公开的其他和进一步的方面而不会脱离其基本范围，且其范围是由所附权利要求来确定的。

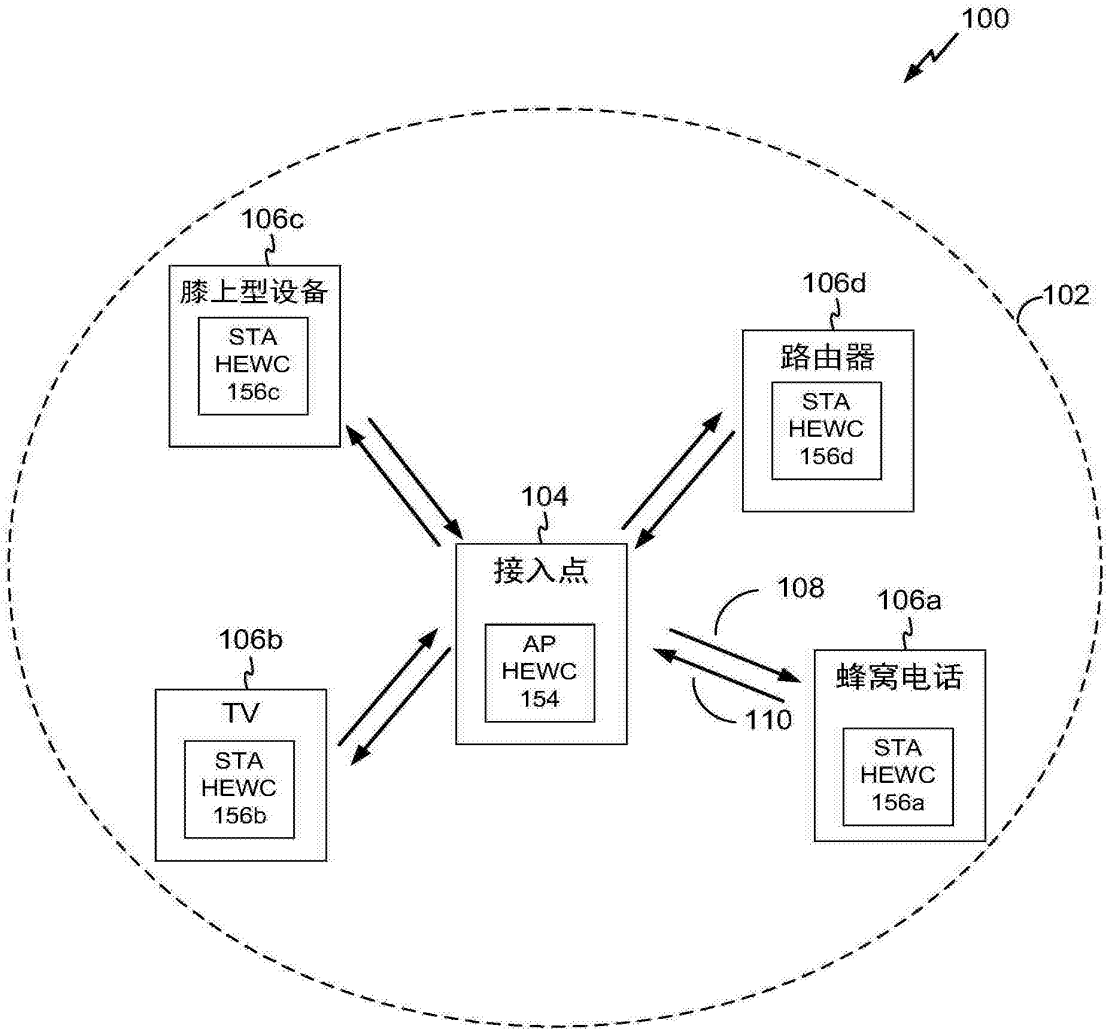

100
102
106c
膝上型设备
STA
HEWC
156c
106d
路由器
STA
HEWC
156d
104
接入点
AP
HEWC
154
108
106a
蜂窝电话
STA
HEWC
156a
110
106b
TV
STA
HEWC
156b

图 1

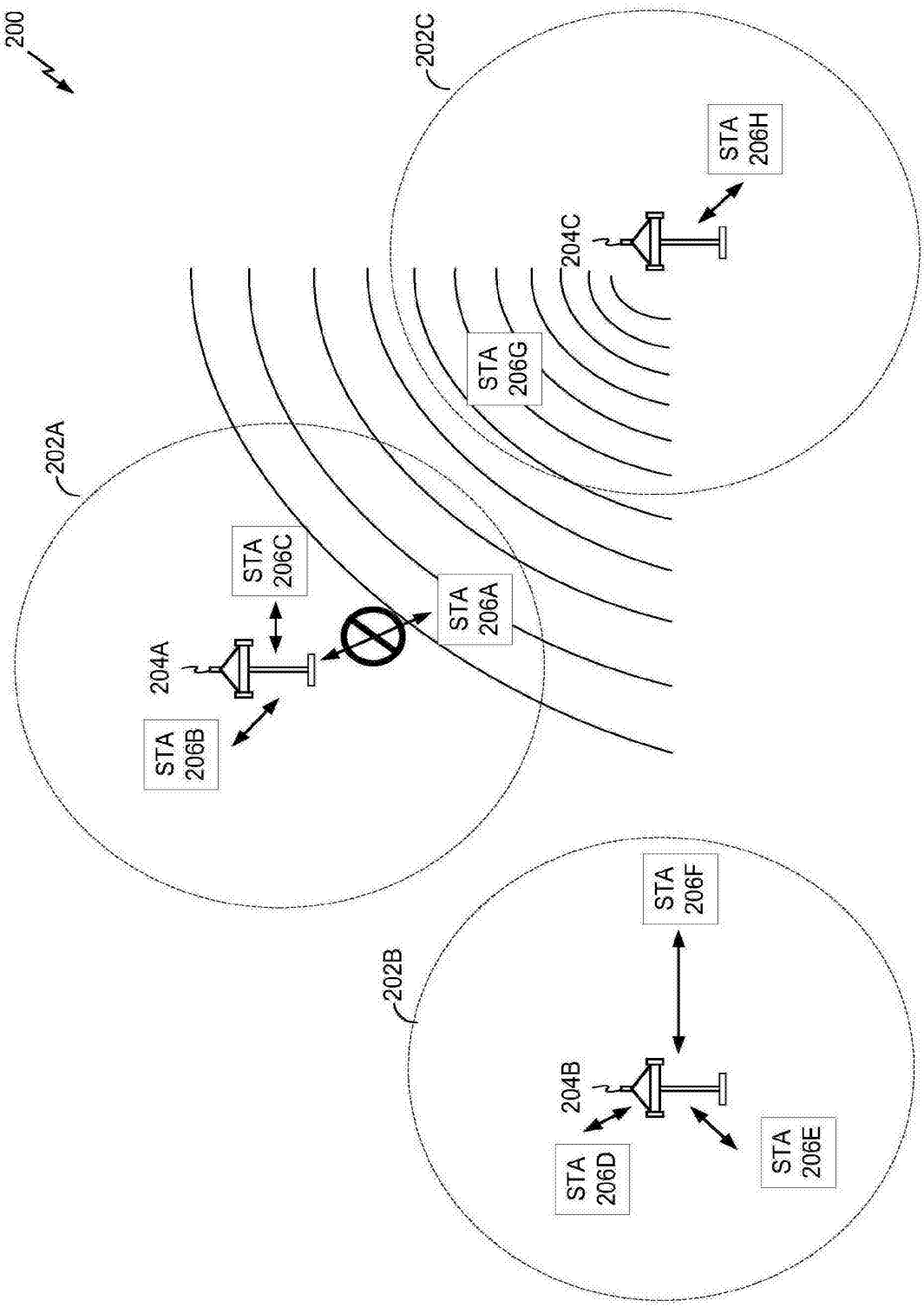

200
202C
STA 206H
204C
STA 206G
202A
STA 206C
STA 206A
204A
STA 206B
202B
STA 206F
204B
STA 206D
STA 206E

图 2A

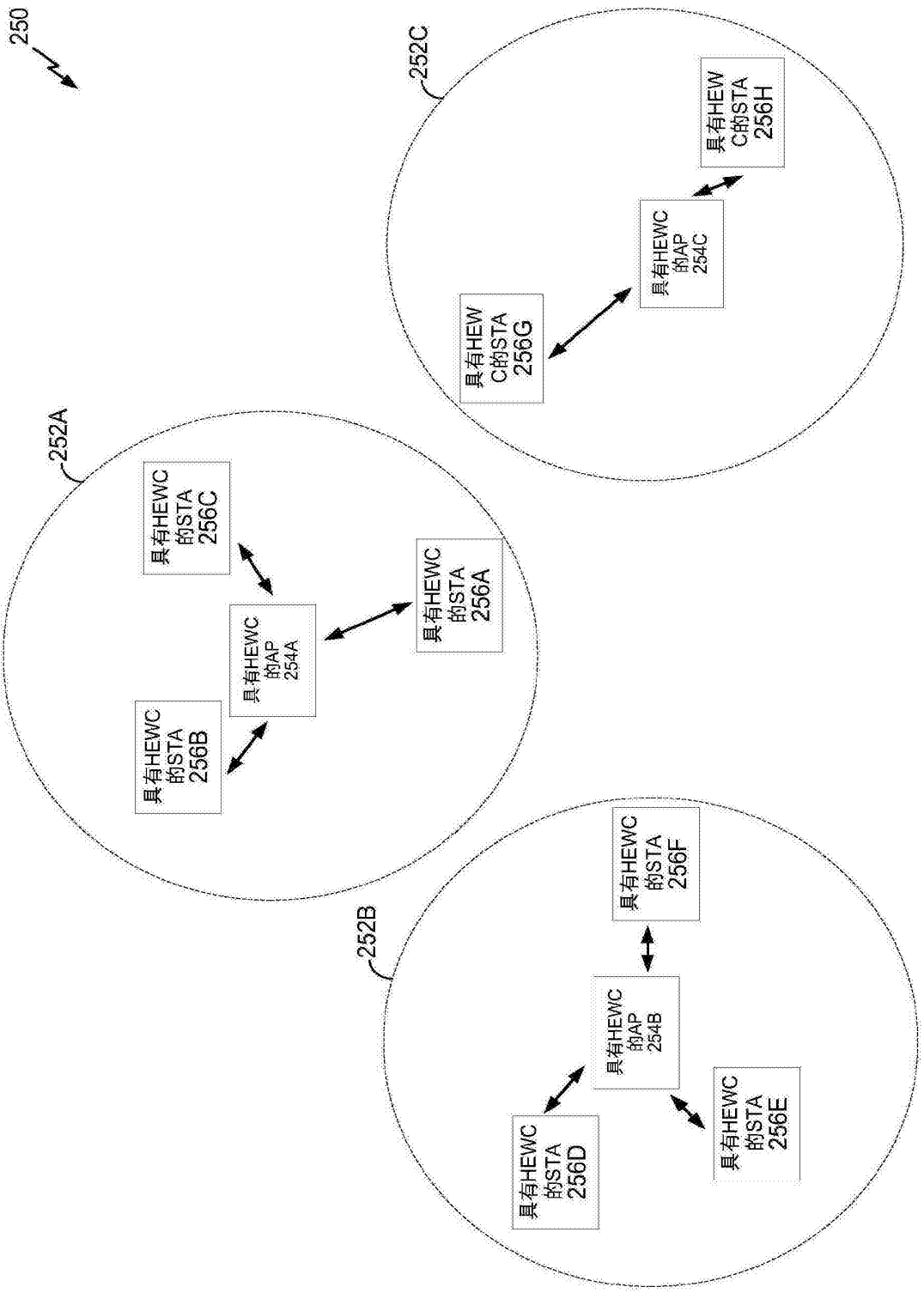

250
252C
具有HEW C的STA 256H
具有HEWC 的AP 254C
具有HEW C的STA 256G
252A
具有HEWC 的STA 256C
具有HEWC 的STA 256A
具有HEWC 的AP 254A
具有HEWC 的STA 256B
252B
具有HEWC 的STA 256F
具有HEWC 的AP 254B
具有HEWC 的STA 256D
具有HEWC 的STA 256E

图 2B

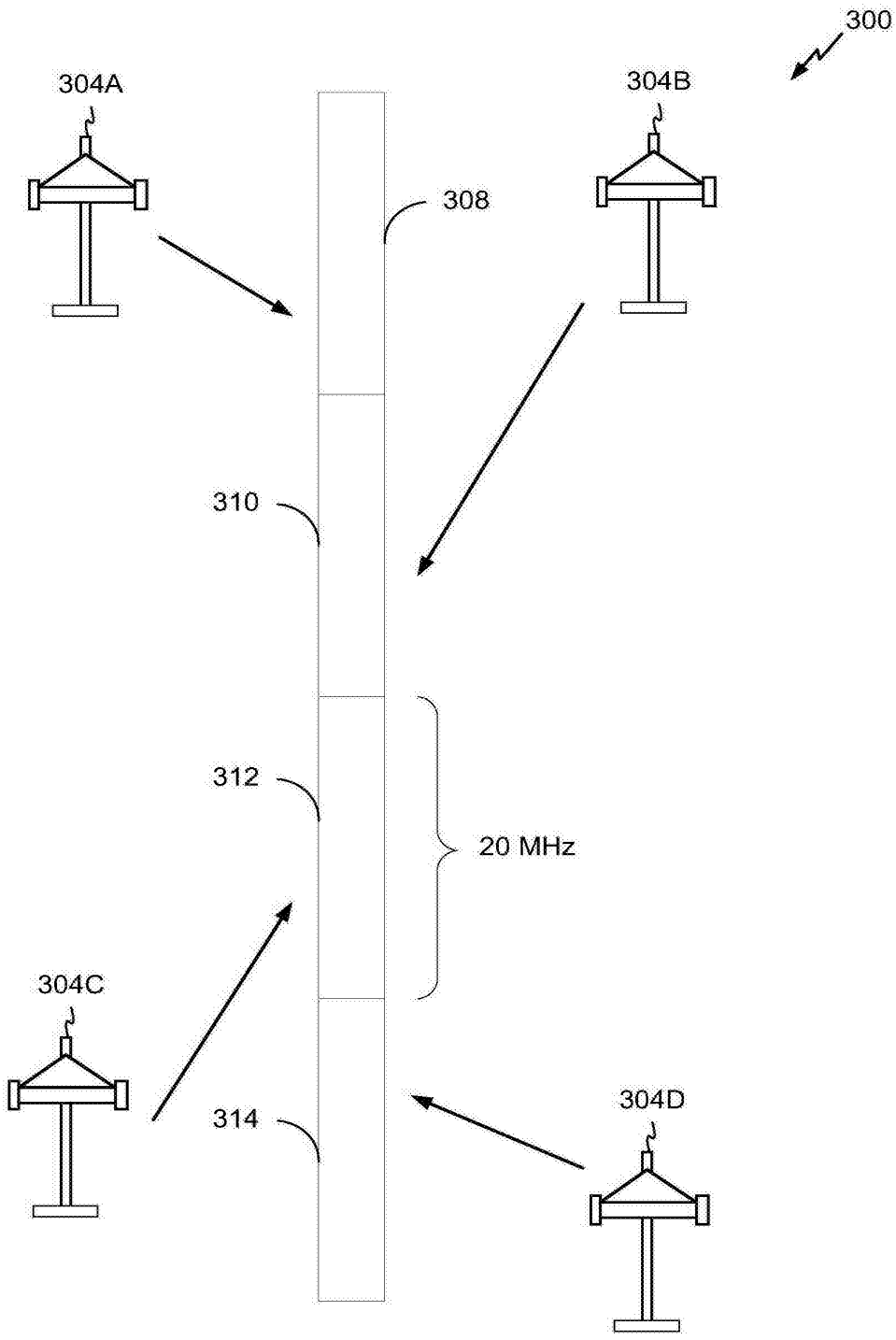


图 3

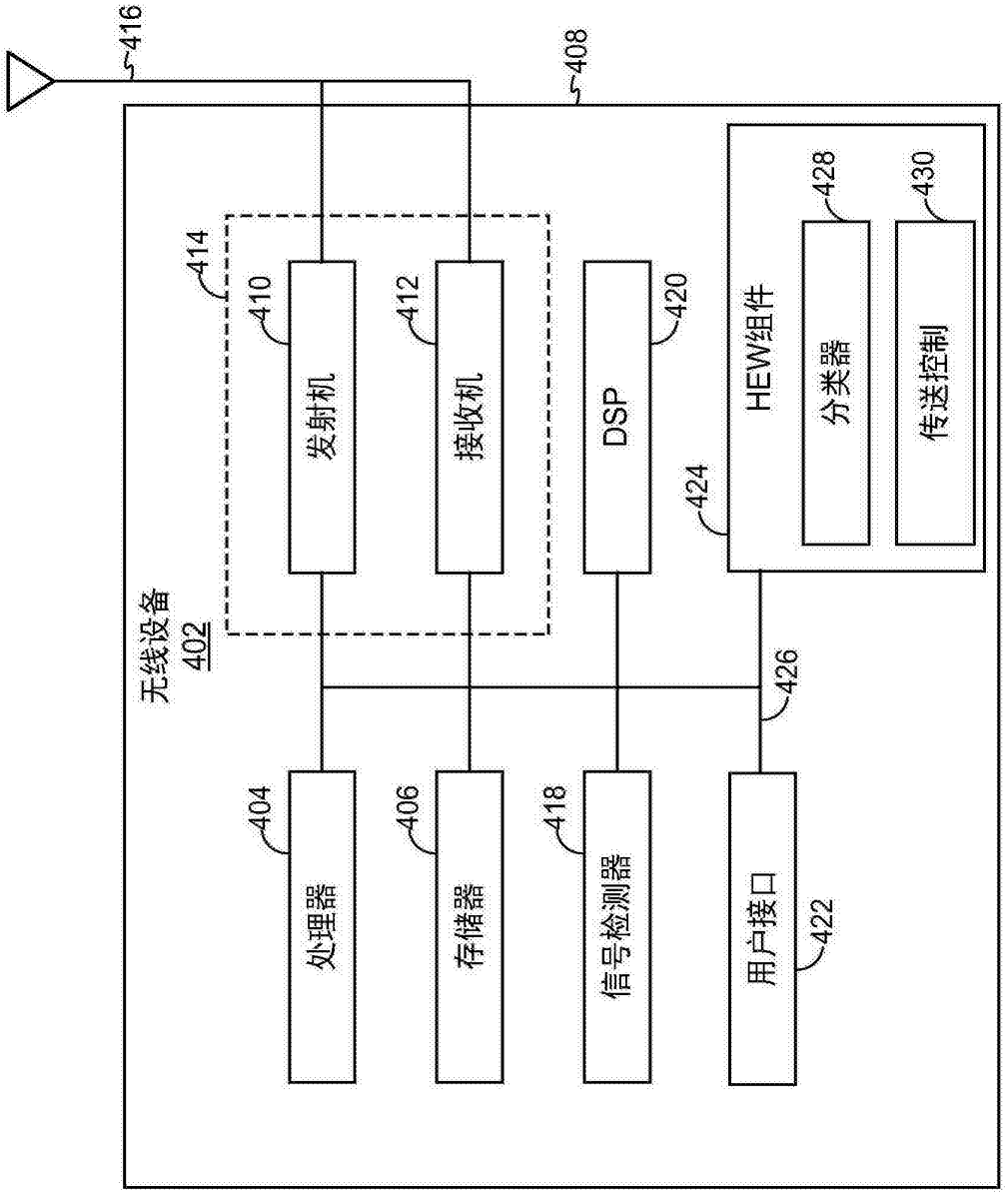

416
408
414
410
发射机
412
接收机
420
DSP
424
HEW组件
428
分类器
430
传送控制
无线设备
402
426
404
处理器
406
存储器
418
信号检测器
用户接口
422

图 4

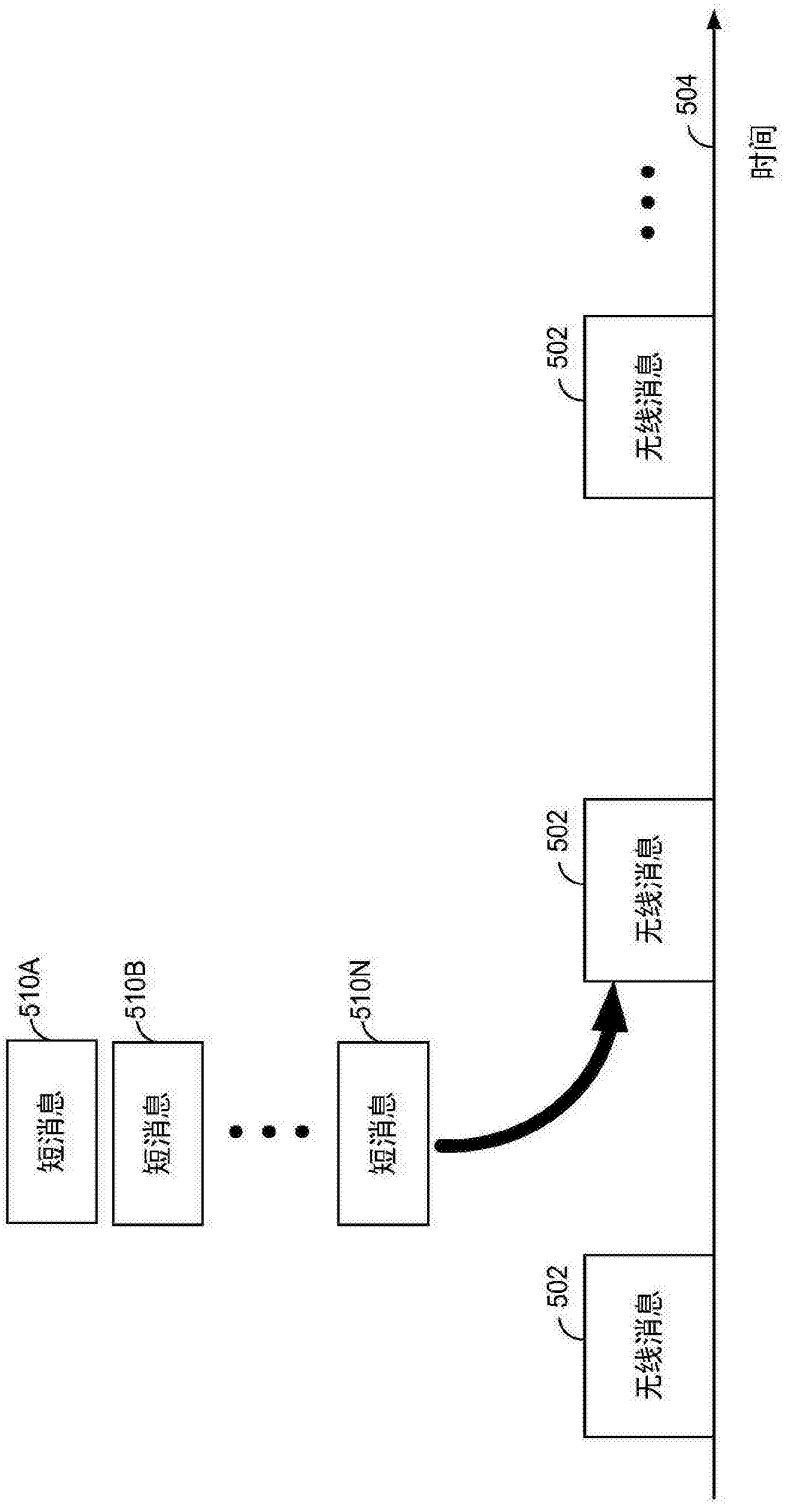


图 5A

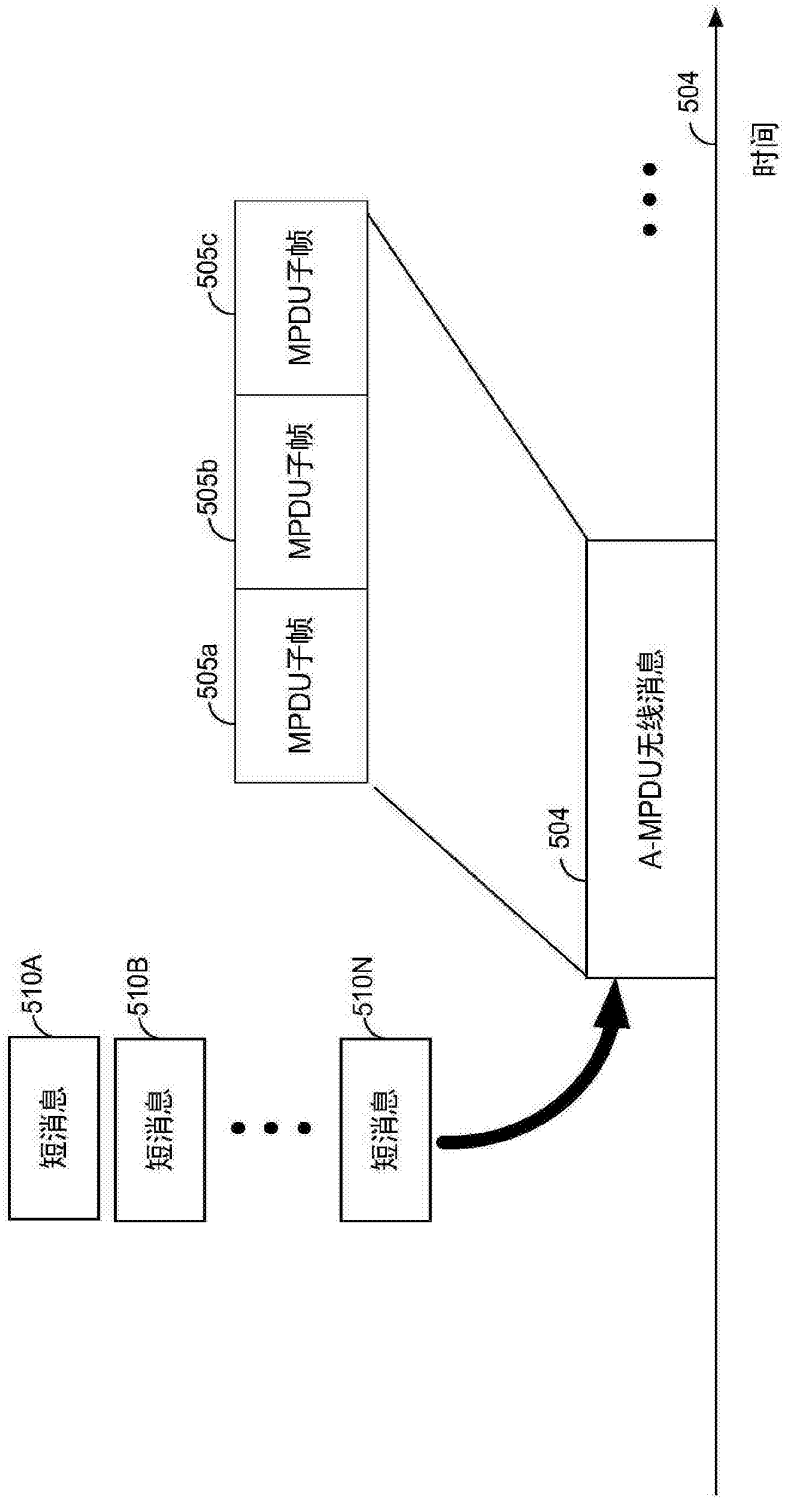

短消息
510A
短消息
510B
短消息
510N
MPDU子帧
505a
MPDU子帧
505b
MPDU子帧
505c
A-MPDU无线消息
504
504
504
时间

图 5B

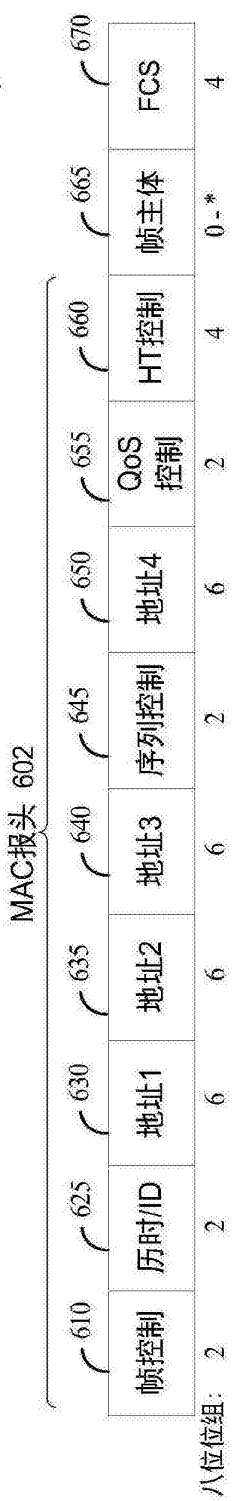

600
MAC报头 602
帧控制 610
历时/ID 625
地址1 630
地址2 635
地址3 640
序列控制 645
地址4 650
QoS 控制 655
HT控制 660
帧主体 665
FCS 670
八位位组: 2 2 6 6 6 2 6 2 4 0-* 4

图 6

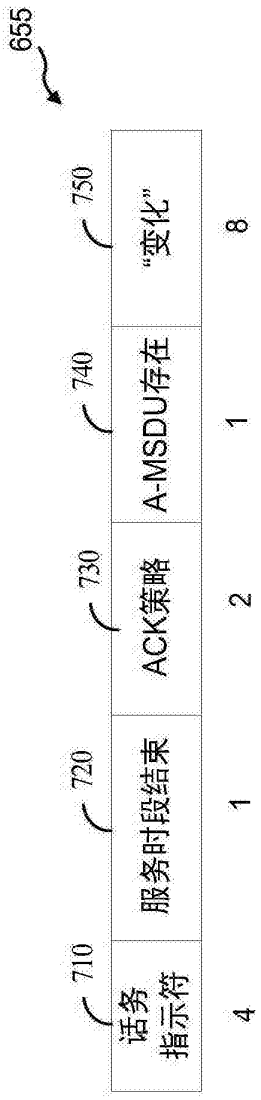

655
710
话务指示符
4
720
服务时段结束
1
730
ACK策略
2
740
A-MSDU存在
1
750
“变化”
8

图 7

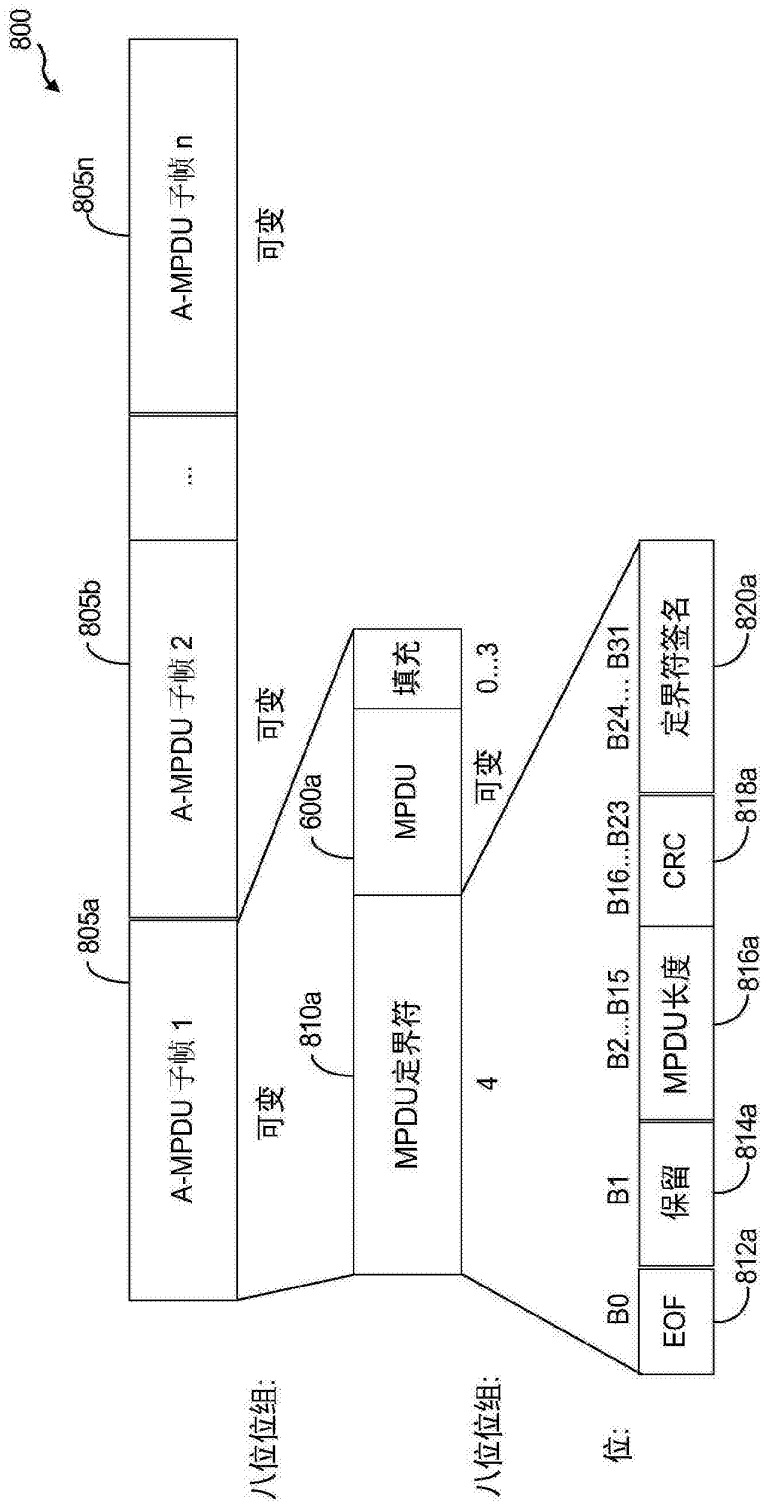

800
805a
A-MPDU 子帧 1
可变
805b
A-MPDU 子帧 2
可变
...
805n
A-MPDU 子帧 n
可变
八位位组:
810a
MPDU定界符
4
600a
MPDU
可变
填充
0...3
八位位组:
位:
B0
B1
B2...B15
B16...B23
B24... B31
EOF
保留
MPDU长度
CRC
定界符签名
812a
814a
816a
818a
820a

图 8

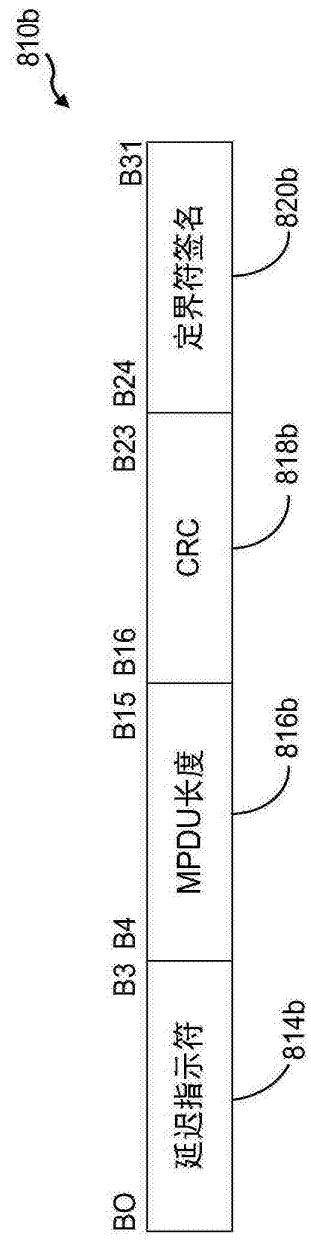

810b
B0
B3 B4
B15 B16
B23 B24
B31
延迟指示符
MPDU长度
CRC
定界符签名
814b
816b
818b
820b

图 9A

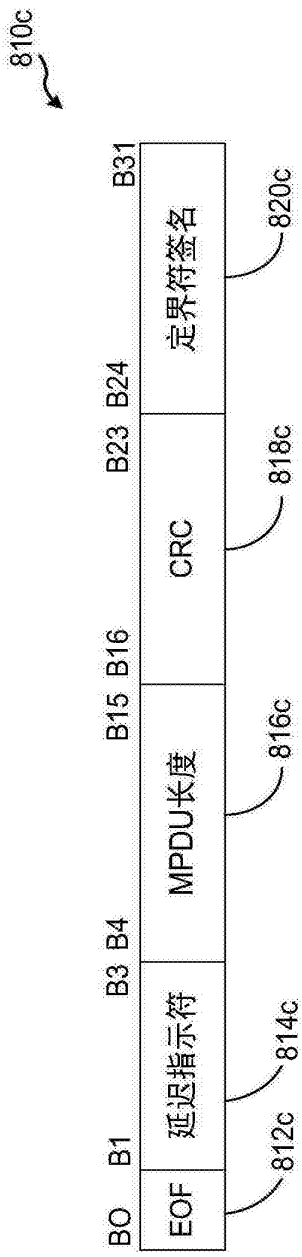

810c
B0
B1
B3 B4
B15 B16
B23 B24
B31
EOF
延迟指示符
MPDU长度
CRC
定界符签名
812c
814c
816c
818c
820c

图 9B

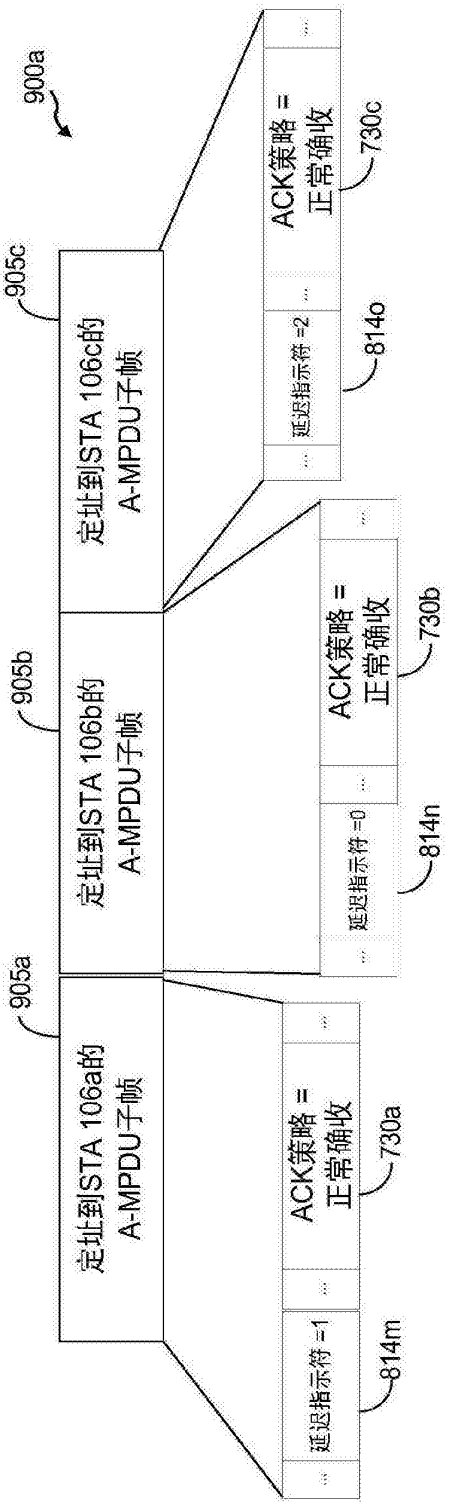

900a
905a
905b
905c
定址到STA 106a的A-MPDU子帧
定址到STA 106b的A-MPDU子帧
定址到STA 106c的A-MPDU子帧
ACK策略 = 正常确收
730a
730b
730c
延迟指示符 =1
延迟指示符 =0
延迟指示符 =2
814m
814n
814o

图 9C

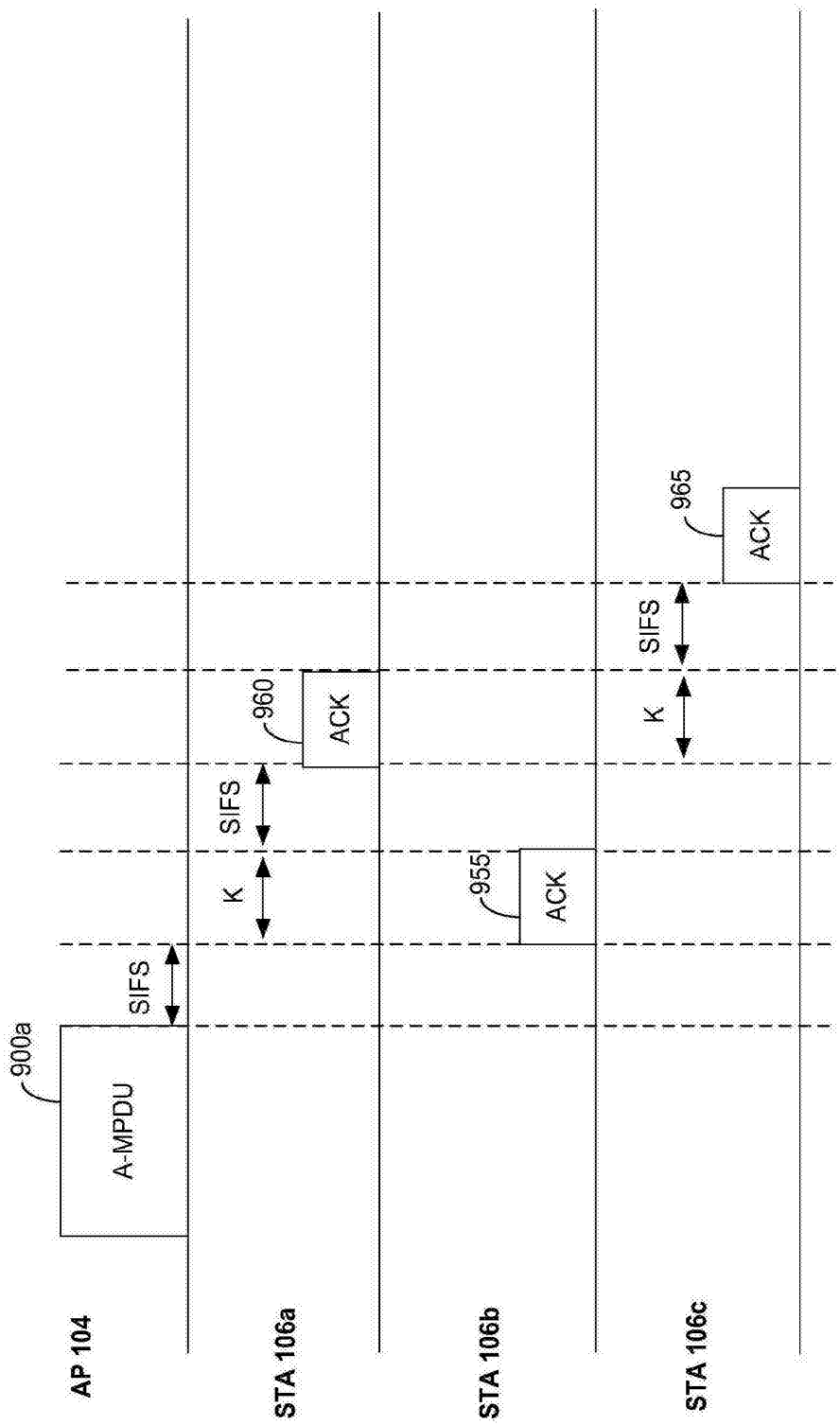

AP 104
STA 106a
STA 106b
STA 106c
900a
A-MPDU
SIFS
K
SIFS
960
ACK
955
ACK
SIFS
K
965
ACK

图 9D

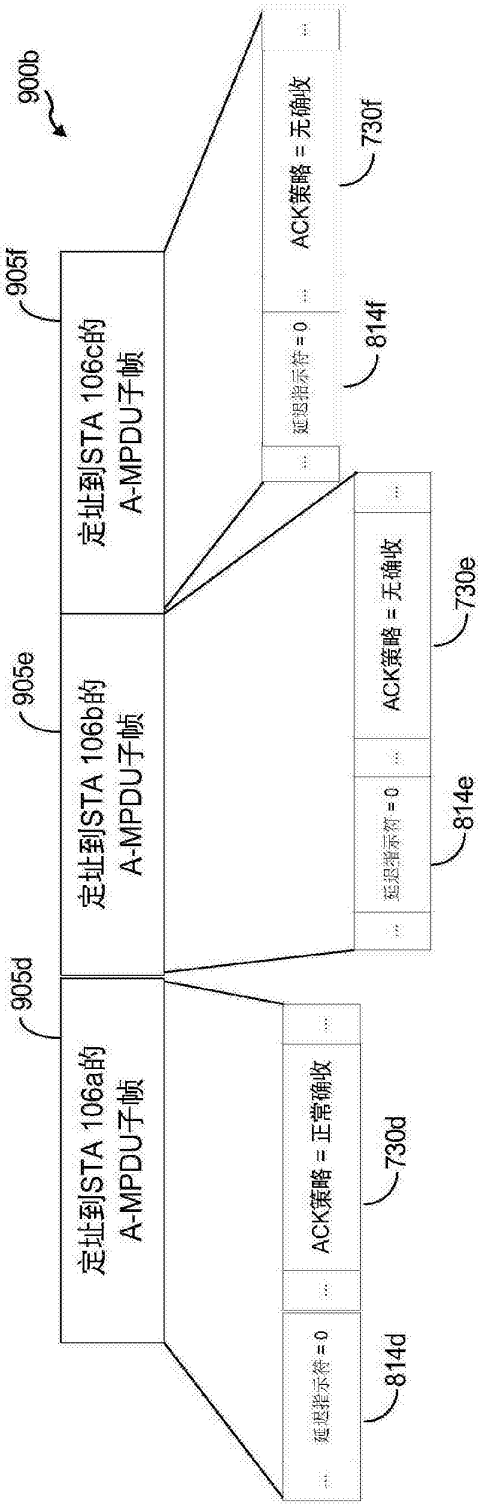

900b
905f
定址到STA 106c的A-MPDU子帧
905e
定址到STA 106b的A-MPDU子帧
905d
定址到STA 106a的A-MPDU子帧
730f
ACK策略 = 无确收
814f
延迟指示符 = 0
730e
ACK策略 = 无确收
814e
延迟指示符 = 0
730d
ACK策略 = 正常确收
814d
延迟指示符 = 0

图 9E

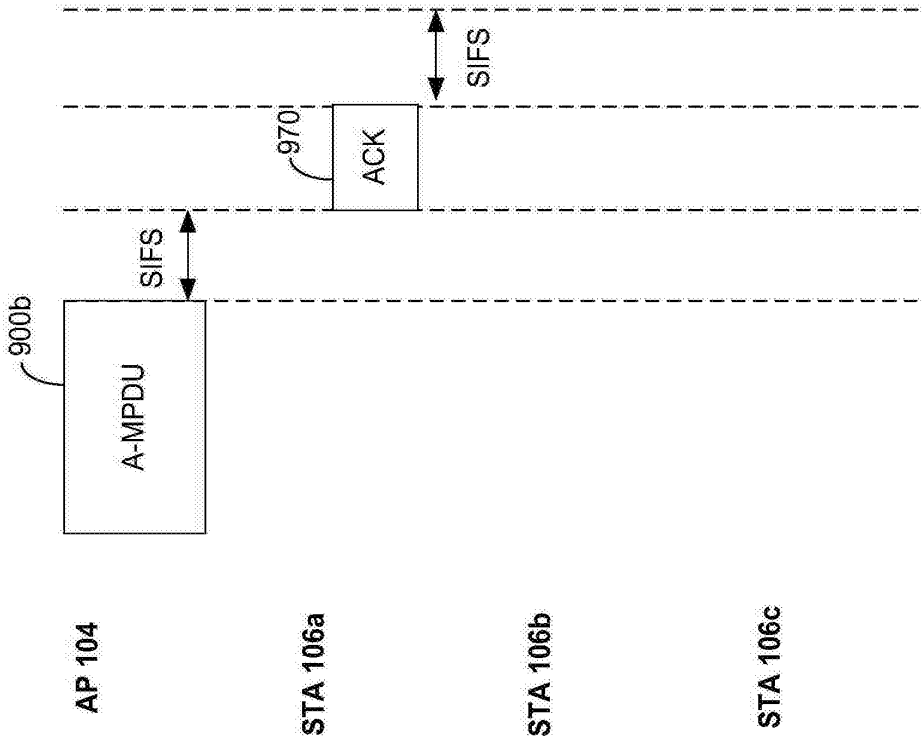


图 9F

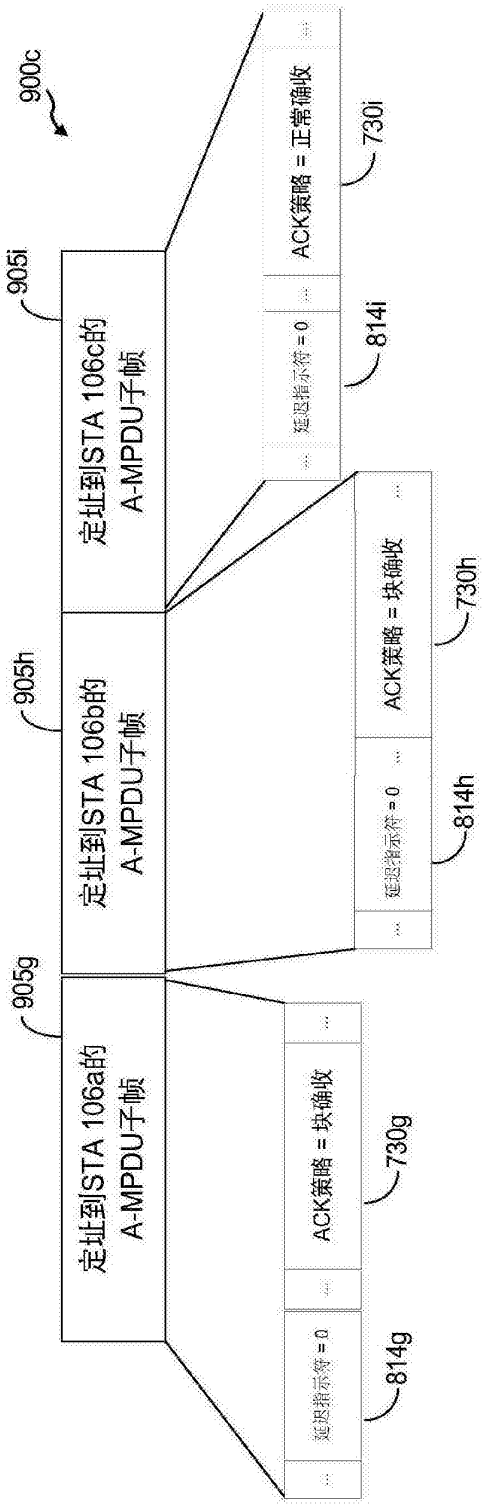

900c
905i
定址到STA 106c的A-MPDU子帧
905h
定址到STA 106b的A-MPDU子帧
905g
定址到STA 106a的A-MPDU子帧
730i
ACK策略 = 正常确收
814i
延迟指示符 = 0
730h
ACK策略 = 块确收
814h
延迟指示符 = 0
730g
ACK策略 = 块确收
814g
延迟指示符 = 0

图 10A

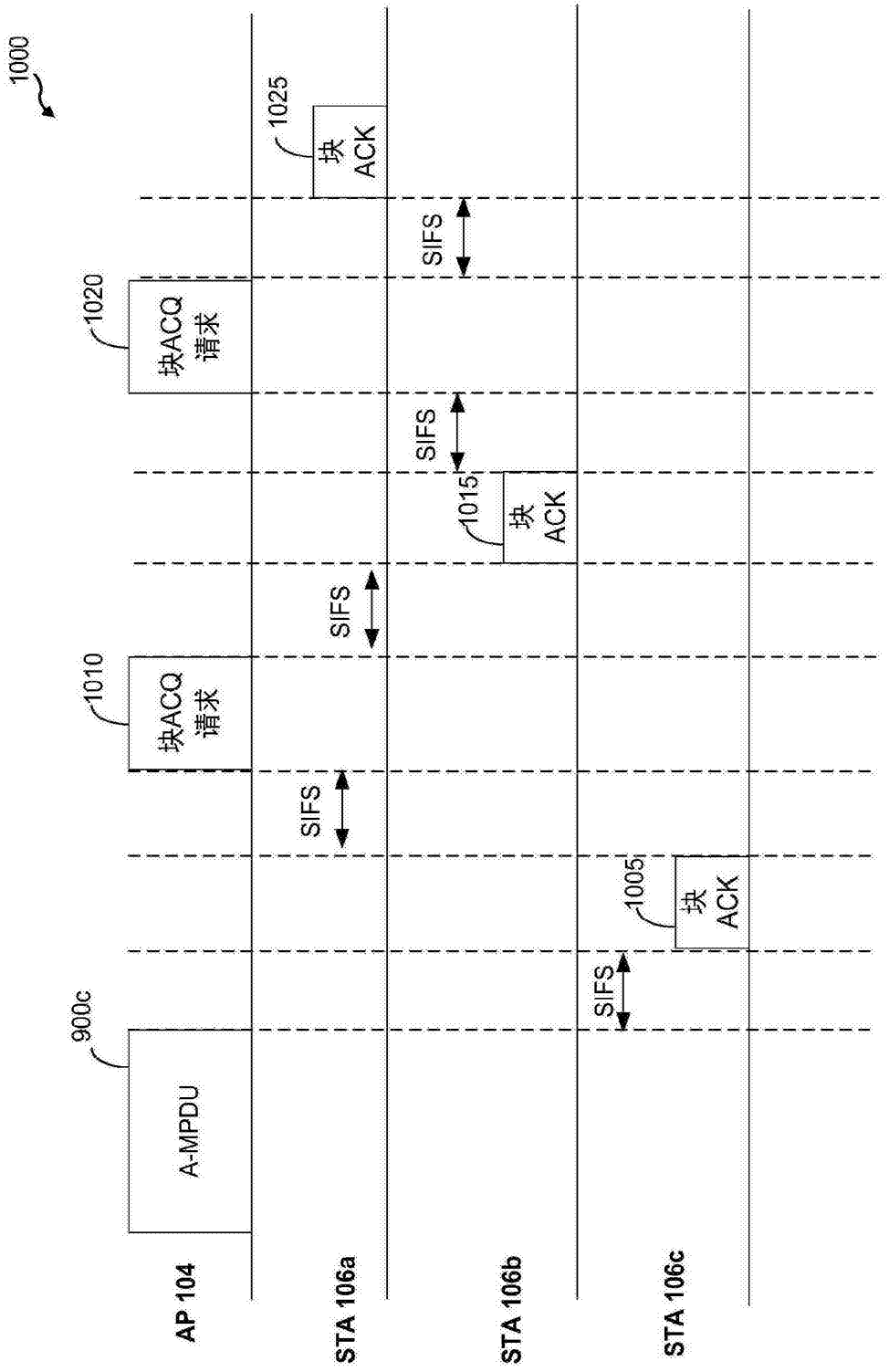

1000
1025
块 ACK
SIFS
1020
块ACQ 请求
SIFS
1015
块 ACK
SIFS
1010
块ACQ 请求
SIFS
1005
块 ACK
SIFS
900c
A-MPDU
AP 104
STA 106a
STA 106b
STA 106c

图 10B

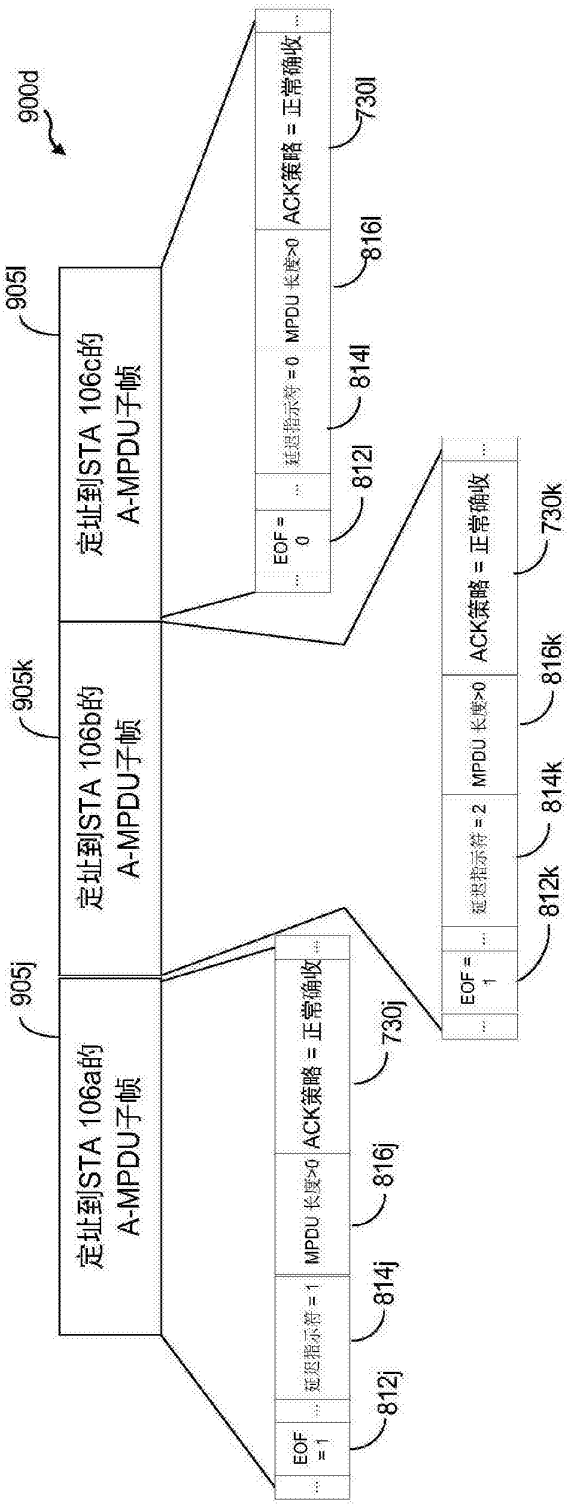

900d
905l
定址到STA 106c的A-MPDU子帧
905k
定址到STA 106b的A-MPDU子帧
905j
定址到STA 106a的A-MPDU子帧
EOF = 0
延迟指示符 = 0
MPDU 长度>0
ACK策略 = 正常确收
812l
814l
816l
730l
EOF = 1
延迟指示符 = 2
MPDU 长度>0
ACK策略 = 正常确收
812k
814k
816k
730k
EOF = 1
延迟指示符 = 1
MPDU 长度>0
ACK策略 = 正常确收
812j
814j
816j
730j

图 10C

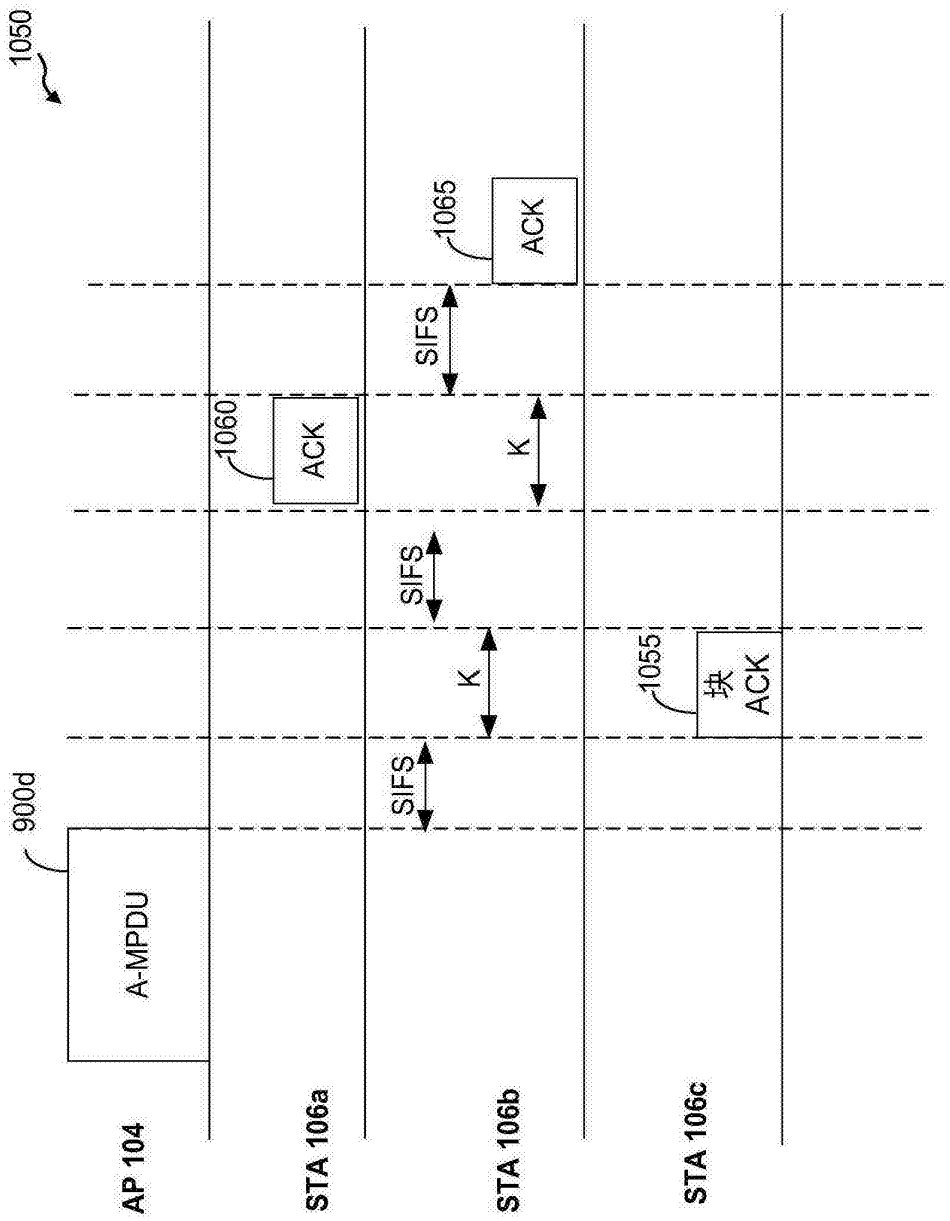

1050
AP 104
STA 106a
STA 106b
STA 106c
900d
A-MPDU
SIFS
1060
ACK
K
SIFS
1055
块
ACK
K
SIFS
1065
ACK

图 10D

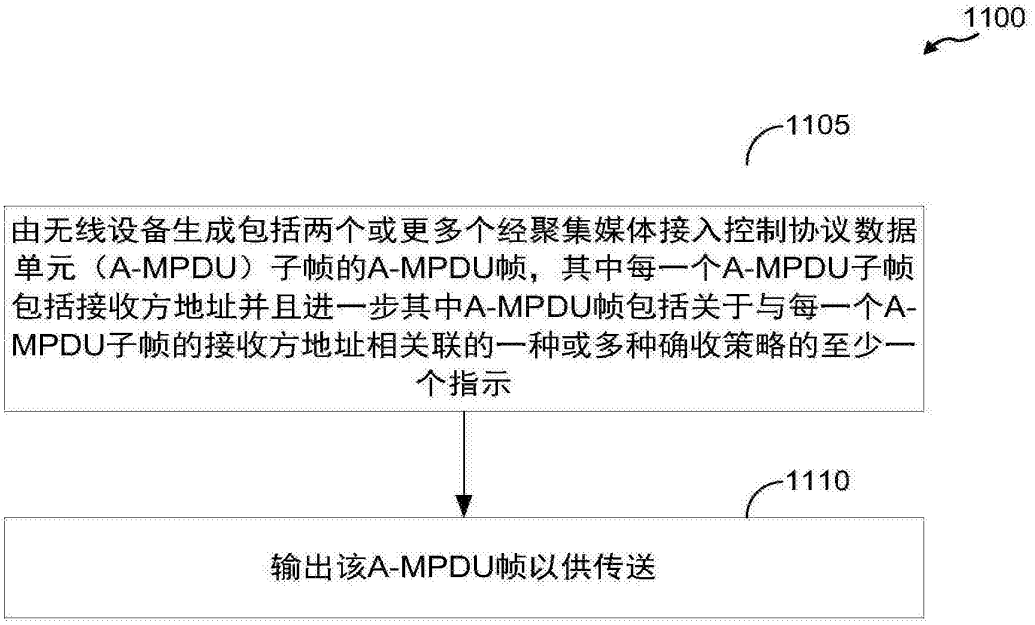

1100
1105
由无线设备生成包括两个或更多个经聚集媒体接入控制协议数据单元（A-MPDU）子帧的A-MPDU帧，其中每一个A-MPDU子帧包括接收方地址并且进一步其中A-MPDU帧包括关于与每一个A-MPDU子帧的接收方地址相关联的一种或多种确收策略的至少一个指示
1110
输出该A-MPDU帧以供传送

图 11A

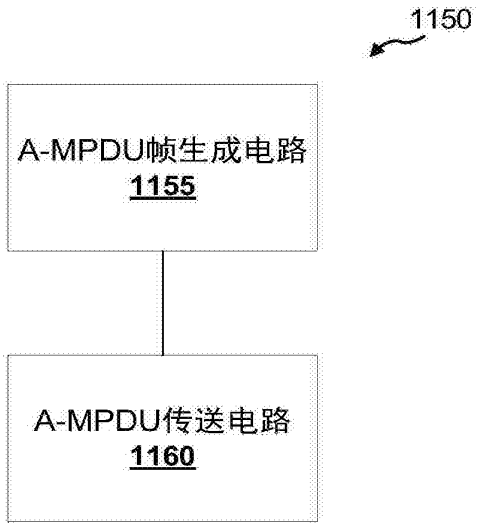

1150
A-MPDU帧生成电路
1155
A-MPDU传送电路
1160

图 11B

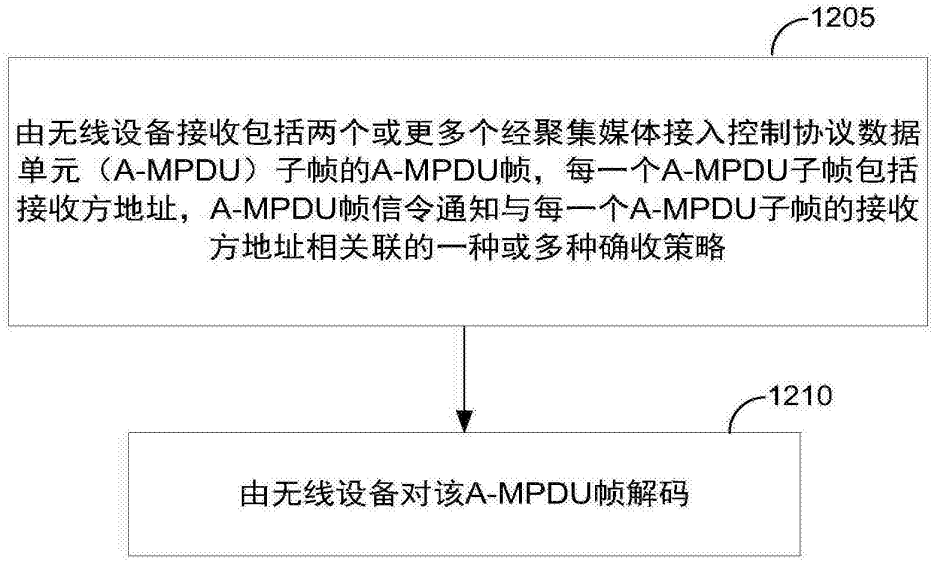

1205
由无线设备接收包括两个或更多个经聚集媒体接入控制协议数据单元（A-MPDU）子帧的A-MPDU帧，每一个A-MPDU子帧包括接收方地址，A-MPDU帧信令通知与每一个A-MPDU子帧的接收方地址相关联的一种或多种确收策略
1210
由无线设备对该A-MPDU帧解码

图 12A

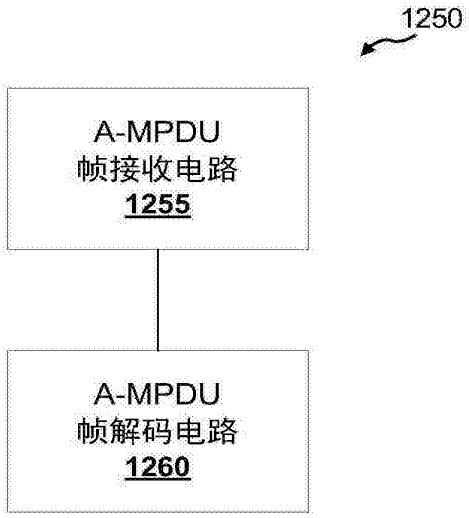

1250
A-MPDU
帧接收电路
1255
A-MPDU
帧解码电路
1260

图 12B

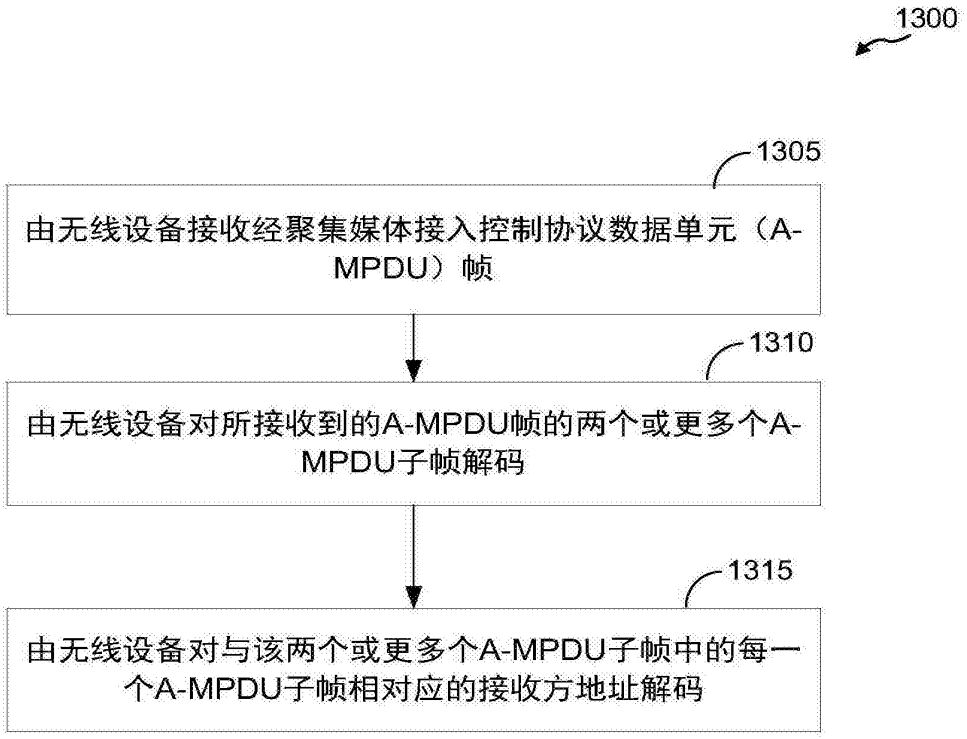

1300
1305
由无线设备接收经聚集媒体接入控制协议数据单元（A-MPDU）帧
1310
由无线设备对所接收到的A-MPDU帧的两个或更多个A-MPDU子帧解码
1315
由无线设备对与该两个或更多个A-MPDU子帧中的每一个A-MPDU子帧相对应的接收方地址解码

图 13A

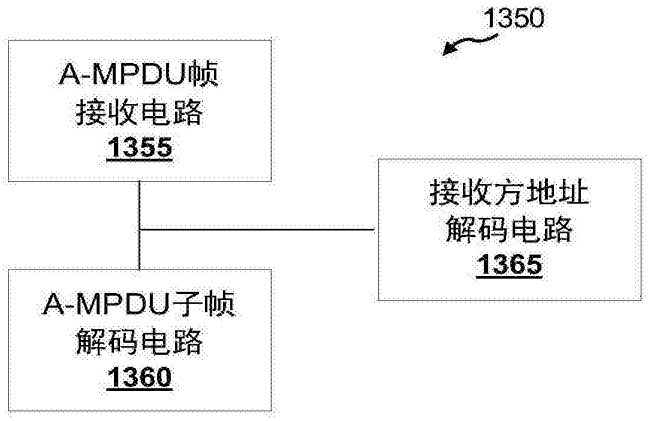

1350
A-MPDU帧
接收电路
1355
接收方地址
解码电路
1365
A-MPDU子帧
解码电路
1360

图 13B

Espacenet

Bibliographic data: WO2016111435 (A1) — 2016-07-14

METHOD AND DEVICE FOR TRANSMITTING FRAME INCLUDING ERROR CHECK BITS FOR HEADER IN WIRELESS LAN

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Applicant(s): LG ELECTRONICS INC [KR] ± (엘지전자 주식회사)

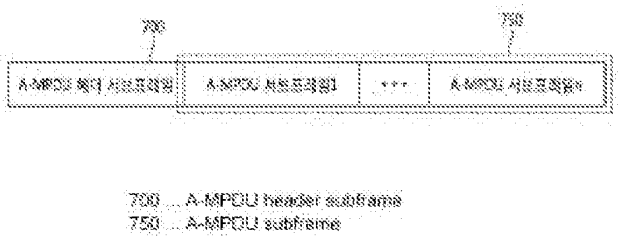
Classification: - international: ***H04W28/04; H04W28/06***
- cooperative: **H04L1/0041 (EP, US); H04L1/0072 (EP, US); H04L1/1614 (EP); H04L1/1685 (EP); H04W28/04 (US); H04W28/06 (US);** H04L69/04 (EP, US); H04L69/22 (EP, US)

Application number: WO2015KR08270 20150807 Global Dossier

Priority number(s): US201562101320P 20150108

Also published as: US10251085 (B2) US2017353887 (A1)

Abstract of WO2016111435 (A1)



A method and a device for transmitting a frame including error check bits for a header in a wireless LAN are disclosed. The method for transmitting a frame in a wireless LAN can comprise the steps of: generating, by an STA, a frame to be transmitted to an AP; and transmitting, by the STA, the frame to the AP, wherein the frame is an A-MPDU, the A-MPDU includes an A-MPDU header subframe and an A-MPDU subframe, the A-MPDU header subframe includes a first MPDU, the A-MPDU subframe includes a second MPDU, the first MPDU, as an MPDU, includes a first MAC header, except for a MAC body, and the second MPDU, as an MPDU, can include the MAC body and a second MAC header.

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CLAIMS WO2016111435A1

1.

How to transmit a frame in a wireless LAN,

generating, by a station (STA), a frame to be transmitted to an access point (AP); and

Comprising the step of the STA (station) transmitting the frame to the AP,

The frame is an aggregated (A)-MPDU (medium access control (MAC) protocol data unit),

The A-MPDU includes an A-MPDU header subframe and an A-MPDU subframe,

The A-MPDU header subframe includes a first MPDU,

The A-MPDU subframe includes a second MPDU,

The first MPDU is an MPDU and includes a first MAC header excluding the MAC body,

The second MPDU is an MPDU and includes a MAC body and a second MAC header.

2.

The method of claim 1,

The A-MDPU header subframe further includes a first error check bit only for the first MAC header,

The A-MPDU subframe further includes a second error check bit for only the second MAC header.

3.

The method of claim 2,

The first MAC header includes a common header field,

The common header field includes MAC header information common to each of a plurality of A-MDPU subframes including the A-MPDU subframe included in the A-MPDU,

The second MAC header includes a unique header field,

The unique header field comprises MAC header information unique to the A-MPDU subframe except for the common header field.

4.

The method of claim 3,

The A-MPDU subframe includes an MPDU delimiter,

The MDPU delimiter includes an error check field and a compression header field,

The error check field includes information indicating whether the second error check bit is included in the A-MPDU subframe,

The compressed header field comprises information indicating whether the second MAC header includes the unique header field.

5.

The method of claim 4,

The A-MPDU subframe further includes a third error check bit for the MAC body,

The first error check bit is used for checking whether the first MAC header has an error by the AP,

The second error check bit is used for checking whether the second MAC header has an error by the AP,

The third error check bit is used for checking whether there is an error in the MAC body by the AP.

6.

An STA (station) that transmits a frame in a wireless LAN is

a radio frequency (RF) unit implemented to transmit or receive a radio signal; and

Including a processor operatively connected to the RF unit,

The processor generates a frame to be transmitted to an access point (AP),

Implemented to transmit the frame to the AP,

The frame is an aggregated (A)-MPDU (medium access control (MAC) protocol data unit),

The A-MPDU includes an A-MPDU header subframe and an A-MPDU subframe,

The A-MPDU header subframe includes a first MPDU,

The A-MPDU subframe includes a second MPDU,

The first MPDU is an MPDU and includes a first MAC header excluding the MAC body,

The second MPDU is an MPDU and includes a MAC body and a second MAC header.

7.

The method of claim 6,

The A-MDPU header subframe further includes a first error check bit only for the first MAC header,

The A-MPDU subframe further includes a second error check bit for only the second MAC header.

8.

The method of claim 7,

The first MAC header includes a common header field,

The common header field includes MAC header information common to each of a plurality of A-MDPU subframes including the A-MPDU subframe included in the A-MPDU,

The second MAC header includes a unique header field,

The STA characterized in that the unique header field includes MAC header information unique to the A-MPDU subframe except for the common header field.

9.

The method of claim 8,

The A-MPDU subframe includes an MPDU delimiter,

The MDPU delimiter includes an error check field and a compression header field,

The error check field includes information indicating whether the second error check bit is included in the A-MPDU subframe,

The compressed header field comprises information indicating whether the second MAC header includes the unique header field.

10.

The method of claim 9,

The A-MPDU subframe further includes a third error check bit for the MAC body,

The first error check bit is used for checking whether the first MAC header has an error by the AP,

The second error check bit is used for checking whether the second MAC header has an error by the AP,

The third error check bit is used for checking whether the MAC body has an error by the AP.

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DESCRIPTION WO2016111435A1

Method and apparatus for transmitting a frame including an error check bit for a header in a wireless LAN The present invention relates to wireless communication, and more particularly, to a method and apparatus for transmitting a frame including an error check bit for a header in a wireless LAN.

Discussion is ongoing for a next-generation wireless local area network (WLAN). In the next-generation WLAN, 1) improvement of the IEEE (institute of electronic and electronics engineers) 802.11 PHY (physical) layer and MAC (medium access control) layer in the 2.4 GHz and 5 GHz bands, 2) spectrum efficiency and area throughput It aims to improve performance in real indoor and outdoor environments, such as an environment where interference sources exist, a dense heterogeneous network environment, and an environment with a high user load. .

An environment mainly considered in the next-generation WLAN is a dense environment with many access points (APs) and stations (STAs), and improvements in spectrum efficiency and area throughput are discussed in this dense environment. In addition, the next-generation WLAN is interested in actual performance improvement in an indoor environment as well as an outdoor environment, which has not been considered much in the existing WLAN.

Specifically, in the next-generation WLAN, there is great interest in scenarios such as wireless office, smart home, stadium, hotspot, and building/apartment. and system performance improvement in a dense environment with many STAs are being discussed.

In addition, in the next-generation WLAN, rather than improving single link performance in one basic service set (BSS), there will be active discussions about system performance improvement in an overlapping basic service set (OBSS) environment, outdoor environment performance improvement, and cellular offloading. expected. The direction of this next-generation WLAN means that the next-generation WLAN will have a technology range similar to that of mobile communication. Considering the recent discussion of mobile communication and WLAN technology in small cell and direct-to-direct (D2D) communication areas, the technological and business convergence of next-generation WLAN and mobile communication is expected to become more active.

It is an object of the present invention to provide a method for transmitting a frame including an error check bit for a header in a wireless LAN.

Another object of the present invention is to provide an apparatus for transmitting a frame including an error check bit for a header in a wireless LAN.

A method for transmitting a frame in a wireless LAN according to an aspect of the present invention for achieving the above-described object of the present invention includes the steps of: a STA (station) generating a frame to be transmitted to an AP (access point), and the STA (station) The method may include transmitting the frame to the AP, wherein the frame is an aggregated (A)-MPDU (medium access control (MAC) protocol data unit), and the A-MPDU is an A-MPDU header subframe and an A -contains an MPDU subframe, the A-MPDU header subframe contains a first MPDU, the A-MPDU subframe contains a second MPDU, and the first MPDU is an MPDU that is a first MPDU excluding the MAC body. a MAC header, and the second MPDU may include a MAC body and a second MAC header as an MPDU.

An STA (station) for transmitting a frame in a wireless LAN according to another aspect of the present invention for achieving the object of the present invention includes an RF (radio frequency) unit implemented to transmit or receive a radio signal and the RF unit A processor, comprising: an operatively coupled processor, wherein the processor is configured to generate a frame to be transmitted to an access point (AP), and transmit the frame to the AP, wherein the frame is an aggregated (A)-MPDU (MAC (MAC) medium access control) protocol data unit), the A-MPDU includes an A-MPDU header subframe and an A-MPDU subframe, the A-MPDU header subframe includes a first MPDU, and the A-MPDU The subframe may include a second MPDU, the first MPDU may include a first MAC header excluding the MAC body as an MPDU, and the second MPDU may include a MAC body and a second MAC header as an MPDU.

By checking an error generated in a medium access control (MAC) header and reducing overhead of the MAC header, it is possible to increase WLAN efficiency.

1 is a conceptual diagram illustrating the structure of a wireless local area network (WLAN).

2 is a conceptual diagram illustrating an A-MSDU.

3 is a conceptual diagram illustrating an A-MPDU.

4 shows a block ACK operation.

5 is a conceptual diagram illustrating the structure of a MAC header.

6 is a conceptual diagram illustrating an existing A-MPDU subframe.

7 is a conceptual diagram illustrating an A-MPDU according to an embodiment of the present invention.

8 is a conceptual diagram illustrating an A-MPDU header subframe according to an embodiment of the present invention.

9 is a conceptual diagram illustrating a common MAC header of an A-MPDU header subframe according to an embodiment of the present invention.

10 is a conceptual diagram illustrating an A-MPDU subframe according to an embodiment of the present invention.

11 is a conceptual diagram illustrating an A-MPDU subframe according to an embodiment of the present invention.

12 is a conceptual diagram illustrating a PPDU format according to an embodiment of the present invention.

13 is a block diagram illustrating a wireless device to which an embodiment of the present invention can be applied.

1 is a conceptual diagram illustrating the structure of a wireless local area network (WLAN).

The upper part of FIG. 1 shows the structure of an infrastructure basic service set (BSS) of the Institute of Electrical and Electronic Engineers (IEEE) 802.11.

Referring to the upper part of FIG. 1 , a wireless LAN system may include one or more infrastructure BSSs 100 and 105 (hereinafter, BSSs). The BSSs 100 and 105 are a set of APs and STAs such as an access point (AP) 125 and a station 100-1 (STA1) that can communicate with each other through successful synchronization, and are not a concept indicating a specific area. The BSS 105 may include one or more combinable STAs 105 - 1 and 105 - 2 to one AP 130 .

The BSS may include at least one STA, the APs 125 and 130 that provide a distribution service, and a distribution system (DS) 110 that connects a plurality of APs.

The distributed system 110 may implement an extended service set (ESS) 140 that is an extended service set by connecting several BSSs 100 and 105 . The ESS 140 may be used as a term indicating one network in which one or several APs 125 and 230 are connected through the distributed system 110 . APs included in one ESS 140 may have the same service set identification (SSID).

The portal 120 is a wireless LAN network (IEEE 802.11) and a different network (eg, 802. It can serve as a bridge that connects to X).

In the BSS as shown in the upper part of FIG. 1 , a network between the APs 125 and 130 and a network between the APs 125 and 130 and the STAs 100 - 1 , 105 - 1 and 105 - 2 may be implemented. However, it may also be possible to establish a network and perform communication between STAs without the APs 125 and 130 . A network for performing communication by establishing a network even between STAs without the APs 125 and 130 is defined as an ad-hoc network or an independent basic service set (IBSS).

The lower part of FIG. 1 is a conceptual diagram illustrating the IBSS.

Referring to the lower part of FIG. 1 , the IBSS is a BSS operating in an ad-hoc mode. Since the IBSS does not include an AP, there is no centralized management entity that performs a centralized management function. That is, in the IBSS, the STAs 150-1, 150-2, 150-3, 155-4, and 155-5 are managed in a distributed manner. In the IBSS, all STAs (150-1, 150-2, 150-3, 155-4, 155-5) can be configured as mobile STAs, and access to a distributed system is not allowed, so a self-contained network network) is formed.

An STA is any functional medium including a medium access control (MAC) and a physical layer interface to a wireless medium that comply with the provisions of the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard, in a broad sense. may be used to include both the AP and the non-AP STA (Non-AP Station).

An STA is a mobile terminal, a wireless device, a wireless transmit/receive unit (WTRU), a user equipment (UE), a mobile station (MS), a mobile subscriber unit (It can also be called various names such as Mobile Subscriber Unit) or simply a user.

2 is a conceptual diagram illustrating an A-MSDU.

In order to reduce MAC (medium access control) error overhead in a WLAN system, a method of aggregating data frames has been defined.

A MAC service data unit (MSDU) 200 generated in the application layer for data frame aggregation may be aggregated in an upper layer of the MAC layer to be generated as one data unit. MSDUs aggregated in an upper layer of the MAC layer may be defined as an aggregate-MSDU (A-MSDU) 250 . The A-MSDU 250 may be generated based on aggregation of a plurality of MSDUs 200 having the same priority and the same receiver address (RA).

A plurality of A-MSDU subframes may be gathered to form one A-MSDU 250 . That is, the A-MSDU 250 may include a plurality of A-MSDU subframes, and the A-MSDU subframe may include a subframe header, an MSDU, and a padding bit. The subframe header may include a destination address (DA), a source address (SA), and an MSDU length. The padding bit may be used to make the total length of the A-MSDU subframe a constant multiple (a multiple of 4 octet).

Unlike a single MSDU, the A-MSDU 250 may be formed and transmitted as a single QoS data MPDU (MAC protocol data unit) without fragmentation. For example, the A-MSDU 350 may be transmitted by a high throughput (HT) STA of a management information base (MIB) field. In the case of an HT STA, it has the ability to de-aggregate the A-MSDU 250, and the HT STA checks whether the A-MSDU 250 is present in the QoS field of the MAC header of the received PPDU. and the A-MSDU 250 may be deaggregated.

When the ACK policy of the HT STA is set to normal ACK, the A-MSDU 250 cannot be aggregated into a MAC protocol data unit (A-MPDU). In addition, whether the A-MSDU 250 can be aggregated into an A-MPDU may vary depending on whether a block ACK agreement for each traffic identifier (TID) is concluded. In addition, even when a block ACK agreement is reached with respect to the TID, the A-MSDU block ACK support indicator of the add block acknowledgment response frame of the receiving side according to the add block acknowledgment request frame indicates the block ACK. If not supported is indicated, the A-MSDU 250 cannot be included in the A-MPDU.

3 is a conceptual diagram illustrating an A-MPDU.

Referring to FIG. 3 , one A-MPDU 350 may be formed by collecting a plurality of MPDUs 300 having the same receiver address (RA), TID, and ACK policy below the MAC layer.

The A-MPDU 350 is composed of one or more A-MPDU subframes, and each A-MPDU subframe may include an MPDU delimiter and an MPDU 400 .

The MPDU may include a MAC header, a MAC body, a frame check sequence (FCS), and a padding bit.

The MPDU delimiter may be used to determine whether there is an error in the A-MPDU subframe constituting the A-MPDU 350 . A plurality of A-MPDU subframes may form one A-MPDU 350 .

Whether or not the reception of the A-MPDU 350 is successful may be indicated based on the block ACK. The A-MPDU 350 can be formed only for the TID with which HT-immediate BA agreement is made, and the duration / ID field of the MPDU 300 constituting the A-MPDU 350 is The value may be set to be the same.

The A-MPDU (or MPDU) may be included in a physical layer (PHY) service data unit (PSDU). The PSDU and the PPDU header (PHY preamble and PHY header) may form a PHY protocol data unit (PPDU). The A-MPDU (or MPDU) may be interpreted in the same data unit as the frame.

4 shows a block ACK operation.

The block ACK mechanism was introduced for transmission of a block ACK frame including ACK information for a plurality of frames transmitted during a transmission opportunity (TXOP) duration (or period).

When the block ACK mechanism is used, reduction of overhead for data transmission and reception procedures like A-MSDU or A-MPDU can be reduced and efficiency of the MAC layer can be improved.

Referring to FIG. 4 , block ACK transmission for an A-MPDU of one TID may be performed based on a setup process, a transmission process, and a tear down process. The establishment process may be a process of requesting and responding to a block ACK session.

The TID is an identifier that can be used by a higher layer and may be used to distinguish the MSDU. For example, TID may have 16 values identified based on traffic stream (TS) and traffic category (TC). The TID may be assigned to the MSDU in a layer higher than the MAC layer. TC may be used to distinguish MSDUs having different user priorities. The TS may indicate a set of MSDUs transmitted based on a specific traffic specification (TSPEC). TSPEC may indicate quality of service (QoS) characteristics of data flow between STAs.

In the transmission process, the transmitting STA (hereinafter, the transmitting STA) transmits continuous data to the receiving STA (hereinafter, the receiving STA), and the receiving STA transmits an aggregated response to the continuous data to the transmitting STA. there is.

The block ACK session established in the tear down process may be released.

Specifically, in the setting process, the transmitting STA may transmit an add block acknowledgment (ADDBA) request frame to the receiving STA, and the receiving STA may transmit an ADDBA response frame to the transmitting STA. Specifically, the transmitting STA may transmit an ADDBA request frame, which is a management frame, to the receiving STA. The ADDBA request frame may request block ACK consent for the current TID. The ADDBA request frame may transmit information about a block ACK policy type, a transmission buffer size of the transmitting side, a timeout value of a block ACK session, a starting sequence number (SSN), etc. to the receiving STA. Upon receiving the ADDBA request frame, the receiving STA may transmit an ADDBA response frame to the transmitting STA in response to the ADDBA request frame. The ADDBA response frame may include a block ACK agreement state, an ACK policy, a buffer size, and a timeout value.

In the transmission process, the transmitting STA may transmit an A-MPDU to the receiving STA. When the transmission condition of a block ack request (BAR) frame for the A-MPDU is satisfied, the transmitting STA may transmit the BAR frame to the receiving STA. When the transmitting STA transmits the A-MPDU successfully, the receiving STA receiving the BAR frame may transmit a block ACK for the A-MPDU to the transmitting STA.

The release process may be performed when a set timeout value of an inactivity timer set in the transmitting STA and the receiving STA expires or there is no more data to transmit for the corresponding TID. For example, in response to expiration of a set timeout value of the stop timer for block ACK error recovery, a delete block acknowledgment (DELBA) frame may be transmitted to the receiving STA or the transmitting STA, and the block ACK session may be terminated. When the transmitting STA receives the block ACK, the stop timer of the transmitting STA may be reset. When the receiving STA receives the MPDU and block ACK request frame, the stop timer of the receiving STA may be reset.

The block ACK frame may include a block ACK start sequence control field and a block ACK bitmap.

The block ACK start sequence control field may include information on the sequence number of the data unit indicated by the first bit included in the block ACK bitmap. In another expression, the block ACK start sequence control field may include information on a starting sequence number (SSN) that is a sequence number of a data unit indicated by the first bit included in the block ACK bitmap.

Each of a plurality of bits included in the block ACK bitmap may indicate whether decoding of each of a plurality of data units (eg, MSDU) is successful. The first bit included in the block ACK bitmap may indicate whether the data unit of the sequence number indicated by the block ACK start sequence control field is successfully received. The remaining bits included in the block ACK bitmap may sequentially indicate whether decoding of data units corresponding to the remaining sequences is successful. That is, the nth bit included in the block ACK bitmap may indicate whether or not reception of a data unit having a sequence number corresponding to SSN+n is successful.

The block ACK bitmap may have a compressed format. One bit included in the block ACK bitmap of the compressed format may indicate whether reception of a plurality of data units (eg, 64 MSDUs, A-MSDUs) is successful.

In addition, the block ACK bitmap may include not only a block ACK bitmap for one TID but also a block ACK bitmap for a plurality of TIDs according to configuration.

In the existing WLAN system, a frame check sequence (FCS) for error detection for the MAC header and MAC body (or MSDU, A-MSDU, frame body) is included in the frame and transmitted. That is, the FCS for cyclic redundancy check (CRC) for only the MAC header of the frame is not included in the frame.

The STA or AP operating in the existing WLAN system may check whether an error occurs in the MAC header and MAC body included in the received frame based on the FCS included in the frame. However, it was not possible to separately determine whether an error occurred with respect to the MAC header. In the WLAN system, the MAC header of the frame includes important information in decoding (or interpreting) the MAC body. Therefore, determining whether an error in the MAC header occurs may be an important issue for improving the performance of the WLAN system.

An embodiment of the present invention discloses a method of performing an error check for only the MAC header by adding a CRC to the MAC headers of a plurality of A-MPDU subframes (or MPDUs) included in the A-MPDU. Also, in an embodiment of the present invention, a method for reducing overhead of a MAC header included in each of a plurality of A-MPDU subframes included in an A-MPDU is disclosed.

5 is a conceptual diagram illustrating the structure of a MAC header.

In FIG. 5, the MAC header structure included in the MDPU (or frame) is disclosed.

The MAC header structure is the 8.2 MAC frame of the IEEE Standard for Information technology Telecommunications and information exchange between systems Local and metropolitan area networks Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications published in October 2013. formats are disclosed. A brief description of the MAC header structure is as follows.

Referring to FIG. 5 , the MAC header includes a frame control field 500 , a duration/identifier (ID) field 510 , an address field 520 , a sequence control field 530 , and quality of service (QoS) control. It may include a field 540 and a high throughput (HT) control field 550 .

The frame control field 500 includes a protocol version field 505, a type field 515, a subtype field 525, a To DS field 535-1, a From DS field 535-2, and additional fragments (MoreFragments). Field 545, Retry Field 555, Power Control Field 565, More Data Field 575, Protected Frame Field 585, Order Field (595).

The protocol version field 505 may include information on the communication protocol version currently used in the wireless LAN.

The type field 515 and the subtype field 525 may be implemented to indicate a function of a frame. In more detail, the type field 515 may include information for indicating whether the frame is a type of a management frame, a control frame, or a data frame. The subtype field 525 may include information for indicating a specific frame among a plurality of frames included in the frame type indicated by the type field 515 .

The To DS field 535 - 1 and the From DS field 535 - 2 may include information for interpretation of the address fields 1 to 4 .

The MoreFragments field 545 may include information indicating whether there is another fragment for the same MSDU.

The retry field 555 may include information for indicating whether a transmitted frame is a retransmission frame of a previous frame.

The power control field 565 may include information for indicating whether to operate in the power save mode.

The More Data field 575 may include information for indicating whether to buffer additional data.

The Protected Frame field 585 may include information for indicating whether the MAC body (or frame body) includes information processed by an encryption algorithm.

The Order field 595 may include information for indicating whether sorted MSDUs are transmitted.

The duration/ID field 510 may include duration information for setting the NAV and identification information of the STA.

Address field 1 (520-1), address field 2 (520-2), address field 3 (520-3), and address field 4 (520-4) each have a To DS field (535-1) and a From DS field (535-2), including information on a source address, a destination address, a transmitting STA address, a receiving STA address, a basic service set identifier (BSSID), etc. can do.

The sequence control field 530 may include information on a sequence number and a fragment number of a frame (or MAC body).

The QoS control field 540 may include information on traffic identifier (TID), information on end of service period (EOSP), and information on acknowledgment (ACK) policy. The TID may include information on user priority (UP) according to traffic category (TC).

The HT control field 550 is a link adaptation field, a calibration position field, a calibration sequence field, a channel state information / steering (CSI (channel state information) / Steering) field, NDP announcement (Null Data Packet Announcement (NDP) announcement) field, etc. may be included.

Link adaptation subfield is a training request (TRQ: Training request) field, MCS (modulation and coding scheme) request or antenna selection indication (MAI: MCS (Modulation and Coding Scheme) Request or ASEL (Antenna Selection) Indication) field, MCS feedback It may include a sequence indication (MFSI: MCS Feedback Sequence Identifier) field, an MCS feedback and antenna selection command/data (MFB/ASELC: MCS Feedback and Antenna Selection Command/data) field.

The TRQ subfield is set to 1 when requesting transmission of a sounding PPDU from a responder, and is set to 0 when transmission of a sounding PPDU is not requested from the responder. And, when the MAI subfield is set to 14, an ASEL indication is indicated, and the MFB/ASELC subfield is interpreted as an antenna selection command/data. Otherwise, the MAI subfield indicates an MCS request, and the MFB/ASELC subfield is interpreted as MCS feedback. When the MAI subfield indicates an MCS request (MRQ: MCS Request), it is set to 0 when no MCS feedback is requested, and is set to 1 when MCS feedback is requested. The sounding PPDU means a PPDU carrying a training symbol that can be used for channel estimation.

6 is a conceptual diagram illustrating an existing A-MPDU subframe.

6 discloses an A-MPDU subframe included in an A-MPDU supported in the existing WLAN system.

Referring to FIG. 6 , the A-MPDU subframe included in the A-MPDU includes an MPDU delimiter 600 , a MAC header 610 , a MAC body (or frame body) 620 , and a frame check sequence (FCS).) field 630 and a padding bit 640 .

The MPDU delimiter 600 may include information about the MPDU length, a CRC bit, and specific pattern information indicating the MPDU delimiter.

The STA receiving the A-MPDU may recognize the MPDU delimiter 600 based on specific pattern information. In addition, the MPDU delimiter 600 may include information on the length of the MPDU (eg, MAC header 610, MAC body 620, FCS 630) included in the A-MPDU subframe. . Therefore, the STA recognizes the MPDU delimiter on the A-MPDU based on the specific pattern information included in the MPDU delimiter 600, and then serves the A-MPDU based on the length information of the MPDU included in the MPDU delimiter 600. MPDU can be extracted from the frame.

The CRC bit included in the MPDU delimiter 600 may be an error check bit for checking an error occurring in the MPDU delimiter 600 . Specifically, the CRC bit may be an error check bit for determining whether information on the MPDU length is in error.

The MAC header 610 may have a different length depending on circumstances. As described above, one A-MPDU may include a plurality of A-MPDU subframes. Each of the plurality of MPDUs included in each of the plurality of A-MPDU subframes may include each of a plurality of MAC headers. Some fields among a plurality of fields included in each of the plurality of MAC headers may be identical to each other.

The MAC body 620 may include traffic data that may be decoded based on the MAC header.

The FCS field 630 may include an error check bit (eg, a 32-bit CRC) used to check errors for the MAC header and MAC body. The error check bit included in the FCS field may be determined by calculating the MAC header and MAC body.

The padding bit 640 may include a bit for setting the length of the A-MPDU subframe in units of 4 octets.

7 is a conceptual diagram illustrating an A-MPDU according to an embodiment of the present invention.

Referring to FIG. 7 , the A-MPDU may include an A-MPDU header subframe 700 and an A-MPDU subframe 750 .

The A-MPDU header subframe 700 may include only the MAC header excluding the MAC body, FCS, and padding bits as an MPDU.

The A-MPDU subframe 750 is an MPDU and may include a MAC header and MAC body, FCS, and padding bits.

The MAC header included in the A-MPDU header subframe 700 may include a common header field.

The MAC header included in the A-MPDU header subframe 700 may be expressed in terms of a common MAC header. The common header field may be a field including common header information for a plurality of A-MPDU subframes included in the A-MPDU. The FCS field included in the A-MPDU header subframe 700 may include an error check bit for only the MAC header. The A-MPDU header subframe 700 may be positioned so that it can be decoded earlier than the remaining A-MPDU subframes 750 in the A-MPDU.

The MAC header included in the A-MPDU subframe 750 may include a unique header field. The MAC header included in the A-MPDU subframe 750 may be expressed in terms of a compressed MAC header (or unique MAC header). The unique header field may include individual header information for the A-MPDU subframe 750 except for the common header field. The FCS may include error check bits for the MAC header and MAC body. According to an embodiment of the present invention, an additional FCS including an error check bit for only the MAC header may be included in the A-MPDU subframe 750 .

When the A-MPDU header subframe 700 includes the common header field and the A-MPDU subframe 750 does not include the common header field, each of a plurality of A-MPDU subframes included in the existing A-MPDU An overhead due to each of a plurality of MAC headers including common header information included in . That is, common header information such as a receiver address, a transmitter address, a BSSID, an ACK policy, a key ID, and a duration/ID is transmitted through one A-MPDU header subframe 700 . By doing so, unnecessary repeated transmission of MAC header information can be reduced. The MAC body included in the A-MPDU subframe 750 is decoded based on the common MAC header included in the A-MPDU header subframe 700 and the compressed MAC header included in the A-MPDU subframe 750 (or interpreted).

In addition, when a separate FCS for the common MAC header and the compressed MAC header included in each of the A-MPDU header subframe 700 and the A-MPDU subframe 750 is included, a separate error occurs only in the MAC header Since it is possible to check whether or not it is possible to reduce unnecessary retransmission, the performance of the wireless LAN can be improved.

Hereinafter, detailed A-MPDU header subframe 700 and A-MPDU subframe 750 according to an embodiment of the present invention are disclosed.

8 is a conceptual diagram illustrating an A-MPDU header subframe according to an embodiment of the present invention.

Referring to FIG. 8 , the A-MPDU header subframe 850 may include an MDPU delimiter 800 , a MAC header 810 , an FCS field 820 , and a padding bit 830 .

The MDPU delimiter 800 may include information on the length of the MPDU (MAC header and FCS field).

The MAC header 810 may include a common header field.

The MAC header 810 included in the A-MPDU header subframe 700 may be expressed in terms of a common MAC header.

As described above, each of the plurality of MAC headers of each of the plurality of A-MPDU subframes included in the A-MPDU supported in the existing WLAN system may include common header information. Specifically, since the A-MPDU is transmitted to one STA, each of the plurality of MAC headers of each of the plurality of A-MPDU subframes included in the existing A-MPDU transmitted to one STA may include common header information. there is. A field including such common header information may be defined as a common header field. In other words, the common header field may be a field of a MAC header corresponding to header information common to each of a plurality of A-MPDU subframes included in the existing A-MPDU.

According to an embodiment of the present invention, the common MAC header 810 of the A-MPDU header subframe 850 may include a common header field. In addition, the compressed MAC header included in each A-MPDU subframe except for the A-MPDU header subframe 850 in the A-MPDU includes individual header information for the A-MPDU subframe except for the common header field. It can contain only header fields.

When the compressed MAC header of an A-MPDU subframe except for the A-MPDU header subframe 850 includes only a unique header field, the overhead due to the MAC header is reduced compared to the MAC header of the existing A-MPDU subframe. can be reduced.

For example, the common header field may be a duration/ID field, an address field, or the like, and the unique header field may be a frame control field, a sequence control field, or the like. The QoS control field and the HT control field may be included in a common header field or a unique header field. The distinction between the common header field and the unique header field is an exemplary distinction. A common header field and a unique header field may be classified according to various criteria.

The FCS field 820 may include an error check bit for the common MAC header 810 including the common header field included in the A-MPDU header subframe 850 . That is, the error check bit included in the FCS field 820 may be calculated for the common header field.

The padding bit 830 may include bits for adjusting the length of the A-MPDU header subframe 850 in units of 4 octets.

The A-MPDU header subframe 850 may be positioned so that it can be decoded earlier than the remaining A-MPDU subframes in the A-MPDU.

In FIG. 8 , it is assumed that the MAC body is not included in the A-MPDU header subframe 850, but the MAC body may be included in the A-MPDU header subframe 850 depending on circumstances. The format of the frame 850 is also included in the scope of the present invention.

9 is a conceptual diagram illustrating a common MAC header of an A-MPDU header subframe according to an embodiment of the present invention.

In FIG. 9 , the common header field included in the common MAC header 960 of the A-MPDU header subframe 950 is disclosed.

Referring to FIG. 9 , the common MAC header 960 may include a duration/ID field 900 , an address field 910 , a QoS control field 920 , and an HT control field 930 .

Duration information for setting the NAV or identification information of the transmitting STA may be the same for each of a plurality of A-MPDU subframes included in the A-MPDU. Accordingly, the duration/ID field 900 may be included in the common header field.

The source address, destination address, transmitting STA address, and receiving STA address for each A-MPDU subframe may also be the same. Accordingly, the address field 910 may be included in the common header field.

Information included in each of the QoS control field 920 and the HT control field 930 may also be the same for each of the plurality of A-MPDU subframes. Accordingly, each of the QoS control field 920 and the HT control field 930 may be included in the common header field 960 . The QoS control field 920 and the HT control field 930 may be included in the compressed MAC header as unique header fields as described later in FIG. 10 . According to another embodiment, the QoS control field 920 and the HT control field 930 are divided according to information included in each of the QoS control field 920 and the HT control field 930 to obtain a common MAC header or compressed MAC header. it can also be included in the header.

The common header field included in the common MAC header disclosed in FIG. 9 is an exemplary field. Combinations of different MAC header fields may be included in the common header, and such an embodiment may also be included in the scope of the present invention.

10 is a conceptual diagram illustrating an A-MPDU subframe according to an embodiment of the present invention.

In FIG. 10, an A-MPDU subframe including a compressed MAC header is disclosed.

Referring to FIG. 10 , the A-MPDU subframe includes an MPDU delimiter 1000 , a compressed MAC header 1010 , a first FCS field (optional) 1055 , a MAC body 1020 , and a second FCS field 1030 .) and a padding bit 1040 .

In the drawing, it is assumed that the first FCS field 1055 is included in the MAC header 1010 . However, the first FCS field 1055 may be included in the A-MPDU subframe in a separate structure.

The MPDU delimiter 1000 of the A-MPDU subframe may include an error check field 1050, a compression header field 1060, an MPDU length field 1070, a CRC 1080, and a delimiter signature 1090. .

The error check field 1050 may include information indicating whether the first FCS field 1055 including the error check bit for the compressed MAC header is included in the A-MPDU subframe. For example, if the value of the error check field 1050 is 1, it means that the first FCS field 1055 including the error check bit for the MAC header 1010 is included in the A-MPDU subframe. can be directed. Conversely, when the value of the error check field 1050 is 0, it may be indicated that the first FCS field 1055 including the error check bit for the MAC header is not included in the A-MPDU subframe.

The compressed header field 1060 may include information indicating whether the MAC header 1010 is a compressed MAC header. For example, if the value of the compressed header field 1060 is 1, it may indicate that the MAC header 1010 included in the A-MPDU subframe is a compressed MAC header. Conversely, when the value of the compressed header field 1060 is 0, it may indicate that the MAC header 1010 included in the A-MPDU subframe is not a compressed MAC header.

The MPDU length field 1070 may include information on the length of the MPDU. For example, the MPDU length field 1070 includes a compressed MAC header 1010 transmitted after the MPDU delimiter 1000, a first FCS field (optional) 1055, a MAC body 1020, and a second FCS field. (1030) may include information about the length of the octet unit.

The CRC 1080 may include an error check bit for information included in the MPDU delimiter 1000 . Specifically, the CRC 1080 may include information for checking errors generated in the error check field 1050 , the compression header field 1060 , and the MPDU length field 1070 included in the MPDU delimiter 1000 . .

The delimiter signature 1090 may include pattern information for detecting the MPDU delimiter 1000 when the delimiter is scanned by the STA.

Referring back to the A-MPDU subframe, the compressed MAC header 1010 may include a unique header field. The unique header field may include individual header information for the A-MPDU subframe. For example, the unique header field may include a frame control field 1015 , a sequence control field 1025 , a QoS control field 1035 , and an HT control field 1045 . Since each of the frame control field 1015, sequence control field 1025, QoS control field 1035, and HT control field 1045 may include unique information for each of a plurality of A-MPDU subframes, a unique header field , and may be included in the compressed MAC header 1010 .

The first FCS field 1055 may include an error check bit for the compressed MAC header 1010 . When the first FCS field 1055 is included, it may be possible to determine (or determine) whether an error has occurred in the compressed MAC header 1010 . If an error occurs in the compressed MAC header 1010, an error MAC is based on information included in the PPDU header (or PHY header) (eg, MAC header related information or information for MAC body decoding). Decoding of the remaining MAC body 1020 part except for the header 1010 may be performed. In the existing WLAN system, the STA cannot determine whether an error has occurred in the MAC header 1010 . Accordingly, when an error occurs in the MAC header 1010, retransmission of the frame is requested through the retransmission procedure. However, according to an embodiment of the present invention, even when an error occurs in the MAC header 1010 , decoding of the MAC body 1020 may be successfully performed. Accordingly, overhead due to retransmission can be reduced.

The first FCS field 1055 may optionally be included in the A-MPDU subframe. 11 , the first FCS field 1055 may not be included in the A-MPDU subframe.

The MAC body 1020 may include traffic data decoded based on the common MAC header included in the A-MPDU header subframe and the compressed MAC header 1010 included in the A-MPDU subframe. As described above, when an error occurs in the MAC header 1010, the MAC body 1020 may be decoded based on the PPDU header.

The second FCS field 1030 may include an error check bit for checking an error occurring in the compressed MAC header 1010 , the first FCS field (optional) 1055 , and the MAC body 1020 . Alternatively, the second FCS 1030 may include an error check bit for error checking only for the MAC body 1020 .

Whether an error has occurred in the MAC body 1020 may be determined based on the second FCS 1030 . For example, when it is determined that an error has not occurred as a result of an error check based on the first FCS 1055 and it is determined that an error has occurred as a result of an error check based on the second FCS 1030, the STA may determine that an error in the MAC body 1020 has occurred.

In the existing wireless LAN system, an error with respect to the MAC body 1020 was not separately determined. In the existing WLAN system, the STA determined that an error occurred in the MPDU (MAC header + MAC body) based on the FCS and performed a retransmission procedure. However, in the present invention, when no error occurs in the MAC header 1010 , information included in the MAC header 1010 may be utilized by the STA. For example, if an error does not occur in the MAC header 1010 and an error occurs in the MAC body 1020 , the STA sets a network allocation vector (NAV) based on information in the MAC header 1010 and sets another BSS threshold You can set a threshold. Accordingly, inefficient channel access using an extended interframe space (EIFS) can be improved.

In addition, when it is determined that errors have occurred in both the MAC body 1020 and the MAC header 1010 , the STA performs a retransmission procedure in the existing WLAN system. However, when the A-MPDU according to the embodiment of the present invention is used, the STA configures NAV based on MAC header related information included in the PPDU header (or information for MAC body decoding included in the PPDU header) and sets other BSSs. Threshold setting and the like can be normally performed. Accordingly, inefficient channel access using EIFS can be improved.

11 is a conceptual diagram illustrating an A-MPDU subframe according to an embodiment of the present invention.

In FIG. 11, an A-MPDU subframe including a compressed MAC header is disclosed.

Referring to FIG. 11 , an A-MPDU subframe not including the first FCS field is disclosed.

The A-MPDU subframe may include only the compressed MAC header 1100 .

12 is a conceptual diagram illustrating a PPDU format according to an embodiment of the present invention.

12 discloses a PPDU format according to an embodiment of the present invention.

12, the PPDU header of the downlink PPDU is L-STF (legacy-short training field), L-LTF (legacy-long training field), L-SIG (legacy-signal), HE-SIG A (high efficiency-signal A), high efficiency-short training field (HE-STF), high efficiency-long training field (HE-LTF), and high efficiency-signal-B (HE-SIG B) may be included.

From the PHY header to the L-SIG may be divided into a legacy part and a high efficiency (HE) part after the L-SIG.

The L-STF 1200 may include a short training orthogonal frequency division multiplexing symbol (OFDM). The L-STF 1000 may be used for frame detection, automatic gain control (AGC), diversity detection, and coarse frequency/time synchronization.

The L-LTF 1210 may include a long training orthogonal frequency division multiplexing symbol (OFDM). The L-LTF 1010 may be used for fine frequency/time synchronization and channel prediction.

The L-SIG 1220 may be used to transmit control information. The L-SIG 1020 may include information on a data rate and a data length.

The HE-SIG A 1230 may include information for indicating the STA to receive the PPDU. For example, the HE-SIG A 1030 may include information for indicating an identifier of a specific STA (or AP) that will receive the PPDU and a group of the specific STA. In addition, when the PPDU is transmitted based on OFDMA or MIMO, the HE-SIG A 1230 may also include resource allocation information for the STA.

In addition, HE-SIG A 1230 is color bits information for BSS identification information, bandwidth information, tail bits, CRC bits, MCS for HE-SIG B 1060 (It may include modulation and coding scheme) information, symbol number information for the HE-SIG B 1260 , and cyclic prefix (CP) (or guard interval (GI)) length information.

HE-SIG A 1230 may be expressed in terms of HE-SIG 1 (or first signal field).

The HE-STF 1240 may be used to improve automatic gain control estimation in a multiple input multiple output (MIMO) environment or an OFDMA environment.

The HE-LTF 1250 may be used to estimate a channel in a MIMO environment or an OFDMA environment.

The HE-SIG B 1260 may include information about the length MCS of a physical layer service data unit (PSDU) for each STA, a tail bit, and the like. In addition, the HE-SIG B 1260 may include information on a STA that will receive the PPDU and OFDMA-based resource allocation information (or MU-MIMO information). When OFDMA-based resource allocation information (or MU-MIMO related information) is included in HE-SIG B 1260 , resource allocation information may not be included in HE-SIG A 1230 . HE-SIG B 1260 may be expressed in terms of HE-SIG 2 (or second signal field).

The size of the IFFT applied to the HE-STF 1240 and the field after the HE-STF 1240 and the size of the IFFT applied to the field before the HE-STF 1240 may be different from each other. For example, the size of the IFFT applied to the HE-STF 1240 and the field after the HE-STF 1240 may be 4 times larger than the size of the IFFT applied to the field before the HE-STF 1240 . The STA may receive the HE-SIG A 1230 and may be instructed to receive a downlink PPDU based on the HE-SIG A 1230 . In this case, the STA may perform decoding based on the HE-STF 1240 and the FFT size changed from the fields after the HE-STF 1240 . Conversely, when the STA is not instructed to receive a downlink PPDU based on the HE-SIG A 1230, the STA may stop decoding and configure a network allocation vector (NAV). The cyclic prefix (CP) of the HE-STF 1240 may have a larger size than the CPs of other fields, and during this CP period, the STA may perform decoding on the downlink PPDU by changing the FFT size.

The order of fields constituting the format of the PPDU disclosed in the upper part of FIG. 12 may be changed. For example, as disclosed in the middle of FIG. 12 , HE-SIG B 1215 of the HE portion may be located immediately after HE-SIG A 1205 . The STA may decode up to HE-SIG A 1205 and HE-SIG B 1215, receive necessary control information, and configure NAV. Similarly, the size of the IFFT applied to the HE-STF 1225 and the field after the HE-STF 1225 may be different from the size of the IFFT applied to the field before the HE-STF 1025 .

The STA may receive HE-SIG A 1205 and HE-SIG B 1215 . When reception of the PPDU is indicated based on the HE-SIG A 1205 , the STA may perform decoding on the PPDU by changing the FFT size from the HE-STF 1225 . Conversely, when the

STA receives the HE-SIG A 1005 and the reception of the downlink PPDU is not indicated based on the HE-SIG A 1205, a network allocation vector (NAV) may be configured.

12, a PPDU format for multi-user (MU) OFDMA transmission is disclosed. For example, the AP may transmit a downlink frame or a downlink PPDU to a plurality of STAs using a PPDU format for DL MU OFDMA transmission. Each of the plurality of downlink PPDUs may be transmitted to each of the plurality of STAs through different transmission resources (frequency resources or spatial streams). The previous field of the HE-SIG B 1245 on the PPDU may be transmitted in a duplicated form in each of different transmission resources. HE-SIG B 1245 may be transmitted in an encoded form on all transmission resources. A field after the HE-SIG B 1245 may include individual information for each of a plurality of STAs receiving the PPDU.

For example, the HE-SIG A 1235 may include identification information on a plurality of STAs that will receive downlink data and information on channels through which downlink data of the plurality of STAs are transmitted.

When fields included in the PPDU are transmitted through each transmission resource, a CRC for each field may be included in the PPDU. Conversely, when a specific field included in the PPDU is encoded and transmitted over all transmission resources, such as the HE-SIG B 1245 , the CRC for each field may not be included in the PPDU. Accordingly, overhead for CRC can be reduced.

Similarly to the PPDU format for MU transmission, the HE-STF (1255) and the fields after the HE-STF (1255) may be encoded based on an IFFT size different from the fields before the HE-STF (1255). Accordingly, when the STA receives the HE-SIG A 1235 and the HE-SIG B 1245 and is instructed to receive a PPDU based on the HE-SIG A 1235, the FFT size from the HE-STF 1255 can be changed to perform decoding on the PPDU.

13 is a block diagram illustrating a wireless device to which an embodiment of the present invention can be applied.

Referring to FIG. 13 , an AP 1300 includes a processor 1310 , a memory 1320 , and a radio frequency unit (RF) 1330 .

The RF unit 1330 may be connected to the processor 1310 to transmit/receive a radio signal.

The processor 1310 may implement the functions, processes and/or methods proposed in the present invention.

For example, the processor 1310 may be implemented to perform the operation of the AP according to the above-described embodiment of the present invention. The processor may perform the operation of the AP disclosed in the embodiments of FIGS. 1 to 12 .

For example, the processor 1310 may be implemented to generate a frame to be transmitted to the STA and transmit the frame to the STA. In this case, the frame is an aggregated (A)-MPDU (medium access control (MAC) protocol data unit), and the A-MPDU may include an A-MPDU header subframe and an A-MPDU subframe. The A-MPDU header subframe may include the first MPDU, and the A-MPDU subframe may include the second MPDU. The first MPDU may include a first MAC header excluding the MAC body as an MPDU, and the second MPDU may include a MAC body and a second MAC header as an MPDU.

The A-MDPU header subframe may further include a first error check bit for only the first MAC header, and the A-MPDU subframe may further include a second error check bit for only the second MAC header.

The first MAC header may include a common header field, and the common header field may include MAC header information common to each of the plurality of A-MDPU subframes including the A-MPDU subframe included in the A-MPDU.

The second MAC header may include a unique header field, and the unique header field may include unique MAC header information for the A-MPDU subframe except for the common header field.

The A-MPDU subframe may include an MPDU delimiter, and the MDPU delimiter may include an error check field and a compression header field. The error check field includes information indicating whether the second error check bit is included in the A-MPDU subframe, and the compressed header field includes information indicating whether the second MAC header includes a unique header field. can do. In addition, the A-MPDU subframe may further include a third error check bit for the MAC body,

The first error check bit may be used by the STA to check whether there is an error in the first MAC header, and the second error check bit may be used by the STA to check whether there is an error in the second MAC header. The third error check bit may be used by the STA to check whether there is an error in the MAC body.

This error check operation may be performed by each of the plurality of STAs when the PPDU transmitted by the AP includes a plurality of frames transmitted to the plurality of STAs as the MU PPDU. Each of the plurality of frames included in the MU PPDU

may include each of the plurality of A-MPDUs for each of the plurality of STAs.

The STA 1350 includes a processor 1360 , a memory 1370 , and a radio frequency unit 1380 .

The RF unit 1380 may be connected to the processor 1360 to transmit/receive a radio signal.

The processor 1360 may implement the functions, processes and/or methods proposed in the present invention. For example, the processor 1320 may be implemented to perform the operation of the STA according to the above-described embodiment of the present invention. The processor 2560 may perform an operation of an STA in the embodiments of FIGS. 1 to 12 .

For example, the processor 1360 may be implemented to generate a frame to be transmitted to an access point (AP) and transmit the frame to the AP. In this case, the frame is an aggregated (A)-MPDU (medium access control (MAC) protocol data unit), and the A-MPDU may include an A-MPDU header subframe and an A-MPDU subframe. The A-MPDU header subframe may include the first MPDU, and the A-MPDU subframe may include the second MPDU. The first MPDU may include a first MAC header excluding the MAC body as an MPDU, and the second MPDU may include a MAC body and a second MAC header as an MPDU.

The A-MDPU header subframe may further include a first error check bit for only the first MAC header, and the A-MPDU subframe may further include a second error check bit for only the second MAC header.

The first MAC header may include a common header field, and the common header field may include MAC header information common to each of the plurality of A-MDPU subframes including the A-MPDU subframe included in the A-MPDU.

The second MAC header may include a unique header field, and the unique header field may include unique MAC header information for the A-MPDU subframe except for the common header field.

The A-MPDU subframe may include an MPDU delimiter, and the MDPU delimiter may include an error check field and a compression header field. The error check field includes information indicating whether the second error check bit is included in the A-MPDU subframe, and the compressed header field includes information indicating whether the second MAC header includes a unique header field. can do. In addition, the A-MPDU subframe may further include a third error check bit for the MAC body,

The first error check bit may be used by the AP to check whether there is an error in the first MAC header, and the second error check bit may be used by the AP to check whether there is an error in the second MAC header. The third error check bit may be used to check whether there is an error in the MAC body by the AP.

The processors 1310 and 1360 may include application-specific integrated circuits (ASICs), other chipsets, logic circuits, data processing devices, and/or converters for converting baseband signals and radio signals to each other. The memories 1320 and 1370 may include read-only memory (ROM), random access memory (RAM), flash memory, memory cards, storage media, and/or other storage devices. The RF units 1330 and 1380 may include one or more antennas for transmitting and/or receiving radio signals.

When the embodiment is implemented in software, the above-described technique may be implemented as a module (process, function, etc.) that performs the above-described function. The modules may be stored in the memories 1320 and 1370 and executed by the processors 1310 and 1360 . The memories 1320 and 1370 may be inside or outside the processors 1310 and 1360 , and may be connected to the processors 1310 and 1360 through various well-known means.

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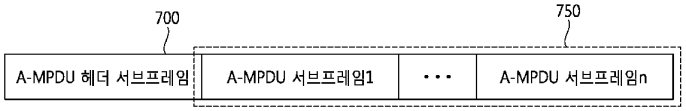
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공개:

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(54) Title: METHOD AND DEVICE FOR TRANSMITTING FRAME INCLUDING ERROR CHECK BITS FOR HEADER IN WIRELESS LAN

(54) 발명의 명칭 : 무선랜에서 헤더에 대한 에러 체크 비트를 포함하는 프레임을 전송하는 방법 및 장치



700 ... A-MPDU header subframe
750 ... A-MPDU subframe

(57) Abstract: A method and a device for transmitting a frame including error check bits for a header in a wireless LAN are disclosed. The method for transmitting a frame in a wireless LAN can comprise the steps of: generating, by an STA, a frame to be transmitted to an AP; and transmitting, by the STA, the frame to the AP, wherein the frame is an A-MPDU, the A-MPDU includes an A-MPDU header subframe and an A-MPDU subframe, the A-MPDU header subframe includes a first MPDU, the A-MPDU subframe includes a second MPDU, the first MPDU, as an MPDU, includes a first MAC header, except for a MAC body, and the second MPDU, as an MPDU, can include the MAC body and a second MAC header.

(57) 요약서: 무선랜에서 헤더에 대한 에러 체크 비트를 포함하는 프레임을 전송하는 방법 및 장치가 개시되어 있다. 무선랜에서 프레임을 전송하는 방법은 STA 이 AP 로 전송할 프레임을 생성하는 단계와 STA 이 프레임을 AP 로 전송하는 단계를 포함할 수 있되, 프레임은 A-MPDU 이고, A-MPDU 는 A-MPDU 헤더 서브프레임과 A-MPDU 서브프레임을 포함하고, A-MPDU 헤더 서브프레임은 제 1 MPDU 를 포함하고, A-MPDU 서브프레임은 제 2 MPDU 를 포함하고, 제 1 MPDU 는 MPDU 로서 MAC 바디를 제외한 제 1 MAC 헤더를 포함하고, 제 2 MPDU 는 MPDU 로서 MAC 바디 및 제 2 MAC 헤더를 포함할 수 있다.

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명세서

발명의 명칭: 무선랜에서 헤더에 대한 에러 체크 비트를 포함하는 프레임을 전송하는 방법 및 장치

기술분야

[1] 본 발명은 무선 통신에 관한 것으로 보다 상세하게는 무선랜에서 헤더에 대한 에러 체크 비트를 포함하는 프레임을 전송하는 방법 및 장치에 관한 것이다.

배경기술

[2] 차세대 WLAN(wireless local area network)를 위한 논의가 진행되고 있다. 차세대 WLAN에서는 1) 2.4GHz 및 5GHz 대역에서 IEEE(institute of electronic and electronics engineers) 802.11 PHY(physical) 계층과 MAC(medium access control) 계층의 향상, 2) 스펙트럼 효율성(spectrum efficiency)과 영역 쓰루풋(area through put)을 높이는 것, 3) 간섭 소스가 존재하는 환경, 밀집한 이종 네트워크(heterogeneous network) 환경 및 높은 사용자 부하가 존재하는 환경과 같은 실제 실내 환경 및 실외 환경에서 성능을 향상 시키는 것 을 목표로 한다.

[3] 차세대 WLAN에서 주로 고려되는 환경은 AP(access point)와 STA(station)이 많은 밀집 환경이며, 이러한 밀집 환경에서 스펙트럼 효율(spectrum efficiency)과 공간 전송률(area throughput)에 대한 개선이 논의된다. 또한, 차세대 WLAN에서는 실내 환경뿐만 아니라, 기존 WLAN에서 많이 고려되지 않던 실외 환경에서의 실질적 성능 개선에 관심을 가진다.

[4] 구체적으로 차세대 WLAN에서는 무선 오피스(wireless office), 스마트 홈(smart home), 스타디움(Stadium), 핫스팟(Hotspot), 빌딩/아파트(building/apartment)와 같은 시나리오에 관심이 크며, 해당 시나리오 기반으로 AP와 STA이 많은 밀집 환경에서의 시스템 성능 향상에 대한 논의가 진행되고 있다.

[5] 또한, 차세대 WLAN에서는 하나의 BSS(basic service set)에서의 단일 링크 성능 향상보다는, OBSS(overlapping basic service set) 환경에서의 시스템 성능 향상 및 실외 환경 성능 개선, 그리고 셀룰러 오프로딩 등에 대한 논의가 활발할 것으로 예상된다. 이러한 차세대 WLAN의 방향성은 차세대 WLAN이 점점 이동 통신과 유사한 기술 범위를 갖게 됨을 의미한다. 최근 스몰셀 및 D2D(Direct-to-Direct) 통신 영역에서 이동 통신과 WLAN 기술이 함께 논의되고 있는 상황을 고려해 볼 때, 차세대 WLAN과 이동 통신의 기술적 및 사업적 융합은 더욱 활발해질 것으로 예측된다.

발명의 상세한 설명

기술적 과제

[6] 본 발명의 목적은 무선랜에서 헤더에 대한 에러 체크 비트를 포함하는 프레임을 전송하는 방법을 제공하는 것이다.

[7] 본 발명의 또 다른 목적은 무선랜에서 헤더에 대한 에러 체크 비트를 포함하는

프레임을 전송하는 장치를 제공하는 것이다.

과제 해결 수단

[8] 상술한 본 발명의 목적을 달성하기 위한 본 발명의 일 측면에 따른 무선랜에서 프레임을 전송하는 방법은 STA(station)이 AP(access point)로 전송할 프레임을 생성하는 단계와 상기 STA(station)이 상기 프레임을 상기 AP로 전송하는 단계를 포함할 수 있되, 상기 프레임은 A(aggregated)-MPDU(MAC(medium access control) protocol data unit)이고, 상기 A-MPDU는 A-MPDU 헤더 서브프레임과 A-MPDU 서브프레임을 포함하고, 상기 A-MPDU 헤더 서브프레임은 제1 MPDU를 포함하고, 상기 A-MPDU 서브프레임은 제2 MPDU를 포함하고, 상기 제1 MPDU는 MPDU로서 MAC 바디를 제외한 제1 MAC 헤더를 포함하고, 상기 제2 MPDU는 MPDU로서 MAC 바디 및 제2 MAC 헤더를 포함할 수 있다.

[9] 상술한 본 발명의 목적을 달성하기 위한 본 발명의 다른 측면에 따른 무선랜에서 프레임을 전송하는 STA(station)은 무선 신호를 송신 또는 수신하기 위해 구현되는 RF(radio frequency) 부와 상기 RF부와 동작 가능하게(operatively) 연결된 프로세서를 포함하되, 상기 프로세서는 AP(access point)로 전송할 프레임을 생성하고, 상기 프레임을 상기 AP로 전송하도록 구현되되, 상기 프레임은 A(aggregated)-MPDU(MAC(medium access control) protocol data unit)이고, 상기 A-MPDU는 A-MPDU 헤더 서브프레임과 A-MPDU 서브프레임을 포함하고, 상기 A-MPDU 헤더 서브프레임은 제1 MPDU를 포함하고, 상기 A-MPDU 서브프레임은 제2 MPDU를 포함하고, 상기 제1 MPDU는 MPDU로서 MAC 바디를 제외한 제1 MAC 헤더를 포함하고, 상기 제2 MPDU는 MPDU로서 MAC 바디 및 제2 MAC 헤더를 포함할 수 있다.

발명의 효과

[10] MAC(medium access control) 헤더에서 발생된 에러를 체크하고, MAC 헤더의 오버헤드를 감소시킴으로써 무선랜 효율을 높일 수 있다.

도면의 간단한 설명

[11] 도 1은 무선랜(wireless local area network, WLAN)의 구조를 나타낸 개념도이다.

[12] 도 2는 A-MSDU를 나타낸 개념도이다.

[13] 도 3은 A-MPDU를 나타낸 개념도이다.

[14] 도 4는 블록 ACK 동작(operation)을 나타낸다.

[15] 도 5는 MAC 헤더의 구조를 나타낸 개념도이다.

[16] 도 6은 기존의 A-MPDU 서브프레임을 나타낸 개념도다.

[17] 도 7은 본 발명의 실시예에 따른 A-MPDU를 나타낸 개념도이다.

[18] 도 8은 본 발명의 실시예에 따른 A-MPDU 헤더 서브프레임을 나타낸 개념도이다.

[19] 도 9는 본 발명의 실시예에 따른 A-MPDU 헤더 서브프레임의 공통 MAC 헤더를 나타낸 개념도이다.

[20] 도 10은 본 발명의 실시예에 따른 A-MPDU 서브프레임을 나타낸 개념도이다.

[21] 도 11은 본 발명의 실시예에 따른 A-MPDU 서브프레임을 나타낸 개념도이다.

[22] 도 12는 본 발명의 실시예에 따른 PPDU 포맷을 나타낸 개념도이다.

[23] 도 13은 본 발명의 실시예가 적용될 수 있는 무선 장치를 나타내는 블록도이다.

발명의 실시를 위한 형태

[24] 도 1은 무선랜(wireless local area network, WLAN)의 구조를 나타낸 개념도이다.

[25] 도 1의 상단은 IEEE(institute of electrical and electronic engineers) 802.11의 인프라스트럭처 BSS(basic service set)의 구조를 나타낸다.

[26] 도 1의 상단을 참조하면, 무선랜 시스템은 하나 또는 그 이상의 인프라스트럭처 BSS(100, 105)(이하, BSS)를 포함할 수 있다. BSS(100, 105)는 성공적으로 동기화를 이루어서 서로 통신할 수 있는 AP(access point, 125) 및 STA1(Station, 100-1)과 같은 AP와 STA의 집합으로서, 특정 영역을 가리키는 개념은 아니다. BSS(105)는 하나의 AP(130)에 하나 이상의 결합 가능한 STA(105-1, 105-2)을 포함할 수도 있다.

[27] BSS는 적어도 하나의 STA, 분산 서비스(distribution Service)를 제공하는 AP(125, 130) 및 다수의 AP를 연결시키는 분산 시스템(distribution System, DS, 110)을 포함할 수 있다.

[28] 분산 시스템(110)는 여러 BSS(100, 105)를 연결하여 확장된 서비스 셋인 ESS(extended service set, 140)를 구현할 수 있다. ESS(140)는 하나 또는 여러 개의 AP(125, 230)가 분산 시스템(110)을 통해 연결되어 이루어진 하나의 네트워크를 지시하는 용어로 사용될 수 있다. 하나의 ESS(140)에 포함되는 AP는 동일한 SSID(service set identification)를 가질 수 있다.

[29] 포털(portal, 120)은 무선랜 네트워크(IEEE 802.11)와 다른 네트워크(예를 들어, 802.X)와의 연결을 수행하는 브리지 역할을 수행할 수 있다.

[30] 도 1의 상단과 같은 BSS에서는 AP(125, 130) 사이의 네트워크 및 AP(125, 130)와 STA(100-1, 105-1, 105-2) 사이의 네트워크가 구현될 수 있다. 하지만, AP(125, 130)가 없이 STA 사이에서도 네트워크를 설정하여 통신을 수행하는 것도 가능할 수 있다. AP(125, 130)가 없이 STA 사이에서도 네트워크를 설정하여 통신을 수행하는 네트워크를 애드-혹 네트워크(Ad-Hoc network) 또는 독립 BSS(independent basic service set, IBSS)라고 정의한다.

[31] 도 1의 하단은 IBSS를 나타낸 개념도이다.

[32] 도 1의 하단을 참조하면, IBSS는 애드-혹 모드로 동작하는 BSS이다. IBSS는 AP를 포함하지 않기 때문에 중앙에서 관리 기능을 수행하는 개체(centralized management entity)가 없다. 즉, IBSS에서 STA(150-1, 150-2, 150-3, 155-4, 155-5)들은 분산된 방식(distributed manner)으로 관리된다. IBSS에서는 모든 STA(150-1, 150-2, 150-3, 155-4, 155-5)이 이동 STA으로 이루어질 수 있으며, 분산 시스템으로의 접속이 허용되지 않아서 자기 완비적 네트워크(self-contained

network)를 이룬다.

[33] STA은 IEEE(Institute of Electrical and Electronics Engineers) 802.11 표준의 규정을 따르는 매체 접속 제어(medium access control, MAC)와 무선 매체에 대한 물리 계층(Physical Layer) 인터페이스를 포함하는 임의의 기능 매체로서, 광의로는 AP와 비-AP STA(Non-AP Station)을 모두 포함하는 의미로 사용될 수 있다.

[34] STA은 이동 단말(mobile terminal), 무선 기기(wireless device), 무선 송수신 유닛(Wireless Transmit/Receive Unit; WTRU), 사용자 장비(User Equipment; UE), 이동국(Mobile Station; MS), 이동 가입자 유닛(Mobile Subscriber Unit) 또는 단순히 유저(user) 등의 다양한 명칭으로도 불릴 수 있다.

[35]

[36] 도 2는 A-MSDU를 나타낸 개념도이다.

[37] 무선랜 시스템에서 MAC(medium access control) 에러 오버헤드를 줄이기 위해 데이터 프레임을 어그리게이션(aggregation)하는 방법이 정의되었다. 데이터 프레임의 어그리게이션을 위해 어플리케이션 계층에서 생성된 MSDU(MAC service data unit)(200)는 MAC 계층의 상위 계층에서 어그리게이션되어 하나의 데이터 단위로 생성될 수 있다. MAC 계층의 상위 계층에서 어그리게이션된 MSDU는 A-MSDU(aggregate-MSDU)(250)라는 용어로 정의될 수 있다. A-MSDU(250)는 우선 순위가 같고, 동일한 RA(receiver address)를 갖는 다수의 MSDU(200)의 어그리게이션을 기반으로 생성될 수 있다.

[38] 복수의 A-MSDU 서브 프레임들이 모여 하나의 A-MSDU(250)가 형성될 수 있다. 즉, A-MSDU(250)는 복수의 A-MSDU 서브프레임을 포함할 수 있고, A-MSDU 서브프레임은 서브프레임 헤더, MSDU 및 패딩 비트를 포함할 수 있다. 서브프레임 헤더는 목적지 주소(destination address, DA), 소스 주소(source address, SA), MSDU 길이(length)를 포함할 수 있다. 패팅 비트는 A-MSDU 서브프레임의 전체 길이를 일정 배수(4octet의 배수)로 만들기 위해 사용될 수 있다.

[39] A-MSDU(250)는 단일 MSDU와 다르게 분할(fragmentation)되지 않고 단일 QoS data MPDU(MAC protocol data unit)로 형성되어 전송될 수 있다. 예를 들어, A-MSDU(350)는 MIB(management information base) 필드의 HT(high throughput) STA에 의해 전송될 수 있다. HT STA인 경우, A-MSDU(250)를 디어그리게이션(de-aggregation)하는 능력을 가지고 있고, HT STA는 수신한 PPDU의 MAC 헤더의 QoS 필드 안에 A-MSDU(250)의 존재 여부를 확인하고 A-MSDU(250)를 디어그리게이션할 수 있다.

[40] HT STA의 ACK 정책(policy)이 노말 ACK으로 설정된 경우, A-MSDU(250)는 A-MPDU(MAC protocol data unit)로 어그리게이션될 수 없다. 또한, A-MSDU(250)가 A-MPDU로 어그리게이션될 수 있는지 여부는 TID(traffic identifier) 별 블록 ACK 동의(block acknowledgement agreement)가 맺어졌는지

여부에 따라 달라질 수 있다. 또한, TID에 대해 블록 ACK 동의가 맺어진 경우라도 ADDBA 요청 프레임(add block acknowledgement request frame)에 따른 수신 측의 ADDBA 응답 프레임(add block acknowledgement response frame)의 A-MSDU 블록 ACK 지원 여부 지시자가 블록 ACK을 지원하지 않음을 지시하는 경우, A-MPDU 안에 A-MSDU(250)가 포함될 수 없다.

[41]

[42] 도 3은 A-MPDU를 나타낸 개념도이다.

[43] 도 3을 참조하면, MAC 계층의 하부에서 동일한 RA(receiver address)와 TID 및 ACK 정책을 가지는 복수개의 MPDU(300)를 모아서 하나의 A-MPDU(350)가 형성될 수 있다.

[44] A-MPDU(350)는 한 개 이상의 A-MPDU 서브프레임으로 구성되어 있으며, 각 A-MPDU 서브프레임은 MPDU 디리미터(delimeter)와 MPDU(400)를 포함할 수 있다. MPDU는 MAC 헤더, MAC 바디, FCS(frame check sequence), 패딩 비트(padding bit)를 포함할 수 있다.

[45] MPDU 디리미터는 A-MPDU(350)를 구성하는 A-MPDU 서브프레임의 에러 여부를 판단하기 위해 사용될 수 있다. 복수의 A-MPDU 서브프레임은 하나의 A-MPDU(350)를 형성할 수 있다.

[46] A-MPDU(350)의 수신 성공 여부는 블록 ACK을 기반으로 지시될 수 있다. HT-즉시 BA 동의(HT-immediate BA agreement)가 맺어져 있는 TID에 대해서만 A-MPDU(350)를 형성할 수 있고, A-MPDU(350)를 구성하는 MPDU(300)의 듀레이션/ID 필드의 값은 동일하게 설정될 수 있다.

[47] A-MPDU(또는 MPDU)는 PSDU(PHY(physical layer) service data unit)에 포함될 수 있다. PSDU와 PPDU 헤더(PHY 프리앰블 및 PHY 헤더)는 PPDU(PHY protocol data unit)를 형성할 수 있다. A-MPDU(또는 MPDU)는 프레임과 동일한 데이터 단위로 해석될 수도 있다.

[48]

[49] 도 4는 블록 ACK 동작(operation)을 나타낸다.

[50] 블록 ACK 메커니즘은 TXOP(transmission opportunity) 듀레이션(또는 기간) 동안에 전송된 복수의 프레임에 대한 ACK 정보를 포함하는 블록 ACK 프레임의 전송을 위해 도입되었다. 블록 ACK 메커니즘이 사용되는 경우, A-MSDU 또는 A-MPDU와 마찬가지로 데이터 송신 및 수신 절차를 위한 오버헤드의 감소가 감소되고 MAC 계층의 효율성이 향상될 수 있다.

[51] 도 4를 참조하면, 하나의 TID의 A-MPDU에 대한 블록 ACK 전송은 설정(setup) 과정, 전송 과정, 해제(tear down) 과정을 기반으로 수행될 수 있다. 설정 과정은 블록 ACK 세션을 요청하고 응답하는 과정일 수 있다.

[52] TID는 상위 레이어(higher layer)에 의해 사용될 수 있는 식별자(identifier)로서 MSDU를 구분하기 위해 사용될 수 있다. 예를 들어, TID는 TS(traffic stream), TC(traffic category)를 기반으로 식별된 16개의 값을 가질 수 있다. TID는 MAC

계층보다 상위 계층에서 MSDU에 할당될 수 있다. TC는 서로 다른 사용자 우선 순위(user priority)를 가지는 MSDU를 구분하기 위해 사용될 수 있다. TS는 특정 TSPEC(traffic specification)을 기반으로 전송되는 MSDU의 집합을 지시할 수 있다. TSPEC은 STA 간의 데이터 플로우(data flow)의 QoS(quality of service) 특징(characteristics)을 지시할 수 있다.

[53] 전송 과정에서 전송측의 STA(이하, 전송 STA)은 연속된 데이터를 수신측의 STA(이하, 수신 STA)으로 전송하고 수신 STA은 연속된 데이터에 대한 어그리게이션된 응답을 전송 STA으로 전송할 수 있다.

[54] 해제(tear down) 과정에서 설정된 블록 ACK 세션은 해제될 수 있다.

[55] 구체적으로 설정 과정에서는 전송 STA은 ADDBA(add block acknowledgement) 요청 프레임을 수신 STA으로 전송하고 수신 STA은 ADDBA 응답 프레임을 전송 STA으로 전송할 수 있다. 구체적으로 전송 STA이 관리 프레임인 ADDBA 요청 프레임을 수신 STA으로 전송할 수 있다. ADDBA 요청 프레임은 현재 TID에 대한 블록 ACK 동의를 요청할 수 있다. ADDBA 요청 프레임은 블록 ACK 정책 종류, 전송측의 전송 버퍼 사이즈, 블록 ACK 세션의 타임 아웃 값, SSN(starting sequence number) 등에 대한 정보를 수신 STA으로 전송할 수 있다. ADDBA 요청 프레임을 수신한 수신 STA은 ADDBA 요청 프레임에 대한 응답으로 ADDBA 응답 프레임을 전송 STA으로 전송할 수 있다. ADDBA 응답 프레임은 블록 ACK 동의 상태, ACK 정책, 버퍼 사이즈, 타임 아웃 값을 포함할 수 있다.

[56] 전송 과정에서 전송 STA은 A-MPDU를 수신 STA으로 전송할 수 있다. A-MPDU에 대한 BAR(block ack request) 프레임의 전송 조건이 만족되는 경우, 전송 STA은 BAR 프레임을 수신 STA으로 전송할 수 있다. 전송 STA의 A-MPDU의 전송이 성공적인 경우, BAR 프레임을 수신한 수신 STA은 A-MPDU에 대한 블록 ACK을 전송 STA으로 전송할 수 있다.

[57] 해제 과정은 전송 STA과 수신 STA에 설정된 정지 타이머(inactivity timer)의 설정된 타임 아웃 값이 만료되거나 더 이상 해당 TID에 대해 전송할 데이터가 없을 경우 수행될 수 있다. 예를 들어, 블록 ACK 에러 회복을 위해 정지 타이머의 설정된 타임 아웃 값의 만료에 따라 DELBA(delete block acknowledgement) 프레임을 수신 STA 또는 전송 STA으로 전송하고 블록 ACK 세션을 종료할 수 있다. 전송 STA이 블록 ACK을 수신하는 경우, 전송 STA의 정지 타이머는 재설정될 수 있다. 수신 STA이 MPDU, 블록 ACK 요청 프레임을 수신하는 경우, 수신 STA의 정지 타이머는 재설정될 수 있다.

[58] 블록 ACK 프레임은 블록 ACK 시작 시퀀스 제어 필드와 블록 ACK 비트맵을 포함할 수 있다.

[59] 블록 ACK 시작 시퀀스 제어 필드는 블록 ACK 비트맵에 포함되는 첫번째 비트에 의해 지시되는 데이터 단위의 시퀀스 번호에 대한 정보를 포함할 수 있다. 다른 표현으로 블록 ACK 시작 시퀀스 제어 필드는 블록 ACK 비트맵에 포함되는 첫번째 비트에 의해 지시하는 데이터 단위의 시퀀스 번호인

SSN(starting sequence number)에 대한 정보를 포함할 수 있다.

[60] 블록 ACK 비트맵에 포함되는 복수의 비트 각각은 복수개의 데이터 단위(예를 들어, MSDU) 각각에 대한 디코딩 성공 여부를 지시할 수 있다. 블록 ACK 비트맵에 포함되는 첫번째 비트는 블록 ACK 시작 시퀀스 제어 필드에 의해 지시된 시퀀스 번호의 데이터 단위에 대한 수신 성공 여부를 지시할 수 있다. 블록 ACK 비트맵에 포함되는 나머지 비트는 순차적으로 나머지 시퀀스에 대응되는 데이터 단위의 디코딩 성공 여부를 지시할 수 있다. 즉, 블록 ACK 비트맵에 포함된 n번째 비트는 SSN+n에 대응되는 시퀀스 번호를 가진 데이터 단위에 대한 수신 성공 여부를 지시할 수 있다.

[61] 블록 ACK 비트맵은 압축된(compressed) 포맷을 가질 수도 있다. 압축된 포맷의 블록 ACK 비트맵에 포함되는 하나의 비트는 복수의 데이터 단위(예를 들어, 64개의 MSDU, A-MSDU)의 수신 성공 여부를 지시할 수도 있다.

[62] 또한, 블록 ACK 비트맵은 하나의 TID에 대한 블록 ACK 비트맵만을 포함할 뿐만 아니라 설정에 따라 복수의 TID에 대한 블록 ACK 비트맵을 포함할 수도 있다.

[63] 기존의 무선랜 시스템에서는 MAC 헤더와 MAC 바디(또는 MSDU, A-MSDU, 프레임바디)에 대한 에러 탐지를 위한 FCS (frame check sequence)가 프레임에 포함되어 전송되었다. 즉, 프레임의 MAC 헤더만에 대한 CRC(cyclic redundancy check)를 위한 FCS가 프레임에 포함되지 않았다.

[64] 기존에 무선랜 시스템에서 동작하는 STA 또는 AP은 수신된 프레임에 포함되는 MAC 헤더 및 MAC 바디에 에러가 발생하였는지 여부를 프레임에 포함되는 FCS를 기반으로 체크할 수 있다. 하지만, MAC 헤더에 대해 에러가 발행하였는지 여부는 별도로 판단할 없었다. 무선랜 시스템에서 프레임의 MAC 헤더는 이후 MAC 바디를 디코딩(또는 해석)함에 있어서 중요한 정보를 포함한다. 따라서, MAC 헤더의 에러 발생 여부를 판단하는 것은 무선랜 시스템의 성능을 향상시키기 위한 중요한 이슈일 수 있다.

[65] 본 발명의 실시예에서는 A-MPDU에서 포함되는 복수의 A-MPDU 서브프레임(또는 MPDU)의 MAC 헤더에 CRC를 추가하여 MAC 헤더만을 위한 에러 체크를 수행하는 방법이 개시된다. 또한, 본 발명의 실시예에서는 A-MPDU에 포함되는 복수의 A-MPDU 서브프레임 각각에 포함되는 MAC 헤더의 오버헤드를 줄이기 위한 방법이 개시된다.

[66] 도 5는 MAC 헤더의 구조를 나타낸 개념도이다.

[67] 도 5에서는 MDPU(또는 프레임)에 포함되는 MAC 헤더 구조가 개시된다.

[68] MAC 헤더 구조는 2013년 10월에 개시된 IEEE Standard for Information technology Telecommunications and information exchange between systems Local and metropolitan area networks Specific requirements Part 11: Wireless LAN Medium Access Control(MAC) and Physical Layer (PHY) Specifications의 8.2 MAC frame formats에 개시되어 있다. MAC 헤더 구조에 대해 간략하게 설명하면 아래와

같다.

[69] 도 5를 참조하면, MAC 헤더는 프레임 제어 필드(500), 듀레이션(duration)/ID(identifier) 필드(510), 주소 필드(520), 시퀀스 제어 필드(530), QoS(quality of service) 제어 필드(540), HT(high throughput) 제어 필드(550)를 포함할 수 있다.

[70] 프레임 제어 필드(500)는 프로토콜 버전 필드(505), 타입 필드(515), 서브타입 필드(525), To DS 필드(535-1), From DS 필드(535-2), 추가 조각(MoreFragments) 필드(545), 재시도(Retry) 필드(555), 파워 제어 필드(565), 추가 데이터(More Data) 필드(575), 보호된 프레임(Protected Frame) 필드(585), 순서(Order) 필드(595)를 포함할 수 있다.

[71] 프로토콜 버전 필드(505)는 현재 무선랜에서 사용되는 통신 프로토콜 버전에 대한 정보를 포함할 있다.

[72] 타입 필드(515) 및 서브타입 필드(525)는 프레임의 기능을 지시하기 위해 구현될 수 있다. 구체적으로 타입 필드(515)는 프레임이 관리 프레임, 제어 프레임 또는 데이터 프레임 중 어떠한 타입인지 여부를 지시하기 위한 정보를 포함할 수 있다. 서브타입 필드(525)는 타입 필드(515)에 지시된 프레임 타입에 포함되는 복수의 프레임 중 특정 프레임을 지시하기 위한 정보를 포함할 수 있다.

[73] To DS 필드(535-1) 및 From DS 필드(535-2)는 주소 필드 1 내지 주소 필드 4의 해석을 위한 정보를 포함할 수 있다.

[74] 추가 조각(MoreFragments) 필드(545)는 동일 MSDU에 대한 다른 프래그먼트(fragment)가 있는지 여부를 지시하는 정보를 포함할 수 있다.

[75] 재시도(Retry) 필드(555)는 전송되는 프렝임이 이전 프레임의 재전송 프레임인지 여부를 지시하기 위한 정보를 포함할 수 있다.

[76] 파워 제어 필드(565)는 파워 세이브 모드로의 운영 여부를 지시하기 위한 정보를 포함할 수 있다.

[77] 추가 데이터(More Data) 필드(575)는 추가적인 데이터의 버퍼 여부를 지시하기 위한 정보를 포함할 수 있다.

[78] 보호된 프레임(Protected Frame) 필드(585)는 MAC 바디(또는 프레임바디)가 암호화 알고리즘에 의해 처리된 정보를 포함하는지 여부를 지시하기 위한 정보를 포함할 수 있다.

[79] 순서(Order) 필드(595)는 정렬된 MSDU의 전송여부를 지시하기 위한 정보를 포함할 수 있다.

[80] 듀레이션/ID 필드(510)는 NAV의 설정을 위한 듀레이션 정보, STA의 식별 정보를 포함할 수 있다.

[81] 주소 필드1(520-1), 주소 필드2(520-2), 주소 필드3(520-3) 및 주소 필드 4(520-4) 각각은 To DS 필드(535-1) 및 From DS 필드(535-2)에 따라 소스 주소(source address), 목적지 주소(destination address), 전송 STA 주소(transmitting STA

address), 수신 STA 주소(receiving STA address), BSSID(basic service set identifier) 등에 대한 정보를 포함할 수 있다.

[82] 시퀀스 제어 필드(530)는 프레임(또는 MAC 바디)의 시퀀스 번호(sequence number)와 조각 번호(fragment number)에 대한 정보를 포함할 수 있다.

[83] QoS 제어 필드(540)는 TID(traffic identifier)에 대한 정보, EOSP(end of service period)에 대한 정보, ACK(acknowledgement) 정책(policy)에 대한 정보를 포함할 수 있다. TID는 TC(traffic category)에 따른 UP(user priority)에 대한 정보를 포함할 수 있다.

[84] HT 제어 필드(550)는 링크 적응(link adaptation) 필드, 캘리브레이션 포지션(calibration position) 필드, 캘리브레이션 시퀀스(calibration sequence) 필드, 채널 상태 정보/조정(CSI(channel state information)/Steering) 필드, NDP 공지(NDP(Null Data Packet Announcement) announcement) 필드 등을 포함할 수 있다.

[85] 링크 적응 서브 필드는 트레이닝 요청(TRQ: Training request) 필드, MCS(modulation and coding scheme) 요청 또는 안테나 선택 지시(MAI: MCS(Modulation and Coding Scheme) Request or ASEL(Antenna Selection) Indication) 필드, MCS 피드백 시퀀스 지시(MFSI: MCS Feedback Sequence Identifier) 필드, MCS 피드백 및 안테나 선택 명령/데이터(MFB/ASELC: MCS Feedback and Antenna Selection Command/data) 필드를 포함할 수 있다.

[86] TRQ 서브필드는 응답자(responder)에게 사운딩 PPDU(sounding PPDU) 전송을 요청하는 경우 1로 설정되고, 응답자에게 사운딩 PPDU 전송을 요청하지 않는 경우 0으로 설정된다. 그리고, MAI 서브필드가 14로 설정되면 안테나 선택 지시(ASEL indication)를 나타내며, MFB/ASELC 서브필드는 안테나 선택 명령/데이터로 해석된다. 그렇지 않은 경우, MAI 서브필드는 MCS 요청을 나타내며, MFB/ASELC 서브필드는 MCS 피드백으로 해석된다. MAI 서브필드가 MCS 요청(MRQ: MCS Request)을 나타내는 경우, 어떠한 MCS 피드백을 요청하지 않는 경우 0으로 설정되고, MCS 피드백을 요청하는 경우 1로 설정된다. 사운딩 PPDU는 채널 추정을 위하여 사용될 수 있는 트레이닝(training) 심볼을 전달하는 PPDU를 의미한다.

[87]

[88] 도 6은 기존의 A-MPDU 서브프레임을 나타낸 개념도다.

[89] 도 6에서는 기존의 무선랜 시스템에서 지원되는 A-MPDU에 포함되는 A-MPDU 서브프레임이 개시된다.

[90] 도 6을 참조하면, A-MPDU에 포함되는 A-MPDU 서브프레임은 MPDU 디리미터(delimiter)(600), MAC 헤더(610), MAC 바디(또는 프레임바디)(620), FCS(frame check sequence) 필드(630) 및 패딩 비트(640)를 포함할 수 있다.

[91] MPDU 디리미터(600)는 MPDU 길이에 대한 정보, CRC 비트 및 MPDU 디리미터를 지시하는 특정 패턴 정보를 포함할 수 있다. A-MPDU를 수신하는

STA은 특정 패턴 정보를 기반으로 MPDU 디리미터(600)를 인지할 수 있다. 또한, MPDU 디리미터(600)는 A-MPDU 서브프레임에 포함되는 MPDU(예를 들어, MAC 헤더(610), MAC 바디(620), FCS(630))의 길이에 대한 정보를 포함할 수 있다. 따라서, STA은 MPDU 디리미터(600)에 포함된 특정 패턴 정보를 기반으로 A-MPDU 상에서 MPDU 디리미터를 인지 후, MPDU 디리미터(600)에 포함된 MPDU의 길이 정보를 기반으로 A-MPDU 서브프레임 상에서 MPDU를 추출할 수 있다.

[92] MPDU 디리미터(600)에 포함되는 CRC 비트는 MPDU 디리미터(600)에 발생한 에러를 체크하기 위한 에러 체크 비트일 수 있다. 구체적으로 CRC 비트는 MPDU 길이에 대한 정보의 오류 여부를 판단하기 위한 에러 체크 비트일 수 있다.

[93] MAC 헤더(610)는 상황에 따라 다른 길이를 가질 수 있다. 전술한 바와 같이 하나의 A-MPDU는 복수의 A-MPDU 서브프레임을 포함할 수 있다. 복수의 A-MPDU 서브프레임 각각에 포함되는 복수의 MPDU 각각은 복수의 MAC 헤더 각각을 포함할 수 있다. 이러한 복수의 MAC 헤더 각각에 포함되는 복수의 필드 중 일부의 필드는 상호 동일할 수 있다.

[94] MAC 바디(620)는 MAC 헤더를 기반으로 디코딩될 수 있는 트래픽 데이터를 포함할 수 있다.

[95] FCS 필드(630)는 MAC 헤더 및 MAC 바디에 대한 에러를 체크하기 위해 사용되는 에러 체크 비트(예를 들어, 32비트 크기의 CRC)를 포함할 수 있다. FCS 필드에 포함되는 에러 체크 비트는 MAC 헤더와 MAC 바디에 대하여 연산되어 결정될 수 있다.

[96] 패딩 비트(640)는 A-MPDU 서브프레임의 길이를 4 옥텟의 단위로 설정하기 위한 비트를 포함할 수 있다.

[97]

[98] 도 7은 본 발명의 실시예에 따른 A-MPDU를 나타낸 개념도이다.

[99] 도 7을 참조하면, A-MPDU는 A-MPDU 헤더 서브프레임(700) 및 A-MPDU 서브프레임(750)을 포함할 수 있다.

[100] A-MPDU 헤더 서브프레임(700)은 MPDU로 MAC 바디를 제외한 MAC 헤더, FCS 및 패딩 비트만을 포함할 수 있다.

[101] A-MPDU 서브프레임(750)은 MPDU로 MAC 헤더 및 MAC 바디, FCS 및 패딩 비트를 포함할 수 있다.

[102] A-MPDU 헤더 서브프레임(700)에 포함되는 MAC 헤더는 공통 헤더 필드(common header field)를 포함할 수 있다. A-MPDU 헤더 서브프레임(700)에 포함되는 MAC 헤더는 공통 MAC 헤더라는 용어로 표현될 수 있다. 공통 헤더 필드는 A-MPDU에 포함되는 복수의 A-MPDU 서브프레임에 대한 공통되는 헤더 정보를 포함하는 필드일 수 있다. A-MPDU 헤더 서브프레임(700)에 포함되는 FCS 필드는 MAC 헤더만을 위한 에러 체크 비트를 포함할 수 있다. A-MPDU 헤더 서브프레임(700)은 A-MPDU 내에서 나머지 A-MPDU 서브프레임(750)보다

먼저 디코딩될 수 있도록 위치할 수 있다.

[103] A-MPDU 서브프레임(750)에 포함되는 MAC 헤더는 고유 헤더 필드(unique header field))를 포함할 수 있다. A-MPDU 서브프레임(750)에 포함되는 MAC 헤더는 압축된 MAC 헤더(또는 고유 MAC 헤더)라는 용어로 표현될 수 있다. 고유 헤더 필드는 공통 헤더 필드를 제외한 A-MPDU 서브프레임(750)에 대한 개별적인 헤더 정보를 포함할 수 있다. FCS는 MAC 헤더 및 MAC 바디에 대한 에러 체크 비트를 포함할 수 있다. 본 발명의 실시예에 따르면, MAC 헤더만을 위한 에러 체크 비트를 포함하는 추가 FCS가 A-MPDU 서브프레임(750)에 포함될 수 있다.

[104] A-MPDU 헤더 서브프레임(700)이 공통 헤더 필드를 포함하고 A-MPDU 서브프레임(750)은 공통 헤더 필드를 포함하지 않는 경우, 기존의 A-MPDU에 포함되는 복수의 A-MPDU 서브프레임 각각에 포함되는 공통되는 헤더 정보를 포함하는 복수의 MAC 헤더 각각으로 인한 오버헤드가 감소될 수 있다. 즉, 수신 주소(receiver address), 전송 주소(transmitter address), BSSID, ACK 정책, 키(Key) ID, 듀레이션/ID 등과 같은 공통된 헤더 정보를 하나의 A-MPDU 헤더 서브프레임(700)을 통해 전송함으로써 불필요하게 반복되는 MAC 헤더 정보의 전송이 감소될 수 있다. A-MPDU 서브프레임(750)에 포함되는 MAC 바디는 A-MPDU 헤더 서브프레임(700)에 포함되는 공통 MAC 헤더 및 A-MPDU 서브프레임(750)에 포함되는 압축된 MAC 헤더를 기반으로 디코딩(또는 해석)될 수 있다.

[105] 또한, A-MPDU 헤더 서브프레임(700) 및 A-MPDU 서브프레임(750) 각각에 포함되는 공통 MAC 헤더 및 압축된 MAC 헤더에 대한 별도의 FCS가 포함되는 경우, MAC 헤더만의 별도의 에러 발생 여부의 체크가 가능하여 불필요한 재전송을 줄이 수 있어 무선랜의 성능이 향상될 수 있다.

[106] 이하, 본 발명의 실시예에 따른 구체적인 A-MPDU 헤더 서브프레임(700) 및 A-MPDU 서브프레임(750)이 개시된다.

[107]

[108] 도 8은 본 발명의 실시예에 따른 A-MPDU 헤더 서브프레임을 나타낸 개념도이다.

[109] 도 8을 참조하면, A-MPDU 헤더 서브프레임(850)은 MDPU 디리미터(800), MAC 헤더(810), FCS 필드(820), 패딩 비트(830)를 포함할 수 있다.

[110] MDPU 디리미터(800)는 MPDU(MAC 헤더 및 FCS 필드)의 길이에 대한 정보를 포함할 수 있다.

[111] MAC 헤더(810)는 공통 헤더 필드를 포함할 수 있다. A-MPDU 헤더 서브프레임(700)에 포함되는 MAC 헤더(810)는 공통 MAC 헤더라는 용어로 표현될 수 있다.

[112] 전술한 바와 같이 기존의 무선랜 시스템에서 지원되는 A-MPDU에 포함되는 복수의 A-MPDU 서브프레임 각각의 복수의 MAC 헤더 각각은 공통되는 헤더

정보를 포함할 수 있다. 구체적으로 A-MPDU는 하나의 STA으로 전송되기 때문에 하나의 STA으로 전송되는 기존의 A-MPDU에 포함되는 복수의 A-MPDU 서브프레임 각각의 복수의 MAC 헤더 각각은 공통되는 헤더 정보를 포함할 수 있다. 이러한 공통 헤더 정보를 포함하는 필드는 공통 헤더 필드라는 용어로 정의될 수 있다. 다른 표현으로 공통 헤더 필드는 기존의 A-MPDU에 포함되는 복수의 A-MPDU 서브프레임 각각에 대한 공통되는 헤더 정보에 대응되는 MAC 헤더의 필드일 수 있다.

[113] 본 발명의 실시예에 따르면, A-MPDU 헤더 서브프레임(850)의 공통 MAC 헤더(810)는 공통 헤더 필드를 포함할 수 있다. 또한, A-MPDU에서 A-MPDU 헤더 서브프레임(850)을 제외한 A-MPDU 서브프레임 각각에 포함되는 압축된 MAC 헤더는 공통 헤더 필드를 제외한 A-MPDU 서브프레임에 대한 개별적인 헤더 정보를 포함하는 고유 헤더 필드만을 포함할 수 있다.

[114] A-MPDU 헤더 서브프레임(850)을 제외한 A-MPDU 서브프레임의 압축된 MAC 헤더가 고유 헤더 필드만을 포함하는 경우, 기존의 A-MPDU 서브프레임의 MAC 헤더와 비교하여 MAC 헤더로 인한 오버헤드가 감소될 수 있다.

[115] 예를 들어, 공통 헤더 필드는 듀레이션/ID 필드, 주소 필드 등이고, 고유 헤더 필드는 프레임 제어 필드, 시퀀스 제어 필드 등일 수 있다. QoS 제어 필드, HT 제어 필드는 공통 헤더 필드 또는 고유 헤더 필드에 포함될 수 있다. 이러한 공통 헤더 필드와 고유 헤더 필드의 구분은 예시적인 구분이다. 다양한 기준으로 공통 헤더 필드와 고유 헤더 필드가 분류될 수 있다.

[116] FCS 필드(820)는 A-MPDU 헤더 서브프레임(850)에 포함되는 공통 헤더 필드를 포함하는 공통 MAC 헤더(810)에 대한 에러 체크 비트를 포함할 수 있다. 즉, FCS 필드(820)에 포함되는 에러 체크 비트는 공통 헤더 필드에 대해 연산될 수 있다.

[117] 패딩 비트(830)는 A-MPDU 헤더 서브프레임(850)의 길이를 4 옥텟 단위로 맞추기 위한 비트를 포함할 수 있다.

[118] A-MPDU 헤더 서브프레임(850)은 A-MPDU 내에서 나머지 A-MPDU 서브프레임보다 먼저 디코딩될 수 있도록 위치할 수 있다.

[119] 도 8에서는 A-MPDU 헤더 서브프레임(850)에 MAC 바디가 포함되지 않는 경우가 가정되었으나, 상황에 따라 A-MPDU 헤더 서브프레임(850)에 MAC 바디가 포함될 수도 있고, 이러한 A-MPDU 헤더 서브프레임(850)의 포맷 또한, 본 발명의 권리 범위에 포함된다.

[120] 도 9는 본 발명의 실시예에 따른 A-MPDU 헤더 서브프레임의 공통 MAC 헤더를 나타낸 개념도이다.

[121] 도 9에서는 A-MPDU 헤더 서브프레임(950)의 공통 MAC 헤더(960)에 포함되는 공통 헤더 필드가 개시된다.

[122] 도 9를 참조하면, 공통 MAC 헤더(960)는 듀레이션/ID 필드(900), 주소 필드(910), QoS 제어 필드(920) 및 HT 제어 필드(930)를 포함할 수 있다.

[123] NAV의 설정을 위한 듀레이션 정보 또는 전송 STA의 식별 정보는 A-MPDU에

포함되는 복수의 A-MPDU 서브프레임 각각에 대하여 동일할 수 있다. 따라서, 듀레이션/ID 필드(900)는 공통 헤더 필드에 포함될 수 있다.

[124] A-MPDU 서브프레임 각각에 대한 소스 주소, 목적지 주소, 전송 STA 주소, 수신 STA 주소도 또한 동일할 수 있다. 따라서, 주소 필드(910)는 공통 헤더 필드에 포함될 수 있다.

[125] QoS 제어 필드(920) 및 HT 제어 필드(930) 각각에 포함되는 정보도 복수의 A-MPDU 서브프레임 각각에 대해 동일할 수 있다. 따라서, QoS 제어 필드(920) 및 HT 제어 필드(930) 각각은 공통 헤더 필드(960)에 포함될 수 있다. QoS 제어 필드(920), HT 제어 필드(930)는 도 10에서 후술하는 바와 같이 고유 헤더 필드로서 압축된 MAC 헤더에 포함될 수도 있다. 또 다른 실시예에 따르면, QoS 제어 필드(920), HT 제어 필드(930)는 QoS 제어 필드(920), HT 제어 필드(930) 각각에 포함되는 정보에 따라 분할되어 공통 MAC 헤더 또는 압축된 MAC 헤더에 포함될 수도 있다.

[126] 도 9에 개시된 공통 MAC 헤더에 포함되는 공통 헤더 필드는 예시적인 필드이다. 다른 MAC 헤더 필드의 조합이 공통 헤더에 포함될 수 있고 이러한 실시예 또한 본 발명의 권리 범위에 포함될 수 있다.

[127]

[128] 도 10은 본 발명의 실시예에 따른 A-MPDU 서브프레임을 나타낸 개념도이다.

[129] 도 10에서는 압축된 MAC 헤더를 포함하는 A-MPDU 서브프레임이 개시된다.

[130] 도 10을 참조하면, A-MPDU 서브프레임은 MPDU 디리미터(1000), 압축된 MAC 헤더(1010), 제1 FCS 필드(선택적)(1055), MAC 바디(1020), 제2 FCS 필드(1030) 및 패딩 비트(1040)를 포함할 수 있다. 도면 상에서는 제1 FCS 필드(1055)가 MAC 헤더(1010)에 포함되는 것으로 가정하였다. 하지만, 제1 FCS 필드(1055)는 별도의 구조로 A-MPDU 서브프레임에 포함될 수도 있다.

[131] A-MPDU 서브프레임의 MPDU 디리미터(1000)는 에러 체크 필드(1050), 압축 헤더 필드(1060), MPDU 길이 필드(1070), CRC(1080), 디리미터 시그니쳐(1090)를 포함할 수 있다.

[132] 에러 체크 필드(1050)는 압축된 MAC 헤더에 대한 에러 체크 비트를 포함하는 제1 FCS 필드(1055)가 A-MPDU 서브프레임에 포함되어 있는지 여부를 지시하는 정보를 포함할 수 있다. 예를 들어, 만약, 에러 체크 필드(1050)의 값이 1인 경우, MAC 헤더(1010)를 위한 에러 체크 비트를 포함하는 제1 FCS 필드(1055)가 A-MPDU 서브프레임에 포함되어 있음이 지시될 수 있다. 반대로, 에러 체크 필드(1050)의 값이 0인 경우, MAC 헤더를 위한 에러 체크 비트를 포함하는 제1 FCS 필드(1055)가 A-MPDU 서브프레임에 포함되어 있지 않음이 지시될 수 있다.

[133] 압축 헤더 필드(1060)는 MAC 헤더(1010)가 압축된 MAC 헤더인지 여부를 지시하는 정보를 포함할 수 있다. 예를 들어, 만약, 압축 헤더 필드(1060)의 값이 1인 경우, A-MPDU 서브프레임에 포함되는 MAC 헤더(1010)가 압축된 MAC 헤더임을 지시할 수 있다. 반대로, 압축 헤더 필드(1060)의 값이 0인 경우,

A-MPDU 서브프레임에 포함되는 MAC 헤더(1010)가 압축된 MAC 헤더가 아님을 지시할 수 있다.

[134] MPDU 길이 필드(1070)는 MPDU의 길이에 대한 정보를 포함할 수 있다. 예를 들어, MPDU 길이 필드(1070)는 MPDU 디리미터(1000) 이후에 전송되는 압축된 MAC 헤더(1010), 제1 FCS 필드(선택적) (1055), MAC 바디(1020), 제2 FCS 필드(1030)의 옥텟 단위의 길이에 대한 정보를 포함할 수 있다.

[135] CRC(1080)는 MPDU 디리미터(1000)에 포함된 정보에 대한 에러 체크 비트를 포함할 수 있다. 구체적으로 CRC(1080)는 MPDU 디리미터(1000)에 포함되는 에러 체크 필드(1050), 압축 헤더 필드(1060) 및 MPDU 길이 필드(1070)에 발생된 에러를 체크하기 위한 정보를 포함할 수 있다.

[136] 디리미터 시그니처(1090)는 STA에 의한 디리미터의 스캐닝시 MPDU 디리미터(1000)를 탐지하기 위한 패턴 정보를 포함할 수 있다.

[137] 다시 A-MPDU 서브프레임을 참조하면, 압축된 MAC 헤더(1010)는 고유 헤더 필드를 포함할 수 있다. 고유 헤더 필드는 A-MPDU 서브프레임에 대한 개별적인 헤더 정보를 포함할 수 있다. 예를 들어, 고유 헤더 필드는 프레임 제어 필드(1015), 시퀀스 제어 필드(1025), QoS 제어 필드(1035), HT 제어 필드(1045)를 포함할 수 있다. 프레임 제어 필드(1015), 시퀀스 제어 필드(1025), QoS 제어 필드(1035), HT 제어 필드(1045) 각각은 복수의 A-MPDU 서브프레임 각각에 대하여 고유한 정보를 포함할 수도 있으므로 고유 헤더 필드로 정의되어 압축된 MAC 헤더(1010)에 포함될 수 있다.

[138] 제1 FCS 필드(1055)는 압축된 MAC 헤더(1010)에 대한 에러 체크 비트를 포함할 수 있다. 제1 FCS 필드(1055)가 포함되는 경우, 압축된 MAC 헤더(1010)에 발생된 에러 여부에 대해 판단(또는 결정)이 가능할 수 있다. 만약, 압축된 MAC 헤더(1010)에 에러가 발생하는 경우, PPDU 헤더(또는 PHY 헤더)에 포함되는 정보(예를 들어, MAC 헤더 관련 정보 또는 MAC 바디 디코딩을 위한 정보)를 기반으로 에러난 MAC 헤더(1010)를 제외한 나머지 MAC 바디(1020) 부분에 대한 디코딩이 수행될 수 있다. 기존의 무선랜 시스템에서는 STA은 MAC 헤더(1010)에 에러가 발생되었는지 여부를 판단할 수 없다. 따라서, MAC 헤더(1010)에 에러가 발생한 경우, 재전송 절차를 통해 프레임의 재전송이 요청되었다. 하지만, 본 발명의 실시예에 따르면, MAC 헤더(1010)에 에러가 발생한 경우에도 MAC 바디(1020)에 대한 디코딩이 성공적으로 수행될 수 있다. 따라서, 재전송으로 인한 오버헤드가 감소될 수 있다.

[139] 제1 FCS 필드(1055)는 선택적으로 A-MPDU 서브프레임에 포함될 수 있다. 도 11에서 개시되는 바와 같이 제1 FCS 필드(1055)가 A-MPDU 서브프레임에 포함되지 않을 수 있다.

[140] MAC 바디(1020)는 A-MPDU 헤더 서브프레임에 포함되는 공통 MAC 헤더 및 A-MPDU 서브프레임에 포함되는 압축된 MAC 헤더(1010)를 기반으로 디코딩되는 트래픽 데이터를 포함할 수 있다. 전술한 바와 같이 MAC

헤더(1010)에 에러가 발생한 경우, PPDU 헤더를 기반으로 MAC 바디(1020)가 디코딩될 수도 있다.

[141] 제2 FCS 필드(1030)는 압축된 MAC 헤더(1010), 제1 FCS 필드(선택적)(1055), MAC 바디(1020)에 발생한 에러를 체크하기 위한 에러 체크 비트를 포함할 수 있다. 또는 제2 FCS(1030)는 MAC 바디(1020)만의 에러 체크를 위한 에러 체크 비트를 포함할 수도 있다.

[142] 제2 FCS(1030)를 기반으로 MAC 바디(1020)에 에러가 발생하였는지 여부가 결정될 수 있다. 예를 들어, 제1 FCS(1055)를 기반으로 한 에러 체크 결과, 에러가 발생되지 않은 것으로 판단되고, 제2 FCS(1030)를 기반으로 한 에러 체크 결과 에러가 발생된 것으로 판단되는 경우, STA은 MAC 바디(1020)의 에러가 발생한 것으로 판단할 수 있다.

[143] 기존의 무선랜 시스템에서는 MAC 바디(1020)에 대한 에러는 별도로 판단되지 못하였다. 기존에 무선랜 시스템에서 STA은 FCS를 기반으로 MPDU(MAC 헤더+MAC 바디)에 에러가 발생한 것으로 판단하고 재전송 절차를 진행하였다. 하지만 본 발명의 경우, MAC 헤더(1010)에는 에러가 발생하지 않은 경우, MAC 헤더(1010)에 포함되는 정보가 STA에 의해 활용될 수 있다. 예를 들어, MAC 헤더(1010)에 에러가 발생하지 않고 MAC 바디(1020)에 에러가 발생한 경우, STA은 MAC 헤더(1010)의 정보를 기반으로 NAV(network allocation vector)를 설정하고 다른 BSS 임계값(threshold)을 설정할 수 있다. 따라서, EIFS(extended interframe space)를 이용한 비효율적인 채널 액세스가 개선될 수 있다.

[144] 또한, MAC 바디(1020)와 MAC 헤더(1010)에 모두 에러가 발생한 것으로 판단되는 경우, 기존의 무선랜 시스템에서 STA은 재전송 절차를 수행하였다. 하지만, 본 발명의 실시예에 따른 A-MPDU가 사용되는 경우, STA은 PPDU 헤더에 포함되는 MAC 헤더 관련 정보(또는 PPDU 헤더에 포함되는 MAC 바디 디코딩을 위한 정보)를 기반으로 NAV 설정, 다른 BSS 임계값 설정 등을 정상적으로 수행할 수 있다. 따라서, EIFS를 이용한 비효율적인 채널 액세스가 개선될 수 있다.

[145]

[146] 도 11은 본 발명의 실시예에 따른 A-MPDU 서브프레임을 나타낸 개념도이다.

[147] 도 11에서는 압축된 MAC 헤더를 포함하는 A-MPDU 서브프레임이 개시된다.

[148] 도 11을 참조하면, 제1 FCS 필드를 포함하지 않는 A-MPDU 서브프레임이 개시된다. A-MPDU 서브프레임은 압축된 MAC 헤더(1100)만을 포함할 수 있다.

[149]

[150] 도 12는 본 발명의 실시예에 따른 PPDU 포맷을 나타낸 개념도이다.

[151] 도 12에서는 본 발명의 실시예에 따른 PPDU 포맷에 대해 개시한다.

[152] 도 12의 상단을 참조하면, 하향링크 PPDU의 PPDU 헤더는 L-STF(legacy-short training field), L-LTF(legacy-long training field), L-SIG(legacy-signal), HE-SIG A(high efficiency-signal A), HE-STF(high efficiency-short training field),

HE-LTF(high efficiency-long training field), HE-SIG B(high efficiency-signal-B)를 포함할 수 있다. PHY 헤더에서 L-SIG까지는 레가시 부분(legacy part), L-SIG 이후의 HE(high efficiency) 부분(HE part)으로 구분될 수 있다.

[153] L-STF(1200)는 짧은 트레이닝 OFDM 심볼(short training orthogonal frequency division multiplexing symbol)을 포함할 수 있다. L-STF(1000)는 프레임 탐지(frame detection), AGC(automatic gain control), 다이버시티 탐지(diversity detection), 대략적인 주파수/시간 동기화(coarse frequency/time synchronization)을 위해 사용될 수 있다.

[154] L-LTF(1210)는 긴 트레이닝 OFDM 심볼(long training orthogonal frequency division multiplexing symbol)을 포함할 수 있다. L-LTF(1010)는 정밀한 주파수/시간 동기화(fine frequency/time synchronization) 및 채널 예측을 위해 사용될 수 있다.

[155] L-SIG(1220)는 제어 정보를 전송하기 위해 사용될 수 있다. L-SIG(1020)는 데이터 전송률(rate), 데이터 길이(length)에 대한 정보를 포함할 수 있다.

[156] HE-SIG A(1230)는 PPDU를 수신할 STA을 지시하기 위한 정보를 포함할 수도 있다. 예를 들어, HE-SIG A(1030)는 PPDU를 수신할 특정 STA(또는 AP)의 식별자, 특정 STA의 그룹을 지시하기 위한 정보를 포함할 수 있다. 또한, HE-SIG A(1230)는 PPDU가 OFDMA 또는 MIMO를 기반으로 전송되는 경우, STA에 대한 자원 할당 정보도 포함될 수 있다.

[157] 또한, HE-SIG A(1230)는 BSS 식별 정보를 위한 칼라 비트(color bits) 정보, 대역폭(bandwidth) 정보, 테일 비트(tail bit), CRC 비트, HE-SIG B(1060)에 대한 MCS(modulation and coding scheme) 정보, HE-SIG B(1260)를 위한 심볼 개수 정보, CP(cyclic prefix)(또는 GI(guard interval)) 길이 정보를 포함할 수도 있다.

[158] HE-SIG A(1230)는 HE-SIG 1(또는 제1 시그널 필드)라는 용어로 표현될 수도 있다.

[159] HE-STF(1240)는 MIMO(multilple input multiple output) 환경 또는 OFDMA 환경에서 자동 이득 제어 추정(automatic gain control estimation)을 향상시키기 위하여 사용될 수 있다.

[160] HE-LTF(1250)는 MIMO 환경 또는 OFDMA 환경에서 채널을 추정하기 위하여 사용될 수 있다.

[161] HE-SIG B(1260)는 각 STA에 대한 PSDU(Physical layer service data unit)의 길이 MCS에 대한 정보 및 테일 비트 등을 포함할 수 있다. 또한 HE-SIG B(1260)는 PPDU를 수신할 STA에 대한 정보, OFDMA 기반의 자원 할당(resource allocation) 정보(또는 MU-MIMO 정보)를 포함할 수도 있다. HE-SIG B(1260)에 OFDMA 기반의 자원 할당 정보(또는 MU-MIMO 관련 정보)가 포함되는 경우, HE-SIG A(1230)에는 자원 할당 정보가 포함되지 않을 수도 있다. HE-SIG B(1260)는 HE-SIG 2(또는 제2 시그널 필드)라는 용어로 표현될 수도 있다.

[162] HE-STF(1240) 및 HE-STF(1240) 이후의 필드에 적용되는 IFFT의 크기와

HE-STF(1240) 이전의 필드에 적용되는 IFFT의 크기는 서로 다를 수 있다. 예를 들어, HE-STF(1240) 및 HE-STF(1240) 이후의 필드에 적용되는 IFFT의 크기는 HE-STF(1240) 이전의 필드에 적용되는 IFFT의 크기보다 4배 클 수 있다. STA은 HE-SIG A(1230)를 수신하고, HE-SIG A(1230)를 기반으로 하향링크 PPDU의 수신을 지시받을 수 있다. 이러한 경우, STA은 HE-STF(1240) 및 HE-STF(1240) 이후 필드부터 변경된 FFT 사이즈를 기반으로 디코딩을 수행할 수 있다. 반대로 STA이 HE-SIG A(1230)를 기반으로 하향링크 PPDU의 수신을 지시받지 못한 경우, STA은 디코딩을 중단하고 NAV(network allocation vector) 설정을 할 수 있다. HE-STF(1240)의 CP(cyclic prefix)는 다른 필드의 CP보다 큰 크기를 가질 수 있고, 이러한 CP 구간 동안 STA은 FFT 사이즈를 변화시켜 하향링크 PPDU에 대한 디코딩을 수행할 수 있다.

[163] 도 12의 상단에서 개시된 PPDU의 포맷을 구성하는 필드의 순서는 변할 수도 있다. 예를 들어, 도 12의 중단에서 개시된 바와 같이 HE 부분의 HE-SIG B(1215)가 HE-SIG A(1205)의 바로 이후에 위치할 수도 있다. STA은 HE-SIG A(1205) 및 HE-SIG B(1215)까지 디코딩하고 필요한 제어 정보를 수신하고 NAV 설정을 할 수 있다. 마찬가지로 HE-STF(1225) 및 HE-STF(1225) 이후의 필드에 적용되는 IFFT의 크기는 HE-STF(1025) 이전의 필드에 적용되는 IFFT의 크기와 다를 수 있다.

[164] STA은 HE-SIG A(1205) 및 HE-SIG B(1215)를 수신할 수 있다. HE-SIG A(1205)를 기반으로 PPDU의 수신이 지시되는 경우, STA은 HE-STF(1225)부터는 FFT 사이즈를 변화시켜 PPDU에 대한 디코딩을 수행할 수 있다. 반대로 STA은 HE-SIG A(1005)를 수신하고, HE-SIG A(1205)를 기반으로 하향링크 PPDU의 수신이 지시되지 않는 경우, NAV(network allocation vector) 설정을 할 수 있다.

[165] 도 12의 하단을 참조하면, MU(multi-user) OFDMA 전송을 위한 PPDU 포맷이 개시된다. 예를 들어,, AP는 DL MU OFDMA 전송을 위한 PPDU 포맷을 사용하여 하향링크 프레임 또는 하향링크 PPDU를 복수의 STA으로 전송할 수 있다. 복수의 하향링크 PPDU 각각은 서로 다른 전송 자원(주파수 자원 또는 공간적 스트림)을 통해 복수의 STA 각각으로 전송될 수 있다. PPDU 상에서 HE-SIG B(1245)의 이전 필드는 서로 다른 전송 자원 각각에서 듀플리케이트된 형태로 전송될 수 있다. HE-SIG B(1245)는 전체 전송 자원 상에서 인코딩된 형태로 전송될 수 있다. HE-SIG B(1245) 이후의 필드는 PPDU를 수신하는 복수의 STA 각각을 위한 개별 정보를 포함할 수 있다.

[166] 예를 들어, HE-SIG A(1235)는 하향링크 데이터를 수신할 복수의 STA에 대한 식별 정보 및 복수의 STA의 하향링크 데이터가 전송되는 채널에 대한 정보를 포함할 수 있다.

[167] PPDU에 포함되는 필드가 전송 자원 각각을 통해 각각 전송되는 경우, 필드 각각에 대한 CRC가 PPDU에 포함될 수 있다. 반대로, HE-SIG B(1245)와 같이 PPDU에 포함되는 특정 필드가 전체 전송 자원 상에서 인코딩되어 전송되는

경우, 필드 각각에 대한 CRC가 PPDU에 포함되지 않을 수 있다. 따라서, CRC에 대한 오버 헤드가 감소될 수 있다.

[168] MU 전송을 위한 PPDU 포맷도 마찬가지로 HE-STF(1255) 및 HE-STF(1255) 이후의 필드는 HE-STF(1255) 이전의 필드와 다른 IFFT 사이즈를 기반으로 인코딩될 수 있다. 따라서, STA은 HE-SIG A(1235) 및 HE-SIG B(1245)를 수신하고, HE-SIG A(1235)를 기반으로 PPDU의 수신을 지시받은 경우, HE-STF(1255)부터는 FFT 사이즈를 변화시켜 PPDU에 대한 디코딩을 수행할 수 있다.

[169]

[170] 도 13은 본 발명의 실시예가 적용될 수 있는 무선 장치를 나타내는 블록도이다.

[171] 도 13을 참조하면, AP(1300)는 프로세서(1310), 메모리(1320) 및 RF부(radio frequency unit, 1330)를 포함한다.

[172] RF부(1330)는 프로세서(1310)와 연결하여 무선신호를 송신/수신할 수 있다.

[173] 프로세서(1310)는 본 발명에서 제안된 기능, 과정 및/또는 방법을 구현할 수 있다. 예를 들어, 프로세서(1310)는 전술한 본 발명의 실시예에 따른 AP의 동작을 수행하도록 구현될 수 있다. 프로세서는 도 1 내지 도 12의 실시예에서 개시한 AP의 동작을 수행할 수 있다.

[174] 예를 들어, 프로세서(1310)는 STA으로 전송할 프레임을 생성하고, 프레임을 STA으로 전송하도록 구현될 수 있다. 이때 프레임은 A(aggregated)-MPDU(MAC(medium access control) protocol data unit)이고, A-MPDU는 A-MPDU 헤더 서브프레임과 A-MPDU 서브프레임을 포함할 수 있다. A-MPDU 헤더 서브프레임은 제1 MPDU를 포함하고, A-MPDU 서브프레임은 제2 MPDU를 포함할 수 있다. 제1 MPDU는 MPDU로서 MAC 바디를 제외한 제1 MAC 헤더를 포함하고, 제2 MPDU는 MPDU로서 MAC 바디 및 제2 MAC 헤더를 포함할 수 있다.

[175] A-MDPU 헤더 서브프레임은 제1 MAC 헤더만을 위한 제1 에러 체크 비트를 더 포함하고, A-MPDU 서브프레임은 상기 제2 MAC 헤더만을 위한 제2 에러 체크 비트를 더 포함할 수 있다.

[176] 제1 MAC 헤더는 공통 헤더 필드를 포함하고, 공통 헤더 필드는 A-MPDU에 포함되는 A-MPDU 서브프레임을 포함하는 복수의 A-MDPU 서브프레임 각각에 공통되는 MAC 헤더 정보를 포함할 수 있다.

[177] 제2 MAC 헤더는 고유 헤더 필드를 포함하고, 고유 헤더 필드는 공통 헤더 필드를 제외한 A-MPDU 서브프레임에 대해 고유한 MAC 헤더 정보를 포함할 수 있다.

[178] A-MPDU 서브프레임은 MPDU 디리미터를 포함하고, MDPU 디리미터는 에러 체크 필드, 압축 헤더 필드를 포함할 수 있다. 에러 체크 필드는 제2 에러 체크 비트가 A-MPDU 서브프레임에 포함되어 있는지 여부를 지시하는 정보를 포함하고, 압축 헤더 필드는 제2 MAC 헤더가 고유 헤더 필드를 포함하는지

여부를 지시하는 정보를 포함할 수 있다. 또한, A-MPDU 서브프레임은 MAC 바디를 위한 제3 에러 체크 비트를 더 포함할 수 있다,

[179] 제1 에러 체크 비트는 STA에 의한 제1 MAC 헤더에 대한 에러 여부의 체크를 위해 사용되고, 제2 에러 체크 비트는 STA에 의한 제2 MAC 헤더에 대한 에러 여부의 체크를 위해 사용될 수 있다. 제3 에러 체크 비트는 STA에 의한 MAC 바디에 대한 에러 여부의 체크를 위해 사용될 수 있다.

[180] 이러한 에러 체크 동작은 AP에 의해 전송되는 PPDU가 MU PPDU로서 복수의 STA으로 전송되는 복수의 프레임을 포함하는 경우, 복수의 STA 각각에 의해 수행될 수 있다. MU PPDU에 포함되는 복수의 프레임 각각은 복수의 STA 각각에 대한 복수의 A-MPDU 각각을 포함할 수 있다.

[181] STA(1350)는 프로세서(1360), 메모리(1370) 및 RF부(radio frequency unit, 1380)를 포함한다.

[182] RF부(1380)는 프로세서(1360)와 연결하여 무선신호를 송신/수신할 수 있다.

[183] 프로세서(1360)는 본 발명에서 제안된 기능, 과정 및/또는 방법을 구현할 수 있다. 예를 들어, 프로세서(1320)는 전술한 본 발명의 실시예에 따른 STA의 동작을 수행하도록 구현될 수 있다. 프로세서(2560)는 도 1 내지 도 12의 실시예에서 STA의 동작을 수행할 수 있다.

[184] 예를 들어, 프로세서(1360)는 AP(access point)로 전송할 프레임을 생성하고, 프레임을 AP로 전송하도록 구현될 수 있다. 이때 프레임은 A(aggregated)-MPDU(MAC(medium access control) protocol data unit)이고, A-MPDU는 A-MPDU 헤더 서브프레임과 A-MPDU 서브프레임을 포함할 수 있다. A-MPDU 헤더 서브프레임은 제1 MPDU를 포함하고, A-MPDU 서브프레임은 제2 MPDU를 포함할 수 있다. 제1 MPDU는 MPDU로서 MAC 바디를 제외한 제1 MAC 헤더를 포함하고, 제2 MPDU는 MPDU로서 MAC 바디 및 제2 MAC 헤더를 포함할 수 있다.

[185] A-MDPU 헤더 서브프레임은 제1 MAC 헤더만을 위한 제1 에러 체크 비트를 더 포함하고, A-MPDU 서브프레임은 상기 제2 MAC 헤더만을 위한 제2 에러 체크 비트를 더 포함할 수 있다.

[186] 제1 MAC 헤더는 공통 헤더 필드를 포함하고, 공통 헤더 필드는 A-MPDU에 포함되는 A-MPDU 서브프레임을 포함하는 복수의 A-MDPU 서브프레임 각각에 공통되는 MAC 헤더 정보를 포함할 수 있다.

[187] 제2 MAC 헤더는 고유 헤더 필드를 포함하고, 고유 헤더 필드는 공통 헤더 필드를 제외한 A-MPDU 서브프레임에 대해 고유한 MAC 헤더 정보를 포함할 수 있다.

[188] A-MPDU 서브프레임은 MPDU 디리미터를 포함하고, MDPU 디리미터는 에러 체크 필드, 압축 헤더 필드를 포함할 수 있다. 에러 체크 필드는 제2 에러 체크 비트가 A-MPDU 서브프레임에 포함되어 있는지 여부를 지시하는 정보를 포함하고, 압축 헤더 필드는 제2 MAC 헤더가 고유 헤더 필드를 포함하는지

여부를 지시하는 정보를 포함할 수 있다. 또한, A-MPDU 서브프레임은 MAC 바디를 위한 제3 에러 체크 비트를 더 포함할 수 있다,

[189] 제1 에러 체크 비트는 AP에 의한 제1 MAC 헤더에 대한 에러 여부의 체크를 위해 사용되고, 제2 에러 체크 비트는 AP에 의한 제2 MAC 헤더에 대한 에러 여부의 체크를 위해 사용될 수 있다. 제3 에러 체크 비트는 AP에 의한 MAC 바디에 대한 에러 여부의 체크를 위해 사용될 수 있다.

[190] 프로세서(1310, 1360)는 ASIC(application-specific integrated circuit), 다른 칩셋, 논리 회로, 데이터 처리 장치 및/또는 베이스밴드 신호 및 무선 신호를 상호 변환하는 변환기를 포함할 수 있다. 메모리(1320, 1370)는 ROM(read-only memory), RAM(random access memory), 플래쉬 메모리, 메모리 카드, 저장 매체 및/또는 다른 저장 장치를 포함할 수 있다. RF부(1330, 1380)는 무선 신호를 전송 및/또는 수신하는 하나 이상의 안테나를 포함할 수 있다.

[191] 실시예가 소프트웨어로 구현될 때, 상술한 기법은 상술한 기능을 수행하는 모듈(과정, 기능 등)로 구현될 수 있다. 모듈은 메모리(1320, 1370)에 저장되고, 프로세서(1310, 1360)에 의해 실행될 수 있다. 메모리(1320, 1370)는 프로세서(1310, 1360) 내부 또는 외부에 있을 수 있고, 잘 알려진 다양한 수단으로 프로세서(1310, 1360)와 연결될 수 있다.

청구범위

[청구항 1] 무선랜에서 프레임을 전송하는 방법은,
STA(station)이 AP(access point)로 전송할 프레임을 생성하는 단계; 및
상기 STA(station)이 상기 프레임을 상기 AP로 전송하는 단계를 포함하되,
상기 프레임은 A(aggregated)-MPDU(MAC(medium access control) protocol data unit)이고,
상기 A-MPDU는 A-MPDU 헤더 서브프레임과 A-MPDU 서브프레임을 포함하고,
상기 A-MPDU 헤더 서브프레임은 제1 MPDU를 포함하고,
상기 A-MPDU 서브프레임은 제2 MPDU를 포함하고,
상기 제1 MPDU는 MPDU로서 MAC 바디를 제외한 제1 MAC 헤더를 포함하고,
상기 제2 MPDU는 MPDU로서 MAC 바디 및 제2 MAC 헤더를 포함하는 것을 특징으로 하는 방법.

[청구항 2] 제1항에 있어서,
상기 A-MDPU 헤더 서브프레임은 상기 제1 MAC 헤더만을 위한 제1 에러 체크 비트를 더 포함하고,
상기 A-MPDU 서브프레임은 상기 제2 MAC 헤더만을 위한 제2 에러 체크 비트를 더 포함하는 것을 특징으로 하는 방법.

[청구항 3] 제2항에 있어서,
상기 제1 MAC 헤더는 공통 헤더 필드를 포함하고,
상기 공통 헤더 필드는 상기 A-MPDU에 포함되는 상기 A-MPDU 서브프레임을 포함하는 복수의 A-MDPU 서브프레임 각각에 공통되는 MAC 헤더 정보를 포함하고,
상기 제2 MAC 헤더는 고유 헤더 필드를 포함하고,
상기 고유 헤더 필드는 상기 공통 헤더 필드를 제외한 상기 A-MPDU 서브프레임에 대해 고유한 MAC 헤더 정보를 포함하는 것을 특징으로 하는 방법.

[청구항 4] 제3항에 있어서,
상기 A-MPDU 서브프레임은 MPDU 디리미터(delimter)를 포함하고,
상기 MDPU 디리미터는 에러 체크 필드, 압축 헤더 필드를 포함하고,
상기 에러 체크 필드는 상기 제2 에러 체크 비트가 상기 A-MPDU 서브프레임에 포함되어 있는지 여부를 지시하는 정보를 포함하고,

상기 압축 헤더 필드는 상기 제2 MAC 헤더가 상기 고유 헤더 필드를 포함하는지 여부를 지시하는 정보를 포함하는 것을 특징으로 하는 방법.

[청구항 5] 제4항에 있어서,
상기 A-MPDU 서브프레임은 상기 MAC 바디를 위한 제3 에러 체크 비트를 더 포함하고,
상기 제1 에러 체크 비트는 상기 AP에 의한 상기 제1 MAC 헤더에 대한 에러 여부의 체크를 위해 사용되고,
상기 제2 에러 체크 비트는 상기 AP에 의한 상기 제2 MAC 헤더에 대한 에러 여부의 체크를 위해 사용되고,
상기 제3 에러 체크 비트는 상기 AP에 의한 상기 MAC 바디에 대한 에러 여부의 체크를 위해 사용되는 것을 특징으로 하는 방법.

[청구항 6] 무선랜에서 프레임을 전송하는 STA(station)은
무선 신호를 송신 또는 수신하기 위해 구현되는 RF(radio frequency) 부; 및
상기 RF부와 동작 가능하게(operatively) 연결된 프로세서를 포함하되,
상기 프로세서는 AP(access point)로 전송할 프레임을 생성하고,
상기 프레임을 상기 AP로 전송하도록 구현되되,
상기 프레임은 A(aggregated)-MPDU(MAC(medium access control) protocol data unit)이고,
상기 A-MPDU는 A-MPDU 헤더 서브프레임과 A-MPDU 서브프레임을 포함하고,
상기 A-MPDU 헤더 서브프레임은 제1 MPDU를 포함하고,
상기 A-MPDU 서브프레임은 제2 MPDU를 포함하고,
상기 제1 MPDU는 MPDU로서 MAC 바디를 제외한 제1 MAC 헤더를 포함하고,
상기 제2 MPDU는 MPDU로서 MAC 바디 및 제2 MAC 헤더를 포함하는 것을 특징으로 하는 STA.

[청구항 7] 제6항에 있어서,
상기 A-MDPU 헤더 서브프레임은 상기 제1 MAC 헤더만을 위한 제1 에러 체크 비트를 더 포함하고,
상기 A-MPDU 서브프레임은 상기 제2 MAC 헤더만을 위한 제2 에러 체크 비트를 더 포함하는 것을 특징으로 하는 STA.

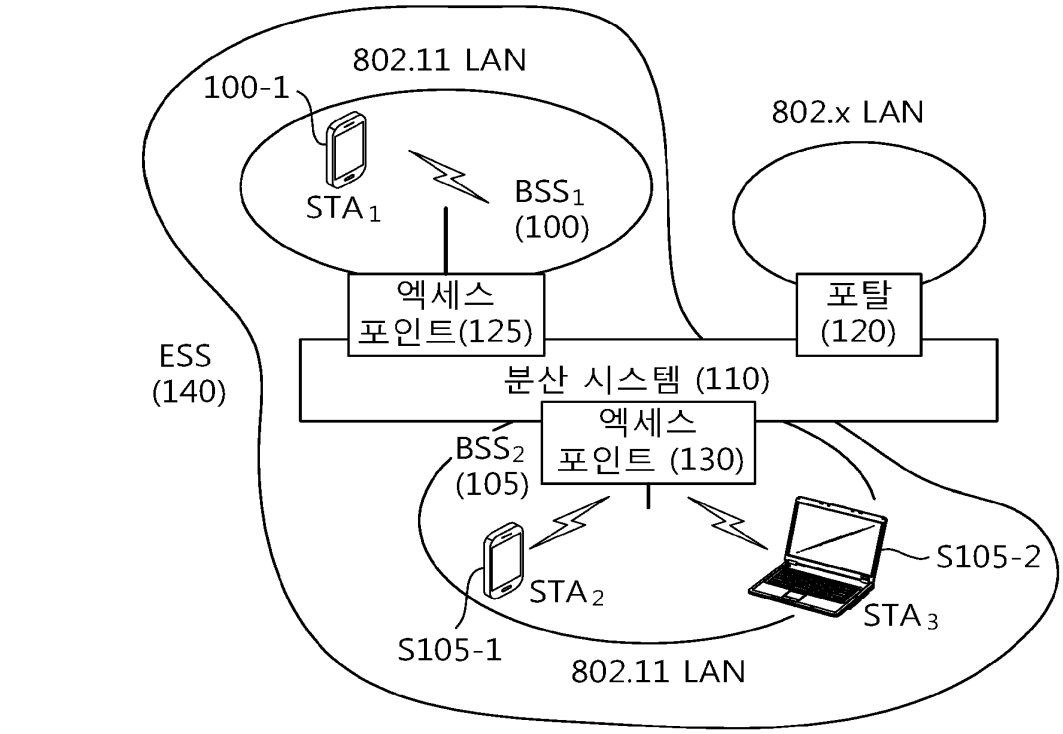
[청구항 8] 제7항에 있어서,
상기 제1 MAC 헤더는 공통 헤더 필드를 포함하고,
상기 공통 헤더 필드는 상기 A-MPDU에 포함되는 상기 A-MPDU 서브프레임을 포함하는 복수의 A-MDPU 서브프레임 각각에

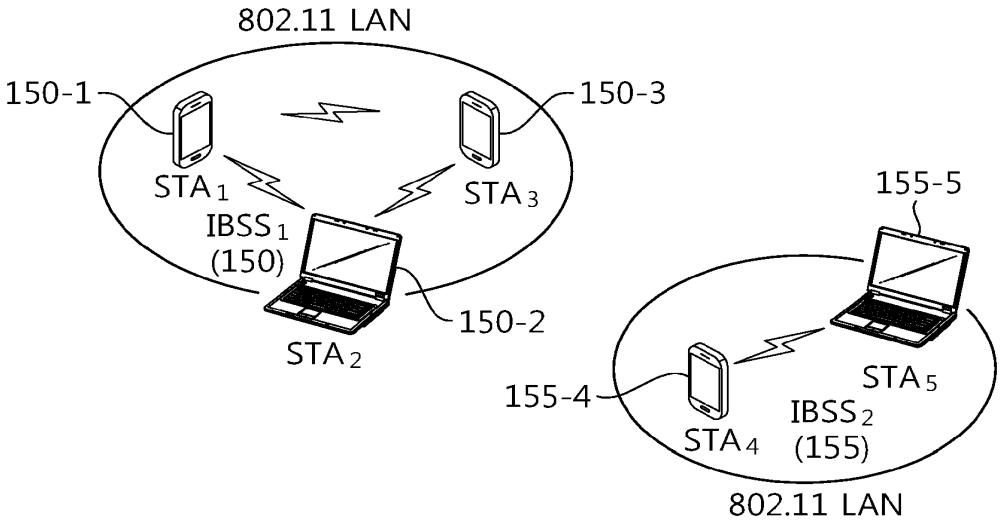
공통되는 MAC 헤더 정보를 포함하고,
상기 제2 MAC 헤더는 고유 헤더 필드를 포함하고,
상기 고유 헤더 필드는 상기 공통 헤더 필드를 제외한 상기 A-MPDU 서브프레임에 대해 고유한 MAC 헤더 정보를 포함하는 것을 특징으로 하는 STA.

[청구항 9] 제8항에 있어서,
상기 A-MPDU 서브프레임은 MPDU 디리미터(delimter)를 포함하고,
상기 MDPU 디리미터는 에러 체크 필드, 압축 헤더 필드를 포함하고,
상기 에러 체크 필드는 상기 제2 에러 체크 비트가 상기 A-MPDU 서브프레임에 포함되어 있는지 여부를 지시하는 정보를 포함하고,
상기 압축 헤더 필드는 상기 제2 MAC 헤더가 상기 고유 헤더 필드를 포함하는지 여부를 지시하는 정보를 포함하는 것을 특징으로 하는 STA.

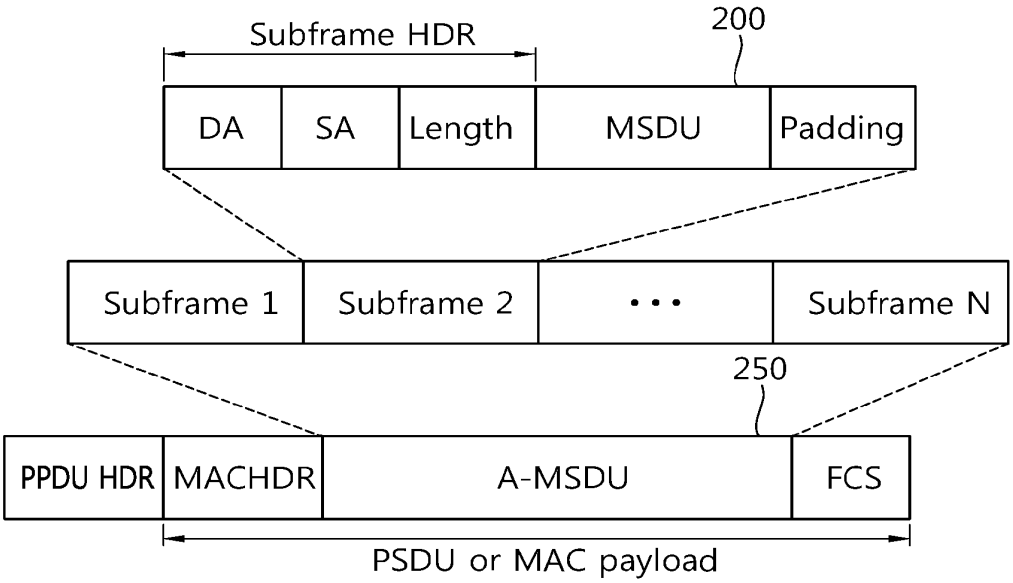
[청구항 10] 제9항에 있어서,
상기 A-MPDU 서브프레임은 상기 MAC 바디를 위한 제3 에러 체크 비트를 더 포함하고,
상기 제1 에러 체크 비트는 상기 AP에 의한 상기 제1 MAC 헤더에 대한 에러 여부의 체크를 위해 사용되고,
상기 제2 에러 체크 비트는 상기 AP에 의한 상기 제2 MAC 헤더에 대한 에러 여부의 체크를 위해 사용되고,
상기 제3 에러 체크 비트는 상기 AP에 의한 상기 MAC 바디에 대한 에러 여부의 체크를 위해 사용되는 것을 특징으로 하는 STA.

[도1]

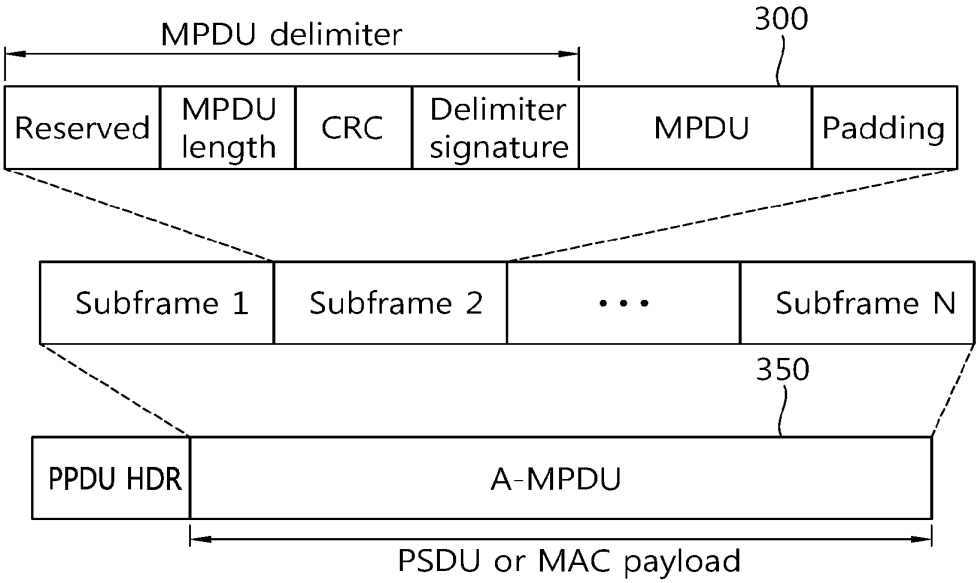

802.11 LAN
100-1
802.x LAN
STA1
BSS1
(100)
엑세스
포인트(125)
포탈
(120)
ESS
(140)
분산 시스템 (110)
엑세스
포인트 (130)
BSS2
(105)
S105-2
STA2
STA3
S105-1
802.11 LAN


802.11 LAN
150-1
150-3
STA1
STA3
IBSS1
(150)
150-2
STA2
155-5
STA5
155-4
IBSS2
(155)
STA4
802.11 LAN

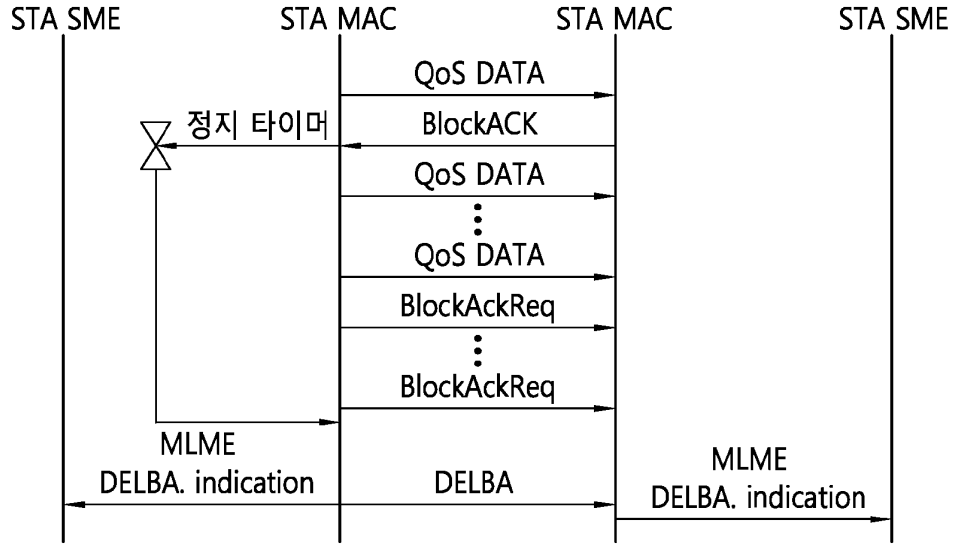
[도2]


Subframe HDR
200
DA
SA
Length
MSDU
Padding
Subframe 1
Subframe 2
• • •
Subframe N
250
PPDU HDR
MACHDR
A-MSDU
FCS
PSDU or MAC payload

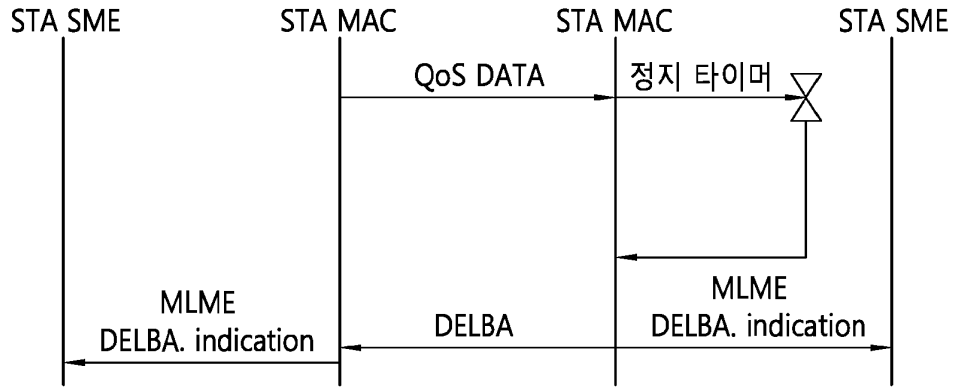
[도3]


MPDU delimiter
300
Reserved
MPDU length
CRC
Delimiter signature
MPDU
Padding
Subframe 1
Subframe 2
• • •
Subframe N
350
PPDU HDR
A-MPDU
PSDU or MAC payload

[도4]

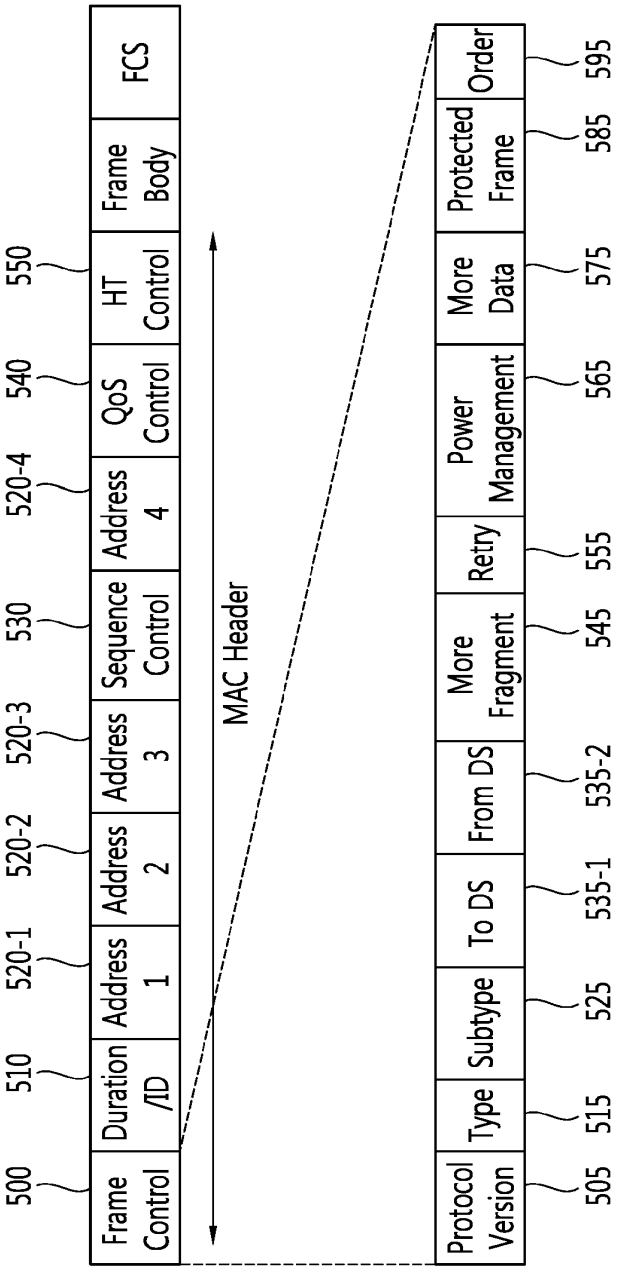

STA SME
STA MAC
STA MAC
STA SME
QoS DATA
정지 타이머
BlockACK
QoS DATA
QoS DATA
BlockAckReq
BlockAckReq
MLME
DELBA. indication
DELBA
MLME
DELBA. indication

(a) 전송측

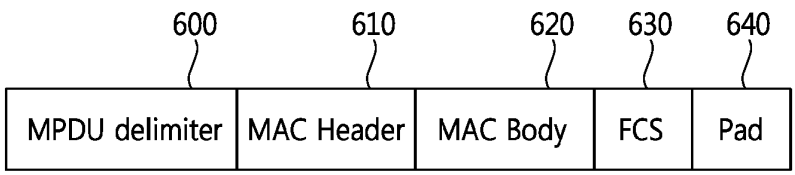

STA SME
STA MAC
STA MAC
STA SME
QoS DATA
정지 타이머
MLME
DELBA. indication
DELBA
MLME
DELBA. indication

(b) 수신측

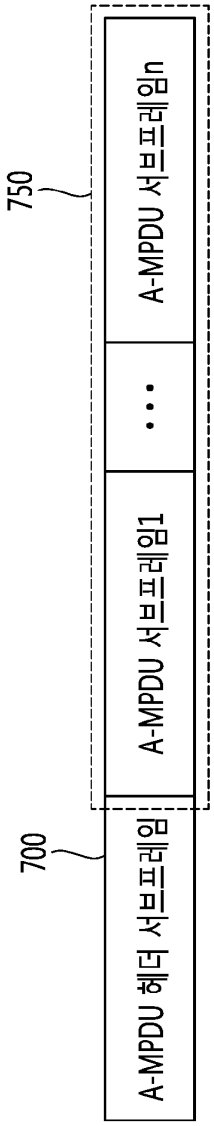
[도5]


Frame Control
500
Duration /ID
510
Address 1
520-1
Address 2
520-2
Address 3
520-3
Sequence Control
530
Address 4
520-4
QoS Control
540
HT Control
550
Frame Body
FCS
MAC Header
Protocol Version
505
Type
515
Subtype
525
To DS
535-1
From DS
535-2
More Fragment
545
Retry
555
Power Management
565
More Data
575
Protected Frame
585
Order
595

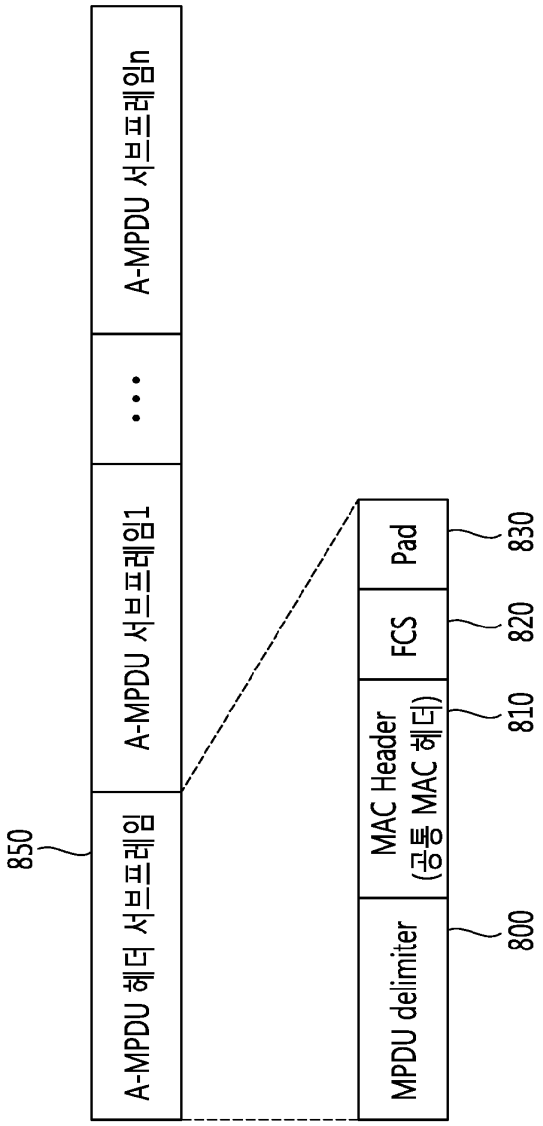
[도6]


600
610
620
630
640
MPDU delimiter
MAC Header
MAC Body
FCS
Pad

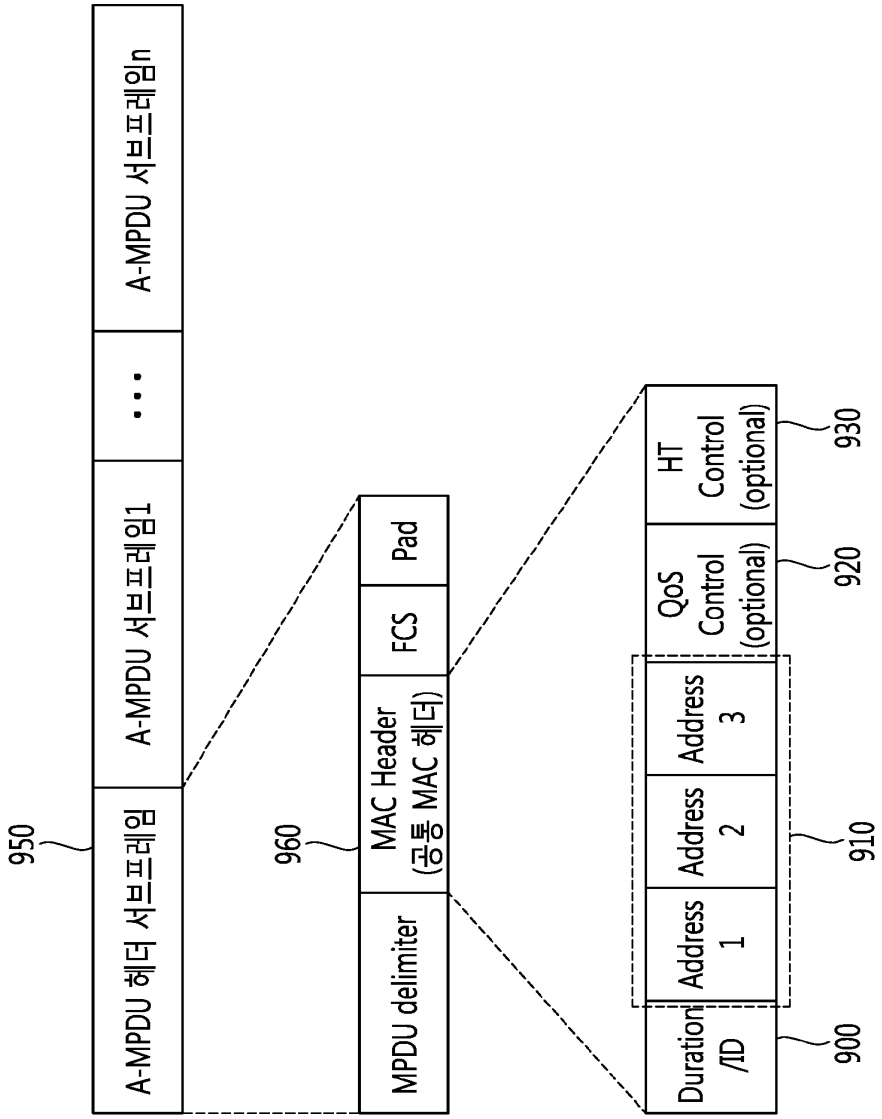
[도7]



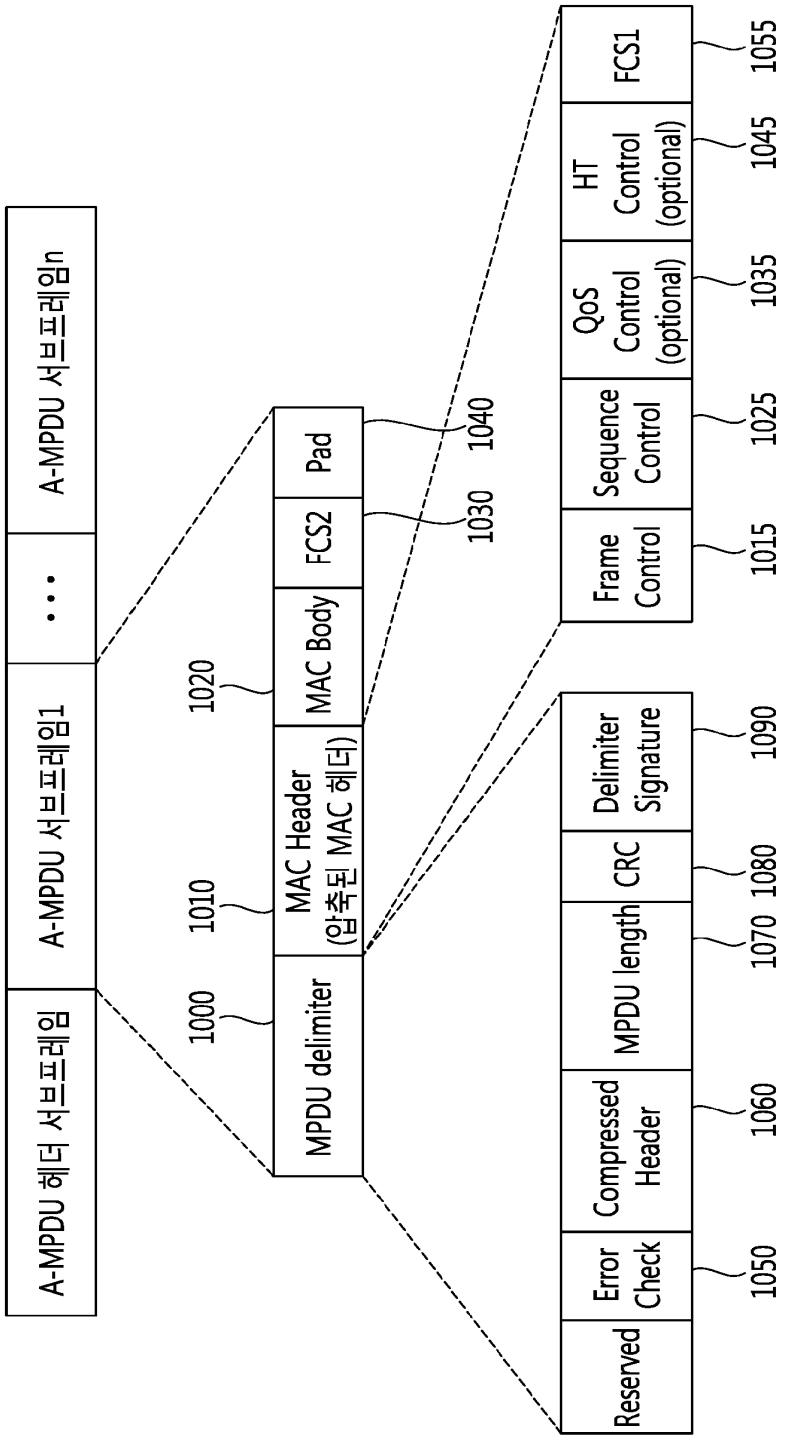
[도8]


850
A-MPDU 헤더 서브프레임
A-MPDU 서브프레임1
• • •
A-MPDU 서브프레임n
MPDU delimiter
MAC Header
(공통 MAC 헤더)
FCS
Pad
800
810
820
830

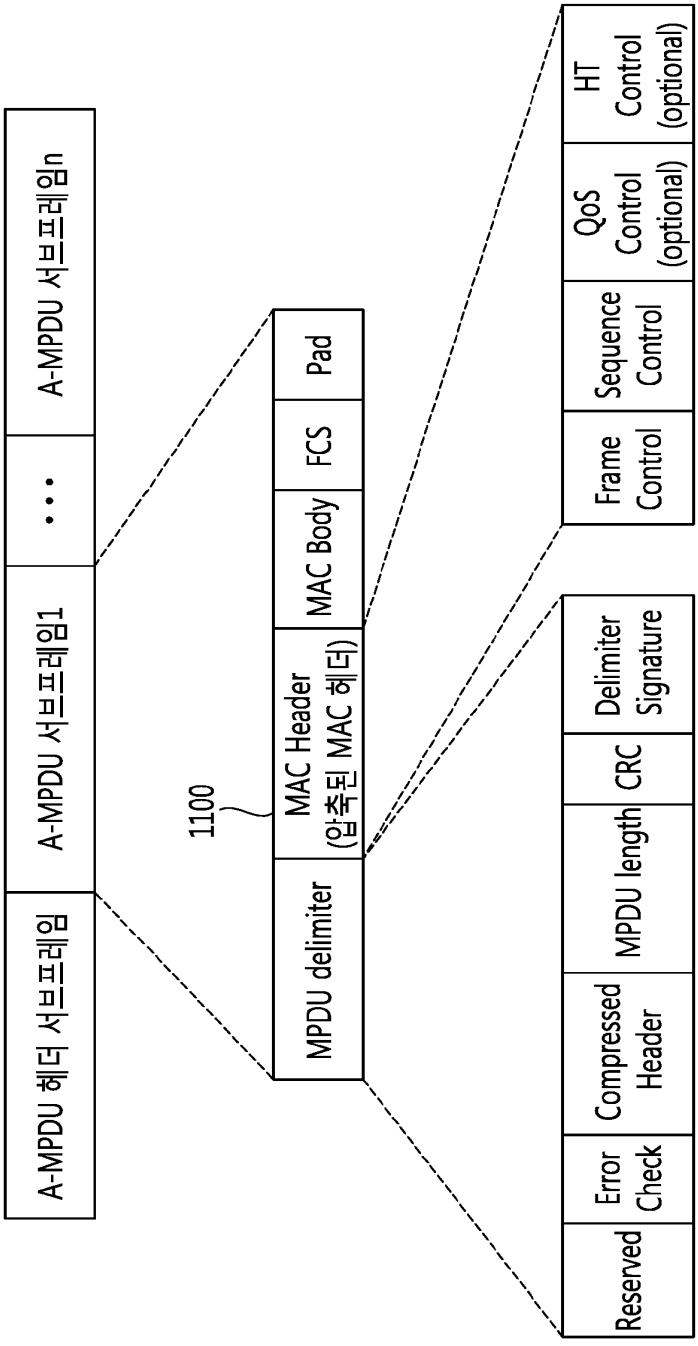
[도9]


950
A-MPDU 헤더 서브프레임
A-MPDU 서브프레임1
• • •
A-MPDU 서브프레임n
960
MPDU delimiter
MAC Header (공통 MAC 헤더)
FCS
Pad
910
Duration /ID
Address 1
Address 2
Address 3
900
QoS Control (optional)
920
HT Control (optional)
930

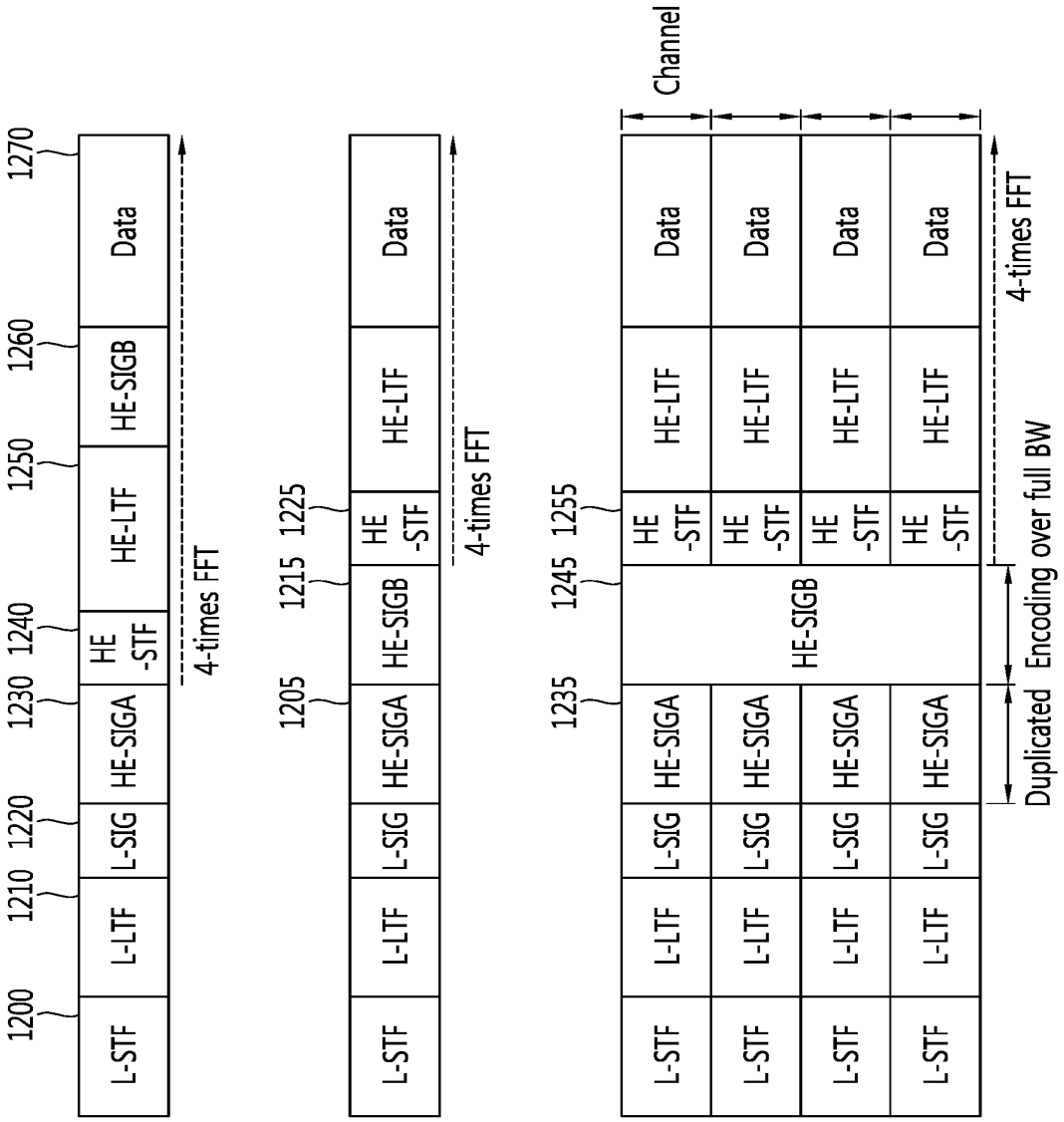
[도10]


A-MPDU 헤더 서브프레임
A-MPDU 서브프레임1
• • •
A-MPDU 서브프레임n
MPDU delimiter
MAC Header (압축된 MAC 헤더)
MAC Body
FCS2
Pad
Reserved
Error Check
Compressed Header
MPDU length
CRC
Delimiter Signature
Frame Control
Sequence Control
QoS Control (optional)
HT Control (optional)
FCS1
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
1015
1025
1035
1045
1055

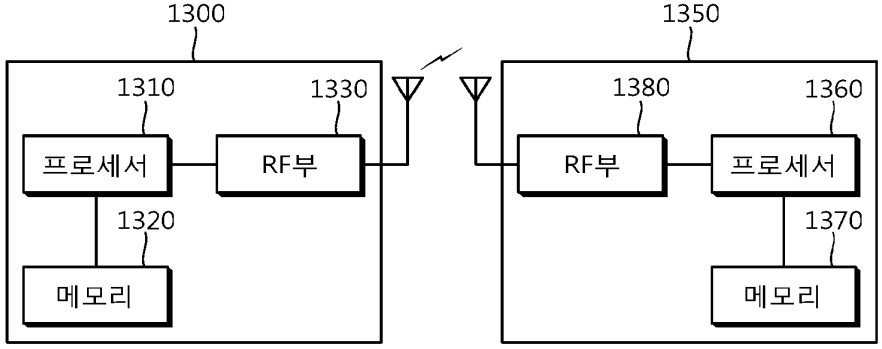
[도11]


A-MPDU 헤더 서브프레임
A-MPDU 서브프레임1
• • •
A-MPDU 서브프레임n
1100
MPDU delimiter
MAC Header (압축된 MAC 헤더)
MAC Body
FCS
Pad
Reserved
Error Check
Compressed Header
MPDU length
CRC
Delimiter Signature
Frame Control
Sequence Control
QoS Control (optional)
HT Control (optional)

[도12]


1270
1260
1250
1240
1230
1220
1210
1200
Data
HE-SIGB
HE-LTF
HE -STF
HE-SIGA
L-SIG
L-LTF
L-STF
4-times FFT
1225
1215
1205
1255
1245
1235
Channel
Duplicated
Encoding over full BW

[도13]


1300
1310
1330
프로세서
RF부
1320
메모리
1350
1380
1360
RF부
프로세서
1370
메모리

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2015/008270

A. CLASSIFICATION OF SUBJECT MATTER

H04W 28/06(2009.01)i, H04W 28/04(2009.01)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 28/06; H04B 7/26; H04Q 7/24; H04M 13/00; H04W 40/34; H04W 72/00; H04W 84/12; H04W 28/04

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: A-MPDU, primary/secondary MPDU, MAC body, MAC header, common header field, unique header field

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013-032124 A1 (LG ELECTRONICS INC.) 07 March 2013 See paragraphs [0047], [0055]-[0059], [0130], [0152]-[0154]; claim 1; and figures 4, 10.	1-2,6-7
A		3-5,8-10
A	WO 2012-159082 A2 (QUALCOMM INCORPORATED) 22 November 2012 See paragraphs [0208]-[0210]; and claim 1.	1-10
A	US 2007-0104162 A1 (KNECKT, Jarkko Lauri Sakari et al.) 10 May 2007 See paragraphs [0024]-[0037]; claim 1; and figures 4-5.	1-10
A	WO 2011-115431 A2 (LG ELECTRONICS INC.) 22 September 2011 See paragraphs [0122]-[0125]; claim 1; and figure 8.	1-10
A	US 2011-0080887 A1 (KRISHNASWAMY, Dilip et al.) 07 April 2011 See paragraphs [0016]-[0021], [0027]-[0028]; and figure 2.	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"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
"P" document published prior to the international filing date but later than the priority date claimed
"T" 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
"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
"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 obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 NOVEMBER 2015 (16.11.2015)	**17 NOVEMBER 2015 (17.11.2015)**
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.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2015/008270

Patent document cited in search report	Publication date	Patent family member	Publication date
WO 2013-032124 A1	07/03/2013	KR 10-2014-0059188 A	15/05/2014
		US 2014-0233483 A1	21/08/2014
WO 2012-159082 A2	22/11/2012	AU 2012-254990 B2	16/07/2015
		CA 2835441 A1	22/11/2012
		CA 2835447 A1	22/11/2012
		CA 2844696 A1	28/02/2013
		CN 103748856 A	23/04/2014
		CN 103765847 A	30/04/2014
		CN 103765848 A	30/04/2014
		EP 2710783 A2	26/03/2014
		EP 2710840 A2	26/03/2014
		EP 2749004 A2	02/07/2014
		EP 2877398 A1	03/06/2015
		JP 05746425 B2	08/07/2015
		JP 2014-515572 A	30/06/2014
		JP 2014-520426 A	21/08/2014
		JP 2014-529242 A	30/10/2014
		KR 10-2014-0013090 A	04/02/2014
		KR 10-2014-0016389 A	07/02/2014
		KR 10-2014-0059254 A	15/05/2014
		KR 10-2015-0090260 A	05/08/2015
		US 2013-0093220 A1	18/04/2013
		US 2013-0128808 A1	23/05/2013
		US 2013-0128809 A1	23/05/2013
		US 2013-0215836 A1	22/08/2013
		US 2013-0327255 A1	12/12/2013
		US 2014-0191005 A1	10/07/2014
		US 8667904 B2	11/03/2014
		US 8826830 B2	09/09/2014
		US 9125181 B2	01/09/2015
		WO 2012-159082 A3	07/02/2013
		WO 2012-159094 A2	22/11/2012
		WO 2013-028777 A2	28/02/2013
		WO 2013-028777 A3	25/04/2013
		WO 2013-055671 A1	18/04/2013
		WO 2013-166067 A1	07/11/2013
US 2007-0104162 A1	10/05/2007	BR PI0619455 A2	04/10/2011
		CN 101326775 A	17/12/2008
		CN 101326775 B	19/12/2012
		EP 1949620 A2	30/07/2008
		EP 1949620 A4	15/02/2012
		JP 2009-516408 A	16/04/2009
		KR 10-0963719 B1	14/06/2010
		KR 10-2008-0066689 A	16/07/2008
		US 7729236 B2	01/06/2010
		WO 2007-066180 A2	14/06/2007
		WO 2007-066180 A3	14/02/2008

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2015/008270

Patent document cited in search report	Publication date	Patent family member	Publication date
		ZA 200803547 A	25/03/2009
WO 2011-115431 A2	22/09/2011	WO 2011-115431 A3	26/01/2012
US 2011-0080887 A1	07/04/2011	US 2008-0080437 A1 US 8300563 B2	03/04/2008 30/10/2012

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

국 제 조 사 보 고 서

국제출원번호
PCT/KR2015/008270

A. 발명이 속하는 기술분류(국제특허분류(IPC))

H04W 28/06(2009.01)i, H04W 28/04(2009.01)i

B. 조사된 분야

조사된 최소문헌(국제특허분류를 기재)

H04W 28/06; H04B 7/26; H04Q 7/24; H03M 13/00; H04W 40/34; H04W 72/00; H04W 84/12; H04W 28/04

조사된 기술분야에 속하는 최소문헌 이외의 문헌

한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC
일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC

국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우))

eKOMPASS(특허청 내부 검색시스템) & 키워드: A-MPDU, 제1/제2 MPDU, MAC 바디, MAC 헤더, 공통 헤더 필드, 고유 헤더 필드

C. 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
X	WO 2013-032124 A1 (엘지전자 주식회사) 2013.03.07 단락 [0047], [0055]-[0059], [0130], [0152]-[0154]; 청구항 1; 및 도면 4, 10 참조.	1-2,6-7
A		3-5,8-10
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A	US 2007-0104162 A1 (JARKKO LAURI SAKARI KNECKT 등) 2007.05.10 단락 [0024]-[0037]; 청구항 1; 및 도면 4-5 참조.	1-10
A	WO 2011-115431 A2 (엘지전자 주식회사) 2011.09.22 단락 [0122]-[0125]; 청구항 1; 및 도면 8 참조.	1-10
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☐ 추가 문헌이 C(계속)에 기재되어 있습니다.

☒ 대응특허에 관한 별지를 참조하십시오.

* 인용된 문헌의 특별 카테고리:

"A" 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌

"E" 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌

"L" 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌

"O" 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌

"P" 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌

"T" 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌

"X" 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다.

"Y" 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다.

"&" 동일한 대응특허문헌에 속하는 문헌

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서식 PCT/ISA/210 (두 번째 용지) (2015년 1월)

국제조사보고서
대응특허에 관한 정보

국제출원번호
PCT/KR2015/008270

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국제조사보고서
대응특허에 관한 정보

국제출원번호
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METHOD FOR TRANSMITTING DATA IN WIRELESS COMMUNICATION SYSTEM AND DEVICE FOR SAME

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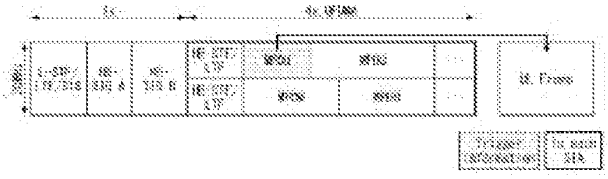
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Abstract of WO2016032258 (A2)

According to one embodiment of the present invention, an access point (AP) downlink (DL) multi-user (MU) transmission method in a wireless



communication system comprises the steps of: transmitting a DL MU physical protocol data unit (PPDU), the DL MU PPDU including a trigger frame, which includes trigger information for uplink (UL) MU transmission, and a DL MU frame; and UL MU-receiving a UL MU PPDU generated on the basis of the DL MU PPDU, wherein the UL MU PPDU can include a UL MU frame based on the trigger frame and an acknowledge (ACK) frame which is a response to the DL MU frame.

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CLAIMS WO2016032258A2

1.

A method for transmitting an access point (AP) downlink (DL) multi-user (MU) in a wireless communication system, the method comprising:

transmitting a DL MU PPDU (Physical Protocol Data Unit); as,

The DL MU PPDU includes a trigger frame including trigger information for uplink (UL) MU transmission and a DL MU frame, and

UL MU receiving a UL MU PPDU generated based on the DL MU PPDU; including,

The UL MU PPDU includes a UL MU frame based on the trigger frame and an acknowledgment (ACK) frame in response to the DL MU frame.

2.

The method of claim 1,

When the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame,

The DL MU frame and the trigger frame are included in a data field allocated to the receiving STA in an Aggregated MAC Protocol Data Unit (A-MPDU) format.

3.

The method of claim 2,

The MAC header of the trigger frame includes a trigger indicator indicating that the trigger frame includes the trigger information.

4.

3. The method of claim 2,

The trigger frame corresponds to a first MPDU among MAC Protocol Data Units (MPDUs) included in the A-MPDU format.

5.

The method of claim 1,

When the trigger frame is not transmitted together to a receiving STA (Station) that receives the DL MU frame,

The trigger frame is included in an MPDU format in a preset data field in the DL MU PPDU,

The DL MU frame is included in another data field in the DL MU PPDU in the MPDU format or the A-MPDU format.

6.

The method of claim 5,

The physical preamble in the DL MU PPDU is

A DL MU transmission method, including a trigger indicator indicating whether the DL MU PPDU includes the trigger frame, or broadcast association identifier (AID) information for receiving the preset data field.

7.

The method of claim 6,

The trigger indicator or the broadcast AID information is included in a High Efficiency-Signal (HE-SIG) field of the physical preamble.

8.

The method of claim 1,

When the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame,

The ACK frame is included in an MPDU format in a preset data field in the UL MU PPDU, and the UL MU frame is included in another data field in the UL MU PPDU in the MPDU format or A-MPDU format. DL MU transmission method .

9.

The method of claim 1,

When the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame,

The ACK frame is piggybacked on the UL MU frame and included in a preset data field in the UL MU PPDU.

10.

The method of claim 1,

The trigger frame includes at least one of Association Identifier (AID) information of an STA performing UL MU transmission, spatial resource indication information for the UL MU transmission, and frequency resource indication information for the UL MU transmission, DL MU transmission method.

11.

In the AP (Access Point) device of the wireless communication system,

RF unit for transmitting and receiving radio signals; and

a processor for controlling the RF unit; including,

The processor is

Transmit a DL MU PPDU (Physical Protocol Data Unit), wherein the DL MU PPDU includes a trigger frame including trigger information for uplink (UL) MU transmission and a DL MU frame, and

UL MU receives the UL MU PPDU generated based on the DL MU PPDU, wherein the UL MU PPDU includes a UL MU frame based on the trigger frame and an ACK (Acknowledge) frame that is a response to the DL MU frame , AP devices.

12.

The method of claim 11,

When the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame,

The DL MU frame and the trigger frame are included in a data field allocated to the receiving STA in an Aggregated MAC Protocol Data Unit (A-MPDU) format.

13.

The method of claim 12,

When the trigger frame is not transmitted together to a receiving STA (Station) that receives the DL MU frame,

The trigger frame is included in an MPDU format in a preset data field in the DL MU PPDU,

The DL MU frame is included in another data field in the DL MU PPDU in the MPDU format or the A-MPDU format.

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DESCRIPTION WO2016032258A2

Data transmission method and apparatus therefor in wireless communication system The present invention relates to a wireless communication system, and more particularly, to a data transmission method for supporting multi-user data transmission, and an apparatus supporting the same.

Wi-Fi is a wireless local area network (WLAN) technology that enables a device to access the Internet in a frequency band of 2.4 GHz, 5 GHz, or 60 GHz.

WLAN is based on the Institute of electrical and electronic engineers (IEEE) 802.11 standard. The Wireless Next Generation Standing Committee (WNG SC) of IEEE 802.11 is an ad-hoc committee that considers a next-generation wireless local area network (WLAN) in the medium to long term.

IEEE 802.11n aims to increase the speed and reliability of the network and extend the operating distance of the wireless network. More specifically, IEEE 802.11n supports High Throughput (HT) that provides a data rate of up to 600 Mbps. It is based on MIMO (Multiple Inputs and Multiple Outputs) technology that uses multiple antennas.

As the spread of WLAN is activated and applications using it are diversified, the next-generation WLAN system supporting very high throughput (VHT) is the next version of the IEEE 802.11n WLAN system, and IEEE 802.11ac has been newly enacted. IEEE 802.11ac supports data processing rates of 1 Gbps or more through 80 MHz bandwidth transmission and/or higher bandwidth transmission (eg, 160 MHz), and operates mainly in the 5 GHz band.

Recently, there is a need for a new WLAN system to support a higher throughput than the data processing speed supported by IEEE 802.11ac.

The scope of IEEE 802.11ax, which is mainly discussed in the next-generation WLAN task group called IEEE 802.11ax or High Efficiency (HEW) WLAN, is 1) 802.11 PHY (physical) layer and MAC in bands such as 2.4 GHz and 5 GHz. (medium access control) layer improvement, 2) spectrum efficiency and area throughput improvement, 3) interference source environment, dense heterogeneous network environment, and high user load. environments, such as improving performance in real indoor environments and outdoor environments.

A scenario mainly considered in IEEE 802.11ax is a dense environment with many access points (APs) and stations (STAs), and IEEE 802.11ax discusses improvement of spectrum efficiency and area throughput in this situation. . In particular, there is an interest in actual performance improvement in an indoor environment as well as an outdoor environment, which has not been considered much in the existing WLAN.

IEEE 802.11ax is interested in scenarios such as wireless office, smart home, stadium, hotspot, and building/apartment. Discussion on system performance improvement in a dense environment with many STAs is being conducted.

In the future, IEEE 802.11ax will focus on system performance improvement and outdoor environment performance improvement in an overlapping basic service set (OBSS) environment rather than single link performance improvement in one basic service set (BSS), and cellular offloading. The discussion is expected to be lively. This direction of IEEE 802.11ax means that next-generation WLAN will have a technology range similar to that of mobile communication. Considering the recent

discussion of mobile communication and WLAN technology in the small cell and direct-to-direct (D2D) communication areas, the technical and business aspects of next-generation WLAN and mobile communication based on IEEE 802.11ax Convergence is predicted to become more active.

An object of the present invention is to propose a method for transmitting/receiving uplink/downlink multi-user data in a wireless communication system.

Another object of the present invention is to propose a HE (High Efficiency) format of a PPDU used for uplink/downlink multi-user transmission/reception in a wireless communication system. In particular, the HE format of the data field included in the PPDU is proposed.

In addition, an object of the present invention is to propose a HE format of a cascade DL/UL MU PPDU for efficiently using DL/UL MU resources.

The technical problems to be achieved in the present invention are not limited to the technical problems mentioned above, and other technical problems not mentioned will be clearly understood by those of ordinary skill in the art to which the present invention belongs from the description below. will be able

In order to solve the above technical problem, an AP device in a WLAN system and a data transmission method of the AP device according to an embodiment of the present invention are proposed.

In the method for transmitting an access point (AP) downlink (DL) multi-user (MU) in a wireless communication system according to an embodiment of the present invention, a DL MU PPDU (Physical Protocol Data Unit) transmitting; The DL MU PPDU includes a trigger frame including trigger information for uplink (UL) MU transmission and a DL MU frame, and the UL MU PPDU generated based on the DL MU PPDU is received by UL MU to do; The UL MU PPDU may include a UL MU frame based on the trigger frame and an acknowledgment (ACK) frame in response to the DL MU frame.

In addition, when the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame, the DL MU frame and the trigger frame are included in the data field assigned to the receiving STA (Aggregated MAC Protocol A-MPDU). Data Unit) format.

Also, the MAC header of the trigger frame may include a trigger indicator indicating that the trigger frame includes the trigger information.

Also, the trigger frame may correspond to a first MPDU among MAC protocol data units (MPDUs) included in the A-MPDU format.

In addition, when the trigger frame is not transmitted together to a receiving STA (Station) that receives the DL MU frame, the trigger frame is included in an MPDU format in a preset data field in the DL MU PPDU, and the DL MU frame is It may be included in another data field in the DL MU PPDU in the MPDU format or the A-MPDU format.

In addition, the physical preamble in the DL MU PPDU includes a trigger indicator indicating whether the DL MU PPDU includes the trigger frame, or broadcast AID (Broadcast Association Identifier) information for receiving the preset data field. can

In addition, the trigger indicator or the broadcast AID information may be included in a High Efficiency-Signal (HE-SIG) field of the physical preamble.

In addition, when the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame, the ACK frame is included in an MPDU format in a preset data field in the UL MU PPDU, and the UL MU frame is Other data fields in the UL MU PPDU may be included in the MPDU format or the A-MPDU format.

Also, when the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame, the ACK frame is piggybacked on the UL MU frame and may be included in a preset data field in the UL MU PPDU.

In addition, the trigger frame may include at least one of Association Identifier (AID) information of an STA performing UL MU transmission, spatial resource indication information for the UL MU transmission, and frequency resource indication information for the UL MU transmission. there is.

In addition, in the AP (Access Point) device of the wireless communication system according to another embodiment of the present invention, for transmitting and receiving a wireless signal, the RF unit; and a processor for controlling the RF unit; including, wherein the processor transmits a DL MU PPDU (Physical Protocol Data Unit), wherein the DL MU PPDU includes trigger information for uplink (UL) MU transmission. A trigger frame and a DL MU frame and UL MU receiving a UL MU PPDU generated based on the DL MU PPDU, wherein the UL MU PPDU is a UL MU frame based on the trigger frame and an ACK

(Acknowledge) that is a response to the DL MU frame.) may include a frame.

In addition, when the trigger frame is transmitted together to a receiving STA (Station) that receives the DL MU frame, the DL MU frame and the trigger frame are included in the data field assigned to the receiving STA (Aggregated MAC Protocol A-MPDU). Data Unit) format.

In addition, when the trigger frame is not transmitted together to a receiving STA (Station) that receives the DL MU frame, the trigger frame is included in an MPDU format in a preset data field in the DL MU PPDU, and the DL MU frame is It may be included in another data field in the DL MU PPDU in the MPDU format or the A-MPDU format.

According to an embodiment of the present invention, since the trigger frame and the DL MU frame are simultaneously transmitted through one DL MU PPDU, DL MU resources are saved and communication performance is increased.

In addition, according to an embodiment of the present invention, since the ACK frame and the UL MU frame are simultaneously transmitted through one UL MU PPDU, UL MU resources are saved and communication performance is increased.

In addition, other effects of the present invention will be further described in the following embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS The accompanying drawings, which are included as a part of the detailed description for better understanding of the present invention, provide embodiments of the present invention, and together with the detailed description, explain the technical features of the present invention.

1 is a diagram illustrating an example of an IEEE 802.11 system to which the present invention can be applied.

2 is a diagram illustrating a structure of a layer architecture of an IEEE 802.11 system to which the present invention can be applied.

3 illustrates a non-HT format PPDU and an HT format PPDU of a wireless communication system to which the present invention can be applied.

4 illustrates a VHT format PPDU format of a wireless communication system to which the present invention can be applied.

5 is a diagram illustrating a constellation for classifying a format of a PPDU of a wireless communication system to which the present invention can be applied.

6 illustrates a MAC frame format of an IEEE 802.11 system to which the present invention can be applied.

7 is a diagram illustrating a frame control field in a MAC frame in a wireless communication system to which the present invention can be applied.

8 illustrates the VHT format of the HT Control field in a wireless communication system to which the present invention can be applied.

9 is a diagram for explaining an arbitrary backoff period and frame transmission procedure in a wireless communication system to which the present invention can be applied.

10 is a diagram illustrating an IFS relationship in a wireless communication system to which the present invention can be applied.

11 is a diagram conceptually illustrating a channel sounding method in a wireless communication system to which the present invention can be applied.

12 is a diagram illustrating a VHT NDPA frame in a wireless communication system to which the present invention can be applied.

13 is a diagram illustrating an NDP PPDU in a wireless communication system to which the present invention can be applied.

14 is a diagram illustrating a VHT compressed beamforming frame format in a wireless communication system to which the present invention can be applied.

15 is a diagram illustrating a beamforming report poll frame format in a wireless communication system to which the present invention can be applied.

16 is a diagram illustrating a Group ID Management frame in a wireless communication system to which the present invention can be applied.

17 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

18 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

19 is a diagram illustrating a downlink MU-MIMO transmission process in a wireless communication system to which the present invention can be applied.

20 is a diagram illustrating an ACK frame in a wireless communication system to which the present invention can be applied.

21 is a diagram illustrating a block ACK request frame in a wireless communication system to which the present invention can be applied.

22 is a diagram illustrating a BAR information field of a block ACK request frame in a wireless communication system to which the present invention can be applied.

23 is a diagram illustrating a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

24 is a diagram illustrating a BA information field of a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

25 is a diagram illustrating a High Efficiency (HE) format PPDU according to an embodiment of the present invention.

26 to 29 are diagrams illustrating HE format PPDUs according to an embodiment of the present invention.

30 illustrates a phase rotation for HE format PPDU detection according to an embodiment of the present invention.

31 and 32 are diagrams illustrating an uplink multi-user transmission procedure according to an embodiment of the present invention.

33 is a diagram illustrating a resource allocation unit in an OFDMA multi-user transmission scheme according to an embodiment of the present invention.

34 is a diagram illustrating an uplink multi-user transmission procedure according to an embodiment of the present invention. In relation to this drawing, descriptions overlapping those of FIGS. 31 and 32 will be omitted.

35 is a diagram illustrating the structure of a DL MU PPDU according to an embodiment of the present invention.

36 is a diagram illustrating the structure of a DL MU PPDU according to the first embodiment of the present invention.

37 is a diagram illustrating a DL MU PPDU and a UL MU PPDU according to an embodiment of the present invention.

38 is a diagram illustrating a DL MU PPDU and a UL MU PPDU according to another embodiment of the present invention.

39 is a diagram illustrating the structure of a DL MU PPDU according to the 2-1 embodiment of the present invention.

40 is a diagram illustrating the structure of a DL MU PPDU according to the second embodiment of the present invention.

41 is a table comparing the effects of the first and second embodiments.

42 is a diagram illustrating a UL MU PPDU according to an embodiment of the present invention.

43 is a flowchart illustrating a UL MU transmission method of an STA device according to an embodiment of the present invention.

44 is a block diagram of each STA device according to an embodiment of the present invention.

Hereinafter, preferred embodiments according to the present invention will be described in detail with reference to the accompanying drawings. DETAILED DESCRIPTION The detailed description set forth below in conjunction with the appended drawings is intended to describe exemplary embodiments of the present invention and is not intended to represent the only embodiments in which the present invention may be practiced. The following detailed description includes specific details in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced without these specific details.

In some cases, well-known structures and devices may be omitted or shown in block diagram form focusing on core functions of

each structure and device in order to avoid obscuring the concept of the present invention.

Specific terms used in the following description are provided to help the understanding of the present invention, and the use of these specific terms may be changed to other forms without departing from the technical spirit of the present invention.

The following technologies are code division multiple access (CDMA), frequency division multiple access (FDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), single carrier frequency division multiple access (SC-FDMA), NOMA (non-orthogonal multiple access) may be used in various wireless access systems. CDMA may be implemented with a radio technology such as universal terrestrial radio access (UTRA) or CDMA2000. TDMA may be implemented with a radio technology such as global system for mobile communications (GSM)/general packet radio service (GPRS)/enhanced data rates for GSM evolution (EDGE). OFDMA may be implemented with a wireless technology such as Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802-20, and evolved UTRA (E-UTRA). UTRA is part of the universal mobile telecommunications system (UMTS). 33rd generation partnership project (GPP) long term evolution (LTE) is a part of evolved UMTS (E-UMTS) using E-UTRA, and employs OFDMA in downlink and SC-FDMA in uplink. LTE-A (advanced) is an evolution of 3GPP LTE.

Embodiments of the present invention may be supported by standard documents disclosed in at least one of the wireless access systems IEEE 802, 3GPP and 3GPP2. That is, steps or parts not described in order to clearly reveal the technical spirit of the present invention among the embodiments of the present invention may be supported by the above documents. In addition, all terms disclosed in this document may be described by the standard document.

For clarity of explanation, the IEEE 802.11 system is mainly described, but the technical features of the present invention are not limited thereto.

system general

1 is a diagram illustrating an example of an IEEE 802.11 system to which the present invention can be applied.

The IEEE 802.11 structure may be composed of a plurality of components, and a wireless communication system supporting station (STA) mobility that is transparent to an upper layer may be provided by their interaction. .

A basic service set (BSS) may correspond to a basic building block in an IEEE 802.11 system.

In FIG. 1 , three BSSs (BSS 1 to BSS 3) exist and two STAs are included as members of each BSS (STA 1 and STA 2 are included in BSS 1, STA 3 and STA 4 are BSS 2 , and STA 5 and STA 6 are included in BSS 3) as an example.

The ellipse indicating the BSS in FIG. 1 may also be understood as indicating a coverage area in which STAs included in the corresponding BSS maintain communication. This area may be referred to as a basic service area (BSA). When the STA moves out of the BSA, it cannot communicate directly with other STAs within the BSA.

In the IEEE 802.11 system, the most basic type of BSS is an independent BSS (IBSS). For example, the IBSS may have a minimal form consisting of only two STAs. In addition, BSS 3 of FIG. 1 having the simplest form and omitting other components may correspond to a representative example of IBSS. This configuration is possible when the STAs can communicate directly. In addition, this type of LAN may be configured when a LAN is required rather than being planned in advance, and may be referred to as an ad-hoc network.

The membership of the STA in the BSS may be dynamically changed by turning the STA on or off, the STA entering or leaving the BSS area, and the like. To become a member of the BSS, the STA may join the BSS using a synchronization process. In order to access all services of the BSS infrastructure, the STA must be associated with the BSS. This association may be established dynamically and may include the use of a Distribution System Service (DSS).

802.11 The direct STA-to-STA distance in the system may be limited by physical layer (PHY: physical) performance. In some cases, this distance limit may be sufficient, but in some cases, communication between STAs at a greater distance may be required. A distribution system (DS) may be configured to support extended coverage.

DS means a structure in which BSSs are interconnected. Specifically, instead of the BSS independently existing as shown in FIG. 1 , the BSS may exist as a component of an extended form of a network composed of a plurality of BSSs.

DS is a logical concept and can be specified by the characteristics of a distribution system medium (DSM). In this regard, the IEEE 802.11 standard logically divides a wireless medium (WM: Wireless Medium) and a Distribution System Medium (DSM). Each logical medium serves a different purpose and is used by different components. The definition of the IEEE 802.11 standard does not limit these media to be the same nor to different. In this way, in that the plurality of media are logically different, the

flexibility of the structure (DS structure or other network structure) of the IEEE 802.11 system can be explained. That is, the IEEE 802.11 system structure may be implemented in various ways, and the corresponding system structure may be independently specified by the physical characteristics of each implementation.

A DS can support a mobile device by providing seamless integration of a plurality of BSSs and providing logical services necessary to handle addresses to destinations.

The AP means an entity that enables access to the DS through the WM for associated STAs and has STA functionality. Data movement between the BSS and the DS may be performed through the AP. For example, STA 2 and STA 3 shown in FIG. 1 provide a function to allow associated STAs (STA 1 and STA 4) to access the DS while having STA functionality. In addition, since all APs basically correspond to STAs, all APs are addressable entities. The address used by the AP for communication on the WM and the address used by the AP for communication on the DSM are not necessarily the same.

Data transmitted from one of the STAs associated with the AP to the STA address of the AP is always received on an uncontrolled port and may be processed by the IEEE 802.1X port access entity. In addition, when the control port is authenticated, transmission data (or frame) may be transmitted to the DS.

A wireless network of arbitrary size and complexity may be configured with DS and BSS. In the IEEE 802.11 system, this type of network is called an Extended Service Set (ESS) network. The ESS may correspond to a set of BSSs connected to one DS. However, the ESS does not include the DS. The ESS network is characterized by being seen as an IBSS network in the Logical Link Control (LLC) layer. STAs included in the ESS can communicate with each other, and mobile STAs can move from one BSS to another (within the same ESS) transparently to the LLC.

In the IEEE 802.11 system, nothing is assumed about the relative physical positions of the BSSs in FIG. 1 , and all of the following forms are possible.

Specifically, BSSs may partially overlap, which is a commonly used form to provide continuous coverage. In addition, the BSSs may not be physically connected, and there is no logical limit to the distance between the BSSs. In addition, the BSSs may be physically located at the same location, which may be used to provide redundancy. Also, one (or one or more) IBSS or ESS networks may physically exist in the same space as one or more ESS networks. This is when an ad-hoc network operates at a location where the ESS network exists, or when IEEE 802.11 networks that are physically overlapped by different organizations are configured, or when two or more different access and security policies are required at the same location. It may correspond to the type of ESS network in such cases.

In a WLAN system, an STA is a device that operates according to the Medium Access Control (MAC)/PHY regulation of IEEE 802.11. As long as the function of the STA is not separately distinguished from the AP, the STA may include an AP STA and a non-AP STA (non-AP STA). However, when communication is performed between the STA and the AP, the STA may be understood as a non-AP STA. In the example of FIG. 1 , STA 1 , STA 4 , STA 5 , and STA 6 correspond to non-AP STAs, and STA 2 and STA 3 correspond to AP STAs.

A Non-AP STA corresponds to a device that a user generally handles directly, such as a laptop computer or a mobile phone. In the following description, a non-AP STA is a wireless device, a terminal, a user equipment (UE), a mobile station (MS), a mobile terminal, and a wireless terminal.), a wireless transmit/receive unit (WTRU), a network interface device, a machine-type communication (MTC) device, a machine-to-machine (M2M) device, and the like.

In addition, the AP is a base station (BS) in other wireless communication fields, a Node-B (Node-B), an evolved Node-B (eNB), a Base Transceiver System (BTS) , a concept corresponding to a femto base station (Femto BS) and the like.

Hereinafter, in the present specification, downlink (DL: downlink) means communication from an AP to a non-AP STA, and uplink (UL: uplink) means communication from a non-AP STA to an AP. In the downlink, a transmitter may be a part of an AP, and a receiver may be a part of a non-AP STA. In the uplink, the transmitter may be a part of a non-AP STA, and the receiver may be a part of the AP.

2 is a diagram illustrating a structure of a layer architecture of an IEEE 802.11 system to which the present invention can be applied.

Referring to FIG. 2 , the layer architecture of the IEEE 802.11 system may include a MAC sublayer and a PHY sublayer.

The PHY sublayer may be divided into a Physical Layer Convergence Procedure (PLCP) entity and a Physical Medium Dependent (PMD) entity. In this case, the PLCP entity serves to connect the MAC sublayer and the data frame, and the PMD entity serves to wirelessly transmit/receive data to and from two or more STAs.

Both the MAC sublayer and the PHY sublayer may include a management entity, and may be referred to as a MAC sublayer management entity (MLME) and a PHY sublayer management entity (PLME), respectively. there is. These management entities provide a layer management service interface through the operation of layer management functions. The MLME may be connected to the PLME to perform a management operation of the MAC sublayer, and similarly, the PLME may also be connected to the MLME to perform a management operation of the PHY sublayer.

In order to provide accurate MAC operation, a Station Management Entity (SME) may exist in each STA. As a management entity independent of each layer, SME collects layer-based state information from MLME and PLME or sets values of specific parameters of each layer. SMEs can perform these functions on behalf of general system management entities and implement standard management protocols.

MLME, PLME, and SME may interact in various ways based on primitives. Specifically, the XX-GET.request primitive is used to request the value of the management information base attribute (MIB attribute: Management Information Base attribute), and the XX-GET.confirm primitive returns the corresponding MIB attribute value if the status is 'SUCCESS'. It returns, and in other cases, an error is displayed in the status field and returned. The XX-SET.request primitive is used to request that a specified MIB attribute be set to a given value. If the MIB attribute implies a specific action, this request requests the execution of that specific action. And, if the status of the XX-SET.confirm primitive is 'SUCCESS', this means that the specified MIB attribute is set to the requested value. Otherwise, the status field indicates an error condition. If this MIB attribute means a specific operation, this primitive can confirm that the corresponding operation is performed.

The operation in each sublayer is briefly described as follows.

The MAC sublayer includes a MAC header and a frame check sequence (FCS) in a MAC service data unit (MSDU) or a fragment of an MSDU received from a higher layer (eg, LLC layer). Sequence) to create one or more MAC Protocol Data Units (MPDUs). The generated MPDU is delivered to the PHY sublayer.

When an aggregated MSDU (A-MSDU) scheme is used, a plurality of MSDUs may be aggregated into a single aggregated MSDU (A-MSDU). The MSDU merging operation may be performed in a MAC upper layer. The A-MSDU is delivered to the PHY sublayer as a single MPDU (if not fragmented).

The PHY sublayer generates a Physical Protocol Data Unit (PPDU) by adding additional fields including information required by the physical layer transceiver to the Physical Service Data Unit (PSDU) received from the MAC sublayer. . The PPDU is transmitted over a wireless medium.

Since the PSDU is received by the PHY sublayer from the MAC sublayer and the MPDU is transmitted by the MAC sublayer to the PHY sublayer, the PSDU is substantially the same as the MPDU.

When an aggregated MPDU (A-MPDU) scheme is used, a plurality of MPDUs (in this case, each MPDU may carry an A-MSDU).) may be merged into a single A-MPDU. The MPDU aggregation operation may be performed in the MAC lower layer. In the A-MPDU, various types of MPDUs (eg, QoS data, ACK (Acknowledge), block ACK (BlockAck), etc.) may be merged. The PHY sublayer receives the A-MPDU as a single PSDU from the MAC sublayer. That is, the PSDU consists of a plurality of MPDUs. Accordingly, the A-MPDU is transmitted over the wireless medium within a single PPDU.

Physical Protocol Data Unit (PPDU) Format

A PPDU (Physical Protocol Data Unit) refers to a data block generated in a physical layer.

Hereinafter, the PPDU format will be described based on the IEEE 802.11 WLAN system to which the present invention can be applied.

3 illustrates a non-HT format PPDU and an HT format PPDU of a wireless communication system to which the present invention can be applied.

3A illustrates a non-HT format PPDU for supporting the IEEE 802.11a/g system. The non-HT PPDU may also be referred to as a legacy PPDU.

Referring to (a) of Figure 3, the non-HT format PPDU is L-STF (Legacy (or Non-HT) Short Training field), L-LTF (Legacy (or Non-HT) Long Training field) and It is configured including a legacy format preamble and a data field consisting of a L-SIG (Legacy (or Non-HT) SIGNAL) field.

The L-STF may include a short training orthogonal frequency division multiplexing symbol (OFDM). L-STF can be used for frame timing acquisition, automatic gain control (AGC), diversity detection, and coarse frequency/time synchronization .

The L-LTF may include a long training orthogonal frequency division multiplexing symbol (OFDM). The L-LTF may be used for fine frequency/time synchronization and channel estimation.

The L-SIG field may be used to transmit control information for demodulation and decoding of the data field.

The L-SIG field consists of a 4-bit Rate field, a 1-bit Reserved bit, a 12-bit Length field, a 1-bit parity bit, and a 6-bit Signal Tail field. can be

The rate field includes data rate information, and the length field indicates the number of octets of the PSDU.

3B illustrates an HT-mixed format PPDU for supporting both the IEEE 802.11n system and the IEEE 802.11a/g system.

Referring to (b) of Figure 3, the HT mixed format PPDU is a legacy format preamble consisting of L-STF, L-LTF and L-SIG fields, HT-SIG (HT-Signal) field, HT-STF (HT Short) Training field), HT-LTF (HT Long Training field) is configured including the HT format preamble and data field.

Since the L-STF, L-LTF, and L-SIG fields mean legacy fields for backward compatibility, the L-STF to L-SIG fields are identical to the non-HT format. The L-STA can interpret the data field through the L-LTF, L-LTF, and L-SIG fields even when receiving the HT and mixed PPDUs. However, the L-LTF may further include information for channel estimation to be performed in order for the HT-STA to receive the HT and mixed PPDU and demodulate the L-SIG field and the HT-SIG field.

The HT-STA can know that it is an HT-mixed format PPDU by using the HT-SIG field following the legacy field, and can decode the data field based on this.

The HT-LTF field may be used for channel estimation for demodulation of the data field. Since IEEE 802.11n supports SU-MIMO (Single-User Multi-Input and Multi-Output), a plurality of HT-LTF fields may be configured for channel estimation for each data field transmitted through a plurality of spatial streams.

The HT-LTF field includes data HT-LTF (data HT-LTF) used for channel estimation for a spatial stream and extension HT-LTF (extension HT-LTF) additionally used for full channel sounding can be composed of Accordingly, the plurality of HT-LTFs may be equal to or greater than the number of transmitted spatial streams.

In the HT-mixed format PPDU, the L-STF, L-LTF and L-SIG fields are transmitted first so that the L-STA can also receive and acquire data. After that, the HT-SIG field is transmitted for demodulation and decoding of data transmitted for the HT-STA.

The HT-SIG field is transmitted without beamforming, so that the L-STA and HT-STA can receive the corresponding PPDU and acquire data, and the HT-STF, HT-LTF and data fields transmitted thereafter are precoded Wireless signal transmission is performed through Here, the HT-STF field is transmitted so that the STA receiving the precoding can take into account the variable power due to the precoding, and thereafter, a plurality of HT-LTFs and data fields are transmitted.

Table 1 below is a table illustrating the HT-SIG field.

3C illustrates an HT-greenfield format PPDU (HT-greenfield format PPDU) for supporting only the IEEE 802.11n system.

Referring to FIG. 3C , the HT-GF format PPDU includes HT-GF-STF, HT-LTF1, HT-SIG fields, a plurality of HT-LTF2 fields, and data fields.

HT-GF-STF is used for frame timing acquisition and AGC.

HT-LTF1 is used for channel estimation.

The HT-SIG field is used for demodulation and decoding of the data field.

HT-LTF2 is used for channel estimation for demodulation of the data field.

Similarly, since the HT-STA uses SU-MIMO, channel estimation is required for each data field transmitted in a plurality of spatial streams, so that HT-LTF2 may be configured in plurality.

The plurality of HT-LTF2 may be composed of a plurality of Data and a plurality of extended HT-LTFs, similar to the HT-LTF field of the HT and mixed PPDU.

In (a) to (c) of FIG. 3, the data field is a payload, a service field, a scrambled PSDU field, tail bits, padding bits. may include All bits in the data field are scrambled.

3(d) shows a service field included in a data field. The service field has 16 bits. Each bit is assigned from 0 to 15, and is transmitted sequentially from bit 0. 0Bits 1 to 6 are set to 0, and are used to synchronize a descrambler in the receiving end.

The IEEE 802.11ac WLAN system supports transmission of a downlink Multi User Multiple Input Multiple Output (MU-MIMO) scheme in which a plurality of STAs simultaneously access the channel in order to efficiently use a radio channel. According to the MU-MIMO transmission method, the AP may simultaneously transmit a packet to one or more MIMO paired STAs.

DL MU transmission (downlink multi-user transmission) refers to a technology in which an AP transmits a PPDU to a plurality of non-AP STAs through the same time resource through one or more antennas.

Hereinafter, the MU PPDU refers to a PPDU that transmits one or more PSDUs for one or more STAs using MU-MIMO technology or OFDMA technology. And, the SU PPDU means a PPDU having a format capable of delivering only one PSDU or no PSDU.

For MU-MIMO transmission, the size of the control information transmitted to the STA may be relatively large compared to the size of the 802.11n control information. As an example of control information additionally required for MU-MIMO support, information indicating the number of spatial streams received by each STA, modulation and coding related information of data transmitted to each STA, etc. can be

Accordingly, when MU-MIMO transmission is performed to simultaneously provide a data service to a plurality of STAs, the size of transmitted control information may increase according to the number of receiving STAs.

In order to efficiently transmit the increased size of control information, a plurality of control information required for MU-MIMO transmission is individually requested to a specific STA and common control information commonly required to all STAs. Dedicated control information to be transmitted may be divided into two types of information.

4 illustrates a VHT format PPDU format of a wireless communication system to which the present invention can be applied.

Figure 4 (a) illustrates a VHT format PPDU (VHT format PPDU) for supporting the IEEE 802.11ac system.

Referring to Figure 4 (a), the VHT format PPDU is a legacy format preamble consisting of L-STF, L-LTF and L-SIG fields, VHT-SIG-A (VHT-Signal-A) field, VHT-STF (VHT Short Training field), VHT-LTF (VHT Long Training field), and VHT-SIG-B (VHT-Signal-B) fields are configured to include a VHT format preamble and data fields.

Since L-STF, L-LTF, and L-SIG refer to legacy fields for backward compatibility, the L-STF to L-SIG fields are the same as in the non-HT format. However, the L-LTF may further include information for channel estimation to be performed in order to demodulate the L-SIG field and the VHT-SIG-A field.

The L-STF, L-LTF, L-SIG field, and VHT-SIG-A field may be repeatedly transmitted in units of 20 MHz channels. For example, when a PPDU is transmitted through four 20 MHz channels (ie, 80 MHz bandwidth), the L-STF, L-LTF, L-SIG field and VHT-SIG-A field are transmitted repeatedly in every 20 MHz channel. can be

The VHT-STA may know that it is a VHT format PPDU by using the VHT-SIG-A field following the legacy field, and may decode the data field based on this.

In the VHT format PPDU, the L-STF, L-LTF and L-SIG fields are transmitted first so that the L-STA can also receive and acquire data. Thereafter, the VHT-SIG-A field is transmitted for demodulation and decoding of data transmitted for the VHT-STA.

The VHT-SIG-A field is a field for transmitting control information common to the AP and MIMO paired VHT STAs, and includes control information for interpreting the received VHT format PPDU.

The VHT-SIG-A field may include a VHT-SIG-A1 field and a VHT-SIG-A2 field.

The VHT-SIG-A1 field is used for channel bandwidth (BW: bandwidth) information, whether or not to apply Space Time Block Coding (STBC), group identification information for indicating a group of STAs grouped in MU-MIMO (Contains information about Group ID: Group Identifier), Number of space-time stream (NSTS)/Partial Association Identifier (AID), and Transmit power save forbidden information. can do. Here, the group ID means an identifier assigned to a transmission target STA group to support MU-MIMO transmission, and may indicate whether the currently used MIMO transmission method is MU-MIMO or SU-MIMO.

Table 2 is a table illustrating the VHT-SIG-A1 field.

The VHT-SIG-A2 field includes information on whether to use a short guard interval (GI), Forward Error Correction (FEC) information, information on Modulation and Coding Scheme (MCS) for a single user, and multiple Information on the type of channel coding for the user, beamforming related information, redundant bits for CRC (Cyclic Redundancy Checking) and tail bits of convolutional decoding (convolutional decoder), etc. can

Table 3 is a table illustrating the VHT-SIG-A2 field.

VHT-STF is used to improve the performance of AGC estimation in MIMO transmission.

The VHT-LTF is used by the VHT-STA to estimate the MIMO channel.

Since the VHT WLAN system supports MU-MIMO, the VHT-LTF may be configured as much as the number of spatial streams through which the PPDU is transmitted.

Additionally, when full channel sounding is supported, the number of VHT-LTFs may be increased.

The VHT-SIG-B field includes dedicated control information required for a pluraility of MU-MIMO paired VHT-STAs to receive a PPDU and acquire data. Therefore, only when the PPDU currently received in the common control information included in the VHT-SIG-A field indicates MU-MIMO transmission, the VHT-STA may be designed to decode the VHT-SIG-B field. . On the other hand, when the common control information indicates that the currently received PPDU is for a single VHT-STA (including SU-MIMO), the STA may be designed not to decode the VHT-SIG-B field.

The VHT-SIG-B field includes a VHT-SIG-B length field, a VHT-MCS field, a reserved field, and a tail field.

The VHT-SIG-B length field indicates the length of the A-MPDU (before end-of-frame (EOF) padding). The VHT-MCS field includes information on modulation, encoding, and rate-matching of each VHT-STA.

The size of the VHT-SIG-B field may vary according to a type of MIMO transmission (MU-MIMO or SU-MIMO) and a channel bandwidth used for PPDU transmission.

Figure 4(b) illustrates the VHT-SIG-B field according to the PPDU transmission bandwidth.

Referring to FIG. 4(b), in 40 MHz transmission, the VHT-SIG-B bit is repeated twice. 80For MHz transmission, the VHT-SIG-B bit is repeated 4 times, and a pad bit set to 0 is attached.

160 For MHz transmission and 80+80 MHz, first, as in 80 MHz transmission, the VHT-SIG-B bit is repeated 4 times, and a pad bit set to 0 is attached. Then, all 117 bits are repeated again.

In order to transmit a PPDU of the same size to STAs paired with an AP in a system supporting MU-MIMO, information indicating the bit size of a data field constituting the PPDU and/or indicating a bit stream size constituting a specific field information may be included in the VHT-SIG-A field.

However, the L-SIG field may be used to effectively use the PPDU format. In order to transmit a PPDU of the same size to all STAs, a length field and a rate field included in the L-SIG field and transmitted may be used to provide necessary information. In this case, since MAC Protocol Data Unit (MPDU) and/or Aggregate MAC Protocol Data Unit (A-MPDU) are set based on bytes (or octets) of the MAC layer, additional padding in the physical layer is may be requested

4 , the data field is a payload, and may include a service field, a scrambled PSDU (PSDU), tail bits, and padding bits.

Since various formats of PPDUs are mixed and used as described above, the STA must be able to distinguish the formats of the received PPDUs.

Here, the meaning of distinguishing the PPDU (or the meaning of distinguishing the PPDU format) may have various meanings. For example, the meaning of classifying the PPDU may include the meaning of determining whether the received PPDU is a PPDU that can be decoded (or interpreted) by the STA. In addition, classifying the PPDU may mean determining whether the received PPDU is a PPDU supportable by the STA. Also, the meaning of distinguishing the PPDU may be interpreted as the meaning of distinguishing what kind of information is transmitted through the received PPDU.

This will be described in more detail with reference to the drawings below.

5 is a diagram illustrating a constellation for classifying a format of a PPDU of a wireless communication system to which the present invention can be applied.

Figure 5 (a) illustrates the constellation of the L-SIG field included in the non-HT format PPDU, Figure 5 (b) illustrates the phase rotation (phase rotation) for HT mixed format PPDU detection, Figure 5 (c) illustrates a phase rotation (phase rotation) for VHT format PPDU detection.

In order for the STA to classify non-HT format PPDU, HT-GF format PPDU, HT mixed format PPDU and VHT format PPDU, the L-SIG field and the L-SIG field constellation of OFDM symbols transmitted after the field (constellation) phase is used. That is, the STA may distinguish the PPDU format based on the phase of the constellation of the OFDM symbol transmitted after the

L-SIG field and/or the L-SIG field of the received PPDU.

Referring to FIG. 5A , BPSK (Binary Phase Shift Keying) is used for OFDM symbols constituting the L-SIG field.

First, in order to distinguish the HT-GF format PPDU, when the first SIG field is detected in the received PPDU, the STA determines whether it is the L-SIG field. That is, the STA attempts decoding based on the constellation as in the example of FIG. 5(a). If the STA fails to decode, it may determine that the corresponding PPDU is an HT-GF format PPDU.

Next, in order to classify the non-HT format PPDU, the HT mixed format PPDU, and the VHT format PPDU, the phase of the constellation of the OFDM symbol transmitted after the L-SIG field may be used. That is, the modulation method of the OFDM symbol transmitted after the L-SIG field may be different, and the STA may distinguish the PPDU format based on the modulation method of the field after the L-SIG field of the received PPDU.

Referring to FIG. 5B , in order to distinguish the HT mixed format PPDU, the phases of two OFDM symbols transmitted after the L-SIG field in the HT mixed format PPDU may be used.

More specifically, phases of OFDM symbol #1 and OFDM symbol #2 corresponding to the HT-SIG field transmitted after the L-SIG field in the HT mixed format PPDU are both rotated counterclockwise by 90 degrees. That is, as a modulation method for OFDM symbol #1 and OFDM symbol #2, Quadrature Binary Phase Shift Keying (QBPSK) is used. The QBPSK constellation may be a constellation whose phase is rotated by 90 degrees in a counterclockwise direction with respect to the BPSK constellation.

The STA attempts to decode the first OFDM symbol and the second OFDM symbol corresponding to the HT-SIG field transmitted after the L-SIG field of the received PPDU based on the constellation as shown in the example of FIG. 5(b). If the STA succeeds in decoding, it is determined that the corresponding PPDU is an HT format PPDU.

Next, in order to distinguish the non-HT format PPDU and the VHT format PPDU, the phase of the constellation of the OFDM symbol transmitted after the L-SIG field may be used.

Referring to Figure 5 (c), in order to classify the VHT format PPDU, the phase of two OFDM symbols transmitted after the L-SIG field in the VHT format PPDU may be used.

More specifically, the phase of OFDM symbol #1 corresponding to the VHT-SIG-A field after the L-SIG field in the VHT format PPDU is not rotated, but the phase of OFDM symbol #2 is rotated counterclockwise by 90 degrees . That is, the modulation method for OFDM symbol #1 uses BPSK, and the modulation method for OFDM symbol #2 uses QBPSK.

The STA attempts to decode the first OFDM symbol and the second OFDM symbol corresponding to the VHT-SIG field transmitted after the L-SIG field of the received PPDU based on the constellation shown in the example of FIG. 5(c). If the STA succeeds in decoding, it may determine that the corresponding PPDU is a VHT format PPDU.

On the other hand, if decoding fails, the STA may determine that the corresponding PPDU is a non-HT format PPDU.

MAC frame format

6 illustrates a MAC frame format of an IEEE 802.11 system to which the present invention can be applied.

Referring to FIG. 6 , a MAC frame (ie, MPDU) includes a MAC header, a frame body, and a frame check sequence (FCS).

MAC Header consists of Frame Control field, Duration/ID field, Address 1 field, Address 2 field, Address 3 field, Sequence control (Sequence) field. Control) field, address 4 field, QoS control (QoS Control) field and HT control (HT Control) field is defined as an area including the field.

The Frame Control field includes information about the corresponding MAC frame characteristics.

A more detailed description of the Frame Control field will be described later.

The Duration/ID field may be implemented to have different values according to the type and subtype of the corresponding MAC frame.

If the type and subtype of the corresponding MAC frame is a PS-Poll frame for power save (PS) operation, the Duration/ID field is an association identifier (AID) of the STA that transmitted the frame. may be set to include In other cases, the Duration/ID field may be set to have a specific duration value according to the type and subtype of the corresponding MAC frame. Also, when the frame is an MPDU included in an aggregate-MPDU (A-MPDU) format, the Duration/ID fields included in the MAC header may all be set to have the same value.

The Address 1 field to the Address 4 field include a BSSID, a source address (SA), a destination address (DA), a transmission address (TA) indicating the transmission STA address, and a reception address (TA) indicating the reception STA address. RA: Receiving Address).

Meanwhile, the address field implemented as the TA field may be set to a bandwidth signaling TA (TA) value. In this case, the TA field may indicate that the corresponding MAC frame contains additional information in the scrambling sequence. The bandwidth signaling TA may be expressed as the MAC address of the STA transmitting the corresponding MAC frame, but individual/group bits included in the MAC address may be set to a specific value (eg, '1'). can

The Sequence Control field is set to include a sequence number and a fragment number. The sequence number may indicate a sequence number assigned to the corresponding MAC frame. The fragment number may indicate the number of each fragment of the corresponding MAC frame.

The QoS Control field includes information related to QoS. The QoS Control field may be included when a QoS data frame is indicated in the Subtype subfield.

The HT Control field includes control information related to HT and/or VHT transmission/reception techniques. The HT Control field is included in the Control Wrapper frame. In addition, the Order subfield value is present in the QoS data frame and the Management frame.

The frame body is defined as a MAC payload, and data to be transmitted from an upper layer is located, and has a variable size. For example, the maximum MPDU size may be 11454 octets, and the maximum PPDU size may be 5.484 ms.

The FCS is defined as a MAC footer and is used for error detection of a MAC frame.

The first three fields (Frame Control field, Duration/ID field, and Address 1 field) and the last field (FCS field) constitute the minimum frame format and are present in all frames. Other fields may exist only in a specific frame type.

7 is a diagram illustrating a frame control field in a MAC frame in a wireless communication system to which the present invention can be applied.

Referring to FIG. 7 , the Frame Control field includes a protocol version subfield, a type subfield, a subtype subfield, a To DS subfield, a From DS subfield, and more fragments. It consists of a subfield, a Retry subfield, a Power Management subfield, a More Data subfield, a Protected Frame subfield, and an Order subfield.

The Protocol Version subfield may indicate the version of the WLAN protocol applied to the corresponding MAC frame.

The Type subfield and the Subtype subfield may be set to indicate information identifying the function of the corresponding MAC frame.

The MAC frame type may include three types of frames: a management frame, a control frame, and a data frame.

In addition, each frame type may be divided into subtypes again.

For example, control frames include a request to send (RTS) frame, a clear-to-send (CTS) frame, an acknowledgment (ACK) frame, a PS-Poll frame, a contention free (CF)-End frame, and a CF -End+CF-ACK frame, Block ACK request (BAR: Block Acknowledgment request) frame, Block ACK (BA: Block Acknowledgment) frame, Control Wrapper (Control+HTcontrol) frame, VHT null data packet notification (NDPA) : Null Data Packet Announcement) and a beamforming report poll (Beamforming Report Poll) frame may be included.

Management frames include a Beacon frame, an Announcement Traffic Indication Message (ATIM) frame, a Disassociation frame, an Association Request/Response frame, and a Reassociation Request/response (Reassociation Request/Response) frame. Response) Frame, Probe Request/Response Frame, Authentication Frame, Deauthentication Frame, Action Frame, Action No ACK Frame, Timing Advertisement It may include a frame.

The To DS subfield and From DS subfield may include information necessary to interpret the Address 1 field to the Address 4 field included in the corresponding MAC frame header. In the case of the Control frame, both the To DS subfield and the From DS subfield are set to '0'. In the case of a management frame, the To DS subfield and From DS subfield are set to '1' and '0' in order if the frame is a QoS Management frame (QMF), and in order if the frame is not QMF Both can be set to '0' or '0'.

The More Fragments subfield may indicate whether a fragment to be transmitted following the corresponding MAC frame exists. If another fragment of the current MSDU or MMPDU exists, it may be set to '1', otherwise it may be set to '0'.

The Retry subfield may indicate whether the corresponding MAC frame is in accordance with retransmission of the previous

MAC frame. In case of retransmission of the previous MAC frame, it may be set to '1', otherwise it may be set to '0'.

The Power Management subfield may indicate the power management mode of the STA. If the value of the Power Management subfield is '1', it may indicate that the STA switches to the power save mode.

The More Data subfield may indicate whether a MAC frame to be additionally transmitted exists. If there is a MAC frame to be additionally transmitted, it may be set to '1', otherwise it may be set to '0'.

The Protected Frame subfield may indicate whether the Frame Body field is encrypted. When the Frame Body field includes information processed by an encrypted encapsulation algorithm, it may be set to '1', otherwise it may be set to '0'.

Information included in each of the fields described above may follow the definition of the IEEE 802.11 system. In addition, each of the fields described above corresponds to an example of fields that may be included in the MAC frame, but is not limited thereto. That is, each field described above may be replaced with another field or additional fields may be further included, and all fields may not necessarily be included.

8 illustrates the VHT format of the HT Control field in a wireless communication system to which the present invention can be applied.

8, the HT Control field is a VHT subfield, an HT Control Middle subfield, an AC constraint (AC Constraint) subfield, and a reverse grant (RDG: Reverse Direction Grant)/additional PPDU (More PPDU) it can be composed of subfields.

The VHT subfield indicates whether the HT Control field has the format of the HT Control field for VHT (VHT=1) or the format of the HT Control field for HT (VHT=0). In FIG. 8, it is assumed that the HT Control field for VHT (ie, VHT=1) is assumed. The HT Control field for VHT may be referred to as a VHT Control field.

The HT Control Middle subfield may be implemented to have a different format according to the indication of the VHT subfield. A more detailed description of the HT Control Middle subfield will be described later.

The AC Constraint subfield indicates whether a mapped Access Category (AC) of a reverse direction (RD) data frame is limited to a single AC.

The RDG/More PPDU subfield may be interpreted differently depending on whether the corresponding field is transmitted by an RD initiator or an RD responder.

When transmitted by the RD initiator, the RDG/More PPDU field is set to '1' if the RDG exists, and is set to '0' if the RDG does not exist. When transmitted by the RD responder, if the PPDU including the corresponding subfield is the last frame transmitted by the RD responder, it is set to '1', and if another PPDU is transmitted, it is set to '0'.

As described above, the HT Control Middle subfield may be implemented to have a different format according to the indication of the VHT subfield.

The HT Control Middle subfield of the HT Control field for VHT is a reserved bit, MCS feedback request (MRQ: Modulation and Coding Scheme) feedback request) subfield, MRQ sequence identifier (MSI: MRQ Sequence Identifier) / Space-time block coding (STBC) subfield, MCS feedback sequence identifier (MFSI)/group ID least significant bit (GID-L: LSB (LSB) of Group ID) subfield, MCS Feedback (MFB: MCS Feedback) Subfield, Group ID Most Significant Bit (GID-H: MSB (MSB) of Group ID) Subfield, Coding Type Subfield, Feedback Transmission Type (FB Tx Type: It may be composed of a Feedback Transmission type) subfield and a voluntary MFB (Unsolicited MFB) subfield.

Table 4 shows a description of each subfield included in the HT Control Middle subfield of the VHT format.

The MFB subfield includes a VHT number of space time streams (NUM_STS) subfield, a VHT-MCS subfield, a bandwidth (BW) subfield, and a signal to noise ratio (SNR) subfield. It may include subfields.

The NUM_STS subfield indicates the number of recommended spatial streams.

The VHT-MCS subfield indicates the recommended MCS. The BW subfield indicates bandwidth information related to the recommended MCS. The SNR subfield indicates the average SNR value on the data subcarrier and spatial stream.

Information included in each of the fields described above may follow the definition of the IEEE 802.11 system. In addition, each of the fields described above corresponds to an example of fields that may be included in the MAC frame, but is not limited thereto. That is, each field described above may be replaced with another field or additional fields may be further included, and all fields may not necessarily be included.

media access mechanism

In IEEE 802.11, communication is performed on a shared wireless medium, and thus has fundamentally different characteristics from a wired channel environment.

In a wired channel environment, communication is possible based on carrier sense multiple access/collision detection (CSMA/CD).

For example, once a signal is transmitted from the transmitting end, there is no significant change in the channel environment, and thus the signal is transmitted to the receiving end without experiencing significant signal attenuation. At this time, if two or more signals collided, detection was possible. This is because the power sensed by the receiving end is momentarily greater than the power transmitted by the transmitting end. However, in the wireless channel environment, since various factors (for example, the signal has a large attenuation depending on the distance or may experience instantaneous deep fading) affect the channel, the signal is transmitted properly at the receiving end. Carrier sensing cannot be accurately performed at the transmitter to determine whether this has occurred or a collision has occurred.

Accordingly, in the WLAN system according to IEEE 802.11, a CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) mechanism is introduced as a basic access mechanism of MAC. The CAMA/CA mechanism is also called Distributed Coordination Function (DCF) of IEEE 802.11 MAC, and basically adopts a "listen before talk" access mechanism. According to this type of access mechanism, before starting transmission, the AP and/or STA senses a radio channel or medium for a predetermined time period (eg, DCF Inter-Frame Space (DIFS)) (Sensing) performs CCA (Clear Channel Assessment). As a result of sensing, if it is determined that the medium is in an idle state, frame transmission is started through the corresponding medium. On the other hand, if it is detected that the medium is in an occupied state, the corresponding AP and/or STA does not start its own transmission and adds the medium to the DIFS on the assumption that several STAs are already waiting to use the medium. The frame transmission may be attempted after further waiting for a delay time for access (eg, a random backoff period).

By applying an arbitrary backoff period, assuming that there are several STAs for transmitting a frame, it is expected that several STAs will have different backoff period values and attempt frame transmission after waiting for different times. , collisions can be minimized.

In addition, the IEEE 802.11 MAC protocol provides a Hybrid Coordination Function (HCF). The HCF is based on the DCF and the Point Coordination Function (PCF). PCF refers to a method of periodically polling so that all receiving APs and/or STAs can receive a data frame in a polling-based synchronous access method. In addition, HCF has EDCA (Enhanced Distributed Channel Access) and HCCA (HCF Controlled Channel Access). EDCA is a contention-based access method for a provider to provide data frames to multiple users, and HCCA uses a contention-free channel access method using a polling mechanism. In addition, the HCF includes a medium access mechanism for improving the quality of service (QoS) of the WLAN, and may transmit QoS data in both a contention period (CP) and a contention free period (CFP).

9 is a diagram for explaining an arbitrary backoff period and frame transmission procedure in a wireless communication system to which the present invention can be applied.

When a specific medium is changed from an occupied (occupy or busy) state to an idle state, several STAs may attempt data (or frame) transmission. In this case, as a method to minimize collision, STAs may each select a random backoff count and attempt transmission after waiting for a corresponding slot time. The random backoff count has a pseudo-random integer value and may be determined as one of values uniformly distributed in a range from 0 to a contention window (CW). Here, CW is the contention window parameter value. CW_min is given as an initial value of the CW parameter, but may take a double value when transmission fails (eg, when an ACK for a transmitted frame is not received). When the CW parameter value reaches CW_max, data transmission can be attempted while maintaining the CW_max value until data transmission is successful. The values of CW, CW_min and CW_max are 2^n-1 (n=0, 1, 2, ...) is preferably set.

When the random backoff process is started, the STA counts down the backoff slot according to the determined backoff count value, and continuously monitors the medium during the countdown. If the medium is monitored as occupied, it stops counting down and waits, and resumes the count down when the medium becomes idle.

In the example of FIG. 9 , when a packet to be transmitted to the MAC of STA 3 arrives, STA 3 may check that the medium is idle by DIFS and immediately transmit the frame.

Meanwhile, the remaining STAs monitor that the medium is in a busy state and wait. In the meantime, data to be transmitted may be generated from each of STA 1, STA 2, and STA 5, and each STA waits for DIFS when the medium is monitored in an idle

state, and then backoff slot according to a random backoff count value selected by each STA count down

The example of FIG. 9 shows a case where STA 2 selects the smallest backoff count value and STA 1 selects the largest backoff count value. That is, when STA 2 finishes the backoff count and starts frame transmission, the remaining backoff time of STA 5 is shorter than the remaining backoff time of STA 1 is exemplified.

STA 1 and STA 5 stop counting down and wait while STA 2 occupies the medium. When the media occupation of STA 2 ends and the medium becomes idle again, STA 1 and STA 5 wait for DIFS and then resume the stopped backoff count. That is, frame transmission may be started after counting down the remaining backoff slots for the remaining backoff time. Since the remaining backoff time of STA 5 is shorter than that of STA 1, frame transmission of STA 5 is started.

Meanwhile, while STA 2 occupies the medium, data to be transmitted may occur in STA 4 as well. In this case, when the medium is idle, STA 4 waits for DIFS and then counts down the backoff slot according to a random backoff count value selected by the STA 4 .

In the example of FIG. 9 , a case in which the remaining backoff time of STA 5 coincides with a random backoff count value of STA 4 is shown. In this case, a collision may occur between STA 4 and STA 5 . When a collision occurs, both STA 4 and STA 5 do not receive an ACK, and thus data transmission fails. In this case, after doubling the CW value, STA 4 and STA 5 select a random backoff count value and count down the backoff slot.

On the other hand, STA 1 waits while the medium is in the occupied state due to the transmission of STA 4 and STA 5, waits for DIFS when the medium becomes idle, and then starts frame transmission when the remaining backoff time elapses.

The CSMA/CA mechanism includes virtual carrier sensing in addition to physical carrier sensing in which an AP and/or STA directly senses a medium.

The virtual carrier sensing is to supplement problems that may occur in medium access, such as a hidden node problem. For virtual carrier sensing, the MAC of the WLAN system uses a Network Allocation Vector (NAV). The NAV is a value indicating to other APs and/or STAs the time remaining until the medium becomes available, by the AP and/or STA currently using or authorized to use the medium. Therefore, the value set to NAV corresponds to a period in which the medium is scheduled to be used by the AP and/or STA transmitting the corresponding frame, and the STA receiving the NAV value is prohibited from accessing the medium during the corresponding period. The NAV may be set, for example, according to a value of a duration field of a MAC header of a frame.

The AP and/or STA may perform a procedure of exchanging a request to send (RTS) frame and a clear to send (CTS) frame to inform that they want to access the medium. The RTS frame and the CTS frame include information indicating a time period in which a wireless medium required for transmission and reception of an ACK frame is reserved for access when actual data frame transmission and acknowledgment (ACK) are supported. The other STA that receives the RTS frame transmitted from the AP and/or STA to which the frame is to be transmitted, or the CTS frame transmitted from the frame transmission target STA, receives during the time period indicated by the information included in the RTS/CTS frame. It can be set not to access the medium. This may be implemented by setting the NAV during the time interval.

interframe space

The time interval between frames is defined as the Interframe Space (IFS).

The STA may determine whether a channel is used during the IFS time period through carrier sensing. 802.11 A plurality of IFSs are defined to provide a priority level that occupies a wireless medium in a WLAN system.

10 is a diagram illustrating an IFS relationship in a wireless communication system to which the present invention can be applied.

All timings may be determined with reference to the physical layer interface primitives, ie, PHY-TXEND.confirm primitives, PHYTXSTART.confirm primitives, PHY-RXSTART.indication primitives, and PHY-RXEND.indication primitives.

Frame intervals according to IFS types are as follows.

a) reduced interframe space (RIFS)

b) short interframe space (SIFS)

c) PCF frame interval (PIFS: PCF interframe space)

d) DCF frame interval (DIFS: DCF interframe space)

e) arbitration interframe space (AIFS)

f) extended interframe space (EIFS)

Different IFSs are determined from properties specified by the physical layer regardless of the bit rate of the STA. IFS timing is defined as the time gap on the medium. Except for AIFS, IFS timing is fixed for each physical layer.

SIFS is an ACK frame, a CTS frame, a block ACK request (BlockAckReq) frame, or a PPDU including a block ACK (BlockAck) frame that is an immediate response to an A-MPDU, the second or consecutive MPDU of a fragment burst, PCF It is used for transmission of the STA's response to polling by , and has the highest priority. SIFS may also be used for point coordinator of frames regardless of the type of frame during the contention free period (CFP) time. SIFS indicates the time from the end of the last symbol of the previous frame or signal extension (if present) to the start of the first symbol of the preamble of the following frame.

SIFS timing is achieved when transmission of successive frames starts at TxSIFS slot boundaries.

SIFS is the shortest among IFSs between transmissions from different STAs. It may be used when the STA occupying the medium needs to maintain the occupation of the medium during a period during which a frame exchange sequence is performed.

By using the smallest gap between transmissions in the frame exchange sequence, it is possible to prevent other STAs from attempting to use the medium, which are required to wait for the medium to become idle during a longer gap. Accordingly, priority can be given to the completion of an ongoing frame exchange sequence.

PIFS is used to gain priority to access media.

PIFS can be used in the following cases.

- STA operating under PCF

- STA that transmits a Channel Switch Announcement frame

- STA that transmits a Traffic Indication Map (TIM) frame

- Hybrid Coordinator (HC) that initiates CFP or Transmission Opportunity (TXOP)

- HC or non-AP QoS STA that is a polled TXOP holder for recovering from the absence of expected reception in a controlled access phase (CAP)

- HT STA using dual CTS protection before transmission of CTS2

- TXOP holder for continuing transmission after transmission failure

- RD (reverse direction) initiator to continue sending using error recovery

- HT AP during PSMP sequence to transmit power save multi-poll (PSMP) recovery frame

- HT STA performing CCA in a secondary channel before transmitting a 40 MHz mask PPDU using EDCA channel access

Except for the case of performing CCA in the secondary channel among the examples listed above, the STA using PIFS starts transmission after a carrier sense (CS) mechanism that determines that the medium is idle at the TxPIFS slot boundary.

DIFS may be used by STAs that operate to transmit data frames (MPDUs) and management frames (MMPDUs) under DCF. The STA using DCF can transmit at the TxDIFS slot boundary if it is determined that the medium is idle through the carrier sense (CS) mechanism after the correctly received frame and the backoff time have expired. Here, the correctly received frame means a frame in which the PHY-RXEND.indication primitive does not indicate an error and the FCS indicates that the frame is error free.

The SIFS time ('aSIFSTime') and the slot time ('aSlotTime') may be determined for each physical layer. The SIFS time has a fixed value, but the slot time can be dynamically changed according to a change in the radio delay time (aAirPropagationTime).

'aSIFSTime' is defined as in Equations 1 and 2 below.

'aSlotTime' is defined as in Equation 3 below.

In Equation 3, the default physical layer parameter is based on 'aMACProcessingDelay' having a value equal to or smaller than 1 μs.

The radio wave spreads at 300 m/s in free space.

For example, 3 μs may be the upper limit of the BSS maximum one-way distance ~450m (round trip is ~900m).

PIFS and SIFS are defined as Equations 4 and 5 below, respectively.

Numerical values in parentheses in Equations 1 to 5 above illustrate general values, but the values may vary for each STA or for each STA location.

The above-described SIFS, PIFS, and DIFS are measured based on MAC slot boundaries (TxSIFS, TxPIFS, and TxDIFS) different from the medium.

Each MAC slot boundary for SIFS, PIFS, and DIFS is defined as Equations 6 to 8 below, respectively.

Channel State Information feedback (feedback) method

SU-MIMO technology, in which a beamformer allocates all antennas to one beamformee and communicates, increases channel capacity through diversity gain using space-time and stream multiplexing. .

The SU-MIMO technology increases the number of antennas compared to the case where the MIMO technology is not applied, thereby extending the spatial freedom, thereby contributing to the improvement of physical layer performance.

In addition, the MU-MIMO technology, in which the Beamformer allocates antennas to a plurality of Beamformees, through a link layer protocol for multiple access of a plurality of Beamformees connected to the Beamformer, increases the transmission rate per Beamformee or increases the reliability of the MIMO antenna by increasing the reliability of the channel. performance can be improved.

In the MIMO environment, how accurately the beamformer knows the channel information can have a big impact on performance, so a feedback procedure for acquiring channel information is required.

Two types of feedback procedures for acquiring channel information may be supported.

One is a method using a control frame, and the other is a method using a channel sounding procedure that does not include a data field.

Sounding means using a corresponding training field to measure a channel for purposes other than data demodulation of a PPDU including a preamble training field.

Hereinafter, a channel information feedback method using a control frame and a channel information feedback method using a null data packet (NDP) will be described in more detail.

1)

Feedback method using control frame

In the MIMO environment, the Beamformer may instruct the feedback of the channel state information through the HT control field included in the MAC header, or the Beamformee may report the channel state information through the HT control field included in the MAC frame header (see FIG. 8). .

The HT control field may be included in a control wrapper frame or a QoS data frame or management frame in which the Order subfield of the MAC header is set to 1.

2)

Feedback method using channel sounding

11 is a diagram conceptually illustrating a channel sounding method in a wireless communication system to which the present invention can be applied.

11 exemplifies a method of feeding back channel state information between a Beamformer (eg, AP) and a Beamformee (eg, a non-AP STA) based on a sounding protocol.

A sounding protocol may refer to a procedure for receiving feedback information on channel state information.

The channel state information sounding method between Beamformer and Beamformee based on the sounding protocol may be

performed in the following steps.

(1) The Beamformer transmits a VHT Null Data Packet Announcement (VHT NDPA) frame notifying transmission of sounding for feedback of Beamformee.

The VHT NDPA frame means a control frame used to inform that channel sounding is started and that a null data packet (NDP) will be transmitted.

In other words, by transmitting the VHT NDPA frame before transmitting the NDP, the Beamformee can prepare to feed back the channel state information before receiving the NDP frame.

The VHT NDPA frame may include association identifier (AID) information and feedback type information of Beamformee to transmit NDP.

A more detailed description of the VHT NDPA frame will be described later.

The VHT NDPA frame may be transmitted in different transmission methods when data is transmitted using MU-MIMO and when data is transmitted using SU-MIMO.

For example, when channel sounding for MU-MIMO is performed, a VHT NDPA frame is transmitted in a broadcast method, but when channel sounding for SU-MIMO is performed, a VHT NDPA frame is sent to one target STA. can be transmitted in a unicast manner.

(2)

After transmitting the VHT NDPA frame, the Beamformer transmits the NDP after the SIFS time. NDP has a VHT PPDU structure excluding data fields.

Beamformees that have received the VHT NDPA frame may check the value of the AID12 subfield included in the STA information field and determine whether they are a sounding target STA.

In addition, Beamformees can know the feedback order through the order of the STA Info field included in the NDPA. 11 exemplifies a case in which the feedback order proceeds in the order of Beamformee 1, Beamformee 2, and Beamformee 3.

(3)

Beamformee 1 obtains downlink channel state information based on a training field included in the NDP and generates feedback information to be transmitted to the Beamformer.

After receiving the NDP frame, Beamformee 1 transmits a VHT Compressed Beamforming frame including feedback information to the Beamformer after SIFS.

The VHT Compressed Beamforming frame may include information about an SNR value for a space-time stream, a compressed beamforming feedback matrix for a subcarrier, and the like.

A more detailed description of the VHT Compressed Beamforming frame will be described later.

(4)

After receiving the VHT Compressed Beamforming frame from Beamformee 1, the Beamformer transmits a Beamforming Report Poll frame to Beamformee 2 to obtain channel information from Beamformee 2 after SIFS.

The Beamforming Report Poll frame is a frame that performs the same role as the NDP frame, and Beamformee 2 may measure a channel state based on the transmitted Beamforming Report Poll frame.

A more detailed description of the beamforming report poll frame frame will be described later.

(5)

After receiving the Beamforming Report Poll frame, Beamformee 2 transmits a VHT Compressed Beamforming frame including feedback information to the Beamformer after SIFS.

(6)

After receiving the VHT Compressed Beamforming frame from Beamformee 2, the Beamformer transmits a Beamforming Report Poll frame to Beamformee 3 to obtain channel information from Beamformee 3 after SIFS.

(7)

After receiving the Beamforming Report Poll frame, Beamformee 3 transmits a VHT Compressed Beamforming frame including feedback information to the Beamformer after SIFS.

Hereinafter, a frame used in the above-described channel sounding procedure will be described.

12 is a diagram illustrating a VHT NDPA frame in a wireless communication system to which the present invention can be applied.

Referring to Figure 12, the VHT NDPA frame is a frame control (Frame Control) field, a duration (Duration) field, RA (Receiving Address) field, TA (Transmitting Address) field, sounding dialog token (Sounding Dialog Token) field, It may consist of an STA information 1 (STA Info 1) field, an STA information n (STA Info n) field, and an FCS.

The RA field value indicates a receiver address or an STA address for receiving the VHT NDPA frame.

When the VHT NDPA frame includes one STA Info field, the RA field value has the address of the STA identified by the AID in the STA Info field.

For example, when transmitting a VHT NDPA frame to one target STA for SU-MIMO channel sounding, the AP transmits the VHT NDPA frame to the target STA by unicast.

On the other hand, when the VHT NDPA frame includes one or more STA Info fields, the RA field value has a broadcast address.

For example, when transmitting a VHT NDPA frame to at least one target STA for MU-MIMO channel sounding, the AP broadcasts the VHT NDPA frame.

The TA field value indicates a transmitter address for transmitting the VHT NDPA frame, an address of a transmitting STA, or a bandwidth for signaling the TA.

The Sounding Dialog Token field may be referred to as a sounding sequence field.

The Sounding Dialog Token Number subfield in the Sounding Dialog Token field contains a value selected by the Beamformer to identify the VHT NDPA frame.

* The VHT NDPA frame includes at least one STA Info field.

That is, the VHT NDPA frame includes an STA Info field including information on a sounding target STA.

One STA Info field may be included for each sounding target STA.

Each STA Info field may include an AID12 subfield, a Feedback Type subfield, and an Nc Index subfield.

Table 5 shows subfields of the STA Info field included in the VHT NDPA frame.

Information included in each of the fields described above may follow the definition of the IEEE 802.11 system.

In addition, each of the fields described above corresponds to an example of fields that may be included in the MAC frame, and may be replaced with other fields or additional fields may be further included.

13 is a diagram illustrating an NDP PPDU in a wireless communication system to which the present invention can be applied.

Referring to FIG. 13 , the NDP may have a format in which a data field is omitted from the VHT PPDU format shown in FIG. 4 above. The NDP may be precoded based on a specific precoding matrix and transmitted to a sounding target STA.

In the L-SIG field of the NDP, the length field indicating the PSDU length included in the data field is set to '0'.

In the VHT-SIG-A field of NDP, the Group ID field indicating whether the transmission scheme used for NDP transmission is MU-MIMO or SU-MIMO is set to a value indicating SU-MIMO transmission.

The data bits of the VHT-SIG-B field of the NDP are set in a fixed bit pattern for each bandwidth.

When the sounding target STA receives the NDP, it estimates a channel based on the VHT-LTF field of the NDP and acquires channel state information.

14 is a diagram illustrating a VHT compressed beamforming frame format in a wireless communication system to which the present invention can be applied.

Referring to FIG. 14 , the VHT compressed beamforming frame is a VHT action frame for supporting the VHT function, and includes an Action field in the Frame Body. The Action field is included in the Frame Body of the MAC frame to provide a mechanism for specifying extended management operations.

The Action field includes a Category field, a VHT Action field, a VHT MIMO Control field, a VHT Compressed Beamforming Report field, and a MU Exclusive Beamforming report. Report) field.

The Category field is set to a value indicating a VHT category (ie, VHT Action frame), and the VHT Action field is set to a value indicating a VHT Compressed Beamforming frame.

The VHT MIMO Control field is used to feed back control information related to beamforming feedback. The VHT MIMO Control field may always exist in the VHT Compressed Beamforming frame.

The VHT Compressed Beamforming Report field is used to feed back information about a beamforming metric including SNR information for a space-time stream used to transmit data.

The MU Exclusive Beamforming Report field is used to feed back SNR information on a spatial stream when MU-MIMO transmission is performed.

The existence and content of the VHT Compressed Beamforming Report field and the MU Exclusive Beamforming Report field are the Feedback Type subfield of the VHT MIMO Control field, the Remaining Feedback Segments subfield, and the first feedback segment (First). Feedback Segment) may be determined according to the value of the subfield.

Hereinafter, the VHT MIMO Control field, the VHT Compressed Beamforming Report field, and the MU Exclusive Beamforming Report field will be described in more detail.

1) The VHT MIMO Control field is an Nc index subfield, an Nr index subfield, a channel width subfield, a grouping subfield, a codebook information subfield, and a feedback type. (Feedback Type) subfield, Remaining Feedback Segments subfield, First Feedback Segment subfield, reserved subfield, and Sounding Dialog Token Number subfield is composed

Table 6 shows subfields of the VHT MIMO Control field.

If the VHT Compressed Beamforming frame does not convey all or part of the VHT Compressed Beamforming Report field, Nc Index subfield, Channel Width subfield, Grouping subfield, Codebook Information subfield, Feedback Type subfield, and Sounding Dialog Token Number subfield is set as a reserved field, the First Feedback Segment subfield is set to '0', and the Remaining Feedback Segments subfield is set to '7'.

The Sounding Dialog Token Number subfield may be referred to as a Sounding Sequence Number subfield.

2) The VHT compressed beamforming report field indicates the compressed beamforming feedback matrix 'V' used by the transmitting Beamformer to determine the steering matrix 'Q' in the form of an angle. used to transmit

Table 7 shows subfields of the VHT compressed beamforming report field.

Referring to Table 7, the VHT compressed beamforming report field may include an average SNR for each space-time stream and a compressed beamforming feedback matrix 'V' for each subcarrier.

The compressed beamforming feedback matrix is a matrix including information on channel conditions and is used to calculate a channel matrix (ie, a steering matrix 'Q') in a transmission method using MIMO.

scidx() means a subcarrier through which the Compressed Beamforming Feedback Matrix subfield is transmitted.

Na is fixed by the value of Nr × Nc (eg, when Nr × Nc = 2 × 1, ?11, ?21, ..).

Ns means the number of subcarriers through which the compressed beamforming feedback matrix is transmitted to the beamformer. Beamformee can reduce the number of Ns through which the compressed beamforming feedback matrix is transmitted by using a grouping method. For example, the number of fed back compressed beamforming feedback matrices can be reduced by grouping a plurality of subcarriers into one group and transmitting the compressed beamforming feedback matrix for each group. Ns may be calculated from the Channel Width subfield and the Grouping subfield included in the VHT MIMO

Control field.

Table 8 illustrates an Average SNR of Space-Time (SNR) Stream subfield of a space-time stream.

Referring to Table 8, the average SNR for each spatio-temporal stream is calculated by calculating the average SNR value for all subcarriers included in the channel and mapping the average SNR value to a range of -128 to +128.

3)

The MU Exclusive Beamforming Report field is used to deliver explicit feedback information expressed in the form of delta () SNR. Information in the VHT Compressed Beamforming Report field and the MU Exclusive Beamforming Report field may be used by the MU Beamformer to determine a steering matrix 'Q'.

Table 9 shows subfields of the MU Exclusive Beamforming Report field included in the VHT compressed beamforming frame.

Referring to Table 9, the MU Exclusive Beamforming Report field may include SNR per spatiotemporal stream for each subcarrier.

Each Delta SNR subfield has a value in increments of 1dB between -8dB and 7dB.

scidx() means subcarrier(s) on which the Delta SNR subfield is transmitted, and Ns means the number of subcarriers on which the Delta SNR subfield is transmitted to the Beamformer.

15 is a diagram illustrating a beamforming report poll frame format in a wireless communication system to which the present invention can be applied.

15 , the Beamforming Report Poll frame includes a Frame Control field, a Duration field, a Receiving Address (RA) field, a Transmitting Address (TA) field, and a Feedback Segment Retransmission Bitmap.) field and FCS.

The RA field value indicates the address of the intended recipient.

The TA field value indicates an address of an STA that transmits the Beamforming Report Poll frame or a bandwidth signaling the TA.

The Feedback Segment Retransmission Bitmap field indicates a feedback segment requested in a VHT Compressed Beamforming report.

If the bit at position n in the Feedback Segment Retransmission Bitmap field value is '1' (n=0 for LSB, n=7 for MSB), the corresponding n in the Remaining Feedback Segments subfield in the VHT MIMO Control field of the VHT compressed beamforming frame is A feedback segment is requested.

On the other hand, if the bit at position n is '0', the feedback segment corresponding to n in the Remaining Feedback Segments subfield in the VHT MIMO Control field is not requested.

Group ID

Since the VHT WLAN system supports the MU-MIMO transmission method for higher throughput, the AP may simultaneously transmit a data frame to at least one MIMO-paired STA.

The AP may simultaneously transmit data to an STA group including at least one STA among a plurality of STAs associated with the AP. For example, the number of paired STAs may be a maximum of 4, and when the maximum number of spatial streams is 8, a maximum of 4 spatial streams may be allocated to each STA.

In addition, in a WLAN system that supports Tunneled Direct Link Setup (TDLS), Direct Link Setup (DLS), or a mesh network, an STA that wants to transmit data transmits the PPDU to a plurality of STAs using the MU-MIMO transmission method. can be sent to

Hereinafter, an example in which the AP transmits a PPDU to a plurality of STAs according to the MU-MIMO transmission scheme will be described.

The AP simultaneously transmits the PPDU through different spatial streams to the STAs belonging to the paired transmission target STA group. As described above, the VHT-SIG A field of the VHT PPDU format includes group ID information and space-time stream information so that each STA can check whether the PPDU is transmitted to itself. In this case, data may not be transmitted because a spatial stream is not allocated to a specific STA of the transmission target STA group.

A Group ID Management frame is used to assign or change a user position corresponding to one or more Group IDs. That is,

the AP may inform STAs associated with a specific group ID through the Group ID Management frame before performing MU-MIMO transmission.

16 is a diagram illustrating a Group ID Management frame in a wireless communication system to which the present invention can be applied.

Referring to FIG. 16 , the Group ID Management frame is a VHT action frame for supporting the VHT function, and includes an Action field in the Frame Body. The Action field is included in the Frame Body of the MAC frame to provide a mechanism for specifying extended management operations.

The Action field includes a Category field, a VHT Action field, a Membership Status Array field, and a User Position Array field.

The Category field is set to a value indicating a VHT category (ie, VHT Action frame), and the VHT Action field is set to a value indicating a Group ID Management frame.

The Membership Status Array field consists of a 1-bit Membership Status subfield for each group. If the Membership Status subfield is set to '0', it indicates that the STA is not a member of the corresponding group, and if it is set to '1', it indicates that the STA is a member of the corresponding group. One or more groups may be assigned to the STA by setting one or more Membership Status subfields in the Membership Status Array field to '1'.

*STA may have one user position in each group to which it belongs.

The User Position Array field consists of a 2-bit User Position subfield for each group.

The user position of the STA in the group to which it belongs is indicated by the User Position subfield in the User Position Array field. The AP may allocate the same user position to different STAs in each group.

The AP may transmit the Group ID Management frame only when the dot11VHTOptionImplemented parameter is 'true'. The Group ID Management frame is transmitted only to the VHT STA in which the MU Beamformee Capable field in the VHT Capabilities element field is set to '1'. The Group ID Management frame is transmitted as a frame addressed to each STA.

The STA receives a Group ID Management frame having an RA field matching its MAC address. The STA updates the PHYCONFIG_VECTOR parameter, GROUP_ID_MANAGEMENT, based on the contents of the received Group ID Management frame.

Transmission of the Group ID Management frame to the STA and transmission of an ACK thereto from the STA are completed before transmitting the MU PPDU to the STA.

The MU PPDU is transmitted to the STA based on the contents of the Group ID Management frame in which it is most recently transmitted and the ACK is received.

Downlink MU-MIMO Frame (DL MU-MIMO Frame)

17 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

Referring to FIG. 17, the PPDU is configured to include a preamble and a data field.

The data field may include a service field, a scrambled PSDU field, tail bits, and padding bits.

The AP may transmit a data frame in an aggregated MPDU (A-MPDU) format by aggregating MPDUs. In this case, the scrambled PSDU (scrambled PSDU) field may consist of an A-MPDU.

The A-MPDU consists of a sequence of one or more A-MPDU subframes.

In the case of VHT PPDU, since the length of each A-MPDU subframe is a multiple of 4 octets, the A-MPDU is 0 after the last A-MPDU subframe in order to fit the A-MPDU to the last octet of the PSDU. It may include an end-of-frame (EOF) pad of to 3 octets.

The A-MPDU subframe consists of an MPDU delimiter, and optionally the MPDU may be included after the MPDU delimiter. In addition, except for the last A-MPDU subframe in one A-MPDU, a pad octet is attached after the MPDU to make the length of each A-MPDU subframe a multiple of 4 octets.

The MPDU Delimiter consists of a Reserved field, an MPDU Length field, a cyclic redundancy check (CRC) field, and a delimiter signature field.

In the case of a VHT PPDU, the MPDU Delimiter may further include an end-of-frame (EOF) field. In the case of an A-MPDU subframe used for padding when the MPDU Length field is 0, or an A-MPDU subframe in which the corresponding MPDU is loaded when the A-MPDU consists of only one MPDU, the EOF field is set to '1' do. Otherwise, it is set to '0'.

The MPDU Length field includes information on the length of the MPDU.

If there is no MPDU in the corresponding A-MPDU subframe, it is set to '0'. The A-MPDU subframe in which the MPDU Length field has a value of '0' is used when padding the A-MPDU to fit the A-MPDU to the available octets in the VHT PPDU.

The CRC field includes CRC information for error checking, and the Delimiter Signature field includes pattern information used to search for the MPDU delimiter.

And, the MPDU consists of a MAC header, a frame body, and a frame check sequence (FCS).

18 is a diagram illustrating a downlink multi-user PPDU format in a wireless communication system to which the present invention can be applied.

18 shows that the number of STAs receiving the corresponding PPDU is 3 and the number of spatial streams allocated to each STA is 1, but the number of STAs paired to the AP and the number of spatial streams allocated to each STA is not limited thereto.

18, the MU PPDU includes an L-TFs field (L-STF field and L-LTF field), L-SIG field, VHT-SIG-A field, and VHT-TFs field (VHT-STF field and VHT-LTF field). field), a VHT-SIG-B field, a Service field, one or more PSDUs, a padding field, and a Tail bit. The L-TFs field, the L-SIG field, the VHT-SIG-A field, the VHT-TFs field, and the VHT-SIG-B field are the same as in the example of FIG. 4 , and thus detailed descriptions thereof will be omitted.

Information for indicating the PPDU duration may be included in the L-SIG field. Within the PPDU, the PPDU duration indicated by the L-SIG field includes a symbol to which the VHT-SIG-A field is assigned, a symbol to which the VHT-TFs field is assigned, a field to which the VHT-SIG-B field is assigned, and the Service field. It includes bits constituting the bits constituting the PSDU, bits constituting the padding field, and bits constituting the Tail field. The STA receiving the PPDU may obtain information on the duration of the PPDU through information indicating the duration of the PPDU included in the L-SIG field.

As described above, group ID information and information on the number of spatiotemporal streams per user are transmitted through VHT-SIG-A, and a coding method and MCS information are transmitted through VHT-SIG-B. Therefore, Beamformees can check VHT-SIG-A and VHT-SIG-B and know whether it is the MU MIMO frame to which they belong. Accordingly, a STA that is not a member of the corresponding Group ID or a member of the corresponding Group ID or an STA whose number of allocated streams is '0' reduces power consumption by setting to stop reception of the physical layer from after the VHT-SIG-A field to the end of the PPDU. can do.

By receiving the Group ID Management frame transmitted by the Beamformer in advance, the Group ID can know which MU group the Beamformee belongs to, which user it belongs to, that is, through which stream it receives the PPDU.

802.11 All MPDUs transmitted in the VHT MU PPDU based on ac are included in the A-MPDU. In the data field of FIG. 18, each VHT A-MPDU may be transmitted in different streams.

In FIG. 18 , since the size of data transmitted to each STA may be different, each A-MPDU may have a different bit size.

In this case, null padding may be performed so that the transmission end time of the plurality of data frames transmitted by the Beamformer is the same as the transmission end time of the maximum interval transmission data frame. The maximum period transmission data frame may be a frame in which valid downlink data is transmitted for the longest period by the Beamformer. The valid downlink data may be downlink data that is not null padded. For example, valid downlink data may be transmitted while being included in the A-MPDU. Null padding may be performed on the remaining data frames except for the maximum interval transmission data frame among the plurality of data frames.

For null padding, the Beamformer may encode and fill one or more A-MPDU subframes located temporally lower in a plurality of A-MPDU subframes within the A-MPDU frame only with the MPDU delimiter field. An A-MPDU subframe having an MPDU length of 0 may be referred to as a null subframe.

As described above, in the null subframe, the EOF field of the MPDU Delimiter is set to '1'. Accordingly, when the MAC layer of the receiving STA detects the EOF field set to 1, power consumption can be reduced by setting the physical layer to stop reception.

Block ACK (Block Ack) Procedure

19 is a diagram illustrating a downlink MU-MIMO transmission process in a wireless communication system to which the present invention can be applied.

802.11

In ac, MU-MIMO is defined in the downlink from the AP to the client (ie, non-AP STA). In this case, a multi-user frame is simultaneously transmitted to multiple receivers, but acknowledgment must be individually transmitted in the uplink.

802.11Since all MPDUs transmitted in the VHT MU PPDU based on ac are included in the A-MPDU, the response to the A-MPDU in the VHT MU PPDU, not the immediate response to the VHT MU PPDU, is a block ACK request by the AP (BAR: It is sent in response to the Block Ack Request) frame.

First, the AP transmits a VHT MU PPDU (ie, preamble and data) to all receivers (ie, STA 1 , STA 2 , STA 3). The VHT MU PPDU includes a VHT A-MPDU transmitted to each STA.

Upon receiving the VHT MU PPDU from the AP, STA 1 transmits a block acknowledgment (BA) frame to the AP after SIFS. A more detailed description of the BA frame will be described later.

* After receiving the BA from STA 1, the AP transmits a block acknowledgment request (BAR) frame to the next STA 2 after SIFS, and STA 2 transmits a BA frame to the AP after SIFS.

After receiving the BA frame from STA 2, the AP transmits a BAR frame to STA 3 after SIFS, and STA 3 transmits a BA frame to the AP after SIFS.

When this process is performed for all STAs, the AP transmits the next MU PPDU to all STAs.

ACK (Acknowledgment) / Block ACK (Block ACK) frame

In general, an ACK frame is used as a response to an MPDU, and a block ACK frame is used as a response to an A-MPDU.

20 is a diagram illustrating an ACK frame in a wireless communication system to which the present invention can be applied.

Referring to FIG. 20, the ACK frame includes a frame control field, a duration field, an RA field, and an FCS.

The RA field is the second address (Address 2) field of a data frame, a management frame, a block ACK request frame, a block ACK (Block Ack) frame, or a PS-Poll frame received immediately before is set to the value of

When the ACK frame is transmitted by the non-QoS (non-QoS) STA, the More Fragments subfield in the Frame Control field of the immediately received Data frame and the Management frame is If '0', the duration value is set to '0'.

In an ACK frame that is not transmitted by a non-QoS (non-QoS) STA, the duration value is a data frame, a management frame, a block ACK request frame, and a block received immediately before. It is set as a value (ms) obtained by subtracting the time required for ACK frame transmission and the SIFS period from the Duration/ID field of the ACK (Block Ack) frame or the PS-Poll frame.

If the calculated duration value is not an integer value, it is rounded up.

Hereinafter, a block ACK (request) frame will be described.

21 is a diagram illustrating a block ACK request frame in a wireless communication system to which the present invention can be applied.

Referring to Figure 21, the block ACK request (BAR) frame is a frame control (Frame Control) field, duration / identifier (Duration / ID) field, receiving address (RA) field, transmission address (TA) field, BAR control (It consists of a BAR control field, a BAR information field, and a frame check sequence (FCS).

The RA field may be set to the address of the STA that receives the BAR frame.

The TA field may be set to the address of the STA transmitting the BAR frame.

The BAR control field includes a BAR Ack Policy subfield, a Multi-TID subfield, a Compressed Bitmap subfield, a Reserved subfield, and a TID information (TID_Info) subfield. includes

Table 10 is a table illustrating the BAR control field.

The BAR information field includes different information according to the type of the BAR frame.

This will be described with reference to FIG. 22 .

22 is a diagram illustrating a BAR information field of a block ACK request frame in a wireless communication system to which the present invention can be applied.

22(a) illustrates the BAR Information field of a Basic BAR frame and a Compressed BAR frame, and FIG. 22(b) illustrates a BAR Information field of a Multi-TID BAR frame.

Referring to FIG. 22(a), in the case of a Basic BAR frame and a Compressed BAR frame, the BAR Information field includes a Block Ack Starting Sequence Control subfield.

In addition, the Block Ack Starting Sequence Control subfield includes a fragment number subfield and a starting sequence number subfield.

The Fragment Number subfield is set to 0.

In the case of a Basic BAR frame, the Starting Sequence Number subfield contains the sequence number of the first MSDU in which the corresponding BAR frame is transmitted. In the case of a Compressed BAR frame, the Starting Sequence Control subfield includes the sequence number of the first MSDU or A-MSDU for transmitting the corresponding BAR frame.

* Referring to FIG. 22(b), in the case of a Multi-TID BAR frame, the BAR Information field includes one or more per TID Info subfields and one or more Block Ack Starting Sequence Control subfields. It is configured repeatedly for each TID.

The Per TID Info subfield includes a Reserved subfield and a TID Value subfield.

The TID Value subfield contains a TID value.

The Block Ack Starting Sequence Control subfield includes the Fragment Number and Starting Sequence Number subfields as described above. The Fragment Number subfield is set to 0. The Starting Sequence Control subfield includes the sequence number of the first MSDU or A-MSDU for which the corresponding BAR frame is to be transmitted.

23 is a diagram illustrating a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

Referring to FIG. 23 , the block ACK (BA) frame includes a frame control field, a duration/identifier (Duration/ID) field, a receiving address (RA) field, a transmission address (TA) field, and a BA control (BA) field. control) field, a BA Information field, and a frame check sequence (FCS).

The RA field may be set to the address of the STA that requested the block ACK.

The TA field may be set to the address of the STA transmitting the BA frame.

The BA control field is a BA Ack Policy subfield, a Multi-TID subfield, a Compressed Bitmap subfield, a Reserved subfield, and a TID information (TID_Info) subfield. includes

Table 11 is a table illustrating the BA control field.

The BA Information field includes different information according to the type of the BA frame.

This will be described with reference to FIG. 24 .

24 is a diagram illustrating a BA Information field of a block ACK (Block Ack) frame in a wireless communication system to which the present invention can be applied.

24(a) illustrates the BA Information field of the Basic BA frame, FIG. 24(b) illustrates the BA Information field of the Compressed BA frame, and FIG. 24(c) illustrates the BA Information field of the Multi-TID BA frame exemplify

Referring to FIG. 24(a), in the case of a Basic BA frame, the BA Information field includes a Block Ack Starting Sequence Control subfield and a Block Ack Bitmap subfield.

The Block Ack Starting Sequence Control subfield includes a Fragment Number subfield and a Starting Sequence Number subfield as described above.

The Fragment Number subfield is set to 0.

The Starting Sequence Number subfield contains the sequence number of the first MSDU for which the corresponding BA frame is transmitted, and is set to the same value as the previously received Basic BAR frame.

The Block Ack Bitmap subfield has a length of 128 octets and is used to indicate the reception status of up to 64 MSDUs. In the Block Ack Bitmap subfield, a value of '1' indicates that the MPDU corresponding to the corresponding bit position was successfully received, and a value of '0' indicates that the MPDU corresponding to the corresponding bit position was not successfully received.

Referring to FIG. 24B , in the case of a compressed BA frame, the BA Information field includes a Block Ack Starting Sequence Control subfield and a Block Ack Bitmap subfield.

The Block Ack Starting Sequence Control subfield includes a Fragment Number subfield and a Starting Sequence Number subfield as described above.

The Fragment Number subfield is set to 0.

The Starting Sequence Number subfield contains the sequence number of the first MSDU or A-MSDU for the BA frame to be transmitted, and is set to the same value as the Basic BAR frame received immediately before.

The Block Ack Bitmap subfield has a length of 8 octets and is used to indicate reception status of up to 64 MSDUs and A-MSDUs. In the Block Ack Bitmap subfield, a value of '1' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received, and a value of '0' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received. indicates that it has not been received.

Referring to FIG. 24(c), in the case of a Multi-TID BA frame, the BA Information field includes a per TID Info subfield, a Block Ack Starting Sequence Control subfield, and a block ACK bit. Map (Block Ack Bitmap) subfields are repeatedly configured for each one or more TIDs, and are configured in the order of increasing TIDs.

The Per TID Info subfield includes a Reserved subfield and a TID Value subfield. The TID Value subfield contains a TID value.

The Block Ack Starting Sequence Control subfield includes the Fragment Number and Starting Sequence Number subfields as described above. The Fragment Number subfield is set to 0. The Starting Sequence Control subfield contains the sequence number of the first MSDU or A-MSDU for which the corresponding BA frame is to be transmitted.

The Block Ack Bitmap subfield consists of a length of 8 octets. In the Block Ack Bitmap subfield, a value of '1' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received, and a value of '0' indicates that a single MSDU or A-MSDU corresponding to the bit position has been successfully received. indicates that it has not been received.

Uplink multi-user transmission method

A new frame for the next-generation WLAN system, 802.11ax, in the context of increasing interest from vendors in various fields for next-generation WiFi and increasing demand for high throughput and quality of experience (QoE) performance improvement after 802.11ac There is an active discussion of format and numerology.

IEEE 802.11ax is one of the recently proposed WLAN systems as a next-generation WLAN system to support a higher data rate and handle a higher user load, so-called High Efficiency WLAN (HEW). It is called Efficiency WLAN).

The IEEE 802.11ax WLAN system may operate in the 2.4 GHz frequency band and the 5 GHz frequency band in the same way as the existing WLAN system.

It can also operate in a higher frequency band of 60 GHz.

In the IEEE 802.11ax system, for average throughput enhancement and outdoor robust transmission against inter-symbol interference in an outdoor environment, the existing IEEE 802.11 OFDM system (IEEE 802.11a, 802.11n) , 802.11ac, etc.) can use an FFT size four times larger at each bandwidth. This will be described with reference to the drawings below.

Hereinafter, in the description of the HE format PPDU in the present invention, the description of the non-HT format PPDU, the HT-mixed format PPDU, the HT-greenfield format PPDU and/or the VHT format PPDU described above is HE format even if there is no separate mention. It may be incorporated into the description of the PPDU.

25 is a diagram illustrating a High Efficiency (HE) format PPDU according to an embodiment of the present invention.

25(a) illustrates a schematic structure of an HE format PPDU, and FIGS. 25(b) to (d) illustrate a more specific structure of an HE format PPDU.

Referring to FIG. 25(a), the HE format PPDU for HEW may be largely composed of a legacy part (L-part), an HE part (HE-

part), and a data field (HE-data).

The L-part consists of an L-STF field, an L-LTF field, and an L-SIG field in the same way as in the form maintained in the existing WLAN system. The L-STF field, the L-LTF field, and the L-SIG field may be referred to as a legacy preamble.

The HE-part is a part newly defined for the 802.11ax standard, and may include a HE-STF field, a HE-SIG field, and a HE-LTF field. Although the order of the HE-STF field, the HE-SIG field, and the HE-LTF field is exemplified in FIG. 25A , they may be configured in a different order. Also, HE-LTF may be omitted. Including the HE-STF field and the HE-LTF field as well as the HE-SIG field, it may be collectively referred to as a HE-preamble.

The HE-SIG may include information (eg, OFDMA, UL MU MIMO, enhanced MCS, etc.) for decoding the HE-data field.

The L-part and the HE-part may have different Fast Fourier Transform (FFT) sizes (ie, subcarrier spacing), and may use different cyclic prefixes (CPs).

802.11 The ax system can use a 4x larger (4x) FFT size compared to the legacy WLAN system. That is, the L-part may be configured in a 1x symbol structure, and the HE-part (particularly, HE-preamble and HE-data) may be configured in a 4x symbol structure. Here, FFTs of 1x, 2x, and 4x sizes refer to sizes relative to legacy WLAN systems (eg, IEEE 802.11a, 802.11n, 802.11ac, etc.).

For example, if the FFT size used for the L-part is 64, 128, 256, and 512 at 20 MHz, 40 MHz, 80 MHz and 160 MHz, respectively, the FFT size used for the HE-part is 256 at 20 MHz, 40 MHz, 80 MHz and 160 MHz, respectively , 512, 1024, or 2048.

As described above, when the FFT size is larger than that of the legacy WLAN system, the subcarrier frequency spacing is reduced, so the number of subcarriers per unit frequency is increased, but the OFDM symbol length is increased.

That is, the use of a larger FFT size means that the subcarrier spacing becomes narrow, and similarly, the IDFT (Inverse Discrete Fourier Transform)/DFT (Discrete Fourier Transform) period increases. Here, the IDFT/DFT period may mean a symbol length excluding the guard period (GI) in the OFDM symbol.

Therefore, if the HE-part (in particular, HE-preamble and HE-data) uses an FFT size 4 times larger than that of the L-part, the subcarrier spacing of the HE-part is 1/4 of the subcarrier spacing of the L-part. is doubled, and the IDFT/DFT period of the HE-part is 4 times the IDFT/DFT period of the L-part. For example, if the subcarrier spacing of the L-part is 312.5kHz (=20MHz/64, 40MHZ/128, 80MHz/256 and/or 160MHz/512), the subcarrier spacing of the HE-part is 78.125kHz (=20MHz/256) , 40 MHz/512, 80 MHz/1024 and/or 160 MHz/2048). In addition, if the IDFT/DFT period of the L-part is 3.2 μs (=1/312.5 kHz), the IDFT/DFT period of the HE-part may be 12.8 μs (=1/78.125 kHz).

Here, since one of 0.8 μs, 1.6 μs, and 3.2 μs can be used for the GI, the OFDM symbol length (or symbol interval) of the HE-part including the GI is 13.6 μs, 14.4 μs, or 16 depending on the GI. It may be μs.

Referring to FIG. 25B , the HE-SIG field may be divided into a HE-SIG A field and a HE-SIG B field.

For example, the HE-part of the HE format PPDU includes a HE-SIG A field having a length of 12.8 μs, a HE-STF field of 1 OFDM symbol, one or more HE-LTF fields, and a HE-SIG B field of 1 OFDM symbol. can do.

In addition, from the HE-STF field except for the HE-SIG A field in the HE-part, an FFT having a size 4 times larger than that of the existing PPDU may be applied. That is, FFTs of sizes 256, 512, 1024 and 2048 may be applied from the HE-STF field of the HE format PPDU of 20 MHz, 40 MHz, 80 MHz, and 160 MHz, respectively.

However, when the HE-SIG is divided into the HE-SIG A field and the HE-SIG B field as shown in FIG. 25(b) and transmitted, the positions of the HE-SIG A field and the HE-SIG B field are shown in FIG. 25(b) may be different from For example, the HE-SIG B field may be transmitted after the HE-SIG A field, and the HE-STF field and the HE-LTF field may be transmitted after the HE-SIG B field. In this case as well, an FFT having a size 4 times larger than that of the existing PPDU may be applied from the HE-STF field.

Referring to FIG. 25(c) , the HE-SIG field may not be divided into a HE-SIG A field and a HE-SIG B field.

For example, the HE-part of the HE format PPDU may include a HE-STF field of 1 OFDM symbol, a HE-SIG field of 1 OFDM symbol, and one or more HE-LTF fields.

Similarly to the above, an FFT having a size 4 times larger than that of the existing PPDU may be applied to the HE-part. That is, FFTs of sizes 256, 512, 1024 and 2048 may be applied from the HE-STF field of the HE format PPDU of 20 MHz, 40 MHz, 80

MHz, and 160 MHz, respectively.

Referring to FIG. 25(d), the HE-SIG field is not divided into a HE-SIG A field and a HE-SIG B field, and the HE-LTF field may be omitted.

For example, the HE-part of the HE format PPDU may include a HE-STF field of 1 OFDM symbol and a HE-SIG field of 1 OFDM symbol.

Similarly to the above, an FFT having a size 4 times larger than that of the existing PPDU may be applied to the HE-part. That is, FFTs of sizes 256, 512, 1024 and 2048 may be applied from the HE-STF field of the HE format PPDU of 20 MHz, 40 MHz, 80 MHz, and 160 MHz, respectively.

The HE format PPDU for the WLAN system according to the present invention may be transmitted through at least one 20 MHz channel. For example, the HE format PPDU may be transmitted in a frequency band of 40 MHz, 80 MHz, or 160 MHz through a total of four 20 MHz channels. This will be described in more detail with reference to the drawings below.

The HE format PPDU for a WLAN system to which the present invention can be applied may be transmitted through at least one 20 MHz channel. For example, the HE format PPDU may be transmitted in a frequency band of 40 MHz, 80 MHz, or 160 MHz through a total of four 20 MHz channels. This will be described in more detail with reference to the drawings below.

Hereinafter, the PPDU format to be described will be described based on FIG. 25(b) above for convenience of description, but the present invention is not limited thereto.

26 is a diagram illustrating an HE format PPDU according to an embodiment of the present invention.

26 illustrates a PPDU format when 80 MHz is allocated to one STA (or when OFDMA resource units are allocated to a plurality of STAs within 80 MHz) or when different streams of 80 MHz are allocated to a plurality of STAs, respectively.

Referring to FIG. 26, L-STF, L-LTF, and L-SIG may be transmitted in OFDM symbols generated based on 64 FFT points (or 64 subcarriers) in each 20 MHz channel.

The HE-SIG A field may include common control information commonly transmitted to STAs receiving the PPDU. The HE-SIG A field may be transmitted in 1 to 3 OFDM symbols. The HE-SIG A field is copied in units of 20 MHz and includes the same information. In addition, the HE-SIG-A field informs the overall bandwidth information of the system.

Table 12 is a table illustrating information included in the HE-SIG A field.

Information included in each field illustrated in Table 12 may follow the definition of the IEEE 802.11 system.

In addition, each of the fields described above corresponds to an example of fields that may be included in the PPDU, but is not limited thereto. That is, each field described above may be replaced with another field or additional fields may be further included, and all fields may not necessarily be included.

HE-STF is used to improve the performance of AGC estimation in MIMO transmission.

The HE-SIG B field may include user-specific information required for each STA to receive its own data (eg, PSDU). The HE-SIG B field may be transmitted in one or two OFDM symbols. For example, the HE-SIG B field may include information about a modulation and coding scheme (MCS) of the corresponding PSDU and the length of the corresponding PSDU.

The L-STF, L-LTF, L-SIG, and HE-SIG A fields may be repeatedly transmitted in units of 20 MHz channels. For example, when a PPDU is transmitted through four 20 MHz channels (ie, an 80 MHz band), the L-STF, L-LTF, L-SIG and HE-SIG A fields may be repeatedly transmitted in every 20 MHz channel. .

If the FFT size is increased, the legacy STA supporting the existing IEEE 802.11a/g/n/ac may not be able to decode the corresponding HE PPDU. In order for the legacy STA and the HE STA to coexist, the L-STF, L-LTF, and L-SIG fields are transmitted through 64 FFT on a 20 MHz channel so that the legacy STA can receive them. For example, the L-SIG field occupies one OFDM symbol, one OFDM symbol time may be 4 μs, and the GI may be 0.8 μs.

The FFT size for each frequency unit may be increased from HE-STF (or HE-SIG A). For example, 256 FFTs may be used in a 20 MHz channel, 512 FFTs may be used in a 40 MHz channel, and 1024 FFTs may be used in an 80 MHz channel. As the size of the FFT increases, the interval between OFDM subcarriers decreases, so the number of OFDM subcarriers per unit frequency increases, but the OFDM symbol time increases. In order to improve system efficiency, the length of the GI after the HE-STF may be set to be the same as the length of the GI of the HE-SIG A.

The HE-SIG A field may include information required for the HE STA to decode the HE PPDU. However, the HE-SIG A field may be transmitted through 64 FFT on a 20 MHz channel so that both the legacy STA and the HE STA can receive it. This is because the HE STA can receive not only the HE format PPDU but also the existing HT/VHT format PPDU, and the legacy STA and the HE STA must distinguish between the HT/VHT format PPDU and the HE format PPDU.

27 is a diagram illustrating an HE format PPDU according to an embodiment of the present invention.

Referring to FIG. 27 , except that the HE-SIG B field is located after the HE-SIG A field, it is the same as the example of FIG. 26 . In this case, the size of the FFT per unit frequency may become larger after HE-STF (or HE-SIG B). For example, from HE-STF (or HE-SIG B), 256 FFTs may be used in a 20 MHz channel, 512 FFTs may be used in a 40 MHz channel, and 1024 FFTs may be used in an 80 MHz channel.

28 is a diagram illustrating an HE format PPDU according to an embodiment of the present invention.

In FIG. 28 , it is assumed that 20 MHz channels are allocated to different STAs (eg, STA 1 , STA 2 , STA 3 , and STA 4).

Referring to FIG. 28 , the HE-SIG B field is located after the HE-SIG A field. In this case, the FFT size per unit frequency may be increased from HE-STF (or HE-SIG B). For example, from HE-STF (or HE-SIG B), 256 FFTs may be used in a 20 MHz channel, 512 FFTs may be used in a 40 MHz channel, and 1024 FFTs may be used in an 80 MHz channel.

Since information transmitted in each field included in the PPDU is the same as the example of FIG. 26 above, the following description will be omitted.

The HE-SIG B field may include information specific to each STA, but may be encoded over the entire band (ie, indicated in the HE-SIG-A field). That is, the HE-SIG B field includes information on all STAs and is received by all STAs.

The HE-SIG B field may inform frequency bandwidth information allocated to each STA and/or stream information in a corresponding frequency band. For example, in FIG. 28 , in HE-SIG-B, 20 MHz to STA 1, 20 MHz to STA 2, 20 MHz to STA 3, and 20 MHz to STA 4 may be allocated. In addition, STA 1 and STA 2 may allocate 40 MHz, and STA 3 and STA 4 may allocate the next 40 MHz. In this case, STA 1 and STA 2 may allocate different streams, and STA 3 and STA 4 may allocate different streams.

In addition, by defining the HE-SIG-C field, the HE-SIG-C field may be added to the example of FIG. 28 . In this case, information on all STAs is transmitted over the entire band in the HE-SIG-B field, and control information specific to each STA may be transmitted in units of 20 MHz through the HE-SIG-C field.

In addition, in the examples of FIGS. 26 to 28 , the HE-SIG-B field may not be transmitted over the entire band, but may be transmitted in units of 20 MHz like the HE-SIG-A field. This will be described with reference to the drawings below.

29 is a diagram illustrating an HE format PPDU according to an embodiment of the present invention.

In FIG. 29 , it is assumed that 20 MHz channels are allocated to different STAs (eg, STA 1 , STA 2 , STA 3 , and STA 4).

Referring to FIG. 29 , as in FIG. 28 , the HE-SIG B field is located after the HE-SIG A field. However, the HE-SIG B field is not transmitted over the entire band, but is transmitted in units of 20 MHz like the HE-SIG A field.

In this case, the FFT size per unit frequency may be increased from HE-STF (or HE-SIG B). For example, from HE-STF (or HE-SIG B), 256 FFT may be used in a 20 MHz channel, 512 FFT may be used in a 40 MHz channel, and 1024 FFT may be used in an 80 MHz channel.

Since information transmitted in each field included in the PPDU is the same as the example of FIG. 26 above, the following description will be omitted.

The HE-SIG A field is transmitted by being duplicated in units of 20 MHz.

The HE-SIG B field may inform frequency bandwidth information allocated to each STA and/or stream information in a corresponding frequency band.

Like the HE-SIG A field, the HE-SIG B field may be transmitted in units of 20 MHz. In this case, since the HE-SIG B field includes information on each STA, information on each STA may be included for each HE-SIG B field in units of 20 MHz. At this time, although the example of FIG. 29 illustrates a case in which 20 MHz is allocated to each STA, for example, when 40 MHz is allocated to an STA, the HE-SIG-B field may be copied and transmitted in units of 20 MHz.

In addition, the HE-SIG B field may include information on all STAs (that is, all information specific to each STA are combined)

and may be duplicated and transmitted in units of 20 MHz like the HE-SIG A field.

As in the examples of FIGS. 27 to 29, when the HE-SIG-B field is located before the HE STF field and the HE-LTF field, the length of the symbol is shortened by using 64 FFT at 20 MHz, and as in the example of FIG. 26, HE When the -SIG-B field is located after the HE STF field and the HE-LTF field, it is possible to configure a long symbol length by using 256 FFT at 20 MHz.

In a situation in which different bandwidths are supported for each BSS, when a partial bandwidth with a small interference level from an adjacent BSS is allocated to an STA, it may be preferable not to transmit the HE-SIG-B field over the entire band as described above. .

26 to 29 , the data field is a payload and may include a SERVICE field, a scrambled PSDU, tail bits, and padding bits.

30 illustrates a phase rotation for HE format PPDU detection according to an embodiment of the present invention.

In order to classify the HE format PPDU, the phases of three OFDM symbols transmitted after the L-SIG field in the HE format PPDU may be used.

Referring to FIG. 30, the phases of OFDM symbol #1 and OFDM symbol #2 transmitted after the L-SIG field in the HE format PPDU are not rotated, but the phase of OFDM symbol #3 is rotated counterclockwise by 90 degrees. can That is, BPSK may be used as a modulation method for OFDM symbol #1 and OFDM symbol #2, and QBPSK may be used as a modulation method for OFDM symbol #3.

The STA attempts to decode the first to third OFDM symbols transmitted after the L-SIG field of the received PPDU based on the constellation shown in the example of FIG. 30 . If the STA succeeds in decoding, it may determine that the corresponding PPDU is an HE format PPDU.

Here, if the HE-SIG A field is transmitted in three OFDM symbols after the L-SIG field, this means that OFDM symbol #1 to OFDM symbol #3 are all used to transmit the HE-SIG A field.

Hereinafter, a multi-user uplink transmission method in a WLAN system will be described.

A method in which an AP operating in a WLAN system transmits data to a plurality of STAs on the same time resource may be referred to as DL MU transmission (downlink multi-user transmission). Conversely, a method in which a plurality of STAs operating in a WLAN system transmit data to an AP on the same time resource may be referred to as UL MU transmission (uplink multi-user transmission).

Such DL MU transmission or UL MU transmission may be multiplexed in a frequency domain or a spatial domain.

When multiplexing in the frequency domain, different frequency resources (eg, subcarriers or tones) are allocated as downlink or uplink resources for each of a plurality of STAs based on orthogonal frequency division multiplexing (OFDMA). can A transmission scheme through different frequency resources in the same time resource may be referred to as 'DL/UL MU OFDMA transmission'.

In the case of multiplexing in the spatial domain, different spatial streams may be allocated as downlink or uplink resources to each of a plurality of STAs. A transmission equation through different spatial streams in the same time resource may be referred to as 'DL/UL MU MIMO' transmission.

The current WLAN system cannot support UL MU transmission due to the following limitations.

Synchronization of the transmission timing of uplink data transmitted from a plurality of STAs is not supported in the current WLAN system. For example, if it is assumed that a plurality of STAs transmit uplink data through the same time resource in the existing WLAN system, in the current WLAN system, each of the plurality of STAs can know the transmission timing of uplink data of another STA. none. Accordingly, it is difficult for the AP to receive uplink data from each of the plurality of STAs on the same time resource.

Also, in the current WLAN system, overlap between frequency resources used for transmitting uplink data by a plurality of STAs may occur. For example, when an oscillator of each of a plurality of STAs is different, a frequency offset may appear differently. If each of a plurality of STAs having different frequency offsets simultaneously performs uplink transmission through different frequency resources, some of the frequency domains used by each of the plurality of STAs may overlap.

In addition, power control for each of the plurality of STAs is not performed in the existing WLAN system. Depending on the distance between each of the plurality of STAs and the channel environment and the channel environment, the AP may receive signals of different powers from each of the plurality of STAs. In this case, a signal arriving with weak power may be relatively

difficult to be detected by the AP compared to a signal arriving with strong power.

Accordingly, the present invention proposes a UL MU transmission method in a WLAN system.

31 is a diagram illustrating an uplink multi-user transmission procedure according to an embodiment of the present invention.

Referring to FIG. 31 , the AP instructs STAs participating in UL MU transmission to prepare for UL MU transmission, receives a UL MU data frame from the corresponding STAs, and responds to the UL MU data frame with an ACK frame (BA (Block Ack) frame) is transmitted.

First, the AP instructs STAs to transmit UL MU data to prepare for UL MU transmission by transmitting a UL MU Trigger frame (3110). Here, the UL MU scheduling frame may be referred to as a 'UL MU scheduling frame'.

Here, the UL MU trigger frame 3110 may include control information such as STA identifier (ID)/address information, resource allocation information to be used by each STA, duration information, and the like.

The STA ID/address information means information on an identifier or address for specifying each STA that transmits uplink data.

The resource allocation information is an uplink transmission resource allocated to each STA (eg, frequency/subcarrier information allocated to each STA in the case of UL MU OFDMA transmission, and a stream index allocated to each STA in the case of UL MU MIMO transmission). means information about

Duration information means information for determining a time resource for transmission of an uplink data frame transmitted by each of a plurality of STAs.

For example, the duration information includes information (eg, bits or symbols) about the duration information or uplink frame length of TXOP (Transmit Opportunity) allocated for uplink transmission of each STA. can

In addition, the UL MU trigger frame 3110 may further include control information such as MCS information and coding information to be used when transmitting the UL MU data frame for each STA.

The above control information is the HE-part (eg, HE-SIG A field or HE-SIG B field) of the PPDU carrying the UL MU trigger frame 3110 or the control field of the UL MU trigger frame 3110 (eg For example, it may be transmitted in the Frame Control field of the MAC frame, etc.).

The PPDU carrying the UL MU trigger frame 3110 has a structure starting with an L-part (eg, an L-STF field, an L-LTF field, an L-SIG field, etc.). Accordingly, legacy STAs may perform Network Allocation Vector (NAV) setting through L-SIG protection from the L-SIG field. For example, legacy STAs may calculate a period for NAV setting (hereinafter, 'L-SIG guard period') based on data length and data rate information in the L-SIG. In addition, the legacy STAs may determine that there is no data to be transmitted to them during the calculated L-SIG guard period.

For example, the L-SIG guard interval may be determined as the sum of the MAC duration field value of the UL MU trigger frame 3110 and the remaining interval after the L-SIG field of the PPDU carrying the UL MU trigger frame 3110. Accordingly, the L-SIG guard period may be set to a value up to the period in which the ACK frame 3130 (or BA frame) transmitted to each STA is transmitted according to the MAC duration value of the UL MU trigger frame 3110 .

Hereinafter, a method of allocating resources for UL MU transmission to each STA will be described in more detail. For convenience of explanation, fields including control information are divided and described, but the present invention is not limited thereto.

The first field may indicate UL MU OFDMA transmission and UL MU MIMO transmission separately. For example, '0' may indicate UL MU OFDMA transmission, and '1' may indicate UL MU MIMO transmission. The size of the first field may consist of 1 bit.

The second field (eg, STA ID/address field) informs STA IDs or STA addresses to participate in UL MU transmission. The size of the second field may be configured by the number of bits for informing the STA ID × the number of STAs participating in the UL MU. For example, when the second field consists of 12 bits, the ID/address of each STA may be indicated by 4 bits.

The third field (eg, resource allocation field) indicates a resource region allocated to each STA for UL MU transmission. In this case, the resource region allocated to each STA may be sequentially indicated to each STA according to the order of the previous second field.

If the first field value is '0', frequency information (eg, frequency index, subcarrier index, etc.) for UL MU transmission is

indicated in the order of the STA ID/address included in the second field, 1 When the field value is '1', MIMO information (eg, stream index, etc.) for UL MU transmission is indicated in the order of the STA IDs/addresses included in the second field.

In this case, since several indexes (ie, frequency/subcarrier index or stream index) may be informed to one STA, the size of the third field is a plurality of bits (or may be configured in a bitmap format) × It may be configured with the number of STAs to participate in UL MU transmission.

For example, it is assumed that the second field is set in the order of 'STA 1' and 'STA 2', and the third field is set in the order of '2' and '2'.

In this case, when the first field is '0', frequency resources may be allocated to STA 1 from an upper (or lower) frequency domain, and subsequent frequency resources may be sequentially allocated to STA 2 . For example, when OFDMA in units of 20 MHz is supported in an 80 MHz band, STA 1 may use an upper (or lower) 40 MHz band, and STA 2 may use the next 40 MHz band.

On the other hand, when the first field is '1', an upper (or lower) stream may be allocated to STA 1 , and a next stream may be sequentially allocated to STA 2 . In this case, the beamforming method according to each stream may be specified in advance, or more specific information on the beamforming method according to the stream may be included in the third field or the fourth field.

Each STA transmits a UL MU data frame (UL MU Data frame, 3121, 3122, 3123) to the AP based on the UL MU trigger frame 3110 transmitted by the AP. Here, after receiving the UL MU trigger frame 3110 from the AP, each STA may transmit the UL MU data frames 3121 , 3122 , and 3123 to the AP after SIFS.

Each STA may determine a specific frequency resource for UL MU OFDMA transmission or a spatial stream for UL MU MIMO transmission based on resource allocation information of the UL MU trigger frame 3110 .

Specifically, in the case of UL MU OFDMA transmission, each STA may transmit an uplink data frame on the same time resource through different frequency resources.

Here, each of STAs 1 to 3 may be allocated different frequency resources for uplink data frame transmission based on STA ID/address information and resource allocation information included in the UL MU trigger frame 3110 . For example, STA ID/address information may sequentially indicate STAs 1 to 3, and resource allocation information may sequentially indicate frequency resource 1, frequency resource 2, and frequency resource 3. In this case, STAs 1 to 3 sequentially indicated based on STA ID/address information may be allocated frequency resource 1, frequency resource 2, and frequency resource 3 sequentially indicated based on resource allocation information, respectively. That is, STA 1 may transmit uplink data frames 3121 , 3122 , and 3123 to the AP through frequency resource 1 , STA 2 frequency resource 2 , and STA 3 frequency resource 3 .

In addition, in the case of UL MU MIMO transmission, each STA may transmit an uplink data frame on the same time resource through at least one different stream among a plurality of spatial streams.

Here, each of STA 1 to STA 3 may be allocated a spatial stream for uplink data frame transmission based on STA ID/address information and resource allocation information included in the UL MU trigger frame 3110 . For example, STA ID/address information may sequentially indicate STAs 1 to 3, and resource allocation information may sequentially indicate spatial stream 1, spatial stream 2, and spatial stream 3. In this case, STAs 1 to 3 sequentially indicated based on STA ID/address information may be allocated spatial stream 1, spatial stream 2, and spatial stream 3 sequentially indicated based on resource allocation information, respectively. That is, STA 1 may transmit uplink data frames 3121 , 3122 , and 3123 to the AP through spatial stream 1 , STA 2 spatial stream 2 , and STA 3 spatial stream 3 .

The PPDU carrying the uplink data frames 3121, 3122, and 3123 can be configured with a new structure without an L-part.

In addition, in the case of UL MU MIMO transmission or UL MU OFDMA transmission in the form of a subband of less than 20 MHz, the L-part of the PPDU carrying the uplink data frames 3121, 3122, 3123 is in the SFN form (that is, all STAs have the same L-part configuration and content can be transmitted simultaneously). On the other hand, in the case of UL MU OFDMA transmission in the form of a subband of 20 MHz or higher, the L-part of the PPDU carrying the uplink data frames 3121, 3122, 3123 is the L-part in the band to which each STA is allocated, in units of 20 MHz. can be transmitted.

If the uplink data frame can be sufficiently configured with the information of the UL MU trigger frame 3110, the HE-SIG field in the PPDU that delivers the uplink data frames 3121, 3122, 3123 (that is, in the method of configuring the data frame) area for transmitting control information) may not be required. For example, the HE-SIG-A field and/or the HE-SIG-B may not be

transmitted. In addition, the HE-SIG-A field and the HE-SIG-C field may be transmitted, and the HE-SIG-B field may not be transmitted.

The AP may transmit an ACK frame (ACK frame, 3130) (or BA frame) in response to the uplink data frames 3121 , 3122 , 3123 received from each STA. Here, the AP may receive uplink data frames 3121 , 3122 , and 3123 from each STA and transmit an ACK frame 3130 to each STA after SIFS.

If the same structure of the existing ACK frame is used, the RA field having a size of 6 octets may include the AIDs (or partial AIDs) of STAs participating in UL MU transmission.

Alternatively, if an ACK frame having a new structure is configured, it can be configured in a form for DL SU transmission or DL MU transmission.

The AP may transmit only the ACK frame 3130 for the successfully received UL MU data frame to the corresponding STA. In addition, the AP may inform whether reception is successful through ACK or NACK through the ACK frame 3130 . If the ACK frame 3130 includes NACK information, the reason for the NACK or information for a subsequent procedure (eg, UL MU scheduling information, etc.) may also be included.

Alternatively, the PPDU carrying the ACK frame 3130 may be configured in a new structure without an L-part.

The ACK frame 3130 may include STA ID or address information, but if the order of the STAs indicated in the UL MU trigger frame 3110 is equally applied, STA ID or address information may be omitted.

In addition, by extending the TXOP (ie, L-SIG guard period) of the ACK frame 3130, a frame for the next UL MU scheduling or a control frame including correction information for the next UL MU transmission is included in the TXOP. may be

Meanwhile, for UL MU transmission, an adjustment process such as synchronization between STAs may be added.

32 is a diagram illustrating an uplink multi-user transmission procedure according to an embodiment of the present invention.

Hereinafter, the same description as in the example of FIG. 31 will be omitted for convenience of description.

Referring to FIG. 32 , the AP instructs STAs to be used for UL MU to prepare UL MU, and after performing an adjustment process such as synchronizing between STAs for UL MU, a UL MU data frame is transmitted. Receive and send ACK.

First, by transmitting a UL MU trigger frame (UL MU trigger frame, 3210), the AP instructs STAs to transmit UL MU data to prepare for UL MU transmission.

Each STA that has received the UL MU trigger frame 3210 from the AP transmits sync signals 3221 , 3222 , and 3223 to the AP. Here, each STA may receive the UL MU trigger frame 3210 and transmit synchronization signals 3221 , 3222 , 3223 to the AP after SIFS.

Then, the AP receiving the synchronization signals 3221 , 3222 , 3223 from each STA transmits an adjustment frame 3230 to each STA. Here, the AP may receive the synchronization signals 3221 , 3222 , and 3223 and transmit the correction frame 3230 after the SIFS.

A procedure for transmitting and receiving the synchronization signals 3221 , 3222 , 3223 and the correction frame 3230 is a procedure for correcting time/frequency/power between STAs for transmission of the UL MU data frame. That is, the STAs transmit their respective synchronization signals 3221 , 3222 , and 3223 , and the AP provides correction information for correcting errors such as time/frequency/power based on the values to each STA through the correction frame 3230 . This is a procedure for correcting and transmitting the value in the UL MU data frame to be transmitted next by notifying it. In addition, since this procedure is performed after the UL MU trigger frame 3210, the STA may have time to prepare a data frame configuration according to scheduling.

More specifically, the STAs indicated in the UL MU trigger frame 3210 transmit synchronization signals 3221 , 3222 , and 3223 to each indicated or designated resource region. Here, the synchronization signals 3221 , 3222 , and 3223 transmitted from each STA may be multiplexed in a time division multiplexing (TDM), code division multiplexing (CDM), and/or spatial division multiplexing (SDM) scheme.

For example, if the order of the STAs indicated in the UL MU trigger frame 3210 is STA 1, STA 2, and STA 3, and the synchronization signals 3221, 3222, 3223 of each STA are multiplexed by CDM, each of them in the order of the designated STAs The allocated sequence 1 (Sequence 1), sequence 2 (Sequence 2), and sequence 3 (Sequence 3) may be transmitted to the AP.

Here, the resources (eg, time/sequence/stream, etc.) to be used by each STA in order for the synchronization signals 3221 , 3222 , 3223 of each STA to be multiplexed in TDM, CDM and/or SDM to be transmitted are in advance of each STA. may be directed or defined by

In addition, the PPDU carrying the synchronization signals 3221 , 3222 , and 3223 may not include an L-part or may be transmitted only with a physical layer signal without configuring a MAC frame.

Upon receiving the synchronization signals 3221 , 3222 , and 3223 from each STA, the AP transmits an adjustment frame 3230 to each STA.

In this case, the AP may transmit the correction frame 3230 to each STA in the DL SU transmission method or to each STA in the DL MU transmission method. That is, in the case of DL SU transmission, the correction frame 3230 may be sequentially transmitted to each STA participating in UL MU transmission, and in the case of DL MU transmission, the correction frame 3230 is a resource (ie, frequency) allocated to each STA. or stream) may be simultaneously transmitted to each STA participating in UL MU transmission.

The correction frame 3230 may include STA ID or address information, and if the order of the STAs indicated in the UL MU trigger frame 3210 is equally applied, STA ID or address information may be omitted.

Also, the correction frame 3230 may include an adjustment field.

The adjustment field may include information for correcting errors such as time/frequency/power. Here, the correction information refers to information informing that an error in time/frequency/power, etc. may occur in signals of STAs received by the AP, and to correct the error gap. In addition, any information capable of more accurately correcting an error such as time/frequency/power of each STA based on the synchronization signals 3221 , 3222 , 3223 received by the AP may be included in the correction frame 3230 . .

* The PPDU carrying the correction frame 3230 may be configured in a new structure without an L-part.

Meanwhile, a procedure for transmitting and receiving the synchronization signals 3221 , 3222 , 3223 and the correction frame 3230 may be performed before transmitting the UL MU trigger frame 3210 of each STA.

In addition, transmission of the synchronization signals 3221 , 3222 , and 3223 may be omitted and the AP may transmit the UL MU trigger frame 3210 including correction information through implicit measurement.

For example, in a pre-procedure to be described later, the AP detects an error such as time/frequency/power between each STA through an NDP or a buffer status/sounding frame transmitted from each STA. Correction information may be generated, and the correction information may be transmitted to each STA through the UL MU trigger frame 3210 .

In addition, if the STAs do not need to be calibrated (eg, when a calibration procedure has been completed between each STA to perform UL MU transmission before), the synchronization signals 3221 , 3222 , 3223 and the correction frame 3230 are transmitted and received. The procedure may be omitted.

In addition, if only a part of the correction procedure is necessary, only that procedure can be corrected. For example, when the cyclic prefix (CP) length of the UL MU data frame is long enough that out of sync between STAs does not become a problem, a procedure for correcting the time difference may be omitted. Alternatively, if a guard band between STAs is sufficient during UL MU OFDMA transmission, a procedure for correcting a frequency difference may be omitted.

Each STA transmits a UL MU data frame (UL MU Data frame, 3241, 3242, 3243) to the AP based on the UL MU trigger frame 3210 and the correction frame 3230 transmitted by the AP. Here, after receiving the correction frame 3230 from the AP, each STA may transmit the UL MU data frames 3241 , 3242 , and 3243 to the AP after SIFS.

The AP may transmit an ACK frame (ACK frame, 3250) (or a block ack (BA) frame) in response to the uplink data frames 3241 , 3242 , and 3243 received from each STA. Here, the AP may receive uplink data frames 3241 , 3242 , and 3243 from each STA and transmit an ACK frame 3250 to each STA after SIFS.

33 is a diagram illustrating a resource allocation unit in an OFDMA multi-user transmission scheme according to an embodiment of the present invention.

When the DL/UL OFDMA transmission scheme is used, a plurality of resource units may be defined in units of n tones (or subcarriers) within the PPDU bandwidth.

The resource unit means an allocation unit of frequency resources for DL/UL OFDMA transmission.

One or more resource units may be allocated as DL/UL frequency resources to one STA, and different resource units may be allocated to a plurality of STAs, respectively.

33 exemplifies a case in which the PPDU bandwidth is 20 MHz.

33 , the number of tones constituting a resource unit may vary.

For example, according to the resource unit configuration method as shown in FIG. 33 (a), one resource unit may be configured with 26 tones.

In addition, according to the resource unit configuration method as shown in FIG. 33(b), one resource unit may consist of 52 tones or 26 tones. In addition, according to the resource unit configuration method as shown in FIG. 33(c), one resource unit may consist of 106 tones or 26 tones. In addition, according to the resource unit configuration method as shown in FIG. 33(d), one resource unit may be configured with 242 tones.

When a resource unit is configured as shown in FIG. 33(a), up to 9 STAs may be supported for DL/UL OFDMA transmission in a 20 MHz band. In addition, when a resource unit is configured as shown in FIG. 33(b), up to 5 STAs may be supported for DL/UL OFDMA transmission in a 20 MHz band. In addition, when a resource unit is configured as shown in FIG. 33(c) , up to three STAs may be supported for DL/UL OFDMA transmission in a 20 MHz band. In addition, when a resource unit is configured as shown in 32(d), a 20 MHz band may be allocated to one STA.

Based on the number of STAs participating in DL/UL OFDMA transmission and/or the amount of data transmitted or received by the STA, any one resource unit configuration method in FIGS. 33(a) to 33(d) may be determined. there is.

Only some of the resource units may be used for DL/UL OFDMA transmission among all the resource units determined according to the resource unit configuration method shown in FIGS. 33(a) to 33(c). For example, when a resource unit is configured within 20 MHz as shown in FIG. 33(a), one resource unit is allocated to less than nine STAs, respectively, and the remaining resource units may not be allocated to any STA.

In the case of DL OFDMA transmission, the data field of the PPDU is multiplexed and transmitted in the frequency domain in units of resource units allocated to each STA.

On the other hand, in the case of UL OFDMA transmission, the data field of the PPDU may be configured in units of resource units allocated to each STA for each STA and transmitted to the AP at the same time. As each STA transmits the PPDU at the same time, the receiving end, the AP, may recognize that the data field of the PPDU transmitted from each STA is multiplexed and transmitted in the frequency domain.

In addition, when DL/UL OFDMA transmission and DL/UL MU-MIMO transmission are simultaneously supported, one resource unit may consist of a plurality of streams in a spatial domain. In addition, one or more streams may be allocated as DL/UL spatial resources to one STA, and different streams may be allocated to a plurality of STAs, respectively.

For example, a resource unit composed of 106 tones in FIG. 33(c) or a resource unit composed of 242 tones as shown in FIG. 33(d) is composed of a plurality of streams in the spatial domain to form DL/UL OFDMA and DL/UL MU-MIMO can be supported simultaneously.

40 In a bandwidth of MHz or more, the resource unit configuration method of the 20 MHz band may be equally applied in units of the 20 MHz band. In addition, the smallest resource unit (ie, a resource unit consisting of 26 tons) may be further configured in the center of the bandwidth.

34 is a diagram illustrating a multi-user transmission procedure according to an embodiment of the present invention.

In relation to this drawing, descriptions overlapping those of FIGS. 31 and 32 will be omitted.

The AP may transmit a DL MU frame to at least one STA, and the at least one STA that has received the DL MU frame transmits an ACK frame (or block ack (BA) frame) to the AP as a response to the received DL MU frame. can In addition, the AP may instruct STAs to transmit UL MU data to prepare for UL MU transmission by transmitting a UL MU trigger frame, and may provide information about UL MU transmission (ie, trigger information).

In this case, the AP may transmit the DL MU frame and the trigger frame using different time resources (or at different time points), as shown in FIG. 34(a). Since this overlaps with the contents described above with reference to FIGS. 31 and 32 , a detailed description thereof will be omitted.

Alternatively, the AP may transmit a DL MU frame and a trigger frame (or trigger information) (not shown) using the same time

resource (or simultaneously) as shown in FIG. 34(b). In this case, the DL MU frame and the trigger frame may be included in the same DL MU PPDU and DL MU transmitted at the same time. As such, a method in which the DL MU frame and the trigger frame are included in one DL MU PPDU and transmitted may be referred to as a 'cascade method'. The STA that receives the trigger frame and the DL MU frame together from the AP may transmit the UL MU frame corresponding to the trigger frame and the ACK frame as a response to the DL MU frame by using one UL MU PPDU. That is, the STA may UL MU transmit one UL MU PPDU including a UL MU frame and an ACK frame in response to the received DL MU PPDU.

According to the above-described embodiment, since overhead due to the trigger frame, SIFS, and physical preamble is reduced, time resources are saved and data transmission efficiency is increased.

Hereinafter, various embodiments of the present invention in which a DL MU frame and a trigger frame are DL MU transmitted using one DL MU PPDU will be described in detail based on the above description.

35 is a diagram illustrating a structure of a PPDU carrying trigger information according to an embodiment of the present invention.

It is assumed that the PPDU in this embodiment does not carry a DL MU frame for convenience of description.

Trigger information for UL MU transmission may be included in the DL MU PPDU and transmitted through the DL MU in two ways as follows.

1. When trigger information is transmitted in NDP format

As a first embodiment, trigger information is included in the HE-SIG B field (or HE-SIG field) included in the physical preamble of the DL MU PPDU, as shown in FIG. . In this way, when trigger information is added to the HE-SIG B field, the length of the HE-SIG B field may become excessively long and communication performance may be deteriorated. Accordingly, in the present specification, in addition to the first HE-SIG B field for DL MU transmission, a second HE-SIG B field for UL MU transmission may be further defined, which will be described in detail below with reference to FIGS. 36 to 38 . to be described later.

2. When trigger information is transmitted in MAC frame format

As a second embodiment, as shown in FIG. 35(b), trigger information may be included in the HE format MAC frame included in the data field of the DL MU PPDU and transmitted by DL MU. In addition, although not shown in this figure, trigger information may be included in a legacy format MAC frame and transmitted by DL MU. Accordingly, the MAC frame described below may refer to MAC frames of the HE format and the legacy format. In this case, the MAC frame including trigger information may be referred to as a 'trigger frame'. The trigger frame may be configured in one MPDU or A-MPDU format according to an embodiment, and a more detailed description thereof will be described below with reference to FIGS. 39 and 40 .

The above-described first embodiment has an effect that the overhead is small. In the case of the second embodiment, it has the flexibility to configure the trigger frame by using the legacy format or by using the HE format.

36 is a diagram illustrating the structure of a DL MU PPDU according to the first embodiment of the present invention.

Referring to FIG. 36 , the DL MU PPDU according to the first embodiment of the present invention includes a legacy preamble (including an L-STF field, an L-LTF field, and an L-SIG field) and a HE-SIG A following the legacy preamble. field, a second HE-SIG B field (or HE-SIG B for UL) 3620 following the HE-SIG A field, a first HE-SIG B field following the second HE-SIG B field (or HE-SIG-B) 3610, a HE preamble (including a HE-STF field and a HE-LTF field) following the first HE-SIG B field 3610, and a data field following the HE-preamble can be composed of The order of the above-described fields is merely an example, and may be configured in various orders according to embodiments, and the above-described fields may be selectively included in the DL MU PPDU according to embodiments.

The first HE-SIG B field 3610 may include user specific information for each STA that receives the data field of the DL MU PPDU (or to which the data field is allocated). Here, the user-specific information means control information individually required for a specific STA among STAs to which resources (including frequency resources and spatial resources) are allocated by the first HE-SIG B field. User-specific information includes identification information (eg, AID, PAID (Partial AID), GID (Group Identifier), etc.) for each STA (or Receiving STA) to which the DL MU resource (frequency/spatial resource) is allocated, STA Spatial resource allocation information for each STA, MCS information of a data field allocated for each STA, beamforming information indicating whether to transmit beamforming, Spce Time Block Coding (STBC) information indicating whether to apply space-time block coding, and error correction it may include at least one of code information.

The second HE-SIG B field 3620 may include trigger information for UL MU transmission. The trigger information may include at least one of identification information for each STA (or receiving STA) performing UL MU transmission and spatial

resource/frequency resource indication information for UL MU transmission. In this case, the identifier (ID: Identifier) format included in the identification information for each STA included in the second HE-SIG B field 3620 is the identifier (ID) included in the identification information for each STA of the first HE-SIG B field 3610 . ID: Identifier) format may be different. For example, the identifier included in the identification information for each STA of the second HE-SIG B field 3620 is newly defined without using AID, PAID, GID, etc. used in the first HE-SIG B field 3610 . ID format can be used.

The first HE-SIG B field 3610 and the second HE-SIG B field 3620 may be distinguished through an indication bit included in each field. For example, the first HE SIG B field 3610 and the second HE-SIG B field 3620 may each include an indication bit of a 1-bit size.

If the indication bit value in the specific HE-SIG B field is set to '1', the corresponding HE-SIG B field is a second HE-SIG B field 3620 including trigger information for UL MU transmission. , may mean that the following first HE-SIG B field 3610 additionally exists. Conversely, if the indication bit value in the specific HE-SIG B field is set to '0', the corresponding HE-SIG B field is the first HE-SIG B field 3610 including user specific information for DL MU transmission. , and may mean that the following second HE-SIG B field 3620 does not additionally exist. In addition, the first HE-SIG B field 3610 and the second HE-SIG B field 3620 may be distinguished in various ways, and the present invention is not limited to the above-described embodiment.

When the DL MU PPDU includes the first HE-SIG B field 3610 and the second HE-SIG B field 3620 (ie, when a plurality of HE-SIG B fields are included), the HE-SIG A field may provide all information regarding the MCS level applied to each of the first HE-SIG B field 3610 and the second HE-SIG B field 3620 . In addition, information on the number, function, type, and/or use of the HE-SIG B field in the HE-SIG A field may also be provided.

Although the DL MU PPDU configured in the order of the second HE-SIG B field 3620 → the first HE-SIG B field 3610 in FIG. 36 is illustrated, the present invention is not limited thereto and the two HE-SIG B fields 3610 , 3620), the HE-SIG B field having a lower MCS level may be preferentially located. Here, the higher/lower MCS level means an MCS level indicating a higher/lower modulation scheme in the number of data bits per symbol, or an MCS level indicating a higher/lower code rate when the modulation scheme is the same. there is. A lower MCS level is advantageous for robust transmission.

For example, the first HE-SIG B field 3610 has an MCS level indicating BPSK modulation and 1/2 code rate, and the second HE-SIG B field 3620 is QPSK modulation and 1/2 code rate. It can be assumed that it has an MCS level indicating . In this case, since the first HE-SIG B field 3610 has a lower MCS level than the second HE-SIG B field 3620 , the first HE-SIG B field 3610 → the second HE-SIG A DL MU PPDU may be configured in the order of the B field 3620 .

In this case, the preceding HE-SIG B field may provide information regarding the existence of the following HE-SIG B field, configuration information, and MCS information. That is, in the case of this figure (FIG. 36), the second HE-SIG B field 3620 provides information regarding the existence of the following first HE-SIG B field 3610, configuration information, and MCS information. can

The data field may be frequency multiplexed or spatially multiplexed according to the resource allocation information included in the first HE-SIG B field 3610 to be allocated and transmitted to at least one STA to which the resource is allocated.

The AP may DL MU transmit the DL MU PPDU including the fields described above to at least one STA. At least one STA that has received the DL MU PPDU may transmit the UL MU PPDU to the AP based on the received DL MU PPDU. In this case, similar to the DL MU frame and the trigger frame that are simultaneously transmitted through one DL MU PPDU, the UL MU frame and the ACK frame (or BA frame) can also be simultaneously transmitted to the AP through one UL MU PPDU. there is. That is, the UL MU frame and the ACK frame may also be included in one UL MU PPDU and transmitted simultaneously in a cascade manner. This will be described later in detail with reference to FIGS. 37 and 38 .

37 is a diagram illustrating a DL MU PPDU and a UL MU PPDU transmitted as a response to the DL MU PPDU according to an embodiment of the present invention.

In this embodiment, the HE-SIG B field of the DL MU PPDU may be configured in the order of the first HE-SIG B field 3710 → the second HE-SIG B field 3720 . In addition, it is assumed that DL MU resources are allocated to STAs 1 to 4 and UL MU resources are allocated to STAs 5 and 6, respectively. That is, it is assumed that the STAs (STAs 1 to 4) receiving the DL MU frame are different from the STAs (STAs 5 and 6) receiving the trigger information.

Referring to FIG. 37A , the first HE-SIG B field 3710 may include allocation information (or user specific information) of DL MU resources for STAs 1 to 4 . For example, the first HE-SIG B field 3710 may include at least one of identification information for STAs 1 to 4, frequency resource allocation information, and spatial resource allocation information. The second HE-SIG B field 3720 may include UL MU resource allocation information for STAs 5 and 6 (or trigger information for UL MU transmission). For

example, the second HE-SIG B field 3720 may include at least one of identification information for STAs 5 and 6 and spatial resource/frequency resource indication information for UL MU transmission. The data fields allocated to STAs 1 to 4 may include DL MU frames respectively received by STAs 1 to 4. The data field may be frequency-multiplexed and/or spatially-multiplexed to be DL MU transmitted.

The AP may DL MU transmit the DL MU PPDU including the fields described above. STAs 1 to 6 that have received the DL MU PPDU may transmit a UL MU PPDU generated based on the received DL MU PPDU.

In more detail, referring to FIG. 37(b), each STA 1 to 4 receiving the DL MU frame transmits an ACK frame (or BA frame) as a response to the received DL MU frame, trigger information The received STAs 5 and 6 may include the UL MU frame generated based on the trigger information in one UL MU PPDU and transmit the UL MU. In this case, the ACK frame (or BA frame) of STA 1 and the UL MU frame of STA 5 have different UL MU transmission STAs and different UL MU resources used for transmission, so the ACK frame of STA 1 is STA 5 It cannot be transmitted because it is piggybacked on the UL MU frame of In addition, the length of the ACK frame transmitted for each STA 1 to 4 may also be different. That is, when the STA receiving the DL MU frame through one DL MU PPDU and the STA receiving the trigger information are different, the receiving STAs transmit the ACK frame and the UL MU frame using one UL MU PPDU. It can be difficult.

In addition, if STAs 1 to 4 do not transmit an ACK frame (or BA frame) to UL MU due to various causes such as failure of reception of the DL MU frame of STAs 1 to 4, the ACK frame (or BA frame))) a predetermined empty time hole is generated due to the transmission member. In a system employing a contention-based channel access scheme, the medium may be occupied by other STAs during the predetermined time interval, and as a result, UL MU transmission of STAs 5 and 6 receiving trigger information may fail.

Accordingly, a configuration of a new DL MU PPDU and a UL MU PPDU transmitted as a response to the DL MU PPPDU to prevent such a problem will be proposed with reference to FIG. 38 below.

38 is a diagram illustrating a DL MU PPDU and a UL MU PPDU according to another embodiment of the present invention.

In this embodiment, the HE-SIG B field of the DL MU PPDU may be configured in the order of the first HE-SIG B field 3810 → the second HE-SIG B field 3820 . In addition, it is assumed that DL MU resources are allocated to STAs 1 to 4 and UL MU resources are allocated to STAs 1 and 2, respectively. That is, it is assumed that the STAs (STAs 1 and 2) receiving the trigger information are a subset of the STAs (STAs 1 to 4) receiving the DL MU frame.

Referring to FIG. 38A , the first HE-SIG B field 3810 may include allocation information (or user specific information) of DL MU resources for STAs 1 to 4 . For example, the first HE-SIG B field 3810 may include at least one of identification information for STAs 1 to 4, frequency resource allocation information, and spatial resource allocation information.

The second HE-SIG B field 3820 may include UL MU resource allocation information for STAs 1 and 2 (or trigger information for UL MU transmission). For example, the second HE-SIG B field 3820 may include at least one of identification information for STAs 1 and 2 and spatial resource/frequency resource indication information for UL MU transmission.

The data field may include DL MU frames respectively received by STAs 1 to 4 to which DL MU resources are allocated. The data field may be frequency-multiplexed and/or spatially-multiplexed to be DL MU transmitted.

The AP may DL MU transmit the DL MU PPDU including the fields described above. Upon receiving the DL MU PPDU, STAs 1 to 4 may UL MU transmit a UL MU PPDU generated based on the received DL MU PPDU.

More specifically, referring to FIG. 38(b), STAs 1 and 2 that have received the DL MU frame and trigger information together receive an ACK frame (or BA frame) that is a response to the received DL MU frame, UL MU transmission may be performed by piggy-backing the UL MU frame generated based on the received trigger information. Hereinafter, for convenience of description, a frame in which an ACK frame (or a BA frame) is piggybacked to a UL MU frame may be referred to as a 'cascade UL MU frame'. Such a cascade UL MU frame may be UL MU transmitted by using the same DL MU resource used for transmitting the DL MU frame received by each STA 1 and STA 2 .

In addition, the STAs 3 and 4 that have received only the DL MU frame may UL MU transmit an ACK frame (or BA frame) that is a response to the received DL MU frame. Even in this case, the ACK frame (or BA frame) may be transmitted by UL MU using the same DL MU resource used for transmitting the DL MU frame received by each STA 3 and 4 .

Since each STA performs UL MU transmission using the same resource as the transmission resource of the DL MU frame received through one DL MU PPDU, the above-described cascade UL MU frame and ACK frame (or BA frame) are one UL MU may be transmitted through the same UL MU PPDU. In this case, each ACK frame (or BA frame) may be padded to have the

same bit size as the maximum bit size of the UL MU frame.

Referring to FIG. 38(c), the AP receiving the UL MU PPDU transmitted by the UL MUs by STAs 1 and 2 sends an ACK frame (or BA frame) that is a response to the received UL MU frame to STA 1 , DL SU can be transmitted to 2. In this case, the AP may DL SU transmit an ACK frame (or BA frame) using a DL SU PPDU having the same bandwidth as that of the received UL MU PPDU. In addition, the ACK frame (or BA frame) may be copied in units of 20 MHz in the DL MU PPDU and transmitted through the DL SU.

In the case of this embodiment, since a predetermined empty time hole does not occur due to the ACK frame (or BA frame) transmission failure of STAs 1 to 4 (because it is transmitted through the same UL MU PPDU), other There is no problem that the UL MU frame transmission of STAs 1 and 2 fails due to the STA's occupation of the medium.

37 and 38, when the STA receiving the trigger information is a subset of the STA receiving the DL MU frame, it can be confirmed that the UL MU frame transmission by the STA does not fail.

In other words, when some of the STAs receiving the DL MU frame transmit the UL MU frame, it can be confirmed that the UL MU frame transmission does not fail.

Therefore, in order to prevent transmission failure of the UL MU frame, when the subset condition is satisfied between the STA receiving the trigger information and the STA receiving the DL MU frame, the AP includes the DL MU PPDU including the trigger information and the DL MU frame. can be transmitted to the DL MU. As a result, at least one cascade UL MU frame may exist in the UL MU PPDU transmitted by the UL MU corresponding to the DL MU PPDU.

In addition, in order to prevent transmission failure of the UL MU frame and efficiently use resources (frequency, time, and space resources), the ACK frame (or BA frame) and the UL MU frame are UL using one UL MU PPDU. Another UL MU PPDU structure for MU transmission may be proposed. In this case, the subset condition does not need to be satisfied between the DL MU receiving STA and the UL MU transmitting STA. This will be described later in detail with reference to FIG. 42 .

Meanwhile, in the present embodiment, the ACK frame (or BA frame) format defined in the 802.11a system or the 802.11ax system may be applied to the ACK frame (or BA frame). However, when transmitted together with the UL MU frame, the ACK frame (or BA frame) format defined in the 802.11ax system may be applied.

Hereinafter, for convenience of description, the ACK frame and the BA frame are collectively referred to as an 'ACK frame'.

The above-described embodiment has been described based on an embodiment in which UL MU transmission is performed using the same resource as the transmission resource of a DL MU frame received through one DL MU PPDU.

However, the cascade UL MU frame and/or the UL MU frame may be UL MU transmitted using a resource different from the DL MU transmission resource of the DL MU frame. In this case, the HE-SIG B field may separately provide the format of the frame to be transmitted by the STA and indication information such as the UL MU transmission resource allocated to each STA. A detailed description thereof will be provided below.

1) Option 1

UL MU resources are preferentially allocated to STAs included in the first HE-SIG B field 3810 but not included in the second HE-SIG B field 3820 (or STAs that will UL MU transmit only the ACK frame), and the remaining UL A method of allocating an MU resource as a resource for transmitting a cascade UL MU frame and/or a UL MU frame may be proposed. In this case, the type and size of the UL MU resource preferentially allocated to each ACK frame may be preset, and the UL MUs preset in the order of the DL MU frame reception STA ID included in the first HE-SIG B field 3810 . resources can be allocated.

For example, it may be assumed that STAs 1 to 4 are sequentially included in the first HE-SIG B field 3810 , and STAs 2 and 3 that will transmit only the ACK frame UL MU may be assumed. In addition, it may be assumed that the UL MU resource allocated for ACK frame transmission is preset as one 26-tone resource unit. In this case, one resource for transmitting the ACK frame may be allocated one by one in the order of STA 2→STA 3 from the first 26-tone resource unit. The remaining resource units allocated to each STA may be allocated to the receiving STA ID included in the second HE-SIG B field 3820 .

2) 2nd option

A method of indicating the ACK frame format and transmission resource for each receiving STA of the DL MU frame in the first HE-SIG B field 3810 may be proposed. For example, the first HE-SIG B field 3810 may include an ACK frame indicator indicating an ACK frame format and transmission resources for each receiving STA. The ACK frame indicator may indicate whether the corresponding STA is an STA that should transmit an ACK frame or an STA that should transmit a cascade UL MU

frame (ACK frame + UL MU frame). If the corresponding STA is an STA that needs to transmit an ACK frame, the ACK frame indicator may additionally indicate information on a UL MU transmission resource to be used for transmitting the ACK frame.

For example, it may be assumed that the bit size of the ACK frame indicator is 1-bit.

At this time, if the bit value of the ACK frame indicator is set to '0', the corresponding ACK frame indicator is the STA that the corresponding STA needs to transmit the cascade UL MU frame or the STA that does not need to transmit the ACK frame (the DL MU frame is In case of No ACK frame) may be indicated.

Conversely, when the bit value of the ACK frame indicator is set to '1', the corresponding ACK frame indicator may indicate that the corresponding STA is an STA that should transmit the ACK frame.

As in the first option, the STA that needs to transmit the ACK frame may transmit the ACK frame using UL MU resources of a preset size allocated in the order of the receiving STA ID included in the first HE-SIG B field 3810. . Alternatively, as described above, the ACK frame indicator may additionally indicate information on UL MU resources to be used for transmitting the ACK frame. In this case, the STA may UL MU transmit the ACK frame using the UL MU resource indicated by the ACK frame indicator.

3) 3rd option

In the second HE-SIG B field 3820 , a method of providing the format of a frame for UL MU transmission for each STA and information on UL MU transmission resources of the frame may be proposed. The second HE-SIG B field 3820 is an ACK frame, a cascade UL MU frame, or It may indicate whether to transmit the UL MU frame. In this case, the second HE-SIG B field 3820 is included in the first HE-SIG B field 3810 with reference to the receiving STA ID included in the first HE-SIG B field 3810 , for example. in the order of received STA IDs) may indicate a frame format corresponding to each receiving STA. Furthermore, the second HE-SIG B field 3820 may also provide information on allocation of UL MU resources to be used for UL MU transmission of each frame (ACK frame, cascade UL MU frame, or UL MU frame) for each STA. .

4) 4th option

A method of preferentially allocating UL MU resources to STAs transmitting a cascade UL MU frame or UL MU frame and allocating the remaining UL MU resources to STAs transmitting an ACK frame may be proposed. Such resource allocation information for each STA may be provided through the second HE-SIG B field 3820 .

5) 5th option

A method of instructing a receiving STA that receives a DL MU frame together with trigger information in the second HE-SIG B field 3820 in a bitmap format may be proposed. For example, if the number of STAs receiving trigger information of the second HE-SIG B field 3820 is N, after configuring N-bits in the second HE-SIG B field 3820 , DL within N-bits A bit value of a position corresponding to an STA that additionally receives the MU frame may be set to '1'. In this case, the second HE-SIG B field 3820 may additionally indicate UL MU resource allocation information for transmitting the cascade UL MU frame to STAs corresponding to the bit position having a value of '1'. Conversely, UL MU resource allocation information for transmitting an ACK frame may be indicated to STAs corresponding to bit positions having a value of '0' in the method proposed in the first to fourth options.

In addition, when there are STAs that transmit only the UL MU frame, the second HE-SIG B field 3820 may indicate the STA IDs of the STAs and the UL MU resources allocated to each STA.

As described above, the embodiment in which trigger information is transmitted while being included in the physical preamble of the DL MU PPDU (in particular, the HE-SIG B field of the physical preamble) has been described in detail. Hereinafter, an embodiment in which a trigger frame including trigger information (ie, a MAC frame format of trigger information) is transmitted in a data field of a DL MU PPDU will be described in detail below.

When the trigger frame is configured in the structure of the MAC frame, the trigger frame may be configured in one MPDU.

In this case, the trigger frame may correspond to a type of a MAC control frame or a MAC management frame, and differently, the trigger frame type may be newly defined.

Alternatively, the trigger frame may be composed of a frame (eg, an HT-Control wrapper frame) including an HT-Control field in the MAC header.

In this case, information for UL MU transmission (ie, trigger information) may be included in the HT-Control field in the corresponding frame. Alternatively, the trigger information may be included in the HE-Control field newly defined in the HE

format in the 802.11ax system. The HE-Control field may be newly defined in the 802.11ax system in a similar manner to the HT-Control field defined in the existing HT format. Accordingly, the HE-Control field may be included in the MAC header in a manner similar to the method in which the HT-Control field illustrated in FIG. 6 is included in the MAC header.

The trigger frame can be largely divided into two structures as follows according to a method included in the DL MU PPDU.

1) Example 2-1

When some of the STAs receiving the DL MU frame perform UL MU transmission (that is, when the UL MU transmitting STA is a subset of the DL MAC frame receiving STA), the DL MU PPDU may include an A-MPDU in the data field. The A-MPDU may be composed of at least one MPDU corresponding to the trigger frame and the remaining MPDUs corresponding to the DL MU frame. In this case, information for UL MU transmission (ie, trigger information) may be included in a MAC header or MAC frame body in the corresponding A-MPDU. A more detailed description thereof will be provided below with reference to FIG. 39 .

2) Example 2-2

Alternatively, when the STA receiving the DL MU frame does not perform UL MU transmission (ie, the UL MU transmitting STA is not a subset of the DL MAC frame receiving STA), the DL MU PPDU is a trigger frame in the data field. It may include only the MPDU corresponding to . In this case, information for UL MU transmission (ie, trigger information) may be included in a MAC header or MAC frame body in the corresponding MPDU. A more detailed description thereof will be provided below with reference to FIG. 40 .

39 is a diagram illustrating the structure of a DL MU PPDU according to the 2-1 embodiment of the present invention.

Referring to FIG. 39 , when some of the STAs receiving the DL MU frame perform UL MU transmission (or when there is an STA that receives both the DL MU frame and the trigger frame), data allocated to each of the some STAs The field may be configured in an A-MPDU format as in the example of FIG. 17 .

In this case, at least one MPDU among the plurality of MPDUs constituting the A-MPDU may correspond to a trigger frame, and the remaining MPDUs may correspond to a DL MU frame.

In this case, the location of the MPDU including the trigger information may be designated in advance. For example, a first MPDU among a plurality of MPDUs constituting the A-MPDU may correspond to a trigger frame, and the remaining MPDUs may correspond to a DL MU frame. In this case, the AP may inform the STAs of the pre-specified MPDU location through a beacon frame or the like.

In addition, the data field allocated to the remaining STAs except for some STAs may be configured in an MPDU or A-MPDU format, and the corresponding MPDU or A-MPDU may correspond to a DL MU frame.

Since the trigger frame included in one A-MPDU and the receiving STA of the DL MU frame are the same, the receiving STA information for the trigger frame may not be separately required. Accordingly, the trigger frame may not separately include information about the STA performing UL MU transmission. The MPDU corresponding to the trigger frame may include an indicator for indicating that the corresponding MPDU includes trigger information. For example, an MPDU including trigger information may inform that the corresponding MPDU corresponds to a trigger frame using a frame subtype included in the MAC header.

Since the above-described embodiment 2-1 is applied when the UL MU transmitting STA is a subset of the DL MU frame receiving STA, certain restrictions may exist in UL MU scheduling.

Meanwhile, in this embodiment, a trigger frame transmitted to an STA participating in DL MU transmission may be referred to as a 'unicast trigger frame'.

40 is a diagram illustrating the structure of a DL MU PPDU according to the second embodiment of the present invention.

Referring to FIG. 40 , when an STA that receives a DL MU frame does not perform UL MU transmission (or when an STA that receives both a trigger frame and a DL MU frame does not exist), a DL MU carrying a DL MU frame A trigger frame may be included in a specific data field among the data fields of the PPDU.

More specifically, the transmission resource of the data field of the DL MU PPDU carrying the DL MU frame may be multiplexed according to the DL OFDMA and/or DL MU-MIMO scheme, and a trigger frame using a specific data field among the multiplexed data fields can carry For example, a trigger frame may be included in a data field corresponding to a predetermined subband in order to transmit the trigger frame.

When a trigger frame is included in a specific data field among the data fields of the DL MU PPDU carrying the DL MU frame, the specific data field may include only one MPDU corresponding to the trigger frame. In this case, information for UL MU transmission (ie, trigger information) may be included in the MAC header or MAC frame body in the corresponding MPDU. In particular, in this embodiment, since the UL MU transmitting STA and the DL MU receiving STA are different, STA information receiving trigger information may be additionally required in addition to the DL MU receiving STA information included in the HE-SIG B field. Therefore, unlike the 2-1 embodiment, in the 2-2 embodiment, as trigger information in the MPDU corresponding to the trigger frame, STA information for receiving the trigger frame (or STA information to perform UL MU transmission) and each All UL MU resource allocation information allocated to the STA may be included.

A specific data field including a trigger frame may be transmitted through broadcast. Accordingly, the AID of the specific data field may be set as the broadcast AID, and the trigger frame of the specific data field may include the AIDs of STAs triggering UL MU transmission. Accordingly, one MPDU (or a trigger frame included in the corresponding MPDU) included in a specific data field may be referred to as a 'broadcast trigger frame'. In other words, a trigger frame transmitted to an STA that does not participate in DL MU transmission may be referred to as a 'broadcast trigger frame'.

When only one MPDU corresponding to the trigger frame is included in the specific data field of the DL MU PPDU, it is necessary to inform the STA that the specific data field including the trigger frame exists.

In this case, the HE-SIG B field corresponding to the corresponding data field may include a trigger indicator indicating that the trigger frame is included in the corresponding data field. For example, a 1-bit size trigger indicator indicating whether a specific data field including trigger information is included may be included in the HE-SIG B field providing user specific information of the specific data field.

Alternatively, as described above, for broadcast transmission of a specific data field, the HE-SIG B field may include a broadcast AID as identification information for a corresponding data field. Accordingly, the STA may recognize that a specific data field including a trigger frame exists through broadcast identification information included in the HE-SIG B field.

When a trigger frame is included in a specific data field among the data fields of the DL MU PPDU carrying the DL MU frame, the location of the data field including the trigger frame (eg, subband location, DL MU STA index, etc.) can be specified. In this case, the AP may notify the STAs of the location of a predetermined specific data field through a beacon frame or the like.

A specific data field including one MPDU may have a smaller bit size than other data fields (eg, a data field including an A-MPDU). Accordingly, a specific data field may be included in the DL MU PPDU by being padded to have the same bit size as other data fields having the maximum bit size (or to be equal to the length of the DL MU PPDU).

Since embodiment 2-2 can be applied when the UL MU transmitting STA is not a subset of the DL MU frame receiving STA, UL MU scheduling has a more advantageous effect.

The structure of the DL MU PPDU according to the second embodiment of the present invention has been described above. The above-described embodiments 2-1 and 2-2 may be applied independently or in combination according to circumstances. When the 2-1 and 2-2 embodiments are applied in combination with each other, the specific data field of the DL MU PPDU may include only one MPDU corresponding to the trigger frame, and the other data fields are the trigger frame and the DL MU frame. may be included as an A-MPDU format.

For example, when the DL MU receiving STAs are STAs 1 and 2 and the UL MU transmitting STAs are 2 and 3, the trigger frame for STA 3 may be included in the first data field as one MPDU, and for STA 2 The trigger frame and the DL MU frame may be included in the second data field as the A-MPDU format, and the DL MU frame for STA 1 may be included in the third data field as the MPDU format or the A-MPDU format.

41 is a table comparing the effects of the first and second embodiments.

Referring to Fig. 41, the first embodiment has the following advantages and effects.

- Flexibility of UL MU scheduling

- Advantage in terms of resource and power saving of UL MU STA and other STAs (Resource saving/ Power saving of other STAs/UL MU STAs)

However, in the case of the first embodiment, there may be a problem that a bit for indicating the ACK frame is additionally required in the HE-SIG B field (see the second option).

In addition, in the case of the first embodiment, there may be a disadvantage that a new HE-SIG B field indicating UL MU

resource allocation information (ie, a second HE-SIG B field) is additionally required.

The 2-1 embodiment has the following advantages and effects.

- Advantage in terms of resource and power saving of UL MU STA and other STAs (Resource saving/ Power saving of other STAs/UL MU STAs)

- Existing DL MU frame format can be used as it is (Use DL MU frame format as it is)

However, in the case of embodiment 2-1, since the UL MU transmitting STA is an embodiment applicable to a subset of the DL MU frame receiving STA, there is a problem that certain restrictions exist in UL MU scheduling.

The 2-2 embodiment has the following advantages and effects.

- A UL MU group can be freely formed (Free to make UL MU group) (or flexibility of UL MU scheduling).

However, in the case of the 2-2 embodiment, there may be a problem that a bit for indicating whether a trigger frame exists is additionally required in the HE-SIG B field. In addition, there may be a problem in that resources and power of STAs other than those of UL MU transmitting STAs may be wasted. This is because, in the case of a specific data field including only the MPDU corresponding to the trigger frame, it is padded and transmitted to have the same length as other data fields. Accordingly, DL MU resources are wasted, and STAs according to the 802.11ax system cannot sleep during the length of the DL MU PPDU to decode the trigger frame (power wasted).

Hereinafter, a structure of a UL MU PPDU transmitted by UL MU corresponding to the DL MU PPDU of the first and second embodiments (including embodiments 2-1 and 2-2) will be described.

42 is a diagram illustrating a UL MU PPDU according to an embodiment of the present invention.

In this embodiment, it is assumed that the DL MU frame is received by STAs 1 and 2, and the trigger frame is received by STAs 2 and 3, and description will be made.

Upon receiving the DL MU PPDU, the STA may generate a UL MU PPDU based on the received DL MU PPDU and transmit the UL MU PPDU to the AP. In this case, each STA may transmit a UL MU frame based on a trigger frame included in the DL MU PPDU, and may transmit an ACK frame as a response to the DL MU frame. In this case, the method of UL MU transmission of the UL MU frame and the ACK frame may vary according to embodiments.

Referring to FIG. 42(a) as an embodiment, the UL MU frame and the ACK frame may be UL MU transmitted using separate UL MU resources. For example, the frequency resource may be largely divided into two regions, of which a first region may be used as a frequency resource for ACK frame transmission, and a second region may be used as a frequency resource for UL MU frame transmission. Furthermore, the first region may be separately allocated to STAs transmitting the ACK frame again, and the second region may also be allocated separately to STAs transmitting the UL MU frame.

Accordingly, a first region for ACK frame transmission may be allocated to STAs 1 and 2, respectively, and a second region for UL MU frame transmission may be allocated to STAs 2 and 3, respectively. As a result, the ACK frame of STA 1, the ACK frame of STA 2, the UL MU frame of STA 2, and the UL MU frame of STA 3 are UL MU transmitted through one UL MU PPDU using different UL MU resources. can

The present embodiment has an advantage that the UL MU transmission method of each frame is simple. However, in the case of an STA capable of simultaneously transmitting the ACK frame and the UL MU frame (in the case of the above-described embodiment, STA 2), since each frame is transmitted using a separate UL MU resource, there is a problem that the UL MU resource is wasted. . In addition, the AP receiving the corresponding UL MU PPDU needs to separately decode two OFDMA packets (an OFDMA packet including an ACK frame of STA 2 and an OFDMA packet including an UL MU frame of STA 2), so there is a problem that resources are wasted. exist. In order to solve this problem, the following UL MU transmission scheme may be proposed.

Referring to FIG. 42(b) as another embodiment, the ACK frame transmitted by the same STA may be piggybacked to the UL MU frame and transmitted. For example, in the case of STA 2 that has received both the DL MU frame and the trigger frame, the ACK frame for the DL MU frame may be piggybacked to the UL MU frame for the trigger frame, and UL MU transmission may be performed. In this case, the data field allocated for UL MU transmission to STA 2 may be configured in an A-MPDU format, at least one of a plurality of MPDUs constituting the A-MPDU may correspond to an ACK frame, and the remaining MPDUs are It can correspond to a UL MU frame.

In this embodiment, UL MU resource allocation information for transmitting the ACK frame of STA 2 is not separately required.

This is because STA 2 may piggyback the ACK frame to the UL MU frame and transmit it. Accordingly, the AP may not separately include UL MU resource allocation information for the ACK frame of STA 2 in the HE-SIG B field of the DL MU PPDU when transmitting the DL MU. Also, in the case of the MCS level applied to the ACK frame, the same MCS level as the UL MU frame may be applied.

On the other hand, as for the allocation method of the UL MU resource for each STA, the embodiments described above in FIGS. 37 and 38 may be applied in the same manner, and overlapping descriptions will be omitted.

In the case of this embodiment, there is an effect that resources are saved. However, the UL MU transmission method is more complicated than the above-described transmission method, and there is a problem that an MCS level (or a lower MCS level) suitable for robust transmission cannot be applied to the piggybacked ACK frame (within the same data field). Because the same MCS level as the UL MU frame can be applied).

43 is a flowchart illustrating a DL MU transmission method of an AP according to an embodiment of the present invention.

The above-described embodiments may be equally applied to the description related to the flowchart. Therefore, the overlapping description will be omitted below.

Referring to FIG. 43 , the AP may transmit a DL MU PPDU (S4310). More specifically, the AP may DL MU transmit a DL MU PPDU including a physical preamble and a data field. In this case, the DL MU PPDU may be a field including a trigger frame including trigger information for triggering UL MU transmission of the receiving STA and a DL MU frame.

Next, the AP may UL MU receive the UL MU PPDU generated based on the DL MU PPDU (S4320). In this case, the UL MU PPDU may include a UL MU frame based on the trigger frame and an ACK frame in response to the DL MU frame.

44 is a block diagram of each STA device according to an embodiment of the present invention.

In FIG. 44 , the STA device 4410 may include a memory 4412 , a processor 4411 , and an RF unit 4413 .

And, as described above, the STA device is a HE STA device, and may be an AP or a non-AP STA.

The RF unit 4413 may be connected to the processor 4411 to transmit/receive a wireless signal. The RF unit 4413 may transmit a signal by up-converting data received from the processor 4411 into a transmission/reception band.

The processor 4411 may be connected to the RF unit 4413 to implement a physical layer and/or a MAC layer according to the IEEE 802.11 system. The processor 4411 may be configured to perform operations according to various embodiments of the present invention according to the drawings and descriptions described above. In addition, a module implementing the operation of the STA 4410 according to various embodiments of the present invention described above may be stored in the memory 4412 and executed by the processor 4411 .

The memory 4412 is connected to the processor 4411 and stores various information for driving the processor 4411 . The memory 4412 may be included in the processor 4411 or installed outside the processor 4411 to be connected to the processor 4411 by a known means.

Also, the STA device 4410 may include a single antenna or multiple antennas.

The specific configuration of the STA device 4410 of FIG. 44 may be implemented so that the matters described in the various embodiments of the present invention described above are independently applied or two or more embodiments are simultaneously applied.

The embodiments described above are those in which elements and features of the present invention are combined in a predetermined form.

Each component or feature should be considered optional unless explicitly stated otherwise. Each component or feature may be implemented in a form that is not combined with other components or features. It is also possible to configure embodiments of the present invention by combining some elements and/or features. The order of operations described in the embodiments of the present invention may be changed. Some features or features of one embodiment may be included in another embodiment, or may be replaced with corresponding features or features of another embodiment. It is obvious that claims that are not explicitly cited in the claims can be combined to form an embodiment or included as a new claim by amendment after filing.

Embodiments according to the present invention may be implemented by various means, for example, hardware, firmware, software, or a combination thereof. In the case of implementation by hardware, an embodiment of the present invention provides one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices

(DSPDs), programmable logic devices (PLDs), FPGAs (field programmable gate arrays), a processor, a controller, a microcontroller, a microprocessor, and the like.

In the case of implementation by firmware or software, an embodiment of the present invention may be implemented in the form of a module, procedure, function, etc. that perform the functions or operations described above. The software code may be stored in the memory and driven by the processor. The memory may be located inside or outside the processor, and may transmit/receive data to and from the processor by various known means.

It is apparent to those skilled in the art that the present invention may be embodied in other specific forms without departing from the essential characteristics of the present invention. Accordingly, the above detailed description should not be construed as restrictive in all respects but as exemplary. The scope of the present invention should be determined by a reasonable interpretation of the appended claims, and all modifications within the equivalent scope of the present invention are included in the scope of the present invention.

Although the frame transmission method in the wireless communication system of the present invention has been described focusing on an example applied to the IEEE 802.11 system, it can be applied to various wireless communication systems in addition to the IEEE 802.11 system.

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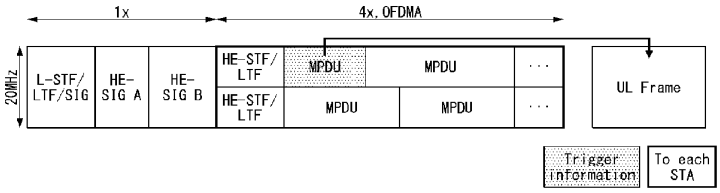
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공개:

— 국제조사보고서 없이 공개하며 보고서 접수 후 이를 별도 공개함 (규칙 48.2(g))

(54) Title: METHOD FOR TRANSMITTING DATA IN WIRELESS COMMUNICATION SYSTEM AND DEVICE FOR SAME

(54) 발명의 명칭 : 무선 통신 시스템에서 데이터 전송 방법 및 이를 위한 장치



(57) Abstract: According to one embodiment of the present invention, an access point (AP) downlink (DL) multi-user (MU) transmission method in a wireless communication system comprises the steps of: transmitting a DL MU physical protocol data unit (PPDU), the DL MU PPDU including a trigger frame, which includes trigger information for uplink (UL) MU transmission, and a DL MU frame; and UL MU-receiving a UL MU PPDU generated on the basis of the DL MU PPDU, wherein the UL MU PPDU can include a UL MU frame based on the trigger frame and an acknowledge (ACK) frame which is a response to the DL MU frame.

(57) 요약서: 본 발명의 일 실시예에 따르면, 무선 통신 시스템에서 AP(Access Point) 하향 링크(DL: Downlink) 다중 사용자(MU: Multi-User) 전송 방법에 있어서, DL MU PPDU(PPDU: Physical Protocol Data Unit)를 전송하는 단계; 로서, 상기 DL MU PPDU 는 상향링크(UL: Uplink) MU 전송을 위한 트리거 정보를 포함하는 트리거 프레임 및 DL MU 프레임을 포함함, 및 상기 DL MU PPDU 를 기초로 생성된 UL MU PPDU 를 UL MU 수신하는 단계; 를 포함하되, 상기 UL MU PPDU 는 상기 트리거 프레임을 기초로 한 UL MU 프레임 및 상기 DL MU 프레임에 대한 응답인 ACK(Acknowledge) 프레임을 포함할 수 있다.

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명세서

발명의 명칭: 무선 통신 시스템에서 데이터 전송 방법 및 이를 위한 장치

기술분야

[1] 본 발명은 무선 통신 시스템에 관한 것으로서, 보다 상세하게 다중 사용자(multi-user)의 데이터 전송을 지원하기 위한 데이터 전송 방법 및 이를 지원하는 장치에 관한 것이다.

배경기술

[2] 와이파이(Wi-Fi)는 2.4GHz, 5GHz 또는 60GHz 주파수 대역에서 기기가 인터넷에 접속 가능하게 하는 WLAN(Wireless Local Area Network) 기술이다.

[3] WLAN은 IEEE(institute of electrical and electronic engineers) 802.11 표준에 기반한다. IEEE 802.11의 WNG SC(Wireless Next Generation Standing Committee)는 차세대 WLAN(wireless local area network)을 중장기적으로 고민하는 애드혹 위원회(committee)이다.

[4] IEEE 802.11n은 네트워크의 속도와 신뢰성을 증가시키고, 무선 네트워크의 운영 거리를 확장하는데 목적을 두고 있다. 보다 구체적으로, IEEE 802.11n에서는 최대 600Mbps 데이터 처리 속도(data rate)를 제공하는 고처리율(HT: High Throughput)을 지원하며, 또한 전송 에러를 최소화하고 데이터 속도를 최적화하기 위해 송신부와 수신부 양단 모두에 다중 안테나를 사용하는 MIMO(Multiple Inputs and Multiple Outputs) 기술에 기반을 두고 있다.

[5] WLAN의 보급이 활성화되고 또한 이를 이용한 어플리케이션이 다양화됨에 따라, 초고처리율(VHT: Very High Throughput)를 지원하는 차세대 WLAN 시스템은 IEEE 802.11n WLAN 시스템의 다음 버전으로서, IEEE 802.11ac가 새롭게 제정되었다. IEEE 802.11ac는 80MHz 대역폭 전송 및/또는 더 높은 대역폭 전송(예를 들어, 160MHz)을 통해 1Gbps 이상의 데이터 처리 속도를 지원하고, 주로 5 GHz 대역에서 동작한다.

[6] 최근에는 IEEE 802.11ac이 지원하는 데이터 처리 속도보다 더 높은 처리율을 지원하기 위한 새로운 WLAN 시스템에 대한 필요성이 대두되고 있다.

[7] 일명 IEEE 802.11ax 또는 고효율(HEW: High Efficiency) WLAN라고 불리는 차세대 WLAN 태스크 그룹에서 주로 논의되는 IEEE 802.11ax의 범위(scope)는 1) 2.4GHz 및 5GHz 등의 대역에서 802.11 PHY(physical) 계층과 MAC(medium access control) 계층의 향상, 2) 스펙트럼 효율성(spectrum efficiency)과 영역 쓰루풋(area throughput) 향상, 3) 간섭 소스가 존재하는 환경, 밀집한 이종 네트워크(heterogeneous network) 환경 및 높은 사용자 부하가 존재하는 환경과 같은 실제 실내 환경 및 실외 환경에서 성능을 향상 등을 포함한다.

[8] IEEE 802.11ax에서 주로 고려되는 시나리오는 AP(access point)와

STA(station)이 많은 밀집 환경이며, IEEE 802.11ax는 이러한 상황에서 스펙트럼 효율(spectrum efficiency)과 공간 전송률(area throughput) 개선에 대해 논의한다. 특히, 실내 환경뿐만 아니라, 기존 WLAN에서 많이 고려되지 않던 실외 환경에서의 실질적 성능 개선에 관심을 가진다.

[9] IEEE 802.11ax에서는 무선 오피스(wireless office), 스마트 홈(smart home), 스타디움(Stadium), 핫스팟(Hotspot), 빌딩/아파트(building/apartment)와 같은 시나리오에 관심이 크며, 해당 시나리오 기반으로 AP와 STA가 많은 밀집 환경에서의 시스템 성능 향상에 대한 논의가 수행되고 있다.

[10] 앞으로 IEEE 802.11ax에서는 하나의 BSS(basic service set)에서의 단일 링크 성능 향상보다는, OBSS(overlapping basic service set) 환경에서의 시스템 성능 향상 및 실외 환경 성능 개선, 그리고 셀룰러 오프로딩(cellular offloading) 등에 대한 논의가 활발할 것으로 예상된다. 이러한 IEEE 802.11ax의 방향성은 차세대 WLAN이 점점 이동 통신과 유사한 기술 범위를 갖게 됨을 의미한다. 최근 스몰 셀(small cell) 및 D2D(Direct-to-Direct) 통신 영역에서 이동 통신과 WLAN 기술이 함께 논의되고 있는 상황을 고려해 볼 때, IEEE 802.11ax를 기반한 차세대 WLAN과 이동 통신의 기술적 및 사업적 융합은 더욱 활발해질 것으로 예측된다.

발명의 상세한 설명

기술적 과제

[11] 본 발명의 목적은 무선 통신 시스템에서 상향링크/하향링크 다중 사용자(multi-user) 데이터 송수신 방법을 제안한다.

[12] 또한, 본 발명의 목적은 무선 통신 시스템에서 상향링크/하향링크 다중 사용자(multi-user) 송수신에 이용되는 PPDU의 HE(High Efficiency) 포맷을 제안한다. 특히, PPDU에 포함된 데이터 필드의 HE 포맷을 제안한다.

[13] 또한, 본 발명의 목적은 DL/UL MU 자원을 효율적으로 사용하기 위한 캐스케이드 방식의 DL/UL MU PPDU의 HE 포맷을 제안한다.

[14] 본 발명에서 이루고자 하는 기술적 과제들은 이상에서 언급한 기술적 과제들로 제한되지 않으며, 언급하지 않은 또 다른 기술적 과제들은 아래의 기재로부터 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 명확하게 이해될 수 있을 것이다.

과제 해결 수단

[15] 상술한 기술적 과제를 해결하기 위하여, 본 발명의 실시예에 따른 WLAN 시스템의 AP 장치 및 AP 장치의 데이터 전송 방법을 제안한다.

[16] 본 발명의 일 실시예에 따른 무선 통신 시스템에서 AP(Access Point) 하향 링크(DL: Downlink) 다중 사용자(MU: Multi-User) 전송 방법에 있어서, DL MU PPDU(PPDU: Physical Protocol Data Unit)를 전송하는 단계; 로서, 상기 DL MU PPDU는 상향링크(UL: Uplink) MU 전송을 위한 트리거 정보를 포함하는 트리거 프레임 및 DL MU 프레임을 포함함, 및 상기 DL MU PPDU를 기초로 생성된 UL

MU PPDU를 UL MU 수신하는 단계; 를 포함하되, 상기 UL MU PPDU는 상기 트리거 프레임을 기초로 한 UL MU 프레임 및 상기 DL MU 프레임에 대한 응답인 ACK(Acknowledge) 프레임을 포함할 수 있다.

[17] 또한, 상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우, 상기 DL MU 프레임과 상기 트리거 프레임은, 상기 수신 STA에 할당된 데이터 필드에 A-MPDU(Agrregated MAC Protocol Data Unit) 포맷으로 포함될 수 있다.

[18] 또한, 상기 트리거 프레임의 MAC 헤더(MAC header)는, 상기 트리거 프레임이 상기 트리거 정보를 포함하고 있음을 지시하는 트리거 지시자를 포함할 수 있다.

[19] 또한, 상기 트리거 프레임은 상기 A-MPDU 포맷에 포함된 MPDU(MAC Protocol Data Unit)들 중 첫 번째 MPDU에 해당할 수 있다.

[20] 또한, 상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되지 않는 경우, 상기 트리거 프레임은 상기 DL MU PPDU 내의 기설정된 데이터 필드에 MPDU 포맷으로 포함되며, 상기 DL MU 프레임은 상기 DL MU PPDU 내의 다른 데이터 필드에 상기 MPDU 포맷 또는 A-MPDU 포맷으로 포함될 수 있다.

[21] 또한, 상기 DL MU PPDU 내의 물리 프리앰블은, 상기 DL MU PPDU가 상기 트리거 프레임을 포함하는지 여부를 지시하는 트리거 지시자, 또는 상기 기설정된 데이터 필드를 수신하는 브로드캐스트 AID(Broadcast Association Identifier) 정보를 포함할 수 있다.

[22] 또한, 상기 트리거 지시자 또는 상기 브로드캐스트 AID 정보는, 상기 물리 프리앰블의 HE-SIG(High Efficiency-Signal) 필드에 포함될 수 있다.

[23] 또한, 상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우, 상기 ACK 프레임은 상기 UL MU PPDU 내의 기설정된 데이터 필드에 MPDU 포맷으로 포함되며, 상기 UL MU 프레임은 상기 UL MU PPDU 내의 다른 데이터 필드에 상기 MPDU 포맷 또는 A-MPDU 포맷으로 포함될 수 있다.

[24] 또한, 상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우, 상기 ACK 프레임은 상기 UL MU 프레임에 피기백되어 상기 UL MU PPDU 내의 기설정된 데이터 필드에 포함될 수 있다.

[25] 또한, 상기 트리거 프레임은 UL MU 전송을 수행하는 STA의 AID(Association Identifier) 정보, 상기 UL MU 전송을 위한 공간 자원 지시 정보, 및 상기 UL MU 전송을 위한 주파수 자원 지시 정보 중 적어도 하나를 포함할 수 있다.

[26] 또한, 본 발명의 다른 실시예에 따른 무선 통신 시스템의 AP(Access Point) 장치에 있어서, 무선 신호를 송수신하는, RF 유닛; 및 상기 RF 유닛을 제어하는, 프로세서; 를 포함하고, 상기 프로세서는, DL MU PPDU(PPDU: Physical Protocol Data Unit)를 전송하되, 상기 DL MU PPDU는 상향링크(UL: Uplink) MU 전송을 위한 트리거 정보를 포함하는 트리거 프레임 및 DL MU 프레임을 포함함, 및

상기 DL MU PPDU를 기초로 생성된 UL MU PPDU를 UL MU 수신하되, 상기 UL MU PPDU는 상기 트리거 프레임을 기초로 한 UL MU 프레임 및 상기 DL MU 프레임에 대한 응답인 ACK(Acknowledge) 프레임을 포함할 수 있다.

[27] 또한, 상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우, 상기 DL MU 프레임과 상기 트리거 프레임은, 상기 수신 STA에 할당된 데이터 필드에 A-MPDU(Agrregated MAC Protocol Data Unit) 포맷으로 포함될 수 있다.

[28] 또한, 상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되지 않는 경우, 상기 트리거 프레임은 상기 DL MU PPDU 내의 기설정된 데이터 필드에 MPDU 포맷으로 포함되며, 상기 DL MU 프레임은 상기 DL MU PPDU 내의 다른 데이터 필드에 상기 MPDU 포맷 또는 A-MPDU 포맷으로 포함될 수 있다.

발명의 효과

[29] 본 발명의 일 실시예에 따르면, 트리거 프레임과 DL MU 프레임이 하나의 DL MU PPDU를 통해 동시에 전송되므로, DL MU 자원이 절약되며 통신 성능이 증가한다는 효과를 갖는다.

[30] 또한, 본 발명의 일 실시예에 따르면, ACK 프레임과 UL MU 프레임이 하나의 UL MU PPDU를 통해 동시에 전송되므로, UL MU 자원이 절약되며 통신 성능이 증대된다는 효과를 갖는다.

[31] 이외에 본 발명의 다른 효과들에 대해서는 이하의 실시예들에서 추가로 설명하도록 한다.

도면의 간단한 설명

[32] 본 발명에 관한 이해를 돕기 위해 상세한 설명의 일부로 포함되는, 첨부 도면은 본 발명에 대한 실시예를 제공하고, 상세한 설명과 함께 본 발명의 기술적 특징을 설명한다.

[33] 도 1은 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 일례를 나타내는 도면이다.

[34] 도 2는 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 계층 아키텍처(layer architecture)의 구조를 예시하는 도면이다.

[35] 도 3은 본 발명이 적용될 수 있는 무선 통신 시스템의 non-HT 포맷 PPDU 및 HT 포맷 PPDU를 예시한다.

[36] 도 4는 본 발명이 적용될 수 있는 무선 통신 시스템의 VHT 포맷 PPDU 포맷을 예시한다.

[37] 도 5는 본 발명이 적용될 수 있는 무선 통신 시스템의 PPDU의 포맷을 구분하기 위한 성상(constellation)을 예시하는 도면이다.

[38] 도 6은 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 MAC 프레임 포맷을 예시한다.

[39] 도 7은 본 발명이 적용될 수 있는 무선 통신 시스템에서 MAC 프레임 내 프레임 제어(Frame Control) 필드를 예시하는 도면이다.

[40] 도 8은 본 발명이 적용될 수 있는 무선 통신 시스템에서 HT Control 필드의 VHT 포맷을 예시한다.

[41] 도 9는 본 발명이 적용될 수 있는 무선 통신 시스템에서 임의 백오프 주기와 프레임 전송 절차를 설명하기 위한 도면이다.

[42] 도 10은 본 발명이 적용될 수 있는 무선 통신 시스템에서 IFS 관계를 예시하는 도면이다.

[43] 도 11은 본 발명이 적용될 수 있는 무선 통신 시스템에서 채널 사운딩(sounding) 방법을 개념적으로 나타내는 도면이다.

[44] 도 12는 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT NDPA 프레임을 예시하는 도면이다.

[45] 도 13은 본 발명이 적용될 수 있는 무선 통신 시스템에서 NDP PPDU을 예시하는 도면이다.

[46] 도 14는 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT 압축된 빔포밍(VHT compressed beamforming) 프레임 포맷을 예시하는 도면이다.

[47] 도 15는 본 발명이 적용될 수 있는 무선 통신 시스템에서 빔포밍 보고 폴(Beamforming Report Poll) 프레임 포맷을 예시하는 도면이다.

[48] 도 16은 본 발명이 적용될 수 있는 무선 통신 시스템에서 Group ID Management 프레임을 예시하는 도면이다.

[49] 도 17은 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[50] 도 18은 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[51] 도 19는 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 MU-MIMO 전송 과정을 예시하는 도면이다.

[52] 도 20은 본 발명이 적용될 수 있는 무선 통신 시스템에서 ACK 프레임을 예시하는 도면이다.

[53] 도 21은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임을 예시하는 도면이다.

[54] 도 22는 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임의 BAR 정보(BAR Information) 필드를 예시하는 도면이다.

[55] 도 23은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임을 예시하는 도면이다.

[56] 도 24는 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임의 BA 정보(BA Information) 필드를 예시하는 도면이다.

[57] 도 25는 본 발명의 일 실시예에 따른 HE(High Efficiency) 포맷 PPDU를 예시하는 도면이다.

[58] 도 26 내지 도 29는 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[59] 도 30은 본 발명의 일 실시예에 따른 HE 포맷 PPDU 검출을 위한 위상 회전(phase rotation)을 예시한다.

[60] 도 31 및 도 32는 본 발명의 일 실시예에 따른 상향링크 다중 사용자(multi-user) 전송 절차를 예시하는 도면이다.

[61] 도 33은 본 발명의 일 실시예에 따른 OFDMA 다중 사용자(multi-user) 전송 방식에서 자원 할당 단위를 예시하는 도면이다.

[62] 도 34는 본 발명의 일 실시예에 따른 상향링크 다중 사용자(multi-user) 전송 절차를 예시하는 도면이다. 본 도면과 관련하여 도 31 및 32와 중복되는 설명은 생략하기로 한다.

[63] 도 35는 본 발명의 실시예에 따른 DL MU PPDU의 구조를 도시한 도면이다.

[64] 도 36은 본 발명의 제1 실시예에 따른 DL MU PPDU의 구조를 도시한 도면이다.

[65] 도 37은 본 발명의 일 실시예에 따른 DL MU PPDU 및 UL MU PPDU를 도시한 도면이다.

[66] 도 38은 본 발명의 다른 실시예에 따른 DL MU PPDU 및 UL MU PPDU를 도시한 도면이다.

[67] 도 39는 본 발명의 제2-1 실시예에 따른 DL MU PPDU의 구조를 도시한 도면이다.

[68] 도 40은 본 발명의 제2-2 실시예에 따른 DL MU PPDU의 구조를 도시한 도면이다.

[69] 도 41은 제1 및 제2 실시예의 효과를 비교한 표이다.

[70] 도 42는 본 발명의 일 실시예에 따른 UL MU PPDU를 도시한 도면이다.

[71] 도 43은 본 발명의 일 실시예에 따른 STA 장치의 UL MU 전송 방법을 나타낸 순서도이다.

[72] 도 44는 본 발명의 일 실시예에 따른 각 STA 장치의 블록도이다.

발명의 실시를 위한 형태

[73] 이하, 본 발명에 따른 바람직한 실시 형태를 첨부된 도면을 참조하여 상세하게 설명한다. 첨부된 도면과 함께 이하에 개시될 상세한 설명은 본 발명의 예시적인 실시형태를 설명하고자 하는 것이며, 본 발명이 실시될 수 있는 유일한 실시형태를 나타내고자 하는 것이 아니다. 이하의 상세한 설명은 본 발명의 완전한 이해를 제공하기 위해서 구체적 세부사항을 포함한다. 그러나, 당업자는 본 발명이 이러한 구체적 세부사항 없이도 실시될 수 있음을 안다.

[74] 몇몇 경우, 본 발명의 개념이 모호해지는 것을 피하기 위하여 공지의 구조 및 장치는 생략되거나, 각 구조 및 장치의 핵심기능을 중심으로 한 블록도 형식으로 도시될 수 있다.

[75] 이하의 설명에서 사용되는 특정 용어들은 본 발명의 이해를 돕기 위해서

제공된 것이며, 이러한 특정 용어의 사용은 본 발명의 기술적 사상을 벗어나지 않는 범위에서 다른 형태로 변경될 수 있다.

[76] 이하의 기술은 CDMA(code division multiple access), FDMA(frequency division multiple access), TDMA(time division multiple access), OFDMA(orthogonal frequency division multiple access), SC-FDMA(single carrier frequency division multiple access), NOMA(non-orthogonal multiple access) 등과 같은 다양한 무선 접속 시스템에 이용될 수 있다. CDMA는 UTRA(universal terrestrial radio access)나 CDMA2000과 같은 무선 기술(radio technology)로 구현될 수 있다. TDMA는 GSM(global system for mobile communications)/GPRS(general packet radio service)/EDGE(enhanced data rates for GSM evolution)와 같은 무선 기술로 구현될 수 있다. OFDMA는 IEEE(institute of electrical and electronics engineers) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802-20, E-UTRA(evolved UTRA) 등과 같은 무선 기술로 구현될 수 있다. UTRA는 UMTS(universal mobile telecommunications system)의 일부이다. 3GPP(3rd generation partnership project) LTE(long term evolution)은 E-UTRA를 사용하는 E-UMTS(evolved UMTS)의 일부로써, 하향링크에서 OFDMA를 채용하고 상향링크에서 SC-FDMA를 채용한다. LTE-A(advanced)는 3GPP LTE의 진화이다.

[77] 본 발명의 실시예들은 무선 접속 시스템들인 IEEE 802, 3GPP 및 3GPP2 중 적어도 하나에 개시된 표준 문서들에 의해 뒷받침될 수 있다. 즉, 본 발명의 실시예들 중 본 발명의 기술적 사상을 명확히 드러내기 위해 설명하지 않은 단계들 또는 부분들은 상기 문서들에 의해 뒷받침될 수 있다. 또한, 본 문서에서 개시하고 있는 모든 용어들은 상기 표준 문서에 의해 설명될 수 있다.

[78] 설명을 명확하게 하기 위해, IEEE 802.11 시스템을 위주로 기술하지만 본 발명의 기술적 특징이 이에 제한되는 것은 아니다.

[79]

[80] <u>시스템 일반</u>

[81] 도 1 은 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 일례를 나타내는 도면이다.

[82] IEEE 802.11 구조는 복수개의 구성요소들로 구성될 수 있고, 이들의 상호작용에 의해 상위계층에 대해 트랜스패런트(transparent)한 스테이션(STA: Station) 이동성을 지원하는 무선 통신 시스템이 제공될 수 있다. 기본 서비스 세트(BSS: Basic Service Set)는 IEEE 802.11 시스템에서의 기본적인 구성 블록에 해당할 수 있다.

[83] 도 1 에서는 3개의 BSS(BSS 1 내지 BSS 3)가 존재하고 각각의 BSS의 멤버로서 2개의 STA이 포함되는 것(STA 1 및 STA 2 는 BSS 1에 포함되고, STA 3 및 STA 4는 BSS 2에 포함되며, STA 5 및 STA 6은 BSS 3에 포함됨)을 예시적으로 도시한다.

[84] 도 1 에서 BSS를 나타내는 타원은 해당 BSS에 포함된 STA들이 통신을

유지하는 커버리지 영역을 나타내는 것으로도 이해될 수 있다. 이 영역을 기본 서비스 영역(BSA: Basic Service Area)이라고 칭할 수 있다. STA가 BSA 밖으로 이동하게 되면 해당 BSA 내의 다른 STA들과 직접적으로 통신할 수 없게 된다.

[85] IEEE 802.11 시스템에서 가장 기본적인 타입의 BSS는 독립적인 BSS(IBSS: Independent BSS)이다. 예를 들어, IBSS는 2 개의 STA만으로 구성된 최소의 형태를 가질 수 있다. 또한, 가장 단순한 형태이고 다른 구성요소들이 생략되어 있는 도 1 의 BSS 3이 IBSS의 대표적인 예시에 해당할 수 있다. 이러한 구성은 STA들이 직접 통신할 수 있는 경우에 가능하다. 또한, 이러한 형태의 LAN은 미리 계획되어서 구성되는 것이 아니라 LAN이 필요한 경우에 구성될 수 있으며, 이를 애드-혹(ad-hoc) 네트워크라고 칭할 수도 있다.

[86] STA의 켜지거나 꺼짐, STA가 BSS 영역에 들어오거나 나감 등에 의해서, BSS에서의 STA의 멤버십이 동적으로 변경될 수 있다. BSS의 멤버가 되기 위해서는, STA는 동기화 과정을 이용하여 BSS에 조인할 수 있다. BSS 기반 구조의 모든 서비스에 액세스하기 위해서는, STA는 BSS에 연계(associated)되어야 한다. 이러한 연계(association)는 동적으로 설정될 수 있고, 분배 시스템 서비스(DSS: Distribution System Service)의 이용을 포함할 수 있다.

[87] 802.11 시스템에서 직접적인 STA-대-STA의 거리는 물리 계층(PHY: physical) 성능에 의해서 제한될 수 있다. 어떠한 경우에는 이러한 거리의 한계가 충분할 수도 있지만, 경우에 따라서는 보다 먼 거리의 STA 간의 통신이 필요할 수도 있다. 확장된 커버리지를 지원하기 위해서 분배 시스템(DS: Distribution System)이 구성될 수 있다.

[88] DS는 BSS들이 상호 연결되는 구조를 의미한다. 구체적으로, 도 1 과 같이 BSS가 독립적으로 존재하는 대신에, 복수개의 BSS들로 구성된 네트워크의 확장된 형태의 구성요소로서 BSS가 존재할 수도 있다.

[89] DS는 논리적인 개념이며 분배 시스템 매체(DSM: Distribution System Medium)의 특성에 의해서 특정될 수 있다. 이와 관련하여, IEEE 802.11 표준에서는 무선 매체(WM: Wireless Medium)와 분배 시스템 매체(DSM: Distribution System Medium)을 논리적으로 구분하고 있다. 각각의 논리적 매체는 상이한 목적을 위해서 사용되며, 상이한 구성요소에 의해서 사용된다. IEEE 802.11 표준의 정의에서는 이러한 매체들이 동일한 것으로 제한하지도 않고 상이한 것으로 제한하지도 않는다. 이와 같이 복수개의 매체들이 논리적으로 상이하다는 점에서, IEEE 802.11 시스템의 구조(DS 구조 또는 다른 네트워크 구조)의 유연성이 설명될 수 있다. 즉, IEEE 802.11 시스템 구조는 다양하게 구현될 수 있으며, 각각의 구현예의 물리적인 특성에 의해서 독립적으로 해당 시스템 구조가 특정될 수 있다.

[90] DS는 복수개의 BSS들의 끊김 없는(seamless) 통합을 제공하고 목적지로의 어드레스를 다루는 데에 필요한 논리적 서비스들을 제공함으로써 이동 장치를

지원할 수 있다.

[91] AP는, 연계된 STA들에 대해서 WM을 통해서 DS로의 액세스를 가능하게 하고 STA 기능성을 가지는 개체를 의미한다. AP를 통해서 BSS 및 DS 간의 데이터 이동이 수행될 수 있다. 예를 들어, 도 1에서 도시하는 STA 2 및 STA 3은 STA의 기능성을 가지면서, 연계된 STA들(STA 1 및 STA 4)가 DS로 액세스하도록 하는 기능을 제공한다. 또한, 모든 AP는 기본적으로 STA에 해당하므로, 모든 AP는 어드레스 가능한 개체이다. WM 상에서의 통신을 위해 AP에 의해서 사용되는 어드레스와 DSM 상에서의 통신을 위해 AP에 의해서 사용되는 어드레스는 반드시 동일할 필요는 없다.

[92] AP에 연계된 STA들 중의 하나로부터 그 AP의 STA 어드레스로 전송되는 데이터는, 항상 비제어 포트(uncontrolled port)에서 수신되고 IEEE 802.1X 포트 액세스 개체에 의해서 처리될 수 있다. 또한, 제어 포트(controlled port)가 인증되면 전송 데이터(또는 프레임)는 DS로 전달될 수 있다.

[93] 임의의(arbitrary) 크기 및 복잡도를 가지는 무선 네트워크가 DS 및 BSS들로 구성될 수 있다. IEEE 802.11 시스템에서는 이러한 방식의 네트워크를 확장된 서비스 세트(ESS: Extended Service Set) 네트워크라고 칭한다. ESS는 하나의 DS에 연결된 BSS들의 집합에 해당할 수 있다. 그러나, ESS는 DS를 포함하지는 않는다. ESS 네트워크는 논리 링크 제어(LLC: Logical Link Control) 계층에서 IBSS 네트워크로 보이는 점이 특징이다. ESS에 포함되는 STA들은 서로 통신할 수 있고, 이동 STA들은 LLC에 트랜스패런트(transparent)하게 하나의 BSS에서 다른 BSS로(동일한 ESS 내에서) 이동할 수 있다.

[94] IEEE 802.11 시스템에서는 도 1 에서의 BSS들의 상대적인 물리적 위치에 대해서 아무것도 가정하지 않으며, 다음과 같은 형태가 모두 가능하다.

[95] 구체적으로, BSS들은 부분적으로 중첩될 수 있고, 이는 연속적인 커버리지를 제공하기 위해서 일반적으로 이용되는 형태이다. 또한, BSS들은 물리적으로 연결되어 있지 않을 수 있고, 논리적으로는 BSS들 간의 거리에 제한은 없다. 또한, BSS들은 물리적으로 동일한 위치에 위치할 수 있고, 이는 리던던시(redundancy)를 제공하기 위해서 이용될 수 있다. 또한, 하나 (또는 하나 이상의) IBSS 또는 ESS 네트워크들이 하나 또는 그 이상의 ESS 네트워크로서 동일한 공간에 물리적으로 존재할 수 있다. 이는 ESS 네트워크가 존재하는 위치에 ad-hoc 네트워크가 동작하는 경우나, 상이한 기관(organizations)에 의해서 물리적으로 중첩되는 IEEE 802.11 네트워크들이 구성되는 경우나, 동일한 위치에서 2 이상의 상이한 액세스 및 보안 정책이 필요한 경우 등에서의 ESS 네트워크 형태에 해당할 수 있다.

[96] WLAN 시스템에서 STA은 IEEE 802.11의 매체 접속 제어(MAC: Medium Access Control)/PHY 규정에 따라 동작하는 장치이다. STA의 기능이 AP와 개별적으로 구분되지 않는 한, STA는 AP STA과 비-AP STA(non-AP STA)를 포함할 수 있다. 다만, STA과 AP 간에 통신이 수행된다고 할 때, STA은 non-AP STA으로 이해될

수 있다. 도 1의 예시에서 STA 1, STA 4, STA 5 및 STA 6은 non-AP STA에 해당하고, STA 2 및 STA 3은 AP STA 에 해당한다.

[97] Non-AP STA는 랩탑 컴퓨터, 이동 전화기와 같이 일반적으로 사용자가 직접 다루는 장치에 해당한다. 이하의 설명에서 non-AP STA는 무선 장치(wireless device), 단말(terminal), 사용자 장치(UE: User Equipment), 이동국(MS: Mobile Station), 이동 단말(Mobile Terminal), 무선 단말(wireless terminal), 무선 송수신 유닛(WTRU: Wireless Transmit/Receive Unit), 네트워크 인터페이스 장치(network interface device), MTC(Machine-Type Communication) 장치, M2M(Machine-to-Machine) 장치 등으로 칭할 수도 있다.

[98] 또한, AP는 다른 무선 통신 분야에서의 기지국(BS: Base Station), 노드-B(Node-B), 발전된 노드-B(eNB: evolved Node-B), 기저 송수신 시스템(BTS: Base Transceiver System), 펨토 기지국(Femto BS) 등에 대응하는 개념이다.

[99] 이하, 본 명세서에서 하향링크(DL: downlink)는 AP에서 non-AP STA로의 통신을 의미하며, 상향링크(UL: uplink)는 non-AP STA에서 AP로의 통신을 의미한다. 하향링크에서 송신기는 AP의 일부이고, 수신기는 non-AP STA의 일부일 수 있다. 상향링크에서 송신기는 non-AP STA의 일부이고, 수신기는 AP의 일부일 수 있다.

[100] 도 2는 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 계층 아키텍처(layer architecture)의 구조를 예시하는 도면이다.

[101] 도 2를 참조하면, IEEE 802.11 시스템의 계층 아키텍처는 MAC 부계층(MAC sublayer)과 PHY 부계층(PHY sublayer)을 포함할 수 있다.

[102] PHY sublayer은 PLCP(Physical Layer Convergence Procedure) 개체(entity)와 PMD(Physical Medium Dependent) 개체로 구분될 수도 있다. 이 경우, PLCP 개체는 MAC sublayer와 데이터 프레임을 연결하는 역할을 수행하고, PMD 개체는 2개 또는 그 이상의 STA과 데이터를 무선으로 송수신하는 역할을 수행한다.

[103] MAC sublayer과 PHY sublayer 모두 관리 개체(Management Entity)를 포함할 수 있으며, 각각 MAC 서브계층 관리 개체(MLME: MAC Sublayer Management Entity)과 PHY 서브계층 관리 개체(PLME: Physical Sublayer Management Entity)로 지칭할 수 있다. 이들 관리 개체은 계층 관리 함수의 동작을 통해 계층 관리 서비스 인터페이스를 제공한다. MLME는 PLME와 연결되어 MAC sublayer의 관리 동작(management operation)을 수행할 수 있고, 마찬가지로 PLME도 MLME와 연결되어 PHY sublayer의 관리 동작(management operation)을 수행할 수 있다.

[104] 정확한 MAC 동작을 제공하기 위하여, SME(Station Management Entity)가 각 STA 내에 존재할 수 있다. SME는 각 계층과 독립적인 관리 개체로서, MLME와 PLME로부터 계층 기반 상태 정보를 수집하거나 각 계층의 특정 파라미터들의 값을 설정한다. SME는 일반 시스템 관리 개체들을 대신하여 이러한 기능을

수행할 수 있으며, 표준 관리 프로토콜을 구현할 수 있다.

[105] MLME, PLME 및 SME은 프리미티브(primitive)를 기반의 다양한 방법으로 상호 작용(interact)할 수 있다. 구체적으로, XX-GET.request 프리미티브는 관리 정보 베이스 속성(MIB attribute: Management Information Base attribute)의 값을 요청하기 위해 사용되고, XX-GET.confirm 프리미티브는 상태가 'SUCCESS'라면, 해당 MIB 속성 값을 리턴(return)하고, 그 외의 경우에는 상태 필드에 오류 표시를 하여 리턴한다. XX-SET.request 프리미티브는 지정된 MIB 속성을 주어진 값으로 설정하도록 요청하기 위해 사용된다. MIB 속성이 특정 동작으로 의미하고 있다면, 이 요청은 그 특정 동작의 실행을 요청한다. 그리고, XX-SET.confirm 프리미티브는 상태가 'SUCCESS'라면, 이는 지정된 MIB 속성이 요청된 값으로 설정되었음을 의미한다. 그 외의 경우에는, 상태 필드는 오류 상황을 나타낸다. 이 MIB 속성이 특정 동작을 의미한다면, 이 프리미티브는 해당 동작의 수행된 것을 확인해 줄 수 있다.

[106] 각 sublayer에서의 동작을 간략하게 설명하면 다음과 같다.

[107] MAC sublayer는 상위 계층(예를 들어, LLC 계층)으로부터 전달 받은 MAC 서비스 데이터 유닛(MSDU: MAC Service Data Unit) 또는 MSDU의 조각(fragment)에 MAC 헤더(header)와 프레임 체크 시퀀스(FCS: Frame Check Sequence)을 부착하여 하나 이상의 MAC 프로토콜 데이터 유닛(MPDU: MAC Protocol Data Unit)을 생성한다. 생성된 MPDU는 PHY sublayer로 전달된다.

[108] A-MSDU(aggregated MSDU) 기법(scheme)이 사용되는 경우, 복수 개의 MSDU는 단일의 A-MSDU(aggregated MSDU)로 병합될 수 있다. MSDU 병합 동작은 MAC 상위 계층에서 수행될 수 있다. A-MSDU는 단일의 MPDU(조각화(fragment)되지 않는 경우)로 PHY sublayer로 전달된다.

[109] PHY sublayer는 MAC sublayer으로부터 전달 받은 물리 서비스 데이터 유닛(PSDU: Physical Service Data Unit)에 물리 계층 송수신기에 의해 필요한 정보를 포함하는 부가필드를 덧붙여 물리 프로토콜 데이터 유닛(PPDU: Physical Protocol Data Unit)을 생성한다. PPDU는 무선 매체를 통해 전송된다.

[110] PSDU는 PHY sublayer가 MAC sublayer로부터 수신한 것이고, MPDU는 MAC sublayer가 PHY sublayer로 전송한 것이므로, PSDU는 실질적으로 MPDU와 동일하다.

[111] A-MPDU(aggregated MPDU) 기법(scheme)이 사용되는 경우, 복수의 MPDU(이때, 각 MPDU는 A-MSDU를 나를 수 있다.)는 단일의 A-MPDU로 병합될 수 있다. MPDU 병합 동작은 MAC 하위 계층에서 수행될 수 있다. A-MPDU는 다양한 타입의 MPDU(예를 들어, QoS 데이터, ACK(Acknowledge), 블록 ACK(BlockAck) 등)이 병합될 수 있다. PHY sublayer는 MAC sublayer로부터 단일의 PSDU로써 A-MPDU를 수신한다. 즉, PSDU는 복수의 MPDU로 구성된다. 따라서, A-MPDU는 단일의 PPDU 내에서 무선 매체를 통해 전송된다.

[112]

[113] **PPDU(Physical Protocol Data Unit) 포맷**

[114] PPDU(Physical Protocol Data Unit)는 물리 계층에서 발생되는 데이터 블록을 의미한다. 이하, 본 발명이 적용될 수 있는 IEEE 802.11 WLAN 시스템을 기초로 PPDU 포맷을 설명한다.

[115] 도 3은 본 발명이 적용될 수 있는 무선 통신 시스템의 non-HT 포맷 PPDU 및 HT 포맷 PPDU를 예시한다.

[116] 도 3의 (a)는 IEEE 802.11a/g 시스템을 지원하기 위한 non-HT 포맷 PPDU을 예시한다. non-HT PPDU은 레거시(legacy) PPDU으로도 불릴 수 있다.

[117] 도 3의 (a)를 참조하면, non-HT 포맷 PPDU은 L-STF(Legacy(또는, Non-HT) Short Training field), L-LTF(Legacy(또는, Non-HT) Long Training field) 및 L-SIG(Legacy(또는 Non-HT) SIGNAL) 필드로 구성되는 레가시 포맷 프리앰블과 데이터 필드를 포함하여 구성된다.

[118] L-STF는 짧은 트레이닝 OFDM(short training orthogonal frequency division multiplexing symbol)을 포함할 수 있다. L-STF는 프레임 타이밍 획득(frame timing acquisition), 자동 이득 제어(AGC: Automatic Gain Control), 다이버시티 검출(diversity detection), 대략적인 주파수/시간 동기화(coarse frequency/time synchronization)을 위해 사용될 수 있다.

[119] L-LTF는 긴 트레이닝 OFDM 심볼(long training orthogonal frequency division multiplexing symbol)을 포함할 수 있다. L-LTF는 정밀한 주파수/시간 동기화(fine frequency/time synchronization) 및 채널 추정(channel estimation)을 위해 사용될 수 있다.

[120] L-SIG 필드는 데이터 필드의 복조 및 디코딩을 위한 제어 정보를 전송하기 위하여 사용될 수 있다.

[121] L-SIG 필드는 4 비트의 레이트(Rate) 필드, 1비트의 예비(Reserved) 비트, 12 비트의 길이(Length) 필드, 1비트의 패리티 비트, 6비트의 신호 테일(Signal Tail) 필드로 구성될 수 있다.

[122] 레이트 필드는 전송율 정보를 포함하고, 길이 필드는 PSDU의 옥텟의 수를 지시한다.

[123] 도 3의 (b)는 IEEE 802.11n 시스템 및 IEEE 802.11a/g 시스템을 모두 지원하기 위한 HT 혼합 포맷 PPDU(HT-mixed format PPDU)을 예시한다.

[124] 도 3의 (b)를 참조하면, HT 혼합 포맷 PPDU은 L-STF, L-LTF 및 L-SIG 필드로 구성되는 레가시 포맷 프리앰블과 HT-SIG(HT-Signal) 필드, HT-STF(HT Short Training field), HT-LTF(HT Long Training field)로 구성되는 HT 포맷 프리앰블 및 데이터 필드를 포함하여 구성된다.

[125] L-STF, L-LTF 및 L-SIG 필드는 하위 호환성(backward compatibility)를 위한 레가시 필드를 의미하므로, L-STF부터 L-SIG 필드까지 non-HT 포맷과 동일하다. L-STA은 HT 혼합 PPDU를 수신하여도 L-LTF, L-LTF 및 L-SIG 필드를 통해 데이터 필드를 해석할 수 있다. 다만 L-LTF는 HT-STA이 HT 혼합 PPDU를

수신하고 L-SIG 필드 및 HT-SIG 필드를 복조하기 위하여 수행할 채널 추정을 위한 정보를 더 포함할 수 있다.

[126] HT-STA는 레가시 필드 뒤에 오는 HT-SIG 필드 이용하여 HT-혼합 포맷 PPDU임을 알 수 있으며, 이를 기반으로 데이터 필드를 디코딩할 수 있다.

[127] HT-LTF 필드는 데이터 필드의 복조를 위한 채널 추정에 사용될 수 있다. IEEE 802.11n은 SU-MIMO(Single-User Multi-Input and Multi-Output)를 지원하므로 복수의 공간 스트림으로 전송되는 데이터 필드 각각에 대하여 채널 추정을 위해 HT-LTF 필드는 복수로 구성될 수 있다.

[128] HT-LTF 필드는 공간 스트림에 대한 채널 추정을 위하여 사용되는 데이터 HT-LTF(data HT-LTF)와 풀 채널 사운딩(full channel sounding)을 위해 추가적으로 사용되는 확장 HT-LTF(extension HT-LTF)로 구성될 수 있다. 따라서, 복수의 HT-LTF는 전송되는 공간 스트림의 개수보다 같거나 많을 수 있다.

[129] HT-혼합 포맷 PPDU은 L-STA도 수신하여 데이터를 획득할 수 있도록 하기 위해 L-STF, L-LTF 및 L-SIG 필드가 가장 먼저 전송된다. 이후 HT-STA을 위하여 전송되는 데이터의 복조 및 디코딩을 위해 HT-SIG 필드가 전송된다.

[130] HT-SIG 필드까지는 빔포밍을 수행하지 않고 전송하여 L-STA 및 HT-STA이 해당 PPDU를 수신하여 데이터를 획득할 수 있도록 하고, 이후 전송되는 HT-STF, HT-LTF 및 데이터 필드는 프리코딩을 통한 무선 신호 전송이 수행된다. 여기서 프리코딩을 하여 수신하는 STA에서 프리코딩에 의한 전력이 가변 되는 부분을 감안할 수 있도록 HT-STF 필드를 전송하고 그 이후에 복수의 HT-LTF 및 데이터 필드를 전송한다.

[131] 아래 표 1은 HT-SIG 필드를 예시하는 표이다.

[132] [표1]

필드	비트	설명(description)
변조 및 코딩 방식(Modulation and Coding Scheme)	7	변조 및 코딩 방식을 지시함
채널 대역폭(CBW) 20/40	1	20MHz 또는 40MHz 보다 크거나(upper) / 작은(lower) 경우, '0', 40MHz인 경우, '1'
HT 길이(Length)	16	PSDU 내 데이터 옥텟의 수를 지시함
스무딩(Smoothing)	1	채널 추정 스무딩(smoothing)이 권고되는 경우, '1', 캐리어 별로 독립적(unsmoothing)으로 채널 추정이 권고되는 경우, '0'
비 사운딩(Not Sounding)	1	PPDU가 사운딩(sounding) PPDU인 경우, '0', PPDU가 사운딩(sounding) PPDU가 아닌 경우, '1'
Reserved	1	1로 셋팅
병합(Aggregation)	1	PPDU가 A-MPDU를 포함하는 경우, '1', 그렇지 않은 경우, '0'
시공간 블록 코딩(STBC)	2	시공간 스트림(space-time stream, NSTS)의 수와 MCS에 의해 지시된 공간 스트림(spatial stream, NSS)의 수 간의 차이를 지시함 STBC가 사용되지 않는 경우, '00'
FEC 코딩	1	LDPC(low-density parity check)가 사용되는 경우, '1', BCC(binary convolutional code)가 사용되는 경우, '0'
짧은 GI(Short GI)	1	HT 트레이닝(training) 이후에 짧은 GI가 사용되는 경우, '1', 그렇지 않은 경우, '0'
확장 공간 스트림의 수(Number of extension spatial streams)	2	확장 공간 스트림(extension spatial stream, NESS)의 수를 지시함 확장 공간 스트림이 없는 경우, '0', 확장 공간 스트림이 1개인 경우, '1', 확장 공간 스트림이 2개인 경우, '2', 확장 공간 스트림이 3개인 경우, '3'
CRC	8	수신자에서 PPDU의 에러를 검출하기 위한 CRC를 포함함
테일 비트(Tail Bits)	6	컨볼루셔널 디코딩(convolutional decoder)의 트렐리스(trellis) 종료를 위해 사용함 '0'으로 설정됨

[133] 도 3의 (c)는 IEEE 802.11n 시스템만을 지원하기 위한 HT-GF 포맷 PPDU(HT-greenfield format PPDU)을 예시한다.

[134] 도 3의 (c)를 참조하면, HT-GF 포맷 PPDU은 HT-GF-STF, HT-LTF1, HT-SIG 필드, 복수의 HT-LTF2 및 데이터 필드를 포함한다.

[135] HT-GF-STF는 프레임 타이밍 획득 및 AGC를 위해 사용된다.

[136] HT-LTF1는 채널 추정을 위해 사용된다.

[137] HT-SIG 필드는 데이터 필드의 복조 및 디코딩을 위해 사용된다.

[138] HT-LTF2는 데이터 필드의 복조를 위한 채널 추정에 사용된다. 마찬가지로 HT-STA은 SU-MIMO를 사용하므로 복수의 공간 스트림으로 전송되는 데이터 필드 각각에 대하여 채널 추정을 요하므로 HT-LTF2는 복수로 구성될 수 있다.

[139] 복수의 HT-LTF2는 HT 혼합 PPDU의 HT-LTF 필드와 유사하게 복수의 Data HT-LTF와 복수의 확장 HT-LTF로 구성될 수 있다.

[140] 도 3의 (a) 내지 (c)에서 데이터 필드는 페이로드(payload)로서, 서비스 필드(SERVICE field), 스크램블링된 PSDU(scrambled PSDU) 필드, 테일 비트(Tail bits), 패딩 비트(padding bits)를 포함할 수 있다. 데이터 필드의 모든 비트는 스크램블된다.

[141] 도 3(d)는 데이터 필드에 포함되는 서비스 필드를 나타낸다. 서비스 필드는 16 비트를 가진다. 각 비트는 0번부터 15번까지 부여되며, 0번 비트부터 순차적으로 전송된다. 0번부터 6번 비트는 0으로 설정되고, 수신단 내 디스크램블러(descrambler)를 동기화하기 위하여 사용된다.

[142] IEEE 802.11ac WLAN 시스템은 무선채널을 효율적으로 이용하기 위하여 복수의 STA들이 동시에 채널에 액세스하는 하향링크 MU-MIMO(Multi User Multiple Input Multiple Output) 방식의 전송을 지원한다. MU-MIMO 전송 방식에 따르면, AP가 MIMO 페어링(pairing)된 하나 이상의 STA에게 동시에 패킷을 전송할 수 있다.

[143] DL MU 전송(downlink multi-user transmission)은 하나 이상의 안테나를 통해 AP가 동일한 시간 자원을 통해 PPDU를 복수의 non-AP STA에게 전송하는 기술을 의미한다.

[144] 이하, MU PPDU는 MU-MIMO 기술 또는 OFDMA 기술을 이용하여 하나 이상의 STA을 위한 하나 이상의 PSDU를 전달하는 PPDU를 의미한다. 그리고, SU PPDU는 하나의 PSDU만을 전달할 수 있거나 PSDU가 존재하지 않는 포맷을 가진 PPDU를 의미한다.

[145] MU-MIMO 전송을 위하여 802.11n 제어 정보의 크기에 비하여 STA에 전송되는 제어 정보의 크기가 상대적으로 클 수 있다. MU-MIMO 지원을 위해 추가적으로 요구되는 제어 정보의 일례로, 각 STA에 의해 수신되는 공간적 스트림(spatial stream)의 수를 지시하는 정보, 각 STA에 전송되는 데이터의 변조 및 코딩 관련 정보 등이 이에 해당될 수 있다.

[146] 따라서, 복수의 STA에 동시에 데이터 서비스를 제공하기 위하여 MU-MIMO 전송이 수행될 때, 전송되는 제어 정보의 크기는 수신하는 STA의 수에 따라 증가될 수 있다.

[147] 이와 같이 증가되는 제어 정보의 크기를 효율적으로 전송하기 위하여, MU-MIMO 전송을 위해 요구되는 복수의 제어 정보는 모든 STA에 공통으로

요구되는 공통 제어 정보(common control information)와 특정 STA에 개별적으로 요구되는 전용 제어 정보(dedicated control information)의 두 가지 타입의 정보로 구분하여 전송될 수 있다.

[148] 도 4는 본 발명이 적용될 수 있는 무선 통신 시스템의 VHT 포맷 PPDU 포맷을 예시한다.

[149] 도 4(a)는 IEEE 802.11ac 시스템을 지원하기 위한 VHT 포맷 PPDU(VHT format PPDU)을 예시한다.

[150] 도 4(a)를 참조하면, VHT 포맷 PPDU은 L-STF, L-LTF 및 L-SIG 필드로 구성되는 레가시 포맷 프리앰블과 VHT-SIG-A(VHT-Signal-A) 필드, VHT-STF(VHT Short Training field), VHT-LTF(VHT Long Training field), VHT-SIG-B(VHT-Signal-B) 필드로 구성되는 VHT 포맷 프리앰블 및 데이터 필드를 포함하여 구성된다.

[151] L-STF, L-LTF 및 L-SIG는 하위 호환성(backward compatibility)를 위한 레가시 필드를 의미하므로, L-STF부터 L-SIG 필드까지 non-HT 포맷과 동일하다. 다만, L-LTF는 L-SIG 필드 및 VHT-SIG-A 필드를 복조하기 위하여 수행할 채널 추정을 위한 정보를 더 포함할 수 있다.

[152] L-STF, L-LTF, L-SIG 필드 및 VHT-SIG-A 필드는 20MHz 채널 단위로 반복되어 전송될 수 있다. 예를 들어, PPDU가 4개의 20MHz 채널(즉, 80 MHz 대역폭)을 통해 전송될 때, L-STF, L-LTF, L-SIG 필드 및 VHT-SIG-A 필드는 매 20MHz 채널에서 반복되어 전송될 수 있다.

[153] VHT-STA는 레가시 필드 뒤에 오는 VHT-SIG-A 필드 이용하여 VHT 포맷 PPDU임을 알 수 있으며, 이를 기반으로 데이터 필드를 디코딩할 수 있다.

[154] VHT 포맷 PPDU은 L-STA도 수신하여 데이터를 획득할 수 있도록 하기 위해 L-STF, L-LTF 및 L-SIG 필드가 가장 먼저 전송된다. 이후, VHT-STA을 위하여 전송되는 데이터의 복조 및 디코딩을 위해 VHT-SIG-A 필드가 전송된다.

[155] VHT-SIG-A 필드는 AP와 MIMO 페이링된(paired) VHT STA들에게 공통되는 제어 정보 전송을 위한 필드로서, 이는 수신된 VHT 포맷 PPDU를 해석하기 위한 제어 정보를 포함하고 있다.

[156] VHT-SIG-A 필드는 VHT-SIG-A1 필드와 VHT-SIG-A2 필드를 포함할 수 있다.

[157] VHT-SIG-A1 필드는 사용하는 채널 대역폭(BW: bandwidth) 정보, 시공간 블록 코딩(STBC: Space Time Block Coding)의 적용 여부, MU-MIMO에서 그룹핑된 STA들의 그룹의 지시하기 위한 그룹 식별 정보(Group ID: Group Identifier), 사용되는 스트림의 개수(NSTS: Number of space-time stream)/부분 AID(Partial AID(association Identifier))에 대한 정보 및 전송 파워 세이브 금지(Transmit power save forbidden) 정보를 포함할 수 있다. 여기서, Group ID는 MU-MIMO 전송을 지원하기 위해 전송 대상 STA 그룹에 대하여 할당되는 식별자를 의미하며, 현재 사용된 MIMO 전송 방법이 MU-MIMO인지 또는 SU-MIMO 인지 여부를 나타낼 수 있다.

[158] 표 2은 VHT-SIG-A1 필드를 예시하는 표이다.

[159] [표2]

필드	비트	설명(description)
BW	2	20MHz 경우, '0', 40MHz 경우, '1', 80MHz 경우, '2', 160MHz 또는 80+80 MHz 경우, '3'으로 설정됨
Reserved	1	
STBC	1	VHT SU PPDU 경우: STBC가 사용된 경우, '1', 그렇지 않은 경우, '0'으로 설정됨 VHT MU PPDU 경우: '0'으로 설정됨
Group ID	6	Group ID를 지시함 '0' 또는 '63'은 VHT SU PPDU를 지시하나, 그렇지 않은 경우 VHT MU PPDU를 지시함
NSTS/Partial AID	12	VHT MU PPDU이 경우, 각각 3 비트씩 4 사용자 위치(user position, 'p')로 구분됨 시공간 스트림이 0인 경우, '0', 시공간 스트림이 1인 경우, '1', 시공간 스트림이 2인 경우, '2', 시공간 스트림이 3인 경우, '3', 시공간 스트림이 4인 경우, '4', VHT SU PPDU이 경우, 상위 3 비트는 다음과 같이 설정됨 시공간 스트림이 1인 경우, '0', 시공간 스트림이 2인 경우, '1', 시공간 스트림이 3인 경우, '2', 시공간 스트림이 4인 경우, '3', 시공간 스트림이 5인 경우, '4', 시공간 스트림이 6인 경우, '5', 시공간 스트림이 7인 경우, '6', 시공간 스트림이 8인 경우, '7', 하위 9비트는 부분 AID(Partial AID)를 지시함
TXOP_PS_NOT_ALLOWED	1	VHT AP가 non-AP VHT STA이 TXOP(transmission opportunity) 동안 파워 세이브 모드로 천이하는 것을 허가하는 경우, '0'으로 설정됨 그렇지 않은 경우, '1'로 설정됨 non-AP VHT STA에 의해 전송되는 VHT PPDU의 경우 '1'로 설정됨
Reserved	1	

[160] VHT-SIG-A2 필드는 짧은 보호구간(GI: Guard Interval) 사용 여부에 대한 정보, 포워드 에러 정정(FEC: Forward Error Correction) 정보, 단일 사용자에 대한 MCS(Modulation and Coding Scheme)에 관한 정보, 복수 사용자에 대한 채널

코딩의 종류에 관한 정보, 빔포밍 관련 정보, CRC(Cyclic Redundancy Checking)를 위한 여분 비트(redundancy bits)와 컨벌루셔널 디코딩(convolutional decoder)의 테일 비트(tail bit) 등을 포함할 수 있다.

[161] 표 3은 VHT-SIG-A2 필드를 예시하는 표이다.

[162] [표3]

필드	비트	설명(description)
Short GI	1	데이터 필드에 짧은 GI가 사용되지 않는 경우, '0', 데이터 필드에 짧은 GI가 사용되는 경우, '1'로 설정됨
Short GI 명확화 (disambiguation)	1	짧은 GI가 사용되고, PPDU의 페이로드를 위해 추가 심볼이 필요한 경우, '1', 추가 심볼이 필요하지 않은 경우, '0'으로 설정됨
SU/MU Coding	1	VHT SU PPDU 경우: BCC(binary convolutional code) 경우, '0', LDPC(low-density parity check) 경우, '1'로 설정됨 VHT MU PPDU 경우: 사용자 위치(user position)가 '0'인 사용자의 NSTS 필드가 '0'이 아닌 경우, 사용되는 코딩을 지시함 BCC 경우, '0', LDPC 경우, '1'로 설정됨 사용자 위치(user position)가 '0'인 사용자의 NSTS 필드가 '0'인 경우, 예비필드로써 '1'로 설정됨
LDPC Extra OFDM Symbol	1	LDPC PPDU 인코딩 절차(SU PPDU 경우) 또는 적어도 하나의 LDPC 사용자의 PPDU 인코딩 절차(VHT MU PPDU 경우)로 인하여 추가 OFDM 심볼(extra OFDM symbol)이 필요한 경우, '1'로 설정됨 그렇지 않은 경우, '0'으로 설정됨
SU VHT MCS/MU Coding	4	VHT SU PPDU 경우: VHT-MCS 인덱스를 나타냄 VHT MU PPDU 경우: 상위 비트부터 순서대로 사용자 위치(user position) '1' 내지 '3'에 대한 코딩을 지시함 각 사용자의 NSTS 필드가 '1'이 아닌 경우, 사용되는 코딩을 지시함 BCC 경우, '0', LDPC 경우, '1'로 설정됨 각 사용자의 NSTS 필드가 '0'인 경우, 예비필드로써 '1'로 설정됨
Beamformed	1	VHT SU PPDU 경우: 빔포밍 스티어링 행렬(Beamforming steering matrix)이 SU 전송에 적용되는 경우 '1'로 설정됨 그렇지 않은 경우 '0'으로 설정됨 VHT MU PPDU 경우: 예비필드로써 '1'로 설정됨
Reserved	1	
CRC	8	수신자에서 PPDU의 에러를 검출하기 위한 CRC를 포함함
Tail	6	컨볼루셔널 디코딩(convolutional decoder)의 트렐리스(trellis) 종료를 위해 사용함 '0'으로 설정됨

[163] VHT-STF는 MIMO 전송에 있어서 AGC 추정의 성능을 개선하기 위해 사용된다.

[164] VHT-LTF는 VHT-STA이 MIMO 채널을 추정하는데 사용된다. VHT WLAN 시스템은 MU-MIMO를 지원하기 때문에, VHT-LTF는 PPDU가 전송되는 공간 스트림의 개수만큼 설정될 수 있다. 추가적으로, 풀 채널 사운딩(full channel sounding)이 지원되는 경우, VHT-LTF의 수는 더 많아질 수 있다.

[165] VHT-SIG-B 필드는 MU-MIMO 페어링된 복수의 VHT-STA이 PPDU를 수신하여 데이터를 획득하는데 필요한 전용 제어 정보를 포함한다. 따라서, VHT-SIG-A 필드에 포함된 공용 제어 정보가 현재 수신된 PPDU가 MU-MIMO 전송을 지시한 경우에만, VHT-STA은 VHT-SIG-B 필드를 디코딩(decoding)하도록 설계될 수 있다. 반면, 공용 제어 정보가 현재 수신된 PPDU가 단일 VHT-STA을 위한 것(SU-MIMO를 포함)임을 지시한 경우 STA은 VHT-SIG-B 필드를 디코딩하지 않도록 설계될 수 있다.

[166] VHT-SIG-B 필드는 VHT-SIG-B 길이(Length) 필드, VHT-MCS 필드, 예비(Reserved) 필드, 테일(Tail) 필드를 포함한다.

[167] VHT-SIG-B 길이(Length) 필드는 A-MPDU의 길이(EOF(end-of-frame) 패딩 이전)를 지시한다. VHT-MCS 필드는 각 VHT-STA들의 변조(modulation), 인코딩(encoding) 및 레이트 매칭(rate-matching)에 대한 정보를 포함한다.

[168] VHT-SIG-B 필드의 크기는 MIMO 전송의 유형(MU-MIMO 또는 SU-MIMO) 및 PPDU 전송을 위해 사용하는 채널 대역폭에 따라 다를 수 있다.

[169] 도 4(b)는 PPDU 전송 대역폭에 따른 VHT-SIG-B 필드를 예시한다.

[170] 도 4(b)를 참조하면, 40MHz 전송에 있어서, VHT-SIG-B 비트는 2번 반복된다. 80MHz 전송에 있어서, VHT-SIG-B 비트는 4번 반복되고, 0로 셋팅된 패드 비트가 부착된다.

[171] 160MHz 전송 및 80+80MHz 에 있어서, 먼저 80MHz 전송과 같이 VHT-SIG-B 비트는 4번 반복되고, 0로 셋팅된 패드 비트가 부착된다. 그리고, 전체 117 비트가 다시 반복된다.

[172] MU-MIMO를 지원하는 시스템에서 동일한 크기의 PPDU를 AP에 페어링된 STA들에게 전송하기 위하여, PPDU를 구성하는 데이터 필드의 비트 크기를 지시하는 정보 및/또는 특정 필드를 구성하는 비트 스트림 크기를 지시하는 정보가 VHT-SIG-A 필드에 포함될 수 있다.

[173] 다만, 효과적으로 PPDU 포맷을 사용하기 위하여 L-SIG 필드가 사용될 수도 있다. 동일한 크기의 PPDU가 모든 STA에게 전송되기 위하여 L-SIG 필드 내 포함되어 전송되는 길이 필드(length field) 및 레이트 필드(rate field)가 필요한 정보를 제공하기 위해 사용될 수 있다. 이 경우, MPDU(MAC Protocol Data Unit) 및/또는 A-MPDU(Aggregate MAC Protocol Data Unit)가 MAC 계층의 바이트(또는 옥텟(oct: octet)) 기반으로 설정되므로 물리 계층에서 추가적인 패딩(padding)이 요구될 수 있다.

[174] 도 4에서 데이터 필드는 페이로드(payload)로서, 서비스 필드(SERVICE field), 스크램블링된 PSDU(scrambled PSDU), 테일 비트(tail bits), 패딩 비트(padding bits)를 포함할 수 있다.

[175] 위와 같이 여러 가지의 PPDU의 포맷이 혼합되어 사용되기 때문에, STA은 수신한 PPDU의 포맷을 구분할 수 있어야 한다.

[176] 여기서, PPDU를 구분한다는 의미(또는, PPDU 포맷을 구분한다는 의미)는 다양한 의미를 가질 수 있다. 예를 들어, PPDU를 구분한다는 의미는 수신한 PPDU가 STA에 의해 디코딩(또는, 해석)이 가능한 PPDU인지 여부에 대하여 판단한다는 의미를 포함할 수 있다. 또한, PPDU를 구분한다는 의미는 수신한 PPDU가 STA에 의해 지원 가능한 PPDU인지 여부에 대하여 판단한다는 의미일 수도 있다. 또한, PPDU를 구분한다는 의미는 수신한 PPDU를 통해 전송된 정보가 어떠한 정보인지를 구분한다는 의미로도 해석될 수 있다.

[177] 이에 대하여 아래 도면을 참조하여 보다 상세히 설명한다.

[178] 도 5는 본 발명이 적용될 수 있는 무선 통신 시스템의 PPDU의 포맷을 구분하기 위한 성상(constellation)을 예시하는 도면이다.

[179] 도 5(a)는 non-HT 포맷 PPDU에 포함되는 L-SIG 필드의 성상(constellation)를 예시하고, 도 5(b)는 HT 혼합 포맷 PPDU 검출을 위한 위상 회전(phase rotation)을 예시하며, 도 5(c)는 VHT 포맷 PPDU 검출을 위한 위상 회전(phase rotation)을 예시한다.

[180] STA이 non-HT 포맷 PPDU, HT-GF 포맷 PPDU, HT 혼합 포맷 PPDU 및 VHT 포맷 PPDU을 구분(classification)하기 위하여, L-SIG 필드 및 L-SIG 필드 이후에 전송되는 OFDM 심볼의 성상(constellation)의 위상(phase)이 사용된다. 즉, STA은 수신한 PPDU의 L-SIG 필드 및/또는 L-SIG 필드 이후에 전송되는 OFDM 심볼의 성상의 위상을 기반으로 PPDU 포맷을 구분할 수 있다.

[181] 도 5(a)를 참조하면, L-SIG 필드를 구성하는 OFDM 심볼은 BPSK(Binary Phase Shift Keying)가 이용된다.

[182] 먼저, HT-GF 포맷 PPDU를 구분하기 위하여, STA은 수신한 PPDU에서 최초의 SIG 필드가 감지되면, L-SIG 필드인지 여부를 판단한다. 즉, STA은 도 5(a)의 예시와 같은 성상을 기반으로 디코딩을 시도한다. STA이 디코딩에 실패하면 해당 PPDU가 HT-GF 포맷 PPDU라고 판단할 수 있다.

[183] 다음으로, non-HT 포맷 PPDU, HT 혼합 포맷 PPDU 및 VHT 포맷 PPDU을 구분(classification)하기 위하여, L-SIG 필드 이후에 전송되는 OFDM 심볼의 성상의 위상이 사용될 수 있다. 즉, L-SIG 필드 이후에 전송되는 OFDM 심볼의 변조 방법이 서로 다를 수 있으며, STA은 수신한 PPDU의 L-SIG 필드 이후의 필드에 대한 변조 방법을 기반으로 PPDU 포맷을 구분할 수 있다.

[184] 도 5(b)를 참조하면, HT 혼합 포맷 PPDU를 구분하기 위하여, HT 혼합 포맷 PPDU에서 L-SIG 필드 이후에 전송되는 2개의 OFDM 심볼의 위상이 사용될 수 있다.

[185] 보다 구체적으로, HT 혼합 포맷 PPDU에서 L-SIG 필드 이후에 전송되는 HT-SIG 필드에 대응되는 OFDM 심볼 #1 및 OFDM 심볼 #2의 위상은 모두 반시계 방향으로 90도만큼 회전된다. 즉, OFDM 심볼 #1 및 OFDM 심볼 #2에 대한 변조 방법은 QBPSK(Quadrature Binary Phase Shift Keying)가 이용된다. QBPSK 성상은 BPSK 성상을 기준으로 반시계 방향으로 90도만큼 위상이 회전한 성상일 수 있다.

[186] STA은 수신한 PPDU의 L-SIG 필드 다음에 전송되는 HT-SIG 필드에 대응되는 제1 OFDM 심볼 및 제2 OFDM 심볼을 도 5(b)의 예시와 같은 성상을 기반으로 디코딩을 시도한다. STA이 디코딩에 성공하면 해당 PPDU가 HT 포맷 PPDU라고 판단한다.

[187] 다음으로, non-HT 포맷 PPDU 및 VHT 포맷 PPDU을 구분하기 위하여, L-SIG 필드 이후에 전송되는 OFDM 심볼의 성상의 위상이 사용될 수 있다.

[188] 도 5(c)를 참조하면, VHT 포맷 PPDU를 구분(classification)하기 위하여, VHT 포맷 PPDU에서 L-SIG 필드 이후에 전송되는 2개의 OFDM 심볼의 위상이 사용될 수 있다.

[189] 보다 구체적으로, VHT 포맷 PPDU에서 L-SIG 필드 이후의 VHT-SIG-A 필드에 대응되는 OFDM 심볼 #1의 위상은 회전되지 않으나, OFDM 심볼 #2의 위상은 반시계 방향으로 90도만큼 회전된다. 즉, OFDM 심볼 #1에 대한 변조 방법은 BPSK가 이용되고, OFDM 심볼 #2에 대한 변조 방법은 QBPSK가 이용된다.

[190] STA은 수신한 PPDU의 L-SIG 필드 다음에 전송되는 VHT-SIG 필드에 대응되는 제1 OFDM 심볼 및 제2 OFDM 심볼을 도 5(c)의 예시와 같은 성상을 기반으로 디코딩을 시도한다. STA이 디코딩에 성공하면 해당 PPDU가 VHT 포맷 PPDU이라고 판단할 수 있다.

[191] 반면, 디코딩에 실패하면, STA은 해당 PPDU가 non-HT 포맷 PPDU이라고 판단할 수 있다.

[192]

[193] **MAC 프레임 포맷**

[194] 도 6은 본 발명이 적용될 수 있는 IEEE 802.11 시스템의 MAC 프레임 포맷을 예시한다.

[195] 도 6을 참조하면, MAC 프레임(즉, MPDU)은 MAC 헤더(MAC Header), 프레임 몸체(Frame Body) 및 프레임 체크 시퀀스(FCS: frame check sequence)로 구성된다.

[196] MAC Header는 프레임 제어(Frame Control) 필드, 지속 시간/식별자(Duration/ID) 필드, 주소 1(Address 1) 필드, 주소 2(Address 2) 필드, 주소 3(Address 3) 필드, 시퀀스 제어(Sequence Control) 필드, 주소 4(Address 4) 필드, QoS 제어(QoS Control) 필드 및 HT 제어(HT Control) 필드를 포함하는 영역으로 정의된다.

[197] Frame Control 필드는 해당 MAC 프레임 특성에 대한 정보를 포함한다. Frame Control 필드에 대한 보다 상세한 설명은 후술한다.

[198] Duration/ID 필드는 해당 MAC 프레임의 타입 및 서브타입에 따른 다른 값을

가지도록 구현될 수 있다.

[199] 만약, 해당 MAC 프레임의 타입 및 서브타입이 파워 세이브(PS: power save) 운영을 위한 PS-폴(PS-Poll) 프레임의 경우, Duration/ID 필드는 프레임을 전송한 STA의 AID(association identifier)를 포함하도록 설정될 수 있다. 그 이외의 경우, Duration/ID 필드는 해당 MAC 프레임의 타입 및 서브타입에 따라 특정 지속시간 값을 가지도록 설정될 수 있다. 또한, 프레임이 A-MPDU(aggregate-MPDU) 포맷에 포함된 MPDU인 경우, MAC 헤더에 포함된 Duration/ID 필드는 모두 동일한 값을 가지도록 설정될 수도 있다.

[200] Address 1 필드 내지 Address 4 필드는 BSSID, 소스 주소(SA: source address), 목적 주소(DA: destination address), 전송 STA 주소를 나타내는 전송 주소 (TA: Transmitting Address), 수신 STA 주소를 나타내는 수신 주소(RA: Receiving Address)를 지시하기 위하여 사용된다.

[201] 한편, TA 필드로 구현된 주소 필드는 대역폭 시그널링 TA(bandwidth signaling TA) 값으로 설정될 수 있으며, 이 경우 TA 필드는 해당 MAC 프레임이 스크램블링 시퀀스에 추가적인 정보를 담고 있음을 지시할 수 있다. 대역폭 시그널링 TA는 해당 MAC 프레임을 전송하는 STA의 MAC 주소로 표현될 수 있으나, MAC 주소에 포함된 개별/그룹 비트(Individual/Group bit)가 특정 값(예를 들어, '1')으로 설정될 수 있다.

[202] Sequence Control 필드는 시퀀스 넘버(sequence number) 및 조각 넘버(fragment number)를 포함하도록 설정된다. 시퀀스 넘버를 해당 MAC 프레임에 할당된 시퀀스 넘버를 지시할 수 있다. 조각 넘버는 해당 MAC 프레임의 각 조각의 넘버를 지시할 수 있다.

[203] QoS Control 필드는 QoS와 관련된 정보를 포함한다. QoS Control 필드는 서브타입(Subtype) 서브필드에서 QoS 데이터 프레임을 지시하는 경우 포함될 수 있다.

[204] HT Control 필드는 HT 및/또는 VHT 송수신 기법과 관련된 제어 정보를 포함한다. HT Control 필드는 제어 래퍼(Control Wrapper) 프레임에 포함된다. 또한, 오더(Order) 서브필드 값이 1인 QoS 데이터(QoS Data) 프레임, 관리(Management) 프레임에 존재한다.

[205] Frame Body는 MAC 페이로드(payload)로 정의되고, 상위 계층에서 전송하고자 하는 데이터가 위치하게 되며, 가변적인 크기를 가진다. 예를 들어, 최대 MPDU의 크기는 11454 옥텟(octets)이고, 최대 PPDU 크기는 5.484 ms일 수 있다.

[206] FCS는 MAC 풋터(footer)로 정의되고, MAC 프레임의 에러 탐색을 위하여 사용된다.

[207] 처음 세 필드(Frame Control 필드, Duration/ID 필드 및 Address 1 필드)와 제일 마지막 필드(FCS 필드)는 최소 프레임 포맷을 구성하며, 모든 프레임에 존재한다. 그 외의 필드는 특정 프레임 타입에서만 존재할 수 있다.

[208] 도 7은 본 발명이 적용될 수 있는 무선 통신 시스템에서 MAC 프레임 내 프레임

제어(Frame Control) 필드를 예시하는 도면이다.

[209] 도 7을 참조하면, Frame Control 필드는 프로토콜 버전(Protocol Version) 서브필드, 타입(Type) 서브필드, 서브타입(Subtype) 서브필드, To DS 서브필드, From DS 서브필드, 추가 조각(More Fragments) 서브필드, 재시도(Retry) 서브필드, 파워 관리(Power Management) 서브필드, 추가 데이터(More Data) 서브필드, 보호된 프레임(Protected Frame) 서브필드 및 오더(Order) 서브필드로 구성된다.

[210] Protocol Version 서브필드는 해당 MAC 프레임에 적용된 WLAN 프로토콜의 버전을 지시할 수 있다.

[211] Type 서브필드 및 Subtype 서브필드는 해당 MAC 프레임의 기능을 식별하는 정보를 지시하도록 설정될 수 있다.

[212] MAC 프레임의 타입은 관리 프레임(Management Frame), 제어 프레임(Control Frame), 데이터 프레임(Data Frame) 3가지의 프레임 타입을 포함할 수 있다.

[213] 그리고, 각 프레임 타입들은 다시 서브타입으로 구분될 수 있다.

[214] 예를 들어, 제어 프레임(Control frames)은 RTS(request to send) 프레임, CTS(clear-to-send) 프레임, ACK(Acknowledgment) 프레임, PS-Poll 프레임, CF(contention free)-End 프레임, CF-End+CF-ACK 프레임, 블록 ACK 요청(BAR: Block Acknowledgment request) 프레임, 블록 ACK(BA: Block Acknowledgment) 프레임, 제어 래퍼(Control Wrapper(Control+HTcontrol)) 프레임, VHT 널 데이터 패킷 공지(NDPA: Null Data Packet Announcement), 빔포밍 보고 폴(Beamforming Report Poll) 프레임을 포함할 수 있다.

[215] 관리 프레임(Management frames)은 비콘(Beacon) 프레임, ATIM(Announcement Traffic Indication Message) 프레임, 연계해제(Disassociation) 프레임, 연계 요청/응답(Association Request/Response) 프레임, 재연계 요청/응답(Reassociation Request/Response) 프레임, 프로브 요청/응답(Probe Request/Response) 프레임, 인증(Authentication) 프레임, 인증해제(Deauthentication) 프레임, 동작(Action) 프레임, 동작 무응답(Action No ACK) 프레임, 타이밍 광고(Timing Advertisement) 프레임을 포함할 수 있다.

[216] To DS 서브필드 및 From DS 서브필드는 해당 MAC 프레임 헤더에 포함된 Address 1 필드 내지 Address 4 필드를 해석하기 위하여 필요한 정보를 포함할 수 있다. Control 프레임의 경우, To DS 서브필드 및 From DS 서브필드는 모두 '0'로 설정된다. Management 프레임의 경우, To DS 서브필드 및 From DS 서브필드는 해당 프레임이 QoS 관리 프레임(QMF: QoS Management frame)이면 순서대로 '1', '0'으로 설정되고, 해당 프레임이 QMF가 아니면 순서대로 모두 '0', '0'로 설정될 수 있다.

[217] More Fragments 서브필드는 해당 MAC 프레임에 이어 전송될 조각(fragment)이 존재하는지 여부를 지시할 수 있다. 현재 MSDU 또는 MMPDU의 또 다른 조각(fragment)가 존재하는 경우 '1'로 설정되고, 그렇지 않은 경우 '0'로 설정될 수

있다.

[218] Retry 서브필드는 해당 MAC 프레임이 이전 MAC 프레임의 재전송에 따른 것인지 여부를 지시할 수 있다. 이전 MAC 프레임의 재전송인 경우 '1'로 설정되고, 그렇지 않은 경우 '0'으로 설정될 수 있다.

[219] Power Management 서브필드는 STA의 파워 관리 모드를 지시할 수 있다. Power Management 서브필드 값이 '1'이면 STA이 파워 세이브 모드로 전환하는 것을 지시할 수 있다.

[220] More Data 서브필드는 추가적으로 전송될 MAC 프레임이 존재하는지 여부를 지시할 수 있다. 추가적으로 전송될 MAC 프레임이 존재하는 경우 '1'로 설정되고, 그렇지 않은 경우 '0'으로 설정될 수 있다.

[221] Protected Frame 서브필드는 프레임 바디(Frame Body) 필드가 암호화되었는지 여부를 지시할 수 있다. Frame Body 필드가 암호화된 인캡슐레이션 알고리즘(cryptographic encapsulation algorithm)에 의해 처리된 정보를 포함하는 경우 '1'로 설정되고, 그렇지 않은 경우 '0'으로 설정될 수 있다.

[222] 앞서 설명한 각 필드들에 포함되는 정보들은 IEEE 802.11 시스템의 정의를 따를 수 있다. 또한, 앞서 설명한 각 필드들은 MAC 프레임에 포함될 수 있는 필드들의 예시에 해당하며, 이에 한정되지 않는다. 즉, 앞서 설명한 각 필드가 다른 필드로 대체되거나 추가적인 필드가 더 포함될 수 있으며, 모든 필드가 필수적으로 포함되지 않을 수도 있다.

[223] 도 8은 본 발명이 적용될 수 있는 무선 통신 시스템에서 HT Control 필드의 VHT 포맷을 예시한다.

[224] 도 8을 참조하면, HT Control 필드는 VHT 서브필드, HT 제어 미들(HT Control Middle) 서브필드, AC 제한(AC Constraint) 서브필드 및 역방향 승인(RDG: Reverse Direction Grant)/추가 PPDU(More PPDU) 서브필드로 구성될 수 있다.

[225] VHT 서브필드는 HT Control 필드가 VHT를 위한 HT Control 필드의 포맷을 가지는지(VHT=1) 또는 HT를 위한 HT Control 필드의 포맷을 가지는지(VHT=0) 여부를 지시한다. 도 8에서는 VHT를 위한 HT Control 필드(즉, VHT=1)를 가정하여 설명한다. VHT를 위한 HT Control 필드를 VHT Control 필드로 지칭할 수 있다.

[226] HT Control Middle 서브필드는 VHT 서브필드의 지시에 따라 다른 포맷을 가지도록 구현될 수 있다. HT Control Middle 서브필드에 대한 보다 상세한 설명은 후술한다.

[227] AC Constraint 서브필드는 역방향(RD: reverse direction) 데이터 프레임의 맵핑된 AC(Access Category)가 단일 AC에 한정된 것인지 여부를 지시한다.

[228] RDG/More PPDU 서브필드는 해당 필드가 RD 개시자(initiator) 또는 RD 응답자(responder)에 의하여 전송되는지 여부에 따라 다르게 해석될 수 있다.

[229] RD 개시자에 의하여 전송된 경우, RDG가 존재하는 경우 RDG/More PPDU 필드가 '1'로 설정되고, RDG가 존재하지 않는 경우 '0'으로 설정된다. RD

응답자에 의하여 전송된 경우, 해당 서브필드를 포함하는 PPDU가 RD 응답자에 의해 전송된 마지막 프레임이면 '1'로 설정되고, 또 다른 PPDU가 전송되면 '0'으로 설정된다.

[230] 상술한 바와 같이, HT Control Middle 서브필드는 VHT 서브필드의 지시에 따라 다른 포맷을 가지도록 구현될 수 있다.

[231] VHT를 위한 HT Control 필드의 HT Control Middle 서브필드는 예비 비트(Reserved bit), MCS 피드백 요청(MRQ: MCS(Modulation and Coding Scheme) feedback request) 서브필드, MRQ 시퀀스 식별자(MSI: MRQ Sequence Identifier)/시공간 블록 코딩(STBC: space-time block coding) 서브필드, MCS 피드백 시퀀스 식별자(MFSI: MCS feedback sequence identifier)/그룹 ID 최하위 비트(GID-L: LSB(Least Significant Bit) of Group ID) 서브필드, MCS 피드백(MFB: MCS Feedback) 서브필드, 그룹 ID 최상위 비트(GID-H: MSB(Most Significant Bit) of Group ID) 서브필드, 코딩 타입(Coding Type) 서브필드, 피드백 전송 타입(FB Tx Type: Feedback Transmission type) 서브필드 및 자발적 MFB(Unsolicited MFB) 서브필드로 구성될 수 있다.

[232] 표 4는 VHT 포맷의 HT Control Middle 서브필드에 포함된 각 서브필드에 대한 설명을 나타낸다.

[233] [표4]

서브필드	의미	정의
MRQ	MCS request	MCS 피드백(비자발적(solicited) MFB)을 요청하는 경우 '1'로 설정됨 그렇지 않은 경우, '0'으로 설정됨
MSI	MRQ sequence identifier	Unsolicited MFB 서브필드가 '0'이고, MRQ 서브필드가 '1'로 설정되면, MSI 서브필드는 특정 요청을 식별하는 0 내지 6 범위 내 시퀀스 번호를 포함함 Unsolicited MFB 서브필드가 '1'이면, 압축된 MSI(Compressed MSI) 서브필드(2비트), STBC 지시(STBC indication) 서브필드(1비트)를 포함함
MFSI/GID-L	MFB sequence identifier/LSB of Group ID	Unsolicited MFB 서브필드가 '0'으로 설정되면, MFSI/GID-L 서브필드는 MFB 정보와 관련된 프레임 내 포함된 MSI의 수신 값을 포함함 Unsolicited MFB 서브필드가 '1'로 설정되고, MFB가 MU PPDU로부터 추정된 것이면, MFSI/GID-L 서브필드는 MFB가 추정된 PPDU의 그룹 ID의 최하위 3비트를 포함함
MFB	VHT N_STS, MCS, BW, SNR feedback	MFB 서브필드는 추천되는 MFB를 포함함. VHT-MCS=15, NUM_STS=7은 피드백이 존재하지 않는 것을 지시함
GID-H	MSB of Group ID	Unsolicited MFB 서브필드가 '1'로 설정되고, MFB가 VHT MU PPDU로부터 추정된 것이면, GID-H 서브필드는 자발적 MFB가 추정된 PPDU의 그룹 ID의 최상위 3비트를 포함함 MFB가 SU PPDU로부터 추정된 것이며, GID-H 서브필드는 모두 1로 설정됨
Coding Type	Coding type of MFB response	Unsolicited MFB 서브필드가 '1'로 설정되면, 코딩 타입 서브필드는 자발적 MFB가 추정된 프레임의 코딩 타입(BCC(binary convolutional code)은 0, LDPC(low-density parity check)은 1)를 포함함
FB Tx Type	Transmission type of MFB response	Unsolicited MFB 서브필드가 '1'로 설정되고 MFB가 빔포밍되지 않은(unbeamformed) VHT PPDU로부터 추정된 것이면, FB Tx Type 서브필드는 '0'으로 설정됨 Unsolicited MFB 서브필드가 '1'로 설정되고 MFB가 빔포밍된(beamformed) VHT PPDU로부터 추정된 것이면 FB Tx Type 서브필드는 '1'로 설정됨
Unsolicited MFB	Unsolicited MCS feedback indicator	MFB가 MRQ에 대한 응답이면 '1'로 설정됨 MFB가 MRQ에 대한 응답이 아니면 '0'으로 설정됨

[234] 그리고, MFB 서브필드는 VHT 공간-시간 스트림 개수(NUM_STS: Number of space time streams) 서브필드, VHT-MCS 서브필드, 대역폭(BW: Bandwidth) 서브필드, 신호 대 잡음비(SNR: Signal to Noise Ratio) 서브필드를 포함할 수 있다.

[235] NUM_STS 서브필드는 추천하는 공간 스트림의 개수를 지시한다. VHT-MCS

서브필드는 추천하는 MCS를 지시한다. BW 서브필드는 추천하는 MCS와 관련된 대역폭 정보를 지시한다. SNR 서브필드는 데이터 서브캐리어 및 공간 스트림 상의 평균 SNR 값을 지시한다.

[236] 앞서 설명한 각 필드들에 포함되는 정보들은 IEEE 802.11 시스템의 정의를 따를 수 있다. 또한, 앞서 설명한 각 필드들은 MAC 프레임에 포함될 수 있는 필드들의 예시에 해당하며, 이에 한정되지 않는다. 즉, 앞서 설명한 각 필드가 다른 필드로 대체되거나 추가적인 필드가 더 포함될 수 있으며, 모든 필드가 필수적으로 포함되지 않을 수도 있다.

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[238] 매체 액세스 메커니즘

[239] IEEE 802.11에서 통신은 공유된 무선 매체(shared wireless medium)에서 이루어지기 때문에 유선 채널(wired channel) 환경과는 근본적으로 다른 특징을 가진다.

[240] 유선 채널 환경에서는 CSMA/CD(carrier sense multiple access/collision detection) 기반으로 통신이 가능하다. 예를 들어 송신단에서 한번 시그널이 전송되면 채널 환경이 큰 변화가 없기 때문에 수신단까지 큰 신호 감쇄를 겪지 않고 전송이 된다. 이때 두 개 이상의 시그널이 충돌되면 감지(detection)이 가능했다. 이는 수신단에서 감지된 전력(power)이 순간적으로 송신단에서 전송한 전력보다 커지기 때문이다. 하지만, 무선 채널 환경은 다양한 요소들 (예를 들어, 거리에 따라 시그널의 감쇄가 크다거나 순간적으로 깊은 페이딩(deep fading)을 겪을 수 있음)이 채널에 영향을 주기 때문에 실제로 수신단에서 신호가 제대로 전송이 되었는지 혹은 충돌이 발생되었는지 송신단에서 정확히 캐리어 센싱(carrier sensing)을 할 수가 없다.

[241] 이에 따라, IEEE 802.11에 따른 WLAN 시스템에서, MAC의 기본 액세스 메커니즘으로서 CSMA/CA(Carrier Sense Multiple Access with Collision Avoidance) 메커니즘을 도입하였다. CAMA/CA 메커니즘은 IEEE 802.11 MAC의 분배 조정 기능(DCF: Distributed Coordination Function)이라고도 불리는데, 기본적으로 "listen before talk" 액세스 메커니즘을 채용하고 있다. 이러한 유형의 액세스 메커니즘에 따르면, AP 및/또는 STA은 전송을 시작하기에 앞서, 소정의 시간 구간(예를 들어, DIFS(DCF Inter-Frame Space)) 동안 무선 채널 또는 매체(medium)를 센싱(sensing)하는 CCA(Clear Channel Assessment)를 수행한다. 센싱 결과, 만일 매체가 유휴 상태(idle status)인 것으로 판단되면, 해당 매체를 통하여 프레임 전송을 시작한다. 반면, 매체가 점유 상태(occupied status)인 것으로 감지되면, 해당 AP 및/또는 STA은 자기 자신의 전송을 시작하지 않고, 이미 여러 STA들이 해당 매체를 사용하기 위해 대기하고 있다는 가정하에 DIFS에 추가적으로 매체 액세스를 위한 지연 시간(예를 들어, 임의 백오프 주기(random backoff period)) 동안 더 기다린 후에 프레임 전송을 시도할 수 있다.

[242] 임의 백오프 주기를 적용함으로써, 프레임을 전송하기 위한 여러 STA들이

존재한다고 가정할 때 여러 STA들은 확률적으로 다른 백오프 주기 값을 가지게 되어 서로 다른 시간 동안 대기한 후에 프레임 전송을 시도할 것이 기대되므로, 충돌(collision)을 최소화시킬 수 있다.

[243] 또한, IEEE 802.11 MAC 프로토콜은 HCF(Hybrid Coordination Function)를 제공한다. HCF는 상기 DCF와 지점 조정 기능(PCF: Point Coordination Function)를 기반으로 한다. PCF는 폴링(polling) 기반의 동기식 액세스 방식으로 모든 수신 AP 및/또는 STA이 데이터 프레임을 수신할 수 있도록 주기적으로 폴링하는 방식을 일컫는다. 또한, HCF는 EDCA(Enhanced Distributed Channel Access)와 HCCA(HCF Controlled Channel Access)를 가진다. EDCA는 제공자가 다수의 사용자에게 데이터 프레임을 제공하기 위한 액세스 방식을 경쟁 기반으로 수행하는 것이고, HCCA는 폴링(polling) 메커니즘을 이용한 비경쟁 기반의 채널 액세스 방식을 사용하는 것이다. 또한, HCF는 WLAN의 QoS(Quality of Service)를 향상시키기 위한 매체 액세스 메커니즘을 포함하며, 경쟁 주기(CP: Contention Period)와 비경쟁 주기(CFP: Contention Free Period) 모두에서 QoS 데이터를 전송할 수 있다.

[244] 도 9는 본 발명이 적용될 수 있는 무선 통신 시스템에서 임의 백오프 주기와 프레임 전송 절차를 설명하기 위한 도면이다.

[245] 특정 매체가 점유(occupy 또는 busy) 상태에서 유휴(idle) 상태로 변경되면, 여러 STA들은 데이터(또는 프레임) 전송을 시도할 수 있다. 이때, 충돌을 최소화하기 위한 방안으로서, STA들은 각각 임의 백오프 카운트(random backoff count)를 선택하고 그에 해당하는 슬롯 시간(slot time)만큼 대기한 후에 전송을 시도할 수 있다. 임의 백오프 카운트는 의사-임의 정수(pseudo-random integer) 값을 가지며, 0 내지 경쟁 윈도우(CW: Contention Window) 범위에서 균일 분포(uniform distribution)한 값 중 하나로 결정될 수 있다. 여기서, CW는 경쟁 윈도우 파라미터 값이다. CW 파라미터는 초기 값으로 CW_min이 주어지지만, 전송이 실패된 경우(예를 들어, 전송된 프레임에 대한 ACK을 수신하지 못한 경우)에 2배의 값을 취할 수 있다. CW 파라미터 값이 CW_max가 되면 데이터 전송이 성공할 때까지 CW_max 값을 유지하면서 데이터 전송을 시도할 수 있고, 데이터 전송이 성공하는 경우에는 CW_min 값으로 리셋된다. CW, CW_min 및 CW_max 값은 2^n-1 (n=0, 1, 2, ...)로 설정되는 것이 바람직하다.

[246] 임의 백오프 과정이 시작되면 STA은 결정된 백오프 카운트 값에 따라서 백오프 슬롯을 카운트 다운하고, 카운트 다운하는 동안에 계속하여 매체를 모니터링한다. 매체게 점유 상태로 모니터링되면 카운트 다운을 중단하고 대기하게 되며, 매체가 유휴 상태가 되면 카운트 다운을 재개한다.

[247] 도 9의 예시에서 STA 3의 MAC에 전송할 패킷이 도달한 경우에, STA 3은 DIFS 만큼 매체가 유휴 상태인 것을 확인하고 바로 프레임을 전송할 수 있다.

[248] 한편, 나머지 STA들은 매체가 점유(busy) 상태인 것을 모니터링하고 대기한다. 그 동안 STA 1, STA 2 및 STA 5의 각각에서도 전송할 데이터가 발생할 수 있고,

각각의 STA은 매체가 유휴 상태로 모니터링되면 DIFS만큼 대기한 후에, 각자가 선택한 임의 백오프 카운트 값에 따라서 백오프 슬롯을 카운트 다운한다.

[249] 도 9의 예시에서는 STA 2가 가장 작은 백오프 카운트 값을 선택하고, STA 1이 가장 큰 백오프 카운트 값을 선택한 경우를 나타난다. 즉, STA 2가 백오프 카운트를 마치고 프레임 전송을 시작하는 시점에서 STA 5의 잔여 백오프 시간은 STA 1의 잔여 백오프 시간보다 짧은 경우를 예시한다.

[250] STA 1 및 STA 5는 STA 2가 매체를 점유하는 동안에 카운트 다운을 멈추고 대기한다. STA 2의 매체 점유가 종료되어 매체가 다시 유휴 상태가 되면, STA 1 및 STA 5는 DIFS만큼 대기한 후에, 멈추었던 백오프 카운트를 재개한다. 즉, 잔여 백오프 시간만큼의 나머지 백오프 슬롯을 카운트 다운한 후에서 프레임 전송을 시작할 수 있다. STA 5의 잔여 백오프 시간이 STA 1보다 짧았으므로 STA 5의 프레임 전송을 시작하게 된다.

[251] 한편, STA 2가 매체를 점유하는 동안에서 STA 4에서도 전송할 데이터가 발생할 수 있다. 이때, STA 4 입장에서는 매체가 유휴 상태가 되면 DIFS 만큼 대기한 후, 자신이 선택한 임의 백오프 카운트 값에 따른 백오프 슬롯의 카운트 다운을 수행한다.

[252] 도 9의 예시에서는 STA 5의 잔여 백오프 시간이 STA 4의 임의 백오프 카운트 값과 우연히 일치하는 경우를 나타내며, 이 경우 STA 4와 STA 5 간에 충돌이 발생할 수 있다. 충돌이 발생하는 경우에는 STA 4와 STA 5 모두 ACK을 수신하지 못하여, 데이터 전송을 실패하게 된다. 이 경우, STA 4와 STA 5는 CW 값을 2배로 늘린 후에 임의 백오프 카운트 값을 선택하고 백오프 슬롯의 카운트 다운을 수행한다.

[253] 한편, STA 1은 STA 4와 STA 5의 전송으로 인해 매체가 점유 상태인 동안에 대기하고 있다가, 매체가 유휴 상태가 되면 DIFS 만큼 대기한 후에, 잔여 백오프 시간이 지나면 프레임 전송을 시작할 수 있다.

[254] CSMA/CA 메커니즘은 AP 및/또는 STA이 매체를 직접 센싱하는 물리적 캐리어 센싱(physical carrier sensing) 외에 가상 캐리어 센싱(virtual carrier sensing)도 포함한다.

[255] 가상 캐리어 센싱은 히든 노드 문제(hidden node problem) 등과 같이 매체 접근상 발생할 수 있는 문제를 보완하기 위한 것이다. 가상 캐리어 센싱을 위하여, WLAN 시스템의 MAC은 네트워크 할당 벡터(NAV: Network Allocation Vector)를 이용한다. NAV는 현재 매체를 사용하고 있거나 또는 사용할 권한이 있는 AP 및/또는 STA이, 매체가 이용 가능한 상태로 되기까지 남아 있는 시간을 다른 AP 및/또는 STA에게 지시하는 값이다. 따라서 NAV로 설정된 값은 해당 프레임을 전송하는 AP 및/또는 STA에 의하여 매체의 사용이 예정되어 있는 기간에 해당하고, NAV 값을 수신하는 STA은 해당 기간 동안 매체 액세스가 금지된다. NAV는, 예를 들어, 프레임의 MAC 헤더(header)의 지속 기간(duration) 필드의 값에 따라 설정될 수 있다.

[256] AP 및/또는 STA은 매체에 접근하고자 함을 알리기 위해 RTS(request to send) 프레임 및 CTS(clear to send) 프레임을 교환하는 절차를 수행할 수 있다. RTS 프레임 및 CTS 프레임은 실질적인 데이터 프레임 전송 및 수신 확인 응답(ACK)이 지원될 경우 ACK 프레임이 송수신 되는데 필요한 무선 매체가 접근 예약된 시간적인 구간을 지시하는 정보를 포함한다. 프레임을 전송하고자 하는 AP 및/또는 STA으로부터 전송된 RTS 프레임을 수신하거나, 프레임 전송 대상 STA으로부터 전송된 CTS 프레임을 수신한 다른 STA은 RTS/CTS 프레임에 포함되어 있는 정보가 지시하는 시간적인 구간 동안 매체에 접근하지 않도록 설정될 수 있다. 이는 시간 구간 동안 NAV가 설정됨을 통하여 구현될 수 있다.

[257]

[258] **<u>프레임 간격(interframe space)</u>**

[259] 프레임 사이의 시간 간격을 프레임 간격(IFS: Interframe Space)으로 정의한다. STA은 캐리어 센싱(carrier sensing)을 통해 IFS 시간 구간 동안 채널이 사용되는지 여부를 판단할 수 있다. 802.11 WLAN 시스템에서 무선 매체를 점유하는 우선 레벨(priority level)을 제공하기 위하여 복수의 IFS이 정의된다.

[260] 도 10은 본 발명이 적용될 수 있는 무선 통신 시스템에서 IFS 관계를 예시하는 도면이다.

[261] 모든 타이밍은 물리 계층 인터페이스 프리미티브 즉, PHY-TXEND.confirm 프리미티브, PHYTXSTART.confirm 프리미티브, PHY-RXSTART.indication 프리미티브 및 PHY-RXEND.indication 프리미티브를 참조하여 정해질 수 있다.

[262] IFS 종류에 따른 프레임 간격은 아래와 같다.

[263] a) 축소된 프레임 간격(RIFS: reduced interframe space)

[264] b) 짧은 프레임 간격(SIFS: short interframe space)

[265] c) PCF 프레임 간격(PIFS: PCF interframe space)

[266] d) DCF 프레임 간격(DIFS: DCF interframe space)

[267] e) 조정 프레임 간격(AIFS: arbitration interframe space)

[268] f) 확장 프레임 간격(EIFS: extended interframe space)

[269] 서로 다른 IFS들은 STA의 비트율(bit rate)과 무관하게 물리 계층에 의해 특정된 속성으로부터 결정된다. IFS 타이밍은 매체 상에서의 시간 갭(time gap)으로 정의된다. AIFS를 제외한 IFS 타이밍은 각 물리 계층 별로 고정된다.

[270] SIFS는 ACK 프레임, CTS 프레임, 블록 ACK 요청(BlockAckReq) 프레임 또는 A-MPDU에 대한 즉각적인 응답인 블록 ACK(BlockAck) 프레임을 포함하는 PPDU, 조각난 버스트(fragment burst)의 두 번째 또는 연속적인 MPDU, PCF에 의한 폴링(polling)에 대한 STA의 응답의 전송을 위해 사용되며 최고 우선 순위를 가진다. SIFS는 또한 비경쟁 구간(CFP) 시간 동안 프레임의 타입과 무관하게 프레임들의 지점 조정(point coordinator)을 위해 사용될 수 있다. SIFS는 이전 프레임의 마지막 심볼의 종료 또는 시그널 확장(존재하는 경우)으로부터 이어지는 다음 프레임의 프리앰블의 첫 번째 심볼의 시작까지의 시간을

나타낸다.

[271] SIFS 타이밍은 TxSIFS 슬롯 경계에서 연속적인 프레임의 전송이 시작될 때 달성된다.

[272] SIFS는 서로 다른 STA들로부터의 전송 간의 IFS 중에서 가장 짧다. 매체를 점유하고 있는 STA이 프레임 교환 시퀀스(frame exchange sequence)가 수행되는 구간 동안 매체의 점유를 유지할 필요가 있는 경우 사용될 수 있다.

[273] 프레임 교환 시퀀스 내 전송 간 가장 작은 갭을 사용함으로써, 더 긴 갭 동안 매체가 유휴 상태가 되길 기다리는 것이 요구되는 다른 STA들이 매체의 사용을 시도하는 것을 방지할 수 있다. 따라서, 진행 중인 프레임 교환 시퀀스가 완료되는데 우선권을 부여할 수 있다.

[274] PIFS는 매체를 액세스하는데 우선권을 획득하기 위하여 사용된다.

[275] PIFS는 다음과 같은 경우에 사용될 수 있다.

[276] - PCF 하에 동작하는 STA

[277] - 채널 스위치 공지(Channel Switch Announcement) 프레임을 전송하는 STA

[278] - 트래픽 지시 맵(TIM: Traffic Indication Map) 프레임을 전송하는 STA

[279] - CFP 또는 전송 기회(TXOP: Transmission Opportunity)를 시작하는 하이브리드 조정자(HC: Hybrid Coordinator)

[280] - CAP(controlled access phase) 내 예상된 수신의 부재로부터 복구(recovering)하기 위한 폴링된 TXOP 홀더(holder)인 HC 또는 non-AP QoS STA

[281] - CTS2의 전송 전 듀얼 CTS 보호를 사용하는 HT STA

[282] - 전송 실패 이후에 계속하여 전송하기 위한 TXOP 홀더(holder)

[283] - 에러 복구(error recovery)를 사용하여 계속하여 전송하기 위한 RD(reverse direction) 개시자

[284] - PSMP(power save multi-poll) 복구 프레임을 전송하는 PSMP 시퀀스 동안 HT AP

[285] - EDCA 채널 액세스를 사용하는 40MHz 마스크 PPDU를 전송하기 전 세컨더리 채널(secondary channel) 내 CCA를 수행하는 HT STA

[286] 앞서 나열된 예시 중 세컨더리 채널(secondary channel)에서 CCA을 수행하는 경우를 제외하고, PIFS를 사용하는 STA은 TxPIFS 슬롯 경계에서 매체가 유휴 상태임을 결정하는 CS(carrier sense) 메커니즘 이후에 전송을 시작한다.

[287] DIFS는 DCF 하에 데이터 프레임(MPDU) 및 관리 프레임(MMPDU: MAC Management Protocol Data Unit)을 전송하도록 동작하는 STA에 의해 사용될 수 있다. DCF를 사용하는 STA은 정확히 수신된 프레임 및 백오프 타임이 만료된 이후 CS(carrier sense) 메커니즘을 통해 매체가 유휴 상태라고 결정되면, TxDIFS 슬롯 경계에서 전송할 수 있다. 여기서, 정확히 수신된 프레임은 PHY-RXEND.indication 프리미티브가 에러를 지시하지 않고, FCS가 프레임이 에러가 아님(error free)을 지시하는 프레임을 의미한다.

[288] SIFS 시간('aSIFSTime')과 슬롯 시간('aSlotTime')은 물리 계층 별로 결정될 수 있다. SIFS 시간은 고정된 값을 가지나, 슬롯 시간은 무선 지연 시간(aAirPropagationTime) 변화에 따라 동적으로 변화할 수 있다.

[289] 'aSIFSTime'은 아래 수학식 1 및 2와 같이 정의된다.

[290] [수식1]

$$aSIFSTime(16\mu s) = aRxRFDelay(0.5) + aRxPLCPDelay(12.5) + aMACProcessingDelay(1 \text{ 또는 } <2) + aRxTxTurnaroundTime(<2)$$

[291] [수식2]

$$aRxTxTurnaroundTime = aTxPLCPDelay(1) + aRxTxSwitchTime(0.25) + aTxRampOnTime(0.25) + aTxRFDelay(0.5)$$

[292] 'aSlotTime'은 아래 수학식 3과 같이 정의된다.

[293] [수식3]

$$aSlotTime = aCCATime(<4) + aRxTxTurnaroundTime(<2) + aAirPropagationTime(<1) + aMACProcessingDelay(<2)$$

[294] 수학식 3에서 기본적인(default) 물리 계층 파라미터는 1μs와 같거나 작은 값을 가지는 'aMACProcessingDelay'에 기반한다. 무선 파는 자유 공간(free space)에서 300m/μs로 확산된다. 예를 들어, 3μs는 BSS 최대 일방향(one-way) 거리 ~450m(왕복 시간(round trip)은 ~900m)의 상한선일 수 있다.

[295] PIFS와 SIFS는 각각 아래 수학식 4 및 5와 같이 정의된다.

[296] [수식4]

$$PIFS(16\mu s) = aSIFSTime + aSlotTime$$

[297] [수식5]

$$DIFS(34\mu s) = aSIFSTime + 2 * aSlotTime$$

[298] 앞서 수학식 1 내지 5에서 괄호 안에 수치는 일반적인 값을 예시하는 것이나, 그 값은 STA 별로 혹은 STA의 위치 별로 달라질 수 있다.

[299] 상술한 SIFS, PIFS 및 DIFS 들은 매체와 서로 다른 MAC 슬롯 경계(TxSIFS, TxPIFS, TxDIFS)를 기반으로 측정된다.

[300] SIFS, PIFS 및 DIFS 에 대한 각 MAC 슬롯 경계는 각각 아래 수학식 6 내지 8과 같이 정의된다.

[301] [수식6]

$$TxSIFS = SIFS - aRxTxTurnaroundTime$$

[302] [수식7]

$$TxPIFS = TxSIFS + aSlotTime$$

[303] [수식8]

$$TxDIFS = TxSIFS + 2 * aSlotTime$$

[304]

[305] **채널 상태 정보(Channel State Information) 피드백(feedback) 방법**

[306] 빔포머(Beamformer)가 모든 안테나를 하나의 빔포미(Beamformee)에 할당하여 통신하는 SU-MIMO 기술은 시공간을 이용한 다이버시티 이득(diversity gain)과 스트림(stream) 다중 전송을 통해 채널 용량을 증대시킨다. SU-MIMO 기술은 MIMO 기술을 적용하지 않을 때에 비해 안테나의 개수를 늘림으로써, 공간 자유도를 확장시켜 물리 계층의 성능 향상에 기여할 수 있다.

[307] 또한, Beamformer가 복수의 Beamformee에게 안테나를 할당하는 MU-MIMO 기술은 Beamformer에 접속한 복수의 Beamformee들의 다중 접속을 위한 링크 계층 프로토콜을 통하여, Beamformee 당 전송률을 높이거나 채널의 신뢰도를 높임으로써 MIMO 안테나의 성능을 향상시킬 수 있다.

[308] MIMO 환경에서는 Beamformer가 채널 정보를 얼마나 정확히 알고 있는지가 성능에 큰 영향을 미칠 수 있으므로, 채널 정보 획득을 위한 피드백 절차가 요구된다.

[309] 채널 정보 획득을 위한 피드백 절차는 크게 두 가지 방식이 지원될 수 있다. 하나는 제어 프레임(Control frame)을 이용하는 방식이며, 남은 하나는 데이터 필드가 포함되지 않은 채널 사운딩(channel sounding) 절차를 이용하는 방식이다. 사운딩은 프리엠블 트레이닝 필드(training field)를 포함하는 PPDU의 데이터 복조 이외의 목적을 위해 채널을 측정하기 위하여 해당 트레이닝 필드(training field)를 이용하는 것을 의미한다.

[310] 이하, 제어 프레임(Control frame)을 이용한 채널 정보 피드백 방법과 NDP(null data packet)을 이용한 채널 정보 피드백 방법에 대하여 보다 구체적으로 살펴본다.

[311] 1) 제어 프레임(Control frame)을 이용한 피드백 방법

[312] MIMO 환경에서 Beamformer는 MAC 헤더에 포함된 HT control 필드를 통해 채널 상태 정보의 피드백을 지시하거나, Beamformee는 MAC 프레임 헤더에 포함된 HT control 필드를 통해 채널 상태 정보를 보고할 수 있다(도 8 참조). HT control 필드는 Control Wrapper 프레임이나 MAC 헤더의 Order 서브필드가 1로 설정된 QoS Data 프레임, 관리 프레임에 포함될 수 있다.

[313] 2) 채널 사운딩(channel sounding)을 이용한 피드백 방법

[314] 도 11은 본 발명이 적용될 수 있는 무선 통신 시스템에서 채널 사운딩(sounding) 방법을 개념적으로 나타내는 도면이다.

[315] 도 11에서는 사운딩 프로토콜(sounding protocol)을 기초로 Beamformer(예를 들어, AP)와 Beamformee(예를 들어, non-AP STA) 간의 채널 상태 정보(channel state information)를 피드백하는 방법을 예시한다. 사운딩 프로토콜(sounding

protocol)은 채널 상태 정보에 대한 정보를 피드백 받는 절차를 의미할 수 있다.

[316] 사운딩 프로토콜을 기초로 한 Beamformer와 Beamformee 간의 채널 상태 정보 사운딩 방법을 아래와 같은 단계로 수행될 수 있다.

[317] (1) Beamformer에서 Beamformee의 피드백을 위한 사운딩 전송을 알리는 VHT NDPA(VHT Null Data Packet Announcement) 프레임을 전송한다.

[318] VHT NDPA 프레임은 채널 사운딩이 개시되고, NDP(Null Data Packet)이 전송될 것임을 알리기 위해 사용되는 제어 프레임(control frame)을 의미한다. 다시 말해, NDP을 전송하기 전 VHT NDPA 프레임을 전송함으로써 Beamformee가 NDP 프레임을 수신하기 전 채널 상태 정보를 피드백 하기 위한 준비를 하도록 할 수 있다.

[319] VHT NDPA 프레임은 NDP을 전송할 Beamformee의 AID(association identifier) 정보, 피드백 타입 정보 등을 포함할 수 있다. VHT NDPA 프레임에 대한 보다 상세한 설명은 후술한다.

[320] VHT NDPA 프레임은 MU-MIMO를 사용하여 데이터를 전송하는 경우와 SU-MIMO를 사용하여 데이터를 전송하는 경우 서로 다른 전송 방식으로 전송될 수 있다. 예를 들어, MU-MIMO를 위한 채널 사운딩을 수행하는 경우 VHT NDPA 프레임을 브로드캐스트(broadcast) 방식으로 전송하나, SU-MIMO를 위한 채널 사운딩을 수행하는 경우 하나의 대상 STA으로 VHT NDPA 프레임을 유니캐스트(unicast) 방식으로 전송할 수 있다.

[321] (2) Beamformer는 VHT NDPA 프레임을 전송한 후, SIFS 시간 후에 NDP을 전송한다. NDP은 데이터 필드를 제외한 VHT PPDU 구조를 가진다.

[322] VHT NDPA 프레임을 수신한 Beamformee들은 STA 정보 필드에 포함된 AID12 서브필드 값을 확인하고, 자신이 사운딩 대상 STA인지 확인할 수 있다.

[323] 또한, Beamformee들은 NDPA에 포함된 STA Info 필드의 순서를 통해 피드백 순서를 알 수 있다. 도 11에서는 피드백 순서가 Beamformee 1, Beamformee 2, Beamformee 3의 순서로 진행되는 경우를 예시한다.

[324] (3) Beamformee 1은 NDP에 포함된 트레이닝 필드(training field)를 기초로 하향링크 채널 상태 정보를 획득하여, Beamformer에게 전송할 피드백 정보를 생성한다.

[325] Beamformee 1은 NDP 프레임을 수신 후 SIFS 이후에 피드백 정보를 포함한 VHT 압축된 빔포밍(VHT Compressed Beamforming) 프레임을 Beamformer에게 전송한다.

[326] VHT Compressed Beamforming 프레임은 시공간 스트림(space-time stream)에 대한 SNR 값, 서브캐리어(subcarrier)에 대한 압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)에 대한 정보 등이 포함될 수 있다. VHT Compressed Beamforming 프레임에 대한 보다 상세한 설명은 후술한다.

[327] (4) Beamformer는 Beamformee 1으로부터 VHT Compressed Beamforming 프레임 수신 후, SIFS 이후에 Beamformee 2로부터 채널 정보를 얻기 위해 빔포밍 보고

폴(Beamforming Report Poll) 프레임을 Beamformee 2에게 전송한다.

[328] Beamforming Report Poll 프레임은 NDP 프레임과 동일한 역할을 수행하는 프레임으로서, Beamformee 2는 전송되는 Beamforming Report Poll 프레임을 기초로 채널 상태를 측정할 수 있다.

[329] Beamforming report poll frame 프레임에 대한 보다 상세한 설명은 후술한다.

[330] (5) Beamforming Report Poll 프레임을 수신한 Beamformee 2는 SIFS 이후에 피드백 정보를 포함한 VHT Compressed Beamforming 프레임을 Beamformer에게 전송한다.

[331] (6) Beamformer는 Beamformee 2로부터 VHT Compressed Beamforming 프레임 수신 후, SIFS 이후에 Beamformee 3로부터 채널 정보를 얻기 위해 Beamforming Report Poll 프레임을 Beamformee 3에게 전송한다.

[332] (7) Beamforming Report Poll 프레임을 수신한 Beamformee 3은 SIFS 이후에 피드백 정보를 포함한 VHT Compressed Beamforming 프레임을 Beamformer에게 전송한다.

[333] 이하, 앞서 설명한 채널 사운딩 절차에서 사용되는 프레임에 대하여 살펴본다.

[334] 도 12는 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT NDPA 프레임을 예시하는 도면이다.

[335] 도 12를 참조하면, VHT NDPA 프레임은 프레임 제어(Frame Control) 필드, 지속 시간(Duration) 필드, RA(Receiving Address) 필드, TA(Transmitting Address) 필드, 사운딩 다이얼로그 토큰(Sounding Dialog Token) 필드, STA 정보 1(STA Info 1) 필드 내지 STA 정보 n(STA Info n) 필드 및 FCS로 구성될 수 있다.

[336] RA 필드 값은 VHT NDPA 프레임을 수신하는 수신자 주소(receiver address) 또는 STA 주소를 나타낸다.

[337] VHT NDPA 프레임이 하나의 STA Info 필드를 포함하는 경우, RA 필드 값은 STA Info 필드 내 AID에 의해 식별되는 STA의 주소를 가진다. 예를 들어, SU-MIMO 채널 사운딩을 위하여 하나의 대상 STA으로 VHT NDPA 프레임을 전송하는 경우, AP는 VHT NDPA 프레임을 대상 STA에게 유니캐스트(unicast)로 전송한다.

[338] 반면, VHT NDPA 프레임이 하나 이상의 STA Info 필드를 포함하는 경우, RA 필드 값은 브로드캐스트 주소(broadcast address)를 가진다. 예를 들어, MU-MIMO 채널 사운딩을 위하여 적어도 하나 이상의 대상 STA으로 VHT NDPA 프레임을 전송하는 경우, AP는 VHT NDPA 프레임을 브로드캐스팅한다.

[339] TA 필드 값은 VHT NDPA 프레임을 전송하는 송신자 주소(transmitter address) 또는 전송하는 STA의 주소 또는 TA를 시그널링하는 대역폭을 나타낸다.

[340] Sounding Dialog Token 필드는 사운딩 시퀀스(Sounding Sequence) 필드로 불릴 수도 있다. Sounding Dialog Token 필드 내 사운딩 다이얼로그 토큰 번호(Sounding Dialog Token Number) 서브필드는 VHT NDPA 프레임을 식별하기 위하여 Beamformer에 의해 선택된 값을 포함한다.

[341]

[342] *VHT NDPA 프레임은 적어도 하나의 STA Info 필드를 포함한다. 즉, VHT NDPA 프레임은 사운딩 대상 STA에 대한 정보를 포함하는 STA Info 필드를 포함한다. STA Info 필드는 사운딩 대상 STA 마다 하나씩 포함될 수 있다.

[343] 각 STA Info 필드는 AID12 서브필드, 피드백 타입(Feedback Type) 서브필드 및 Nc 인덱스(Nc Index) 서브필드로 구성될 수 있다.

[344] 표 5는 VHT NDPA 프레임에 포함되는 STA Info 필드의 서브필드를 나타낸다.

[345] [표5]

서브필드	실명(description)
AID12	사운딩 피드백 대상이 되는 STA의 AID를 포함함 대상 STA이 AP이거나 메쉬(mesh) STA이거나 IBSS 멤버인 STA인 경우, AID12 서브필드 값은 '0'로 설정함
Feedback Type	사운딩 대상 STA에 대한 피드백 요청 타입을 지시함 SU-MIMO인 경우 '0' MU-MIMO인 경우 '1'
Nc Index	Feedback Type 서브필드가 MU-MIMO를 지시하는 경우, 압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)의 열(column) 개수(Nc)에서 1을 차감한 값을 지시함 Nc=1 경우, '0', Nc=2 경우, '1', ... Nc=8 경우, '7' SU-MIMO인 경우, 예비 서브필드로 설정됨

[346] 앞서 설명한 각 필드들에 포함되는 정보들은 IEEE 802.11 시스템의 정의를 따를 수 있다. 또한, 앞서 설명한 각 필드들은 MAC 프레임에 포함될 수 있는 필드들의 예시에 해당하며, 다른 필드로 대체되거나, 추가적인 필드가 더 포함될 수 있다.

[347] 도 13은 본 발명이 적용될 수 있는 무선 통신 시스템에서 NDP PPDU을 예시하는 도면이다.

[348] 도 13을 참조하면, NDP은 앞서 도 4와 같은 VHT PPDU 포맷에서 데이터 필드가 생략된 포맷을 가질 수 있다. NDP은 특정 프리코딩 행렬(precoding matrix)를 기반으로 프리코딩(precoding)되어 사운딩 대상 STA으로 전송될 수 있다.

[349] NDP의 L-SIG 필드에서 데이터 필드에 포함된 PSDU 길이를 지시하는 길이 필드는 '0'으로 설정된다.

[350] NDP의 VHT-SIG-A 필드에서 NDP 전송을 위해 사용된 전송 기법이 MU-MIMO 인지 또는 SU-MIMO 인지 지시하는 Group ID 필드는 SU-MIMO 전송을 지시하는 값으로 설정된다.

[351] NDP의 VHT-SIG-B 필드의 데이터 비트는 대역폭 별로 고정된 비트 패턴(bit pattern)으로 설정된다.

[352] 사운딩 대상 STA은 NDP를 수신하면, NDP의 VHT-LTF 필드를 기반으로 채널을 추정하고 채널 상태 정보를 획득한다.

[353] 도 14는 본 발명이 적용될 수 있는 무선 통신 시스템에서 VHT 압축된 빔포밍(VHT compressed beamforming) 프레임 포맷을 예시하는 도면이다.

[354] 도 14를 참조하면, VHT compressed beamforming 프레임은 VHT 기능을 지원하기 위한 VHT 동작(VHT Action) 프레임으로서, Frame Body에 Action 필드를 포함한다. Action 필드는 MAC 프레임의 Frame Body에 포함되어 확장된 관리 동작들을 명시하기 위한 메커니즘을 제공한다.

[355] Action 필드는 카테고리(Category) 필드, VHT 동작(VHT Action) 필드, VHT MIMO 제어(VHT MIMO Control) 필드, VHT 압축된 빔포밍 보고(VHT Compressed Beamforming Report) 필드 및 MU 전용 빔포밍 보고(MU Exclusive Beamforming Report) 필드로 구성된다.

[356] Category 필드는 VHT 카테고리(즉, VHT Action 프레임)를 지시하는 값으로 설정되고, VHT Action 필드는 VHT Compressed Beamforming 프레임을 지시하는 값으로 설정된다.

[357] VHT MIMO Control 필드는 빔포밍 피드백과 관련된 제어 정보를 피드백하기 위하여 사용된다. VHT MIMO Control 필드는 VHT Compressed Beamforming 프레임에 항상 존재할 수 있다.

[358] VHT Compressed Beamforming Report 필드는 데이터를 전송하는데 사용되는 시공간 스트림(space-time stream)에 대한 SNR 정보가 포함된 빔포밍 매트릭에 대한 정보를 피드백하기 위하여 사용된다.

[359] MU Exclusive Beamforming Report 필드는 MU-MIMO 전송을 수행하는 경우 공간적 스트림(spatial stream)에 대한 SNR 정보를 피드백하기 위하여 사용된다.

[360] VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드의 존재 여부 및 내용(content)은 VHT MIMO Control 필드의 피드백 타입(Feedback Type) 서브필드, 잔여 피드백 세그먼트(Remaining Feedback Segments) 서브필드, 최초 피드백 세그먼트(First Feedback Segment) 서브필드의 값에 따라 결정될 수 있다.

[361] 이하, VHT MIMO Control 필드, VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드에 대하여 보다 구체적으로 살펴본다.

[362] 1) VHT MIMO Control 필드는 Nc 인덱스(Nc Index) 서브필드, Nr 인덱스(Nr Index) 서브필드, 채널 폭(Channel Width) 서브필드, 그룹핑(Grouping) 서브필드, 코드북 정보(Codebook Information) 서브필드, 피드백 타입(Feedback Type) 서브필드, 잔여 피드백 세그먼트(Remaining Feedback Segments) 서브필드, 최초 피드백 세그먼트(First Feedback Segment) 서브필드, 예비(reserved) 서브필드 및 사운딩 다이얼로그 토큰 번호(Sounding Dialog Token Number) 서브필드로 구성된다.

[363] 표 6은 VHT MIMO Control 필드의 서브필드를 나타낸다.

[364] [표6]

서브필드	비트수	설명(description)
Nc Index	3	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)의 열(column) 개수(Nc)에서 1을 차감한 값을 지시함. Nc=1 경우, '0', Nc=2 경우, '1', ... Nc=8 경우, '7'
Nr Index	3	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)의 행(row) 개수(Nr)에서 1을 차감한 값을 지시함. Nr=1 경우, '0', Nr=2 경우, '1', ... Nr=8 경우, '7'
Channel Width	2	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)을 생성하기 위하여 측정되는 채널의 대역폭을 지시함. 20 MHz 경우, '0', 40 MHz 경우,'1', 80 MHz 경우, '2',160 MHz 또는 80+80 MHz 경우, '3'
Grouping	2	압축된 빔포밍 피드백 행렬(compressed beamforming feedback matrix)에 사용된 서브캐리어 그룹핑(Ng)을 지시함. Ng=1(그룹핑 없음) 경우, '0', Ng=2 경우, '1', Ng=4 경우, '2', '3' 값은 예비 값으로 설정됨
Codebook Information	1	코드북 엔트리(entries)의 사이즈를 지시함 피드백 타입이 SU-MIMO 경우, bΨ=2, bΦ=4 경우, '0', bΨ=4, bΦ=6 경우, '1' 피드백 타입이 MU-MIMO 경우, bΨ=5, bΦ=7 경우, '0', bΨ=7, bΦ=9 경우, '1' 여기서, bΨ 및 bΦ는 양자화된 비트 수를 의미함
Feedback Type	1	피드백 타입을 지시함 SU-MIMO 경우, '0', MU-MIMO 경우, '1'
Remaining Feedback Segments	3	관련된 VHT Compressed Beamforming 프레임에 대한 잔여 피드백 세그먼트의 개수를 지시함. 분할된 보고(segmented report)의 마지막 피드백 세그먼트 또는 분할되지 않은 보고(unsegmented report)의 세그먼트인 경우, '0'으로 설정됨. 분할된 보고(segmented report)의 최초 그리고 마지막 피드백 세그먼트가 아닌 경우, '1'에서 '6'사이의 값으로 설정됨. 분할된 보고(segmented report)의 마지막 세그먼트가 아닌 피드백 세그먼트인 경우, '1'에서 '6'사이의 값으로 설정됨 재전송 피드백 세그먼트의 경우, 필드는 본래 전송(original transmission)의 관련된 세그먼트와 동일한 값으로 설정됨
First Feedback Segment	1	분할된 보고(segmented report)의 최초 피드백 세그먼트 또는 분할되지 않은 보고(unsegmented report)의 피드백 세그먼트인 경우, '1'로 설정됨 최초 피드백 세그먼트가 아닌 경우 또는 VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드가 프레임에 존재하지 않는 경우, '0'으로 설정됨 재전송 피드백 세그먼트의 경우, 필드는 본래 전송(original transmission)의 관련된 세그먼트와 동일한 값으로 설정됨
Sounding Dialog Token Number	6	NDPA 프레임의 사운딩 다이얼로그 토큰(Sounding Dialog Token) 값으로 설정됨

[365] VHT Compressed Beamforming 프레임이 VHT Compressed Beamforming Report 필드의 전부 또는 일부를 전달하지 않는 경우, Nc Index 서브필드, Channel Width 서브필드, Grouping 서브필드, Codebook Information 서브필드, Feedback Type 서브필드 및 Sounding Dialog Token Number 서브필드는 예비 필드로 설정되고,

First Feedback Segment 서브필드는 '0'로 설정되며, Remaining Feedback Segments 서브필드는 '7'로 설정된다.

[366] Sounding Dialog Token Number 서브필드는 사운딩 시퀀스 번호(Sounding Sequence Number) 서브필드로 불릴 수도 있다.

[367] 2) VHT compressed beamforming report 필드는 전송 Beamformer가 스티어링 행렬(steering matix) 'Q'를 결정하기 위해 사용하는 압축된 빔포밍 피드백 행렬(comporessed beamforming feedback matrix) 'V'를 각도의 형태로 나타낸 명시적인 피드백 정보를 전달하기 위하여 사용된다.

[368] 표 7은 VHT compressed beamforming report 필드의 서브필드를 나타낸다.

[369] [표7]

서브필드	비트수	설명(description)
시공간 스트림 1의 평균 SNR (Average SNR of Space-Time Stream 1)	8	Beamformee에서 시공간 스트림 1에 대한 모든 서브캐리어들 상에서의 평균 SNR
...	...	...
시공간 스트림 Nc의 평균 SNR (Average SNR of Space-Time Stream Nc)	8	Beamformee에서 시공간 스트림 Nc에 대한 모든 서브캐리어들 상에서의 평균 SNR
서브캐리어 k=scidx(0)에 대한 압축된 빔포밍 피드백 행렬 V (Compressed Beamforming Feedback Matrix V for subcarrier k=scidx(0))	Na*(bψ+bΦ)/2	해당 서브캐리어에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix)의 각도의 순서
서브캐리어 k=scidx(1)에 대한 압축된 빔포밍 피드백 행렬 V (Compressed Beamforming Feedback Matrix V for subcarrier k=scidx(1))	Na*(bψ+bΦ)/2	해당 서브캐리어에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix)의 각도의 순서
...	...	...
서브캐리어 k=scidx(Ns-1)에 대한 압축된 빔포밍 피드백 행렬 V (Compressed Beamforming Feedback Matrix V for subcarrier k=scidx(Ns-1))	Na*(bψ+bΦ)/2	해당 서브캐리어에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix)의 각도의 순서

[370] 표 7을 참조하면, VHT compressed beamforming report 필드에서는 시공간 스트림 각각에 대한 평균 SNR과 각각의 서브캐리어에 대한 압축된 빔포밍 피드백 행렬(Compressed Beamforming Feedback Matrix) 'V'가 포함될 수 있다. 압축된 빔포밍 피드백 행렬은 채널 상황에 대한 정보를 포함한 행렬로서 MIMO를 사용한 전송 방법에서 채널 행렬(즉, 스티어링 행렬(steering matix) 'Q')을 산출하기 위하여 사용된다.

[371] scidx()는 Compressed Beamforming Feedback Matrix 서브필드가 전송되는

서브캐리어를 의미한다. Na는 Nr × Nc 값에 의해 고정된다(예를 들어, Nr × Nc= 2 × 1인 경우, Φ11, Ψ21, ...).

[372] Ns는 Beamformer에게 압축된 빔포밍 피드백 행렬이 전송되는 서브캐리어의 개수를 의미한다. Beamformee는 그룹핑 방법을 사용하여 압축된 빔포밍 피드백 행렬이 전송되는 Ns의 수를 줄일 수 있다. 예를 들어, 복수의 서브캐리어를 하나의 그룹으로 묶고 해당 그룹 별로 압축된 빔포밍 피드백 행렬을 전송함으로써 피드백되는 압축된 빔포밍 피드백 행렬의 개수를 줄일 수 있다. Ns는 VHT MIMO Control 필드에 포함된 Channel Width 서브필드와 Grouping 서브필드로부터 산출될 수 있다.

[373] 표 8은 시공간 스트림의 평균 SNR(Average SNR of Space-Time) Stream 서브필드를 예시한다.

[374] [표8]

Average SNR of Space-Time i 서브필드	AvgSNR_i
-128	≤ -10 dB
-127	-9.75 dB
-126	-9.5 dB
...	...
+126	53.5 dB
+127	≥ 53.75 dB

[375] 표 8을 참조하면, 시공간 스트림 각각에 대한 평균 SNR은 채널에 포함되는 서브캐리어 전체에 대한 평균 SNR 값을 산출하여 그 값을 -128~+128 범위로 매핑하여 산출된다.

[376] 3) MU Exclusive Beamforming Report 필드는 델타() SNR의 형태로 나타낸 명시적인 피드백 정보를 전달하기 위하여 사용된다. VHT Compressed Beamforming Report 필드 및 MU Exclusive Beamforming Report 필드 내 정보는 MU Beamformer가 스티어링 행렬(steering matix) 'Q'를 결정하기 위하여 사용될 수 있다.

[377] 표 9는 VHT compressed beamforming 프레임에 포함되는 MU Exclusive Beamforming Report 필드의 서브필드를 나타낸다.

[378] [표9]

서브필드	비트수	설명(description)
시공간 스트림 1, 서브캐리어 k=sscidx(0)에 대한 델타 SNR (Delta SNR for space-time stream 1 for subcarrier k=sscidx(0))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 Nc, 서브캐리어 k=sscidx(0)에 대한 델타 SNR (Delta SNR for space-time stream Nc for subcarrier k=sscidx(0))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 1, 서브캐리어 k=sscidx(1)에 대한 델타 SNR (Delta SNR for space-time stream 1 for subcarrier k=sscidx(1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 Nc, 서브캐리어 k=sscidx(1)에 대한 델타 SNR (Delta SNR for space-time stream Nc for subcarrier k=sscidx(1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 1, 서브캐리어 k=sscidx(Ns'-1)에 대한 델타 SNR (Delta SNR for space-time stream 1 for subcarrier k=sscidx(Ns'-1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차
...	...	...
시공간 스트림 Nc, 서브캐리어 k=sscidx(Ns'-1)에 대한 델타 SNR (Delta SNR for space-time stream Nc for subcarrier k=sscidx(Ns'-1))	4	해당 서브캐리어에 대한 SNR과 해당 시공간 스트림의 전체 서브캐리어에 대한 평균 SNR 간의 편차

[379] 표 9를 참조하면, MU Exclusive Beamforming Report 필드에서는 서브캐리어 별로 시공간 스트림 당 SNR이 포함될 수 있다.

[380] 각 Delta SNR 서브필드는 -8dB에서 7dB 사이에서 1dB씩 증가되는 값을 가진다.

[381] scidx()는 Delta SNR 서브필드가 전송되는 서브캐리어(들)을 의미하고, Ns는 Beamformer로 Delta SNR 서브필드가 전송되는 서브캐리어의 수를 의미한다.

[382] 도 15는 본 발명이 적용될 수 있는 무선 통신 시스템에서 빔포밍 보고 폴(Beamforming Report Poll) 프레임 포맷을 예시하는 도면이다.

[383] 도 15를 참조하면, Beamforming Report Poll 프레임은 프레임 제어(Frame Control) 필드, 지속 시간(Duration) 필드, RA(Receiving Address) 필드, TA(Transmitting Address) 필드, 피드백 세그먼트 재전송 비트맵(Feedback

Segment Retransmission Bitmap) 필드 및 FCS를 포함하여 구성된다.

[384] RA 필드 값은 대상 수신자(intended recipient)의 주소를 나타낸다.

[385] TA 필드 값은 Beamforming Report Poll 프레임을 전송하는 STA의 주소 또는 TA를 시그널링하는 대역폭을 나타낸다.

[386] Feedback Segment Retransmission Bitmap 필드는 VHT 압축된 빔포밍 보고(VHT Compressed Beamforming report)에서 요청되는 피드백 세그먼트를 지시한다.

[387] Feedback Segment Retransmission Bitmap 필드 값에서 위치 n의 비트가 '1'이면(LSB 경우 n=0, MSB 경우 n=7), VHT compressed beamforming 프레임의 VHT MIMO Control 필드 내 Remaining Feedback Segments 서브필드에서 n과 상응하는 피드백 세그먼트가 요청된다. 반면, 위치 n의 비트가 '0'이면, VHT MIMO Control 필드 내 Remaining Feedback Segments 서브필드에서 n과 상응하는 피드백 세그먼트가 요청되지 않는다.

[388]

[389] **그룹 식별자(Group ID)**

[390] VHT WLAN 시스템은 보다 높은 처리율을 위하여 MU-MIMO 전송 방법을 지원하므로, AP는 MIMO 페어링된 적어도 하나 이상의 STA에게 동시에 데이터 프레임을 전송할 수 있다. AP는 자신과 결합(association)되어 있는 복수의 STA들 중 적어도 하나 이상의 STA을 포함하는 STA 그룹에게 데이터를 동시에 전송할 수 있다. 예를 들어, 페어링된 STA의 수는 최대 4개일 수 있으며, 최대 공간 스트림 수가 8개일 때 각 STA에는 최대 4개의 공간 스트림이 할당될 수 있다.

[391] 또한, TDLS(Tunneled Direct Link Setup) 이나 DLS(Direct Link Setup), 메쉬 네트워크(mesh network)를 지원하는 WLAN 시스템에서는 데이터를 전송하고자 하는 STA이 MU-MIMO 전송기법을 사용하여 PPDU를 복수의 STA들에게 전송할 수 있다.

[392] 이하, AP가 복수의 STA에게 MU-MIMO 전송 기법에 따라 PPDU를 전송하는 것을 예로 들어 설명하도록 한다.

[393] AP는 페어링 된 전송 대상 STA 그룹에 속하는 STA에게 서로 다른 공간 스트림(spatial stream)을 통하여 PPDU를 동시에 전송한다. 상술한 바와 같이, VHT PPDU 포맷의 VHT-SIG A 필드는 그룹 ID 정보 및 시공간 스트림 정보를 포함하여 각 STA은 자신에게 전송되는 PPDU인지 확인할 수 있다. 이때, 전송 대상 STA 그룹의 특정 STA에게는 공간 스트림이 할당되지 않아 데이터가 전송되지 않을 수도 있다.

[394] 하나 이상의 Group ID에 상응하는 사용자 위치(user position)를 할당(assignment)하거나 또는 변경(change)하기 위하여 그룹 ID 관리 (Group ID Management) 프레임이 이용된다. 즉, AP는 MU-MIMO 전송을 수행하기 전에 Group ID Management 프레임을 통해 특정 그룹 ID와 연결된 STA들을 알려줄 수 있다.

[395] 도 16은 본 발명이 적용될 수 있는 무선 통신 시스템에서 Group ID Management

프레임을 예시하는 도면이다.

[396] 도 16을 참조하면, Group ID Management 프레임은 VHT 기능을 지원하기 위한 VHT 동작(VHT Action) 프레임으로서, Frame Body에 Action 필드를 포함한다. Action 필드는 MAC 프레임의 Frame Body에 포함되어 확장된 관리 동작들을 명시하기 위한 메커니즘을 제공한다.

[397] Action 필드는 카테고리(Category) 필드, VHT 동작(VHT Action) 필드, 멤버십 상태 어레이(Membership Status Array) 필드 및 사용자 위치 어레이(User Position Array) 필드로 구성된다.

[398] Category 필드는 VHT 카테고리(즉, VHT Action 프레임)를 지시하는 값으로 설정되고, VHT Action 필드는 Group ID Management 프레임을 지시하는 값으로 설정된다.

[399] Membership Status Array 필드는 각 그룹 별로 1 비트의 멤버십 상태(Membership Status) 서브필드로 구성된다. Membership Status 서브필드가 '0'으로 설정되면 STA이 해당 그룹의 멤버가 아님을 나타내고, '1'로 설정되면 STA이 해당 그룹의 멤버임을 나타낸다. STA은 Membership Status Array 필드 내 하나 이상의 Membership Status 서브필드가 '1'로 설정됨으로써 하나 이상의 그룹이 할당될 수 있다.

[400]

[401] *STA은 자신이 속한 각 그룹에서 하나의 사용자 위치(user position)를 가질 수 있다.

[402] User Position Array 필드는 각 그룹 별로 2 비트의 사용자 위치(User Position) 서브필드로 구성된다. 자신이 속한 그룹 내에서 STA의 사용자 위치(user position)는 User Position Array 필드 내 User Position 서브필드에 의해 지시된다. AP는 각 그룹에서 동일한 사용자 위치(user position)을 서로 다른 STA에게 할당할 수 있다.

[403] AP는 dot11VHTOptionImplemented 파라미터가 'true'인 경우에만, Group ID Management 프레임을 전송할 수 있다. Group ID Management 프레임은 VHT 능력 요소(VHT Capabilities element) 필드 내 MU Beamformee Capable 필드가 '1'로 설정된 VHT STA에게만 전송된다. Group ID Management 프레임은 각 STA에게 어드레스된(addressed) 프레임으로 전송된다.

[404] STA은 자신의 MAC 주소와 매칭되는 RA 필드를 가지는 Group ID Management 프레임을 수신한다. STA은 수신한 Group ID Management 프레임의 내용에 기반하여 PHYCONFIG_VECTOR 파라미터인 GROUP_ID_MANAGEMENT를 업데이트 한다.

[405] STA으로 Group ID Management 프레임의 전송 및 그에 대한 STA으로부터 ACK의 전송은 STA에게 MU PPDU를 전송하기 전에 완료된다.

[406] MU PPDU는 가장 최근에 STA에게 전송되고 ACK이 수신된 Group ID Management 프레임의 내용에 기반하여 STA에게 전송된다.

[407]

[408] **하향링크 MU-MIMO 프레임(DL MU-MIMO Frame)**

[409] 도 17은 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[410] 도 17을 참조하면, PPDU은 프리앰블 및 데이터 필드(Data field)를 포함하여 구성된다. 데이터 필드는 서비스 필드(SERVICE field), 스크램블링된 PSDU(scrambled PSDU) 필드, 테일 비트(Tail bits), 패딩 비트(padding bits)를 포함할 수 있다.

[411] AP는 MPDU를 병합(aggregation)하여 A-MPDU(aggregated MPDU) 포맷으로 데이터 프레임을 전송할 수 있다. 이 경우, 스크램블링된 PSDU(scrambled PSDU) 필드는 A-MPDU로 구성될 수 있다.

[412] A-MPDU는 하나 이상의 A-MPDU 서브프레임(A-MPDU subframe)의 배열(sequence)로 구성된다.

[413] VHT PPDU의 경우, 각 A-MPDU 서브프레임의 길이가 4 옥텟의 배수이므로, A-MPDU는 PSDU의 마지막 옥텟에 A-MPDU를 맞추기 위하여 마지막 A-MPDU 서브프레임(A-MPDU subframe) 이후에 0 내지 3 옥텟의 EOF(end-of-frame) 패드(pad)를 포함할 수 있다.

[414] A-MPDU 서브프레임은 MPDU 딜리미터(delimiter)로 구성되고, 선택적으로 MPDU가 MPDU 딜리미터(Delimiter) 이후에 포함될 수 있다. 또한, 하나의 A-MPDU 내 마지막 A-MPDU 서브프레임을 제외하고, 각 A-MPDU 서브프레임의 길이를 4 옥텟의 배수로 만들기 위하여 패드 옥텟이 MPDU 이후에 부착된다.

[415] MPDU Delimiter는 예비(Reserved) 필드, MPDU 길이(MPDU Length) 필드, CRC (cyclic redundancy check) 필드, 딜리미터 시그니처(Delimiter Signature) 필드로 구성된다.

[416] VHT PPDU의 경우, MPDU Delimiter는 EOF(end-of-frame) 필드를 더 포함할 수 있다. MPDU Length 필드가 0이고 패딩하기 위하여 사용되는 A-MPDU 서브프레임, 또는 A-MPDU가 하나의 MPDU만으로 구성되는 경우 해당 MPDU가 실어지는 A-MPDU 서브프레임의 경우, EOF 필드는 '1'로 셋팅된다. 그렇지 않은 경우 '0'으로 셋팅된다.

[417] MPDU Length 필드는 MPDU의 길이에 대한 정보를 포함한다.

[418] 해당 A-MPDU 서브프레임에 MPDU가 존재하지 않는 경우 '0'으로 셋팅된다. MPDU Length 필드가 '0' 값을 가지는 A-MPDU 서브프레임은 VHT PPDU 내 가용한 옥텟에 A-MPDU를 맞추기 위해 해당 A-MPDU에 패딩할 때 사용된다.

[419] CRC 필드는 에러 체크를 위한 CRC 정보, Delimiter Signature 필드는 MPDU 딜리미터를 검색하기 위하여 사용되는 패턴 정보를 포함한다.

[420] 그리고, MPDU는 MAC 헤더(MAC Header), 프레임 몸체(Frame Body) 및 프레임 체크 시퀀스(FCS)로 구성된다.

[421] 도 18은 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 다중 사용자(multi-user) PPDU 포맷을 예시하는 도면이다.

[422] 도 18은 해당 PPDU를 수신하는 STA의 개수가 3개이고, 각 STA에 할당되는 공간적 스트림(spatial stream)의 개수가 1이라고 가정하나 AP에 페어링된 STA의 수, 각 STA에 할당되는 공간적 스트림의 수는 이에 한정되지 않는다.

[423] 도 18을 참조하면, MU PPDU는 L-TFs 필드(L-STF 필드 및 L-LTF 필드), L-SIG 필드, VHT-SIG-A 필드, VHT-TFs 필드(VHT-STF 필드 및 VHT-LTF 필드), VHT-SIG-B 필드, Service 필드, 하나 이상의 PSDU, padding 필드 및 Tail 비트를 포함하여 구성된다. L-TFs 필드, L-SIG 필드, VHT-SIG-A 필드, VHT-TFs 필드, VHT-SIG-B 필드는 앞서 도 4의 예시와 동일하므로 이하 상세한 설명은 생략한다.

[424] PPDU 지속기간을 지시하기 위한 정보가 L-SIG 필드에 포함될 수 있다. PPDU 내에서, L-SIG 필드에 의해 지시된 PPDU 지속기간은 VHT-SIG-A 필드가 할당된 심볼, VHT-TFs 필드가 할당된 심볼, VHT-SIG-B 필드가 할당된 필드, Service 필드를 구성하는 비트, PSDU를 구성하는 비트, padding 필드를 구성하는 비트 및 Tail 필드를 구성하는 비트를 포함한다. PPDU를 수신하는 STA은 L-SIG 필드에 포함된 PPDU 지속시간을 지시하는 정보를 통해 PPDU의 지속기간에 대한 정보를 획득할 수 있다.

[425] 상술한 바와 같이, VHT-SIG-A를 통해 Group ID 정보, 각 사용자 당 시공간 스트림 수 정보가 전송되고, VHT-SIG-B를 통해 코딩(coding) 방법 및 MCS 정보 등이 전송된다. 따라서, Beamformee들은 VHT-SIG-A와 VHT-SIG-B를 확인하고, 자신이 속한 MU MIMO 프레임인지 여부를 알 수 있다. 따라서, 해당 Group ID의 멤버 STA이 아니거나 해당 Group ID의 멤버이나 할당된 스트림 수가 '0'인 STA은 VHT-SIG-A 필드 이후부터 PPDU 끝까지 물리 계층의 수신을 중단하도록 설정함으로써 전력 소모를 절감할 수 있다.

[426] Group ID는 사전에 Beamformer가 전송하는 Group ID Management 프레임을 수신함으로써, Beamformee가 어떤 MU 그룹에 속하는지, 자신이 속하는 그룹 중에서 몇 번째 사용자인지, 즉 어떤 스트림을 통해 PPDU를 수신하는지 알 수 있다.

[427] 802.11ac을 기반으로 하는 VHT MU PPDU 내 전송되는 모든 MPDU는 A-MPDU에 포함된다. 도 18의 데이터 필드에서 각 VHT A-MPDU는 서로 다른 스트림으로 전송될 수 있다.

[428] 도 18에서 각 STA에 전송되는 데이터의 크기가 상이할 수 있으므로, 각각의 A-MPDU는 서로 다른 비트 크기를 가질 수 있다.

[429] 이 경우, Beamformer가 전송하는 복수의 데이터 프레임의 전송이 종료되는 시간은 최대 구간 전송 데이터 프레임의 전송이 종료되는 시간과 동일하도록 널 패딩(null padding)을 수행할 수 있다. 최대 구간 전송 데이터 프레임은 Beamformer에 의해 유효 하향링크 데이터가 가장 오랜 구간 동안 전송되는

프레임일 수 있다. 유효 하향링크 데이터는 널 패딩되지 않은 하향링크 데이터일 수 있다. 예를 들어, 유효 하향링크 데이터는 A-MPDU에 포함되어 전송될 수 있다. 복수의 데이터 프레임 중 최대 구간 전송 데이터 프레임을 제외한 나머지 데이터 프레임은 널 패딩을 수행할 수 있다.

[430] 널 패딩을 위해 Beamformer는 A-MPDU 프레임 내 복수의 A-MPDU 서브프레임에서 시간적으로 후순위에 위치한 하나 이상의 A-MPDU 서브프레임을 MPDU delimiter 필드만으로 인코딩하여 채울 수 있다. MPDU 길이가 0인 A-MPDU 서브프레임을 널 서브프레임(Null subframe)으로 지칭할 수 있다.

[431] 앞서 살펴본 바와 같이, 널 서브프레임은 MPDU Delimiter의 EOF 필드가 '1'로 셋팅된다. 따라서, 수신측 STA의 MAC 계층에서는 1로 셋팅된 EOF 필드를 감지하면, 물리 계층에 수신을 중단하도록 설정함으로써 전력 소모를 절감할 수 있다.

[432]

[433] **<u>블록 ACK(Block Ack) 절차</u>**

[434] 도 19는 본 발명이 적용될 수 있는 무선 통신 시스템에서 하향링크 MU-MIMO 전송 과정을 예시하는 도면이다.

[435] 802.11ac에서는 MU-MIMO는 AP로부터 클라이언트(즉, non-AP STA)으로 향하는 하향링크에서 정의된다. 이때, 다중 사용자 프레임(multi-user frame)은 다중 수신자에게 동시에 전송되나, 수신 확인(acknowledgement)은 상향링크에서 개별적으로 전송되어야 한다.

[436] 802.11ac을 기반으로 하는 VHT MU PPDU 내 전송되는 모든 MPDU는 A-MPDU에 포함되므로, VHT MU PPDU에 대한 즉각적인 응답이 아닌 VHT MU PPDU 내 A-MPDU에 대한 응답은 AP에 의한 블록 ACK 요청(BAR: Block Ack Request) 프레임에 대한 응답으로 전송된다.

[437] 먼저, AP는 모든 수신자(즉, STA 1, STA 2, STA 3)에게 VHT MU PPDU(즉, 프리앰블 및 데이터)를 전송한다. VHT MU PPDU는 각 STA에 전송되는 VHT A-MPDU를 포함한다.

[438] AP로부터 VHT MU PPDU를 수신한 STA 1은 SIFS 이후에 블록 ACK(BA: Block Acknowledgement) 프레임을 AP로 전송한다. BA 프레임에 대하여 보다 상세한 설명은 후술한다.

[439]

[440] *STA 1으로부터 BA를 수신한 AP는 SIFS 이후에 BAR(block acknowledgement request) 프레임을 다음 STA 2로 전송하고, STA 2는 SIFS 이후에 BA 프레임을 AP로 전송한다. STA 2로부터 BA 프레임을 수신한 AP는 SIFS 이후에 BAR 프레임을 STA 3로 전송하고, STA 3은 SIFS 이후에 BA 프레임을 AP로 전송한다.

[441] 이러한 과정이 모든 STA들에 대해 수행되면, AP는 다음 MU PPDU를 모든 STA에게 전송한다.

[442]

[443] **ACK(Acknowledgement)/블록 ACK(Block ACK) 프레임**

[444] 일반적으로 MPDU의 응답으로 ACK 프레임을 사용하고, A-MPDU의 응답으로 블록 ACK 프레임을 사용한다.

[445] 도 20은 본 발명이 적용될 수 있는 무선 통신 시스템에서 ACK 프레임을 예시하는 도면이다.

[446] 도 20을 참조하면, ACK 프레임은 프레임 제어(Frame Control) 필드, 지속기간(Duration) 필드, RA 필드 및 FCS로 구성된다.

[447] RA 필드는 직전에 수신된 데이터(Data) 프레임, 관리(Management) 프레임, 블록 ACK 요청(Block Ack Request) 프레임, 블록 ACK(Block Ack) 프레임 또는 PS-Poll 프레임의 제2 주소(Address 2) 필드의 값으로 설정된다.

[448] 비 QoS(non-QoS) STA에 의해 ACK 프레임이 전송되는 경우, 직전에 수신된 데이터(Data) 프레임, 관리(Management) 프레임의 프레임 제어(Frame Control) 필드 내 모어 프래그먼트(More Fragments) 서브필드가 '0'이면, 지속기간(duration) 값은 '0'으로 설정된다.

[449] 비 QoS(non-QoS) STA에 의해 전송되지 않는 ACK 프레임에서 지속기간(duration) 값은 직전에 수신된 데이터(Data) 프레임, 관리(Management) 프레임, 블록 ACK 요청(Block Ack Request) 프레임, 블록 ACK(Block Ack) 프레임 또는 PS-Poll 프레임의 Duration/ID 필드에서 ACK 프레임 전송을 위해 요구되는 시간 및 SIFS 구간을 차감한 값(ms)으로 설정된다. 계산된 지속기간(duration) 값이 정수 값이 아닌 경우, 반올림된다.

[450] 이하, 블록 ACK (요청) 프레임에 대하여 살펴본다.

[451] 도 21은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임을 예시하는 도면이다.

[452] 도 21을 참조하면, 블록 ACK 요청(BAR) 프레임은 프레임 제어(Frame Control) 필드, 지속기간/식별자(Duration/ID) 필드, 수신 주소(RA) 필드, 전송 주소(TA) 필드, BAR 제어(BAR control) 필드, BAR 정보(BAR Information) 필드 및 프레임 체크 시퀀스(FCS)로 구성된다.

[453] RA 필드는 BAR 프레임을 수신하는 STA의 주소로 설정될 수 있다.

[454] TA 필드는 BAR 프레임을 전송하는 STA의 주소로 설정될 수 있다.

[455] BAR control 필드는 BAR Ack 정책(BAR Ack Policy) 서브필드, 다중-TID(Multi-TID) 서브필드, 압축 비트맵(Compressed Bitmap) 서브필드, 예비(Reserved) 서브필드 및 TID 정보(TID_Info) 서브필드를 포함한다.

[456] 표 10은 BAR control 필드를 예시하는 표이다.

[457] [표10]

서브필드	비트	설명(description)
BAR Ack Policy	1	송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하는 경우, '0'로 설정됨. 송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하지 않는 경우, '1'로 설정됨
Multi-TID	1	Multi-TID 서브필드 및 Compressed Bitmap 서브필드 값에 따라 BAR 프레임의 타입을 지시함 00: 기본 BAR(Basic BAR) 01: 압축 BAR(Compressed BAR) 10: 예비 값 11: 다중 TID BAR(Multi-TID BAR)
Compressed Bitmap	1	
Reserved	9	
TID_Info	4	BAR 프레임의 타입에 따라 TID_Info 필드의 의미가 결정됨 Basic BAR 프레임, Compressed BAR 프레임의 경우, BA 프레임이 요청되는 TID를 포함함 Multi-TID BAR 프레임의 경우, TID의 개수를 포함함

[458] BAR Information 필드는 BAR 프레임의 타입에 따라 상이한 정보가 포함된다. 이에 대하여 도 22를 참조하여 설명한다.

[459] 도 22는 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK 요청(Block Ack Request) 프레임의 BAR 정보(BAR Information) 필드를 예시하는 도면이다.

[460] 도 22(a)는 Basic BAR 프레임 및 Compressed BAR 프레임의 BAR Information 필드를 예시하고, 도 22(b)는 Multi-TID BAR 프레임의 BAR Information 필드를 예시한다.

[461] 도 22(a)를 참조하면, Basic BAR 프레임 및 Compressed BAR 프레임의 경우, BAR Information 필드는 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드를 포함한다.

[462] 그리고, Block Ack Starting Sequence Control 서브필드는 조각 번호(Fragment Number) 서브필드, 시작 시퀀스 번호(Starting Sequence Number) 서브필드를 포함한다.

[463] Fragment Number 서브필드는 0으로 설정된다.

[464] Basic BAR 프레임의 경우, Starting Sequence Number 서브필드는 해당 BAR 프레임이 전송되는 첫 번째 MSDU의 시퀀스 번호를 포함한다. Compressed BAR 프레임의 경우, Starting Sequence Control 서브필드는 해당 BAR 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함한다.

[465]

[466] *도 22(b)를 참조하면, Multi-TID BAR 프레임의 경우, BAR Information 필드는 TID 별 정보(Per TID Info) 서브필드 및 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드가 하나 이상의 TID 별로 반복되어 구성된다.

[467] Per TID Info 서브필드는 예비(Reserved) 서브필드 및 TID 값(TID Value)

서브필드를 포함한다. TID Value 서브필드는 TID 값을 포함한다.

[468] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 및 Starting Sequence Number 서브필드를 포함한다. Fragment Number 서브필드는 0으로 설정된다. Starting Sequence Control 서브필드는 해당 BAR 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함한다.

[469] 도 23은 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임을 예시하는 도면이다.

[470] 도 23을 참조하면, 블록 ACK(BA) 프레임은 프레임 제어(Frame Control) 필드, 지속기간/식별자(Duration/ID) 필드, 수신 주소(RA) 필드, 전송 주소(TA) 필드, BA 제어(BA control) 필드, BA 정보(BA Information) 필드 및 프레임 체크 시퀀스(FCS)로 구성된다.

[471] RA 필드는 블록 ACK을 요청한 STA의 주소로 설정될 수 있다.

[472] TA 필드는 BA 프레임을 전송하는 STA의 주소로 설정될 수 있다.

[473] BA control 필드는 BA Ack 정책(BA Ack Policy) 서브필드, 다중-TID(Multi-TID) 서브필드, 압축 비트맵(Compressed Bitmap) 서브필드, 예비(Reserved) 서브필드 및 TID 정보(TID_Info) 서브필드를 포함한다.

[474] 표 11은 BA control 필드를 예시하는 표이다.

[475] [표11]

서브필드	비트	설명(description)
BA Ack Policy	1	송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하는 경우, '0'로 설정됨. 송신자가 데이터 전송에 대한 즉각적인 ACK을 요청하지 않는 경우, '1'로 설정됨
Multi-TID	1	Multi-TID 서브필드 및 Compressed Bitmap 서브필드 값에 따라 BA 프레임의 타입을 지시함 00: 기본 BA(Basic BA) 01: 압축 BA(Compressed BA) 10: 예비 값 11: 다중 TID BA(Multi-TID BA)
Compressed Bitmap	1	
Reserved	9	
TID_Info	4	BA 프레임의 타입에 따라 TID_Info 필드의 의미가 결정됨 Basic BA 프레임 및 Compressed BA 프레임의 경우, BA 프레임이 전송되는 TID를 포함함 Multi-TID BA 프레임의 경우, TID의 개수를 포함함

[476] BA Information 필드는 BA 프레임의 타입에 따라 상이한 정보가 포함된다. 이에 대하여 도 24를 참조하여 설명한다.

[477] 도 24는 본 발명이 적용될 수 있는 무선 통신 시스템에서 블록 ACK(Block Ack) 프레임의 BA 정보(BA Information) 필드를 예시하는 도면이다.

[478] 도 24(a)의 Basic BA 프레임의 BA Information 필드를 예시하고, 도 24(b)는

Compressed BA 프레임의 BA Information 필드를 예시하고, 도 24(c)는 Multi-TID BA 프레임의 BA Information 필드를 예시한다.

[479] 도 24(a)를 참조하면, Basic BA 프레임의 경우, BA Information 필드는 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드 및 블록 ACK 비트맵(Block Ack Bitmap) 서브필드를 포함한다.

[480] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 서브필드 및 Starting Sequence Number 서브필드를 포함한다.

[481] Fragment Number 서브필드는 0으로 설정된다.

[482] Starting Sequence Number 서브필드는 해당 BA 프레임이 전송되기 위한 첫 번째 MSDU의 시퀀스 번호를 포함하고, 직전에 수신한 Basic BAR 프레임과 동일한 값으로 설정된다.

[483] Block Ack Bitmap 서브필드는 128 옥텟의 길이로 구성되고, 최대 64개의 MSDU의 수신 상태를 지시하기 위하여 사용된다. Block Ack Bitmap 서브필드에서 '1' 값은 해당 비트 위치에 대응되는 MPDU가 성공적으로 수신되었음을 지시하고, '0' 값은 해당 비트 위치에 대응되는 MPDU가 성공적으로 수신되지 않았음을 지시한다.

[484] 도 24(b)를 참조하면, Compressed BA 프레임의 경우, BA Information 필드는 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드 및 블록 ACK 비트맵(Block Ack Bitmap) 서브필드를 포함한다.

[485] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 서브필드 및 Starting Sequence Number 서브필드를 포함한다.

[486] Fragment Number 서브필드는 0으로 설정된다.

[487] Starting Sequence Number 서브필드는 해당 BA 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함하고, 직전에 수신한 Basic BAR 프레임과 동일한 값으로 설정된다.

[488] Block Ack Bitmap 서브필드는 8 옥텟의 길이로 구성되고, 최대 64개의 MSDU 및 A-MSDU의 수신 상태를 지시하기 위하여 사용된다. Block Ack Bitmap 서브필드에서 '1' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되었음을 지시하고, '0' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되지 않았음을 지시한다.

[489] 도 24(c)를 참조하면, Multi-TID BA 프레임의 경우, BA Information 필드는 TID 별 정보(Per TID Info) 서브필드, 블록 ACK 시작 시퀀스 제어(Block Ack Starting Sequence Control) 서브필드 및 블록 ACK 비트맵(Block Ack Bitmap) 서브필드가 하나 이상의 TID 별로 반복되어 구성되고, TID가 증가되는 순서대로 구성된다.

[490] Per TID Info 서브필드는 예비(Reserved) 서브필드 및 TID 값(TID Value) 서브필드를 포함한다. TID Value 서브필드는 TID 값을 포함한다.

[491] Block Ack Starting Sequence Control 서브필드는 상술한 바와 같이 Fragment Number 및 Starting Sequence Number 서브필드를 포함한다. Fragment Number

서브필드는 0으로 설정된다. Starting Sequence Control 서브필드는 해당 BA 프레임이 전송되기 위한 첫 번째 MSDU 또는 A-MSDU의 시퀀스 번호를 포함한다.

[492] Block Ack Bitmap 서브필드는 8 옥텟의 길이로 구성된다. Block Ack Bitmap 서브필드에서 '1' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되었음을 지시하고, '0' 값은 해당 비트 위치에 대응되는 단일 MSDU 또는 A-MSDU가 성공적으로 수신되지 않았음을 지시한다.

[493]

[494] **상향링크 다중 사용자 전송 방법**

[495] 차세대 WiFi에 대한 다양한 분야의 벤더들의 많은 관심과 802.11ac 이후의 높은 스루풋(high throughput) 및 QoE(quality of experience) 성능 향상에 대한 요구가 높아지고 있는 상황에서 차세대 WLAN 시스템인 802.11ax 시스템을 위한 새로운 프레임 포맷 및 뉴머롤로지(numerology)에 대한 논의가 활발히 진행 중이다.

[496] IEEE 802.11ax은 더 높은 데이터 처리율(data rate)을 지원하고 더 높은 사용자 부하(user load)를 처리하기 위한 차세대 WLAN 시스템으로서 최근에 새롭게 제안되고 있는 WLAN 시스템 중 하나로서, 일명 고효율 WLAN(HEW: High Efficiency WLAN)라고 불린다.

[497] IEEE 802.11ax WLAN 시스템은 기존 WLAN 시스템과 동일하게 2.4 GHz 주파수 대역 및 5 GHz 주파수 대역에서 동작할 수 있다. 또한, 그보다 높은 60 GHz 주파수 대역에서도 동작할 수 있다.

[498] IEEE 802.11ax 시스템에서는 평균 스루풋 향상(average throughput enhancement)과 실외 환경에서의 심볼 간 간섭(inter-symbol interference)에 대한 강인한 전송(outdoor robust transmission)을 위해서 기존 IEEE 802.11 OFDM system (IEEE 802.11a, 802.11n, 802.11ac 등)보다 각 대역폭에서 4배 큰 FFT 크기를 사용할 수 있다. 이에 대하여 아래 도면을 참조하여 설명한다.

[499] 이하, 본 발명에 HE 포맷 PPDU에 대한 설명에 있어서, 별도의 언급이 없더라도 앞서 설명한 non-HT 포맷 PPDU, HT-mixed 포맷 PPDU, HT-greenfield 포맷 PPDU 및/또는 VHT 포맷 PPDU에 대한 설명이 HE 포맷 PPDU에 대한 설명에 병합될 수 있다.

[500] 도 25는 본 발명의 일 실시예에 따른 HE(High Efficiency) 포맷 PPDU를 예시하는 도면이다.

[501] 도 25(a)는 HE 포맷 PPDU의 개략적인 구조를 예시하고, 도 25(b) 내지 (d)는 HE 포맷 PPDU의 보다 구체적인 구조를 예시한다.

[502] 도 25(a)를 참조하면, HEW를 위한 HE 포맷 PPDU는 크게 레가시 부분(L-part), HE 부분(HE-part) 및 데이터 필드(HE-data)로 구성될 수 있다.

[503] L-part는 기존의 WLAN 시스템에서 유지하는 형태와 동일하게 L-STF 필드, L-LTF 필드 및 L-SIG 필드로 구성된다. L-STF 필드, L-LTF 필드 및 L-SIG 필드를 레가시 프리앰블(legacy preamble)이라고 지칭할 수 있다.

[504] HE-part는 802.11ax 표준을 위하여 새롭게 정의되는 부분으로서, HE-STF 필드, HE-SIG 필드 및 HE-LTF 필드를 포함할 수 있다. 도 25(a)에서는 HE-STF 필드, HE-SIG 필드 및 HE-LTF 필드의 순서를 예시하고 있으나, 이와 상이한 순서로 구성될 수 있다. 또한, HE-LTF는 생략될 수도 있다. HE-STF 필드 및 HE-LTF 필드뿐만 아니라 HE-SIG 필드를 포함하여 HE-preamble로 통칭할 수도 있다.

[505] HE-SIG는 HE-data 필드를 디코딩하기 위한 정보(예를 들어, OFDMA, UL MU MIMO, 향상된 MCS 등)을 포함할 수 있다.

[506] L-part와 HE-part는 서로 다른 FFT(Fast Fourier Transform) 크기(즉, 서브캐리어 간격(spacing))을 가질 수 있으며, 서로 다른 CP(Cyclic Prefix)를 사용할 수도 있다.

[507] 802.11ax 시스템에서는 레가시 WLAN 시스템에 비하여 4배 큰(4x) FFT 크기를 사용할 수 있다. 즉, L-part는 1x 심볼 구조로 구성되고, HE-part(특히, HE-preamble 및 HE-data)는 4x 심볼 구조로 구성될 수 있다. 여기서, 1x, 2x, 4x 크기의 FFT는 레가시 WLAN 시스템(예를 들어, IEEE 802.11a, 802.11n, 802.11ac 등)에 대한 상대적인 크기를 의미한다.

[508] 예를 들어, L-part에 이용되는 FFT 크기는 20MHz, 40MHz, 80MHz 및 160MHz에서 각각 64, 128, 256, 512라면, HE-part에 이용되는 FFT 크기는 20MHz, 40MHz, 80MHz 및 160MHz에서 각각 256, 512, 1024, 2048일 수 있다.

[509] 이와 같이 레가시 WLAN 시스템 보다 FFT 크기가 커지면, 서브캐리어 주파수 간격(subcarrier frequency spacing)이 작아지므로 단위 주파수 당 서브캐리어의 수가 증가되나, OFDM 심볼 길이가 길어진다.

[510] 즉, 보다 큰 FFT 크기가 사용된다는 것은 서브캐리어 간격이 좁아진다는 의미이며, 마찬가지로 IDFT(Inverse Discrete Fourier Transform)/DFT(Discrete Fourier Transform) 주기(period)가 늘어난다는 의미이다. 여기서, IDFT/DFT 주기는 OFDM 심볼에서 보호 구간(GI)을 제외한 심볼 길이를 의미할 수 있다.

[511] 따라서, HE-part(특히, HE-preamble 및 HE-data)는 L-part에 비하여 4배 큰 FFT 크기가 사용된다면, HE-part의 서브캐리어 간격은 L-part의 서브캐리어 간격의 1/4 배가 되고, HE-part의 IDFT/DFT 주기는 L-part의 IDFT/DFT 주기의 4배가 된다. 예를 들어, L-part의 서브캐리어 간격이 312.5kHz(=20MHz/64, 40MHZ/128, 80MHz/256 및/또는 160MHz/512)라면 HE-part의 서브캐리어 간격은 78.125kHz(=20MHz/256, 40MHZ/512, 80MHz/1024 및/또는 160MHz/2048)일 수 있다. 또한, L-part의 IDFT/DFT 주기가 3.2μs(=1/312.5kHz)이라면, HE-part의 IDFT/DFT 주기는 12.8μs(=1/78.125kHz)일 수 있다.

[512] 여기서, GI는 0.8μs, 1.6μs, 3.2μs 중 하나가 사용될 수 있으므로, GI를 포함하는 HE-part의 OFDM 심볼 길이(또는 심볼 간격(symbol interval))은 GI에 따라 13.6μs, 14.4μs, 16μs일 수 있다.

[513] 도 25(b)를 참조하면, HE-SIG 필드는 HE-SIG A 필드와 HE-SIG B 필드로 구분될 수 있다.

[514] 예를 들어, HE 포맷 PPDU의 HE-part는 12.8㎲ 길이를 가지는 HE-SIG A 필드, 1 OFDM 심볼의 HE-STF 필드, 하나 이상의 HE-LTF 필드 및 1 OFDM 심볼의 HE-SIG B 필드를 포함할 수 있다.

[515] 또한, HE-part에서 HE-SIG A 필드는 제외하고 HE-STF 필드부터는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다. 즉, 256, 512, 1024 및 2048 크기의 FFT가 각각 20MHz, 40MHz, 80MHz 및 160MHz의 HE 포맷 PPDU의 HE-STF 필드부터 적용될 수 있다.

[516] 다만, 도 25(b)와 같이 HE-SIG가 HE-SIG A 필드와 HE-SIG B 필드로 구분되어 전송될 때, HE-SIG A 필드 및 HE-SIG B 필드의 위치는 도 25(b)와 상이할 수 있다. 예를 들어, HE-SIG A 필드 다음에 HE-SIG B 필드가 전송되고, HE-SIG B 필드 다음에 HE-STF 필드와 HE-LTF 필드가 전송될 수 있다. 이 경우에도 마찬가지로 HE-STF 필드부터는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다.

[517] 도 25(c)를 참조하면, HE-SIG 필드는 HE-SIG A 필드와 HE-SIG B 필드로 구분되지 않을 수 있다.

[518] 예를 들어, HE 포맷 PPDU의 HE-part는 1 OFDM 심볼의 HE-STF 필드, 1 OFDM 심볼의 HE-SIG 필드 및 하나 이상의 HE-LTF 필드를 포함할 수 있다.

[519] 위와 유사하게 HE-part는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다. 즉, 256, 512, 1024 및 2048 크기의 FFT가 각각 20MHz, 40MHz, 80MHz 및 160MHz의 HE 포맷 PPDU의 HE-STF 필드부터 적용될 수 있다.

[520] 도 25(d)를 참조하면, HE-SIG 필드는 HE-SIG A 필드와 HE-SIG B 필드로 구분되지 않으며, HE-LTF 필드는 생략될 수 있다.

[521] 예를 들어, HE 포맷 PPDU의 HE-part는 1 OFDM 심볼의 HE-STF 필드 및 1 OFDM 심볼의 HE-SIG 필드를 포함할 수 있다.

[522] 위와 유사하게 HE-part는 기존의 PPDU 보다 4배 큰 크기의 FFT가 적용될 수 있다. 즉, 256, 512, 1024 및 2048 크기의 FFT가 각각 20MHz, 40MHz, 80MHz 및 160MHz의 HE 포맷 PPDU의 HE-STF 필드부터 적용될 수 있다.

[523] 본 발명에 따른 WLAN 시스템을 위한 HE 포맷 PPDU는 적어도 하나의 20MHz 채널을 통해 전송될 수 있다. 예를 들어, HE 포맷 PPDU은 총 4개의 20MHz 채널을 통해 40MHz, 80MHz 또는 160MHz 주파수 대역에서 전송될 수 있다. 이에 대하여 아래 도면을 참조하여 보다 상세히 설명한다.

[524] 본 발명이 적용될 수 있는 WLAN 시스템을 위한 HE 포맷 PPDU는 적어도 하나의 20MHz 채널을 통해 전송될 수 있다. 예를 들어, HE 포맷 PPDU은 총 4개의 20MHz 채널을 통해 40MHz, 80MHz 또는 160MHz 주파수 대역에서 전송될 수 있다. 이에 대하여 아래 도면을 참조하여 보다 상세히 설명한다.

[525] 이하, 설명하는 PPDU 포맷은 설명의 편의를 위해 앞서 도 25(b)를 기반으로 설명하나, 본 발명이 이에 한정되는 것은 아니다.

[526] 도 26은 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[527] 도 26에서는 하나의 STA에 80MHz가 할당된 경우(또는 80MHz 내 복수의 STA에게 OFDMA 자원 유닛이 할당된 경우) 혹은 복수의 STA에게 각각 80MHz의 서로 다른 스트림이 할당된 경우의 PPDU 포맷을 예시한다.

[528] 도 26을 참조하면, L-STF, L-LTF 및 L-SIG은 각 20MHz 채널에서 64 FFT 포인트(또는 64 서브캐리어)에 기반하여 생성된 OFDM 심볼로 전송될 수 있다.

[529] HE-SIG A 필드는 PPDU를 수신하는 STA들에게 공통으로 전송되는 공용 제어 정보를 포함할 수 있다. HE-SIG A 필드는 1개 내지 3개의 OFDM 심볼에서 전송될 수 있다. HE-SIG A 필드는 20MHz 단위로 복사되어 동일한 정보를 포함한다. 또한, HE-SIG-A 필드는 시스템의 전체 대역폭 정보를 알려준다.

[530] 표 12는 HE-SIG A 필드에 포함되는 정보를 예시하는 표이다.

[531] [표12]

필드	비트	설명(description)
대역폭 (bandwidth)	2	PPDU가 전송되는 대역폭을 지시함 예를 들어, 20MHz, 40MHz, 80MHz 또는 160MHz
그룹 식별자 (Group ID)	6	PPDU를 수신할 STA 또는 STA들의 그룹을 지시함
스트림 정보 (Stream information)	12	각 STA을 위한 공간 스트림(spatial stream)의 위치 또는 번호를 지시하거나 STA의 그룹을 위한 공간 스트림의 위치 또는 번호 지시함
상향링크 지시 (UL indication)	1	PPDU가 AP로 향하는지(uplink) 또는 STA으로 향하는지(downlink) 지시함
MU 지시 (MU indication)	1	PPDU가 SU-MIMO PPDU 인지 MU-MIMO PPDU인지 지시함
가드 인터벌 지시 (GI indication)	1	짧은 GI가 사용되는지 긴 GI가 사용되는지 지시함
할당 정보 (Allocation information)	12	PPDU가 전송되는 대역에서 각 STA에 할당된 밴드 또는 채널(서브채널 인덱스 또는 서브밴드 인덱스) 지시함
전송 파워 (Transmission power)	12	각 채널 또는 각 STA을 위한 전송 파워를 지시함

[532] 표 12에 예시되는 각 필드들에 포함되는 정보들은 IEEE 802.11 시스템의 정의를 따를 수 있다. 또한, 앞서 설명한 각 필드들은 PPDU에 포함될 수 있는 필드들의 예시에 해당하며, 이에 한정되지 않는다. 즉, 앞서 설명한 각 필드가 다른 필드로 대체되거나 추가적인 필드가 더 포함될 수 있으며, 모든 필드가 필수적으로 포함되지 않을 수도 있다.

[533] HE-STF는 MIMO 전송에 있어서 AGC 추정의 성능을 개선하기 위해 사용된다.

[534] HE-SIG B 필드는 각 STA이 자신의 데이터(예를 들어, PSDU)를 수신하기 위하여 요구되는 사용자 특정(user-specific) 정보를 포함할 수 있다. HE-SIG B 필드는 하나 또는 두 개의 OFDM 심볼에서 전송될 수 있다. 예를 들어, HE-SIG B 필드는 해당 PSDU의 변조 및 코딩 기법(MCS) 및 해당 PSDU의 길이에 관한 정보를 포함할 수 있다.

[535] L-STF, L-LTF, L-SIG 및 HE-SIG A 필드는 20MHz 채널 단위로 반복되어 전송될 수 있다. 예를 들어, PPDU가 4개의 20MHz 채널(즉, 80MHz 대역)을 통해 전송될 때, L-STF, L-LTF, L-SIG 및 HE-SIG A 필드는 매 20MHz 채널에서 반복되어 전송될 수 있다.

[536] FFT 크기가 커지면, 기존의 IEEE 802.11a/g/n/ac를 지원하는 레가시 STA은 해당 HE PPDU를 디코딩하지 못할 수 있다. 레가시 STA과 HE STA이 공존(coexistence)하기 위하여, L-STF, L-LTF 및 L-SIG 필드는 레가시 STA이 수신할 수 있도록 20MHz 채널에서 64 FFT를 통해 전송된다. 예를 들어, L-SIG 필드는 하나의 OFDM 심볼을 점유하고, 하나의 OFDM 심볼 시간은 4㎲이며, GI는 0.8㎲일 수 있다.

[537] 각 주파수 단위 별 FFT 크기는 HE-STF(또는 HE-SIG A)부터 더욱 커질 수 있다. 예를 들어, 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다. FFT 크기가 커지면, OFDM 서브캐리어 간의 간격이 작아지므로 단위 주파수 당 OFDM 서브캐리어의 수가 증가되나, OFDM 심볼 시간은 길어진다. 시스템의 효율을 향상시키기 위하여 HE-STF 이후의 GI의 길이는 HE-SIG A의 GI의 길이와 동일하게 설정될 수 있다.

[538] HE-SIG A 필드는 HE STA이 HE PPDU를 디코딩하기 위하여 요구되는 정보를 포함할 수 있다. 그러나, HE-SIG A 필드는 레가시 STA과 HE STA이 모두 수신할 수 있도록 20MHz 채널에서 64 FFT를 통해 전송될 수 있다. 이는 HE STA가 HE 포맷 PPDU 뿐만 아니라 기존의 HT/VHT 포맷 PPDU를 수신할 수 있으며, 레가시 STA 및 HE STA이 HT/VHT 포맷 PPDU와 HE 포맷 PPDU를 구분하여야 하기 때문이다.

[539] 도 27은 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[540] 도 27을 참조하면, HE-SIG B 필드가 HE-SIG A 필드 다음에 위치하는 점을 제외하고는, 앞서 도 26의 예시와 동일하다. 이 경우, 단위 주파수 당 FFT 크기는 HE-STF(또는 HE-SIG B) 이후부터 더욱 커질 수 있다. 예를 들어, HE-STF(또는 HE-SIG B)부터 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다.

[541] 도 28은 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[542] 도 28에서는 20MHz 채널들이 각각 서로 다른 STA들(예를 들어, STA 1, STA 2, STA 3 및 STA 4)에 할당되는 경우를 가정한다.

[543] 도 28을 참조하면, HE-SIG B 필드가 HE-SIG A 필드 다음에 위치한다. 이 경우, 단위 주파수 당 FFT 크기는 HE-STF(또는 HE-SIG B)부터 더욱 커질 수 있다. 예를 들어, HE-STF(또는 HE-SIG B)부터 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다.

[544] PPDU에 포함되는 각 필드에서 전송되는 정보는 앞서 도 26의 예시와 동일하므로 이하 설명을 생략한다.

[545] HE-SIG B 필드는 각 STA에 특정된 정보를 포함할 수 있으나, 전체 밴드(즉, HE-SIG-A 필드에서 지시)에 걸쳐서 인코딩될 수 있다. 즉, HE-SIG B 필드는 모든 STA에 대한 정보를 포함하며 모든 STA들이 수신하게 된다.

[546] HE-SIG B 필드는 각 STA 별로 할당되는 주파수 대역폭 정보 및/또는 해당 주파수 대역에서 스트림 정보를 알려줄 수 있다. 예를 들어, 도 28에서 HE-SIG-B는 STA 1는 20MHz, STA 2는 그 다음 20MHz, STA 3는 그 다음 20MHz, STA 4는 그 다음 20MHz가 할당될 수 있다. 또한, STA 1과 STA 2는 40MHz를 할당하고, STA 3와 STA 4는 그 다음 40MHz를 할당할 수 있다. 이 경우, STA 1과 STA 2는 서로 다른 스트림을 할당하고, STA 3와 STA 4는 서로 다른 스트림을 할당할 수 있다.

[547] 또한, HE-SIG-C 필드를 정의하여, 도 28의 예시에 HE-SIG C 필드가 추가될 수 있다. 이 경우, HE-SIG-B 필드에서는 전대역에 걸쳐서 모든 STA에 대한 정보가 전송되고, 각 STA에 특정한 제어 정보는 HE-SIG-C 필드를 통해 20MHz 단위로 전송될 수도 있다.

[548] 또한, 도 26 내지 도 28의 예시에서, HE-SIG-B 필드는 전대역에 걸쳐 전송하지 않고 HE-SIG-A 필드와 동일하게 20MHz 단위로 전송될 수 있다. 이에 대하여 아래 도면을 참조하여 설명한다.

[549] 도 29는 본 발명의 일 실시예에 따른 HE 포맷 PPDU을 예시하는 도면이다.

[550] 도 29에서는 20MHz 채널들이 각각 서로 다른 STA들(예를 들어, STA 1, STA 2, STA 3 및 STA 4)에 할당되는 경우를 가정한다.

[551] 도 29를 참조하면, 도 28과 마찬가지로 HE-SIG B 필드가 HE-SIG A 필드 다음에 위치한다. 다만, HE-SIG B 필드는 전대역에 걸쳐 전송되지 않고, HE-SIG A 필드와 동일하게 20MHz 단위로 전송된다.

[552] 이 경우, 단위 주파수 당 FFT 크기는 HE-STF(또는 HE-SIG B)부터 더욱 커질 수 있다. 예를 들어, HE-STF(또는 HE-SIG B)부터 256 FFT가 20MHz 채널에서 사용되고, 512 FFT가 40MHz 채널에서 사용되며, 1024 FFT가 80MHz 채널에서 사용될 수 있다.

[553] PPDU에 포함되는 각 필드에서 전송되는 정보는 앞서 도 26의 예시와 동일하므로 이하 설명을 생략한다.

[554] HE-SIG A 필드는 HE-SIG A 필드는 20MHz 단위로 복사되어(duplicated) 전송된다.

[555] HE-SIG B 필드는 각 STA 별로 할당되는 주파수 대역폭 정보 및/또는 해당 주파수 대역에서 스트림 정보를 알려줄 수 있다.

[556] HE-SIG B 필드는 HE-SIG A 필드와 마찬가지로 20MHz 단위로 전송될 수 있다. 이 경우, HE-SIG B 필드는 각 STA에 대한 정보를 포함하므로 20MHz 단위의 각 HE-SIG B 필드 별로 각 STA에 대한 정보가 포함될 수 있다. 이때, 도 29의 예시에서는 각 STA 별로 20MHz가 할당되는 경우를 예시하고 있으나, 예를 들어 STA에 40MHz가 할당되는 경우, 20MHz 단위로 HE-SIG-B 필드가 복사되어

전송될 수도 있다.

[557] 또한, HE-SIG B 필드에 모든 STA에 대한 정보(즉, 각 STA에 특정된 정보들이 모두 합쳐짐)가 포함되어 HE-SIG A 필드와 마찬가지로 20MHz 단위로 복사되어(duplicated) 전송될 수도 있다.

[558] 도 27 내지 도 29 예시와 같이, HE-SIG-B 필드가 HE STF 필드 및 HE-LTF 필드 앞에 위치하는 경우 20MHz에서 64 FFT를 이용함으로써 심볼의 길이를 짧게 구성하고, 도 26의 예시와 같이 HE-SIG-B 필드가 HE STF 필드 및 HE-LTF 필드 뒤에 위치하는 경우, 20MHz에서 256 FFT를 이용함으로써 심볼의 길이를 길게 구성할 수 있다.

[559] 각 BSS 별로 서로 다른 대역폭을 지원하는 상황에서 인접한 BSS로부터의 간섭 레벨이 적은 일부의 대역폭을 STA에게 할당하는 경우에 위와 같이 HE-SIG-B 필드를 전대역에 걸쳐서 전송하지 않는 것이 보다 바람직할 수 있다.

[560] 도 26 내지 도 29에서 데이터 필드는 페이로드(payload)로서, 서비스 필드(SERVICE field), 스크램블링된 PSDU, 테일 비트(tail bits), 패딩 비트(padding bits)를 포함할 수 있다.

[561] 도 30은 본 발명의 일 실시예에 따른 HE 포맷 PPDU 검출을 위한 위상 회전(phase rotation)을 예시한다.

[562] HE 포맷 PPDU를 구분(classification)하기 위하여, HE 포맷 PPDU에서 L-SIG 필드 이후에 전송되는 3개의 OFDM 심볼의 위상이 사용될 수 있다.

[563] 도 30을 참조하면, HE 포맷 PPDU에서 L-SIG 필드 이후에 전송되는 OFDM 심볼 #1 및 OFDM 심볼 #2의 위상은 회전되지 않으나, OFDM 심볼 #3의 위상은 시계 반대 방향으로 90도만큼 회전될 수 있다. 즉, OFDM 심볼 #1 및 OFDM 심볼 #2에 대한 변조 방법은 BPSK가 이용되고, OFDM 심볼 #3에 대한 변조 방법은 QBPSK가 이용될 수 있다.

[564] STA은 수신한 PPDU의 L-SIG 필드 다음에 전송되는 제1 OFDM 심볼 내지 제3 OFDM 심볼을 도 30의 예시와 같은 성상을 기반으로 디코딩을 시도한다. STA이 디코딩에 성공하면 해당 PPDU가 HE 포맷 PPDU라고 판단할 수 있다.

[565] 여기서, L-SIG 필드 이후에 HE-SIG A 필드가 세 개의 OFDM 심볼에서 전송된다면, 이는 OFDM 심볼 #1 내지 OFDM 심볼 #3 모두 HE-SIG A 필드를 전송하기 위하여 사용되는 것을 의미한다.

[566] 이하, WLAN 시스템에서 다중 사용자(multi-user) 상향링크 전송 방법에 대하여 설명한다.

[567] WLAN 시스템에서 동작하는 AP가 동일한 시간 자원 상에서 복수의 STA으로 데이터를 전송하는 방식을 DL MU 전송(downlink multi-user transmission)이라고 지칭할 수 있다. 반대로, WLAN 시스템에서 동작하는 복수의 STA이 동일한 시간 자원 상에서 AP로 데이터를 전송하는 방식을 UL MU 전송(uplink multi-user transmission)이라고 지칭할 수 있다.

[568] 이러한 DL MU 전송 또는 UL MU 전송은 주파수 도메인 또는 공간

도메인(spatial domain) 상에서 다중화될 수 있다.

[569] 주파수 도메인 상에서 다중화되는 경우, OFDMA(orthogonal frequency division multiplexing)를 기반으로 복수의 STA 각각에 대해 서로 다른 주파수 자원(예를 들어, 서브캐리어 또는 톤(tone))이 하향링크 또는 상향링크 자원으로 할당될 수 있다. 이러한 동일한 시간 자원에서 서로 다른 주파수 자원을 통한 전송 방식을 'DL/UL MU OFDMA 전송'이라고 지칭할 수 있다.

[570] 공간 도메인(spatial domain) 상에서 다중화되는 경우, 복수의 STA 각각에 대해 서로 다른 공간 스트림이 하향링크 또는 상향링크 자원으로 할당될 수 있다. 이러한 동일한 시간 자원에서 서로 다른 공간적 스트림을 통한 전송 식을 'DL/UL MU MIMO' 전송이라고 지칭할 수 있다.

[571] 현재 WLAN 시스템에서는 아래와 같은 제약 사항으로 인해 UL MU 전송을 지원하지 못한다.

[572] 현재 WLAN 시스템에서는 복수의 STA으로부터 전송되는 상향링크 데이터의 전송 타이밍에 대한 동기화가 지원되지 않는다. 예를 들어, 기존의 WLAN 시스템에서 복수의 STA들이 동일한 시간 자원을 통해 상향링크 데이터를 전송하는 경우를 가정하면, 현재 WLAN 시스템에서는 복수의 STA 각각은 다른 STA의 상향링크 데이터의 전송 타이밍을 알 수 없다. 따라서, AP는 복수의 STA 각각으로부터 동일한 시간 자원 상에서 상향링크 데이터를 수신하기 어렵다.

[573] 또한, 현재 WLAN 시스템에서는 복수의 STA에 의해 상향링크 데이터를 전송하기 위해 사용되는 주파수 자원 간의 중첩이 발생될 수 있다. 예를 들어, 복수의 STA 각각의 오실레이터(oscillator)가 다를 경우, 주파수 오프셋(frequency offset)이 다르게 나타날 수 있다. 만약, 주파수 오프셋이 다른 복수의 STA 각각이 서로 다른 주파수 자원을 통해 동시에 상향링크 전송을 수행하는 경우, 복수의 STA 각각에 의해 사용되는 주파수 영역 중 일부가 중첩될 수 있다.

[574] 또한, 기존의 WLAN 시스템에서는 복수의 STA 각각에 대한 파워 제어가 수행되지 않는다. 복수의 STA 각각과 AP 사이의 거리와 채널 환경에 종속적으로 AP는 복수의 STA 각각으로부터 서로 다른 파워의 신호를 수신할 수 있다. 이러한 경우, 약한 파워로 도착하는 신호는 강한 파워로 도착하는 신호에 비해 상대적으로 AP에 의해 검출되기 어려울 수 있다.

[575] 이에 따라, 본 발명은 WLAN 시스템에서의 UL MU 전송 방법을 제안한다.

[576] 도 31은 본 발명의 일 실시예에 따른 상향링크 다중 사용자(multi-user) 전송 절차를 예시하는 도면이다.

[577] 도 31을 참조하면, AP가 UL MU 전송에 참여하는 STA들에게 UL MU 전송을 준비할 것을 지시하고, 해당 STA들로부터 UL MU 데이터 프레임을 수신하며, UL MU 데이터 프레임에 대한 응답으로 ACK 프레임(BA(Block Ack) 프레임)을 전송한다.

[578] 먼저 AP는 UL MU 트리거 프레임(UL MU Trigger frame, 3110)을 전송함으로써, UL MU 데이터를 전송할 STA들에게 UL MU 전송을 준비할 것을 지시한다.

여기서, UL MU 스케줄링 프레임은 'UL MU 스케줄링(scheduling) 프레임'의 용어로 불릴 수도 있다.

[579] 여기서, UL MU 트리거 프레임(3110)은 STA 식별자(ID: Identifier)/주소(address) 정보, 각 STA이 사용할 자원 할당 정보, 지속기간(duration) 정보 등과 같은 제어 정보를 포함할 수 있다.

[580] STA ID/주소 정보는 상향링크 데이터를 전송하는 각 STA을 특정하기 위한 식별자 또는 주소에 대한 정보를 의미한다.

[581] 자원 할당 정보는 각 STA 별로 할당되는 상향링크 전송 자원(예를 들어, UL MU OFDMA 전송의 경우 각 STA에게 할당되는 주파수/서브캐리어 정보, UL MU MIMO 전송의 경우 각 STA에게 할당되는 스트림 인덱스)에 대한 정보를 의미한다.

[582] 지속기간(duration) 정보는 복수의 STA 각각에 의해 전송되는 상향링크 데이터 프레임의 전송을 위한 시간 자원을 결정하기 위한 정보를 의미한다.

[583] 예를 들어, 지속 기간 정보는 각 STA의 상향링크 전송을 위해 할당된 TXOP(Transmit Opportunity)의 구간 정보 혹은 상향링크 프레임 길이(frame length)에 대한 정보(예를 들어, 비트 또는 심볼)를 포함할 수 있다.

[584] 또한, UL MU 트리거 프레임(3110)은 각 STA 별로 UL MU 데이터 프레임 전송 시 사용해야 할 MCS 정보, 코딩(Coding) 정보 등과 같은 제어 정보를 더 포함할 수도 있다.

[585] 위와 같은 제어 정보는 UL MU 트리거 프레임(3110)을 전달하는 PPDU의 HE-part(예를 들어, HE-SIG A 필드 또는 HE-SIG B 필드)나 UL MU 트리거 프레임(3110)의 제어 필드(예를 들어, MAC 프레임의 Frame Control 필드 등)에서 전송될 수 있다.

[586] UL MU 트리거 프레임(3110)을 전달하는 PPDU는 L-part(예를 들어, L-STF 필드, L-LTF 필드, L-SIG 필드 등)으로 시작하는 구조를 가진다. 이에 따라, 레가시 STA들은 L-SIG 필드로부터 L-SIG 보호(L-SIG protection)을 통해 NAV(Network Allocation Vector) 셋팅을 수행할 수 있다. 예를 들어, 레가시 STA들은 L-SIG에서 데이터 길이(length) 및 데이터율(data rate) 정보를 기반으로 NAV 셋팅을 위한 구간(이하, 'L-SIG 보호 구간')을 산출할 수 있다. 그리고, 레가시 STA들은 산출된 L-SIG 보호 구간 동안에는 자신에게 전송될 데이터가 없다고 판단할 수 있다.

[587] 예를 들어, L-SIG 보호 구간은 UL MU 트리거 프레임(3110)의 MAC duration 필드 값과 UL MU 트리거 프레임(3110)을 나르는 PPDU의 L-SIG 필드 이후의 잔여 구간의 합으로 결정될 수 있다. 이에 따라, L-SIG 보호 구간은 UL MU 트리거 프레임(3110)의 MAC duration 값에 따라 각 STA에게 전송되는 ACK 프레임(3130)(또는 BA 프레임)을 전송하는 구간까지의 값으로 설정될 수 있다.

[588] 이하, 각 STA에게 UL MU 전송을 위한 자원 할당 방법을 보다 구체적으로 살펴본다. 설명의 편의를 위해 제어 정보가 포함되는 필드를 구분하여 설명하나

본 발명이 이에 한정되는 것은 아니다.

[589] 제1 필드는 UL MU OFDMA 전송과 UL MU MIMO 전송을 구분하여 지시할 수 있다. 예를 들어, '0'이면 UL MU OFDMA 전송을 지시하고, '1'이면 UL MU MIMO 전송을 지시할 수 있다. 제1 필드의 크기는 1 비트로 구성될 수 있다.

[590] 제2 필드(예를 들어, STA ID/주소 필드)는 UL MU 전송에 참여할 STA ID 혹은 STA 주소들을 알려준다. 제2 필드의 크기는 STA ID를 알려주기 위한 비트 수 × UL MU에 참여할 STA 수로 구성될 수 있다. 예를 들어, 제2 필드가 12 비트로 구성되는 경우, 4 비트 별로 각 STA의 ID/주소를 지시할 수 있다.

[591] 제3 필드(예를 들어, 자원 할당 필드)는 UL MU 전송을 위해 각 STA에 할당되는 자원 영역을 지시한다. 이때, 각 STA에 할당되는 자원 영역은 앞서 제2 필드의 순서에 따라 각 STA에게 순차적으로 지시될 수 있다.

[592] 만약, 제1 필드 값이 '0'인 경우, 제2 필드에 포함된 STA ID/주소의 순서대로 UL MU 전송을 위한 주파수 정보(예를 들어, 주파수 인덱스, 서브캐리어 인덱스 등)를 나타내고, 제1 필드 값이 '1'인 경우, 제2 필드에 포함된 STA ID/주소의 순서대로 UL MU 전송을 위한 MIMO 정보(예를 들어, 스트림 인덱스 등)를 나타낸다.

[593] 이때, 하나의 STA에게 여러 개의 인덱스(즉, 주파수/서브캐리어 인덱스 또는 스트림 인덱스)를 알려줄 수도 있으므로, 제3 필드의 크기는 복수의 비트(혹은, 비트맵(bitmap) 형식으로 구성될 수 있음) × UL MU 전송에 참여할 STA 개수로 구성될 수 있다.

[594] 예를 들어, 제2 필드가 'STA 1', 'STA 2'의 순서로 설정되고, 제3 필드가 '2', '2'의 순서로 설정된다고 가정한다.

[595] 이 경우, 제1 필드가 '0'인 경우, STA 1은 상위(또는, 하위) 주파수 영역부터 주파수 자원이 할당되고, STA 2는 그 다음의 주파수 자원이 순차적으로 할당될 수 있다. 일례로, 80MHz 대역에서 20MHz 단위의 OFDMA를 지원하는 경우, STA 1은 상위(또는, 하위) 40MHz 대역, STA 2는 그 다음의 40MHz 대역을 사용할 수 있다.

[596] 반면, 제1 필드가 '1'인 경우, STA 1은 상위(또는, 하위) 스트림이 할당되고, STA 2는 그 다음 스트림이 순차적으로 할당될 수 있다. 이때, 각 스트림에 따른 빔포밍 방식은 사전에 지정되어 있거나, 제3 필드 또는 제4 필드에서 스트림에 따른 빔포밍 방식에 대한 보다 구체적인 정보가 포함될 수도 있다.

[597] 각 STA은 AP에 의해 전송되는 UL MU 트리거 프레임(3110)을 기반으로 UL MU 데이터 프레임(UL MU Data frame, 3121, 3122, 3123)을 AP에 전송한다. 여기서, 각 STA은 AP로부터 UL MU 트리거 프레임(3110)을 수신 후 SIFS 이후에 UL MU 데이터 프레임(3121, 3122, 3123)을 AP에 전송할 수 있다.

[598] 각 STA은 UL MU 트리거 프레임(3110)의 자원 할당 정보를 기반으로 UL MU OFDMA 전송을 위한 특정한 주파수 자원 또는 UL MU MIMO 전송을 위한 공간적 스트림을 결정할 수 있다.

[599] 구체적으로, UL MU OFDMA 전송의 경우, 각 STA은 서로 다른 주파수 자원을 통해 동일한 시간 자원 상에서 상향링크 데이터 프레임을 전송할 수 있다.

[600] 여기서, STA 1 내지 STA 3 각각은 UL MU 트리거 프레임(3110)에 포함된 STA ID/주소 정보 및 자원 할당 정보를 기반으로 상향링크 데이터 프레임 전송을 위한 서로 다른 주파수 자원을 할당 받을 수 있다. 예를 들어, STA ID/주소 정보가 STA 1 내지 STA 3을 순차적으로 지시하고, 자원 할당 정보가 주파수 자원 1, 주파수 자원 2, 주파수 자원 3을 순차적으로 지시할 수 있다. 이 경우, STA ID/주소 정보를 기반으로 순차적으로 지시된 STA 1 내지 STA 3은 자원 할당 정보를 기반으로 순차적으로 지시된 주파수 자원 1, 주파수 자원 2, 주파수 자원 3을 각각 할당 받을 수 있다. 즉, STA 1은 주파수 자원 1, STA 2는 주파수 자원 2, STA 3은 주파수 자원 3을 통해 상향링크 데이터 프레임(3121, 3122, 3123)을 AP로 전송할 수 있다.

[601] 또한, UL MU MIMO 전송의 경우, 각 STA은 복수의 공간적 스트림 중 적어도 하나의 서로 다른 스트림을 통해 동일한 시간 자원 상에서 상향링크 데이터 프레임을 전송할 수 있다.

[602] 여기서, STA 1 내지 STA 3 각각은 UL MU 트리거 프레임(3110)에 포함된 STA ID/주소 정보 및 자원 할당 정보 기반으로 상향링크 데이터 프레임 전송을 위한 공간적 스트림을 할당 받을 수 있다. 예를 들어, STA ID/주소 정보가 STA 1 내지 STA 3을 순차적으로 지시하고, 자원 할당 정보가 공간적 스트림 1, 공간적 스트림 2, 공간적 스트림 3을 순차적으로 지시할 수 있다. 이 경우, STA ID/주소 정보를 기반으로 순차적으로 지시된 STA 1 내지 STA 3은 자원 할당 정보 기반으로 순차적으로 지시된 공간적 스트림 1, 공간적 스트림 2, 공간적 스트림 3을 각각 할당 받을 수 있다. 즉, STA 1은 공간적 스트림 1, STA 2는 공간적 스트림 2, STA 3은 공간적 스트림 3을 통해 상향링크 데이터 프레임(3121, 3122, 3123)을 AP로 전송할 수 있다.

[603] 상향링크 데이터 프레임(3121, 3122, 3123)을 전달하는 PPDU는 L-part 없이도 새로운 구조로도 구성이 가능하다.

[604] 또한, UL MU MIMO 전송이거나 20MHz 미만의 서브밴드 형태의 UL MU OFDMA 전송의 경우, 상향링크 데이터 프레임(3121, 3122, 3123)을 전달하는 PPDU의 L-part는 SFN 형태(즉, 모든 STA이 동일한 L-part 구성과 내용을 동시에 전송)로 전송될 수 있다. 반면, 20MHz 이상의 서브밴드 형태의 UL MU OFDMA 전송의 경우, 상향링크 데이터 프레임(3121, 3122, 3123)을 전달하는 PPDU의 L-part는 각 STA이 할당된 대역에서 20MHz 단위로 각각 L-part가 전송될 수 있다.

[605] UL MU 트리거 프레임(3110)의 정보로 상향링크 데이터 프레임을 충분히 구성할 수 있다면, 상향링크 데이터 프레임(3121, 3122, 3123)을 전달하는 PPDU 내 HE-SIG 필드(즉, 데이터 프레임의 구성 방식에 대한 제어 정보를 전송하는 영역)도 필요 없을 수 있다. 예를 들어, HE-SIG-A 필드 및/또는 HE-SIG-B가 전송되지 않을 수 있다. 또한, HE-SIG-A 필드와 HE-SIG-C 필드는 전송되고,

HE-SIG-B 필드는 전송되지 않을 수 있다.

[606] AP는 각 STA으로부터 수신한 상향링크 데이터 프레임(3121, 3122, 3123)에 대한 응답으로 ACK 프레임(ACK frame, 3130)(또는 BA 프레임)을 전송할 수 있다. 여기서, AP는 각 STA으로부터 상향링크 데이터 프레임(3121, 3122, 3123)을 수신하고 SIFS 이후에 ACK 프레임(3130)을 각 STA에게 전송할 수 있다.

[607] 만일, 기존의 ACK 프레임의 구조를 동일하게 이용한다면, 6 옥텟 크기를 가지는 RA 필드에 UL MU 전송에 참여하는 STA들의 AID(혹은, 부분 AID(Partial AID))를 포함하여 구성할 수 있다.

[608] 또는, 새로운 구조의 ACK 프레임을 구성한다면 DL SU 전송 또는 DL MU 전송을 위한 형태로 구성이 가능하다.

[609] AP는 수신에 성공한 UL MU 데이터 프레임에 대한 ACK 프레임(3130)만을 해당 STA에게 전송할 수 있다. 또한, AP는 ACK 프레임(3130)을 통해 수신 성공 여부를 ACK 또는 NACK으로 알려줄 수 있다. 만약 ACK 프레임(3130)이 NACK 정보를 포함한다면, NACK에 대한 이유나 그 후의 절차를 위한 정보(예를 들어, UL MU 스케줄링 정보 등)도 포함할 수 있다.

[610] 또는, ACK 프레임(3130)을 전달하는 PPDU는 L-part 없이 새로운 구조로 구성할 수도 있다.

[611] ACK 프레임(3130)은 STA ID 혹은 주소 정보를 포함할 수도 있으나, UL MU 트리거 프레임(3110)에서 지시된 STA의 순서를 동일하게 적용한다면, STA ID 혹은 주소 정보를 생략할 수도 있다.

[612] 또한, ACK 프레임(3130)의 TXOP(즉, L-SIG 보호 구간)을 연장하여 다음의 UL MU 스케줄링을 위한 프레임이나, 다음의 UL MU 전송을 위한 보정 정보 등을 포함하는 제어 프레임이 TXOP 내 포함될 수도 있다.

[613] 한편, UL MU 전송을 위하여 STA들 간에 동기를 맞추는 등의 보정(adjustment) 과정을 추가될 수도 있다.

[614] 도 32는 본 발명의 일 실시예에 따른 상향링크 다중 사용자(multi-user) 전송 절차를 예시하는 도면이다.

[615] 이하, 설명의 편의를 위해 앞서 도 31의 예시와 동일한 설명은 생략한다.

[616] 도 32를 참조하면, AP가 UL MU에 사용할 STA들에게 UL MU를 준비할 것을 지시하고, UL MU를 위한 STA들 간에 동기를 맞추는 등의 보정(adjustment) 과정을 거친 후 UL MU 데이터 프레임을 전송 받고 ACK을 전송할 수 있다.

[617] 먼저 AP는 UL MU 트리거 프레임(UL MU trigger frame, 3210)을 전송함으로써, UL MU 데이터를 전송할 STA들에게 UL MU 전송을 준비할 것을 지시한다.

[618] AP로부터 UL MU 트리거 프레임(3210)을 수신한 각 STA은 동기 신호(Sync signal, 3221, 3222, 3223)을 AP에 전송한다. 여기서, 각 STA은 UL MU 트리거 프레임(3210)을 수신하고 SIFS 이후에 동기 신호(3221, 3222, 3223)를 AP에 전송할 수 있다.

[619] 그리고, 각 STA으로부터 동기 신호(3221, 3222, 3223)를 수신한 AP는 각

STA에게 보정 프레임(Adjustment frame, 3230)을 전송한다. 여기서, AP는 동기 신호(3221, 3222, 3223)를 수신하고 SIFS 이후에 보정 프레임(3230)을 전송할 수 있다.

[620] 동기 신호(3221, 3222, 3223) 및 보정 프레임(3230)을 송수신하는 절차는 UL MU 데이터 프레임의 전송을 위하여 각 STA들 간의 시간/주파수/파워 등을 보정해 주기 위한 절차이다. 즉, STA들이 각자의 동기 신호(3221, 3222, 3223)를 전송하고, AP는 그 값들을 기반으로 시간/주파수/파워 등의 오차를 보정해주는 보정 정보를 보정 프레임(3230)을 통해 각 STA에게 알려줌으로써 다음에 전송될 UL MU 데이터 프레임에서 그 값을 보정해서 전송할 수 있도록 하기 위한 절차이다. 또한 이러한 절차가 UL MU 트리거 프레임(3210) 뒤에 수행됨으로써 STA은 스케줄링에 따라 데이터 프레임 구성을 준비할 시간을 가질 수 있다.

[621] 보다 구체적으로, UL MU 트리거 프레임(3210)에서 지시된 STA들은 각자 지시된 혹은 지정된 자원 영역에 동기 신호(3221, 3222, 3223)를 전송한다. 여기서, 각 STA으로부터 전송되는 동기 신호(3221, 3222, 3223)는 TDM(time division multiplexing), CDM(code division multiplexing) 및/또는 SDM(spatial division multiplexing) 방식으로 다중화될 수 있다.

[622] 예를 들어, UL MU 트리거 프레임(3210)에서 지시된 STA의 순서가 STA 1, STA 2, STA 3이고, CDM으로 각 STA의 동기 신호(3221, 3222, 3223) 다중화된다면, 지정된 STA 순서대로 각각 할당된 시퀀스 1(Sequence 1), 시퀀스 2(Sequence 2), 시퀀스 3(Sequence 3)을 AP에 전송할 수 있다.

[623] 여기서, 각 STA의 동기 신호(3221, 3222, 3223)가 TDM, CDM 및/또는 SDM로 다중화되어 전송되기 위하여 각 STA이 사용할 자원(예를 들어, 시간/시퀀스/스트림 등)은 사전에 각 STA에게 지시되거나 정의될 수 있다.

[624] 또한, 동기 신호(3221, 3222, 3223)를 전달하는 PPDU은 L-part를 포함하지 않거나, MAC 프레임의 구성없이 물리 계층 신호만으로 전송될 수 있다.

[625] 각 STA으로부터 동기 신호(3221, 3222, 3223)를 수신한 AP는 보정(adjustment) 프레임(3230)을 각 STA에게 전송한다.

[626] 이때, AP는 보정 프레임(3230)을 DL SU 전송 방식으로 각 STA에게 전송하거나 DL MU 전송 방식으로 각 STA에게 전송할 수 있다. 즉, DL SU 전송의 경우 보정 프레임(3230)은 UL MU 전송에 참여하는 각 STA에게 순차적으로 전송될 수 있으며, DL MU 전송의 경우 보정 프레임(3230)은 각 STA에 할당된 자원(즉, 주파수 혹은 스트림)을 통해 UL MU 전송에 참여하는 각 STA에게 동시에 전송될 수 있다.

[627] 보정 프레임(3230)은 STA ID 혹은 주소 정보를 포함할 수도 있으며, UL MU 트리거 프레임(3210)에서 지시된 STA의 순서를 동일하게 적용한다면, STA ID 혹은 주소 정보를 생략할 수도 있다.

[628] 또한, 보정 프레임(3230)은 보정(adjustment) 필드를 포함할 수 있다.

[629] adjustment 필드는 시간/주파수/전력 등의 오차를 보정하기 위한 정보를 포함할

수 있다. 여기서, 보정 정보는 AP가 수신하는 STA들의 신호가 시간/주파수/전력 등의 오차가 발생할 수 있는데 그 오차 갭(gap)을 보정하도록 알려주는 정보를 의미한다. 그 외에도 AP가 수신하는 동기 신호(3221, 3222, 3223)를 기반으로 각 STA의 시간/주파수/전력 등의 오차를 더 정확하게 보정할 수 있는 정보라면 어떤 정보라도 보정 프레임(3230)에 포함될 수 있다.

[630]

[631] *보정 프레임(3230)을 전달하는 PPDU는 L-part 없이 새로운 구조로 구성될 수 있다.

[632] 한편, 동기 신호(3221, 3222, 3223) 및 보정 프레임(3230)을 송수신하는 절차는 각 STA의 UL MU 트리거 프레임(3210)을 전송하기 전에 수행될 수도 있다.

[633] 또한, 동기 신호(3221, 3222, 3223)의 전송을 생략하고, 암묵적(implicit)인 측정을 통해 AP가 UL MU 트리거 프레임(3210)에 보정 정보를 포함하여 전송할 수도 있다. 예를 들어, 후술하는 사전 절차(pre-procedure)에서 AP는 각 STA으로부터 전송되는 NDP 또는 버퍼 상태(buffer status)/사운딩(sounding) 프레임을 통해 각 STA 간의 시간/주파수/파워 등의 오차를 보정해주는 보정 정보를 생성하고, 보정 정보를 UL MU 트리거 프레임(3210)을 통해 각 STA에게 전송할 수도 있다.

[634] 또한, 보정할 필요가 없는 STA들이라면(예를 들어, 이전에 UL MU 전송을 수행할 각 STA 간에 보정 절차가 완료된 경우 등) 동기 신호(3221, 3222, 3223) 및 보정 프레임(3230)을 송수신하는 절차는 생략될 수도 있다.

[635] 또한, 일부의 보정 절차만 필요하다면 그 절차만 보정해 줄 수 있다. 예를 들어, UL MU 데이터 프레임의 CP(cyclic prefix) 길이가 STA 간의 어긋난 동기가 문제되지 않을 정도로 긴 경우, 시간 차이를 보정하기 위한 절차는 생략될 수 있다. 혹은 UL MU OFDMA 전송을 할 때 STA 간에 가드 밴드(Guard band)가 충분하다면 주파수 차이를 보정하기 위한 절차는 생략될 수 있다.

[636] 각 STA은 AP에 의해 전송되는 UL MU 트리거 프레임(3210) 및 보정 프레임(3230)을 기반으로 UL MU 데이터 프레임(UL MU Data frame, 3241, 3242, 3243)을 AP에 전송한다. 여기서, 각 STA은 AP로부터 보정 프레임(3230)을 수신 후 SIFS 이후에 UL MU 데이터 프레임(3241, 3242, 3243)을 AP에 전송할 수 있다.

[637] AP는 각 STA으로부터 수신한 상향링크 데이터 프레임(3241, 3242, 3243)에 대한 응답으로 ACK 프레임(ACK frame, 3250)(또는 BA(Block Ack) 프레임)을 전송할 수 있다. 여기서, AP는 각 STA으로부터 상향링크 데이터 프레임(3241, 3242, 3243)을 수신하고 SIFS 이후에 ACK 프레임(3250)을 각 STA에게 전송할 수 있다.

[638]

[639] 도 33은 본 발명의 일 실시예에 따른 OFDMA 다중 사용자(multi-user) 전송 방식에서 자원 할당 단위를 예시하는 도면이다.

[640] DL/UL OFDMA 전송 방식이 사용될 때, PPDU 대역폭 내에서 n개의

톤(tone)(또는 서브캐리어(subcarrier)) 단위로 복수 개의 자원 유닛(Resource Unit)이 정의될 수 있다.

[641] 자원 유닛은 DL/UL OFDMA 전송을 위한 주파수 자원의 할당 단위를 의미한다.

[642] 하나의 STA에게 DL/UL 주파수 자원으로 하나 이상의 자원 유닛이 할당되어, 복수 개의 STA에게 각각 서로 다른 자원 유닛이 할당될 수 있다.

[643] 도 33에서는 PPDU 대역폭이 20MHz인 경우를 예시한다.

[644] 도 33과 같이, 자원 유닛을 구성하는 톤의 개수는 다양할 수 있다.

[645] 예를 들어, 도 33(a)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 26개의 톤으로 구성될 수 있다. 또한, 도 33(b)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 52개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 또한, 도 33(c)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 106개의 톤으로 구성되거나 26개의 톤으로 구성될 수 있다. 또한, 도 33(d)와 같은 자원 유닛 구성 방식에 따르면, 하나의 자원 유닛은 242개의 톤으로 구성될 수 있다.

[646] 도 33(a)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 9개의 STA까지 지원할 수 있다. 또한, 도 33(b)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 5개의 STA까지 지원할 수 있다. 또한, 도 33(c)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역에서 DL/UL OFDMA 전송을 위해 최대 3개의 STA까지 지원할 수 있다. 또한, 32(d)와 같이 자원 유닛이 구성되는 경우, 20MHz 대역은 하나의 STA에게 할당될 수 있다.

[647] DL/UL OFDMA 전송에 참여하는 STA의 수 및/또는 해당 STA이 전송하는 혹은 수신하는 데이터의 양 등에 기반하여 도 33(a) 내지 도 33(d) 중에 어느 하나의 자원 유닛 구성 방식이 결정될 수 있다.

[648] 도 33(a) 내지 도 33(c)와 같은 자원 유닛 구성 방식에 따라 결정된 전체 자원 유닛 중 DL/UL OFDMA 전송을 위해 일부의 자원 유닛만이 이용될 수도 있다. 예를 들어, 20MHz 내에서 도 33(a)과 같이 자원 유닛이 구성되는 경우, 9개 미만의 STA에게 각각 하나씩 자원 유닛이 할당되고, 나머지 자원 유닛은 어느 STA에게도 할당되지 않을 수 있다.

[649] DL OFDMA 전송의 경우, PPDU의 데이터 필드는 각 STA에게 할당된 자원 유닛 단위로 주파수 영역(frequency domain)에서 다중화되어 전송된다.

[650] 반면, UL OFDMA 전송의 경우, 각 STA 별로 각각 자신이 할당 받은 자원 유닛 단위로 PPDU의 데이터 필드를 구성하고 동시에 AP에게 전송할 수 있다. 이처럼 각 STA이 동시에 PPDU를 전송하므로, 수신단인 AP 입장에서는 각 STA으로부터 전송되는 PPDU의 데이터 필드가 주파수 영역(frequency domain)에서 다중화되어 전송되는 것으로 인식될 수 있다.

[651] 또한, DL/UL OFDMA 전송과 DL/UL MU-MIMO 전송이 동시에 지원되는 경우,

하나의 자원 유닛은 공간 영역(spatial domain)에서 복수의 스트림으로 구성될 수 있다. 그리고, 하나의 STA에게 DL/UL 공간 자원(spatial resource)으로서 하나 이상의 스트림이 할당되어, 복수 개의 STA에게 각각 서로 다른 스트림이 할당될 수 있다.

[652] 예를 들어, 도 33(c)에서 106 톤으로 구성되는 자원 유닛 또는 도 33(d)와 같이 242 톤으로 구성되는 자원 유닛은 공간 영역(spatial domain)에서 복수의 스트림으로 구성되어 DL/UL OFDMA와 DL/UL MU-MIMO를 동시에 지원할 수 있다.

[653] 40MHz 이상의 대역폭에서 자원 유닛 구성 방식은 20MHz 대역 단위로 상술한 20MHz 대역의 자원 유닛 구성 방식이 동일하게 적용될 수 있다. 또한, 추가로 대역폭 중심에 가장 작은 자원 유닛(즉, 26톤으로 구성되는 자원 유닛)이 더 설정될 수도 있다.

[654]

[655] 도 34는 본 발명의 일 실시예에 따른 다중 사용자(multi-user) 전송 절차를 예시하는 도면이다. 본 도면과 관련하여 도 31 및 32와 중복되는 설명은 생략하기로 한다.

[656] AP는 DL MU 프레임을 적어도 하나의 STA으로 전송할 수 있으며, DL MU 프레임을 수신한 적어도 하나의 STA은 수신한 DL MU 프레임에 대한 응답으로서 ACK 프레임(또는 BA(Block Ack) 프레임)을 AP로 전송할 수 있다. 또한, AP는 UL MU 트리거 프레임을 전송함으로써 UL MU 데이터를 전송할 STA들에게 UL MU 전송을 준비할 것을 지시하고, UL MU 전송에 관한 정보(즉, 트리거 정보)를 제공할 수 있다.

[657] 이 경우, AP는 도 34(a)에 도시한 바와 같이, DL MU 프레임과 트리거 프레임을 서로 다른 시간 자원을 이용하여(또는 서로 다른 시점에) 전송할 수 있다. 이는 도 31 및 32와 관련하여 상술한 내용과 중복되므로 상세한 설명은 생략한다.

[658] 또는, AP는 도 34(b)에 도시한 바와 같이, DL MU 프레임과 트리거 프레임(또는, 트리거 정보)(미도시)을 동일한 시간 자원을 이용하여(또는 동시에) 전송할 수 있다. 이 경우, DL MU 프레임과 트리거 프레임은 동일한 DL MU PPDU에 포함되어 동시에 DL MU 전송될 수 있다. 이렇듯 DL MU 프레임과 트리거 프레임이 하나의 DL MU PPDU에 포함되어 전송되는 방식을 '캐스케이드 방식'이라 지칭할 수 있다. AP로부터 트리거 프레임 및 DL MU 프레임을 함께 수신한 STA은 상기 트리거 프레임에 대응하는 UL MU 프레임 및 상기 DL MU 프레임에 대한 응답인 ACK 프레임을 하나의 UL MU PPDU을 이용하여 UL MU 전송할 수 있다. 즉, STA은 수신한 DL MU PPDU에 대응하여 UL MU 프레임과 ACK 프레임이 포함된 하나의 UL MU PPDU를 UL MU 전송할 수 있다.

[659] 상술한 실시예에 따를 때, 트리거 프레임, SIFS, 및 물리 프리앰블로 인한 오버헤드가 줄어들게 되므로, 시간 자원이 절약되며 데이터 전송 효율이 증가한다는 효과가 발생한다.

[660] 이하에서는 상술한 내용을 바탕으로 DL MU 프레임과 트리거 프레임을 하나의 DL MU PPDU를 이용하여 DL MU 전송하는 본 발명의 다양한 실시예들에 관하여 상세히 후술하기로 한다.

[661]

[662] 도 35는 본 발명의 실시예에 따른 트리거 정보를 나르는 PPDU 구조를 도시한 예시한 도면이다. 본 실시예에서의 PPDU는 설명의 편의를 위해 DL MU 프레임은 나르지 않는다고 가정한다.

[663] UL MU 전송을 위한 트리거 정보는 아래와 같이 크게 2가지 방식으로 DL MU PPDU에 포함되어 DL MU 전송될 수 있다.

[664] 1. 트리거 정보가 NDP 포맷으로 전송되는 경우

[665] 제1 실시예로서 트리거 정보는 도 35(a)에 도시한 바와 같이, DL MU PPDU의 물리 프리앰블에 포함되어 있는 HE-SIG B 필드(또는 HE-SIG 필드)에 포함되어 DL MU 전송될 수 있다. 이와 같이 HE-SIG B 필드에 트리거 정보가 추가되는 경우, HE-SIG B 필드의 길이가 지나치게 길어져 통신 성능이 저하될 수 있다. 따라서, 본 명세서에서는 DL MU 전송을 위한 제1 HE-SIG B 필드 외에 UL MU 전송을 위한 제2 HE-SIG B 필드가 추가로 정의될 수 있는데 이에 관하여는 도 36 내지 38과 관련하여 이하에서 상세히 후술하기로 한다.

[666] 2. 트리거 정보가 MAC 프레임 포맷으로 전송되는 경우

[667] 제2 실시예로서 트리거 정보는 도 35(b)에 도시한 바와 같이, DL MU PPDU의 데이터 필드에 포함되어 있는 HE 포맷의 MAC 프레임에 포함되어 DL MU 전송될 수 있다. 이외에도, 본 도면에는 도시하지 않았으나, 트리거 정보는 레가시 포맷의 MAC 프레임에 포함되어 DL MU 전송될 수도 있다. 따라서, 이하에서 설명하는 MAC 프레임은 HE 포맷 및 레가시 포맷의 MAC 프레임을 통칭하는 의미일 수 있다. 이때, 트리거 정보를 포함한 MAC 프레임을 '트리거 프레임'이라 지칭할 수 있다. 트리거 프레임은 실시예에 따라 하나의 MPDU 또는 A-MPDU 포맷으로 구성될 수 있으며, 이에 관한 보다 상세한 설명은 도 39 및 40과 관련하여 이하에서 후술하기로 한다.

[668] 상술한 제1 실시예의 경우 오버헤드가 적다는 효과를 갖는다. 제2 실시예의 경우, 트리거 프레임을 레가시 포맷을 이용하여 구성하거나, HE 포맷을 이용하여 구성할 수 있다는 유연성(flexibility)을 갖는다.

[669] 도 36은 본 발명의 제1 실시예에 따른 DL MU PPDU의 구조를 도시한 도면이다.

[670] 도 36을 참조하면, 본 발명의 제1 실시예에 따른 DL MU PPDU는 레가시 프리앰블(L-STF 필드, L-LTF 필드, 및 L-SIG 필드 포함), 상기 레가시 프리앰블에 뒤따르는 HE-SIG A 필드, 상기 HE-SIG A 필드에 뒤따르는 제2 HE-SIG B 필드(또는 HE-SIG B for UL)(3620), 상기 제2 HE-SIG B 필드에 뒤따르는 제1 HE-SIG B 필드(또는 HE-SIG-B)(3610), 상기 제1 HE-SIG B 필드(3610)에 뒤따르는 HE 프리앰블(HE-STF 필드 및 HE-LTF 필드 포함), 및 상기 HE-프리앰블에 뒤따르는 데이터 필드로 구성될 수 있다. 상술한 필드의 순서는

예시에 불과하며, 실시예에 따라 다양한 순서로 구성될 수 있으며, 상술한 필드는 실시예에 따라 선택적으로 DL MU PPDU에 포함될 수 있다.

[671] 제1 HE-SIG B 필드(3610)에는 DL MU PPDU의 데이터 필드를 수신하는(또는 데이터 필드가 할당된) STA별 사용자 특정 정보(User specific information)가 포함되어 있을 수 있다. 여기서 사용자 특정 정보는 상기 제1 HE-SIG B 필드에 의해 자원(주파수 자원 및 공간 자원 포함)이 할당된 STA들 중 특정 STA에 개별적으로 요구되는 제어 정보를 의미한다. 사용자 특정 정보는 DL MU 자원(주파수/공간 자원)이 할당된 STA(또는 수신(Receiving) STA)별 식별 정보(예를 들어, AID, PAID(Partial AID), GID(Group Identifier) 등), STA별 공간 자원 할당 정보, STA별로 할당된 데이터 필드의 MCS 정보, 빔 포밍(beamforming) 전송 여부를 지시하는 빔 포밍 정보, 시공간 블록 코딩 적용 여부를 지시하는 STBC(Spce Time Block Coding) 정보, 및 에러 정정 코드 정보 중 적어도 하나를 포함할 수 있다.

[672] 제2 HE-SIG B 필드(3620)는 UL MU 전송을 위한 트리거 정보를 포함할 수 있다. 트리거 정보는 UL MU 전송을 수행하는 STA(또는 수신(Receiving) STA)별 식별 정보, UL MU 전송을 위한 공간 자원/주파수 자원 지시 정보 중 적어도 하나를 포함할 수 있다. 이때, 제2 HE-SIG B 필드(3620)에 포함되는 STA별 식별 정보에 포함되는 식별자(ID: Identifier) 포맷은 제1 HE-SIG B 필드(3610)의 STA별 식별 정보에 포함되는 식별자(ID: Identifier) 포맷과 다를 수 있다. 예를 들어, 제2 HE-SIG B 필드(3620)의 STA별 식별 정보에 포함되는 식별자는 제1 HE-SIG B 필드(3610)에서 사용되는 AID, PAID, GID 등을 사용하지 않고 새로 정의된 ID 포맷을 사용할 수 있다.

[673] 제1 HE-SIG B 필드(3610)와 제2 HE-SIG B 필드(3620)는 각 필드에 포함되어 있는 지시 비트(indication bit)를 통해 구별될 수 있다. 예를 들어, 제1 HE SIG B 필드(3610) 및 제2 HE-SIG B 필드(3620)는 각각 1-bit 사이즈의 지시 비트를 포함할 수 있다.

[674] 만일, 특정 HE-SIG B 필드 내의 지시 비트 값이 '1'로 설정되어 있는 경우, 해당 HE-SIG B 필드는 UL MU 전송을 위한 트리거 정보를 포함하는 제2 HE-SIG B 필드(3620)이며, 뒤따르는 제1 HE-SIG B 필드(3610)가 추가로 존재함을 의미할 수 있다. 반대로, 특정 HE-SIG B 필드 내의 지시 비트 값이 '0'으로 설정되어 있는 경우, 해당 HE-SIG B 필드는 DL MU 전송을 위한 사용자 특정 정보를 포함하는 제1 HE-SIG B 필드(3610)이며, 뒤따르는 제2 HE-SIG B 필드(3620)가 추가로 존재하지 않음을 의미할 수 있다. 이외에도 다양한 방식으로 제1 HE-SIG B 필드(3610)와 제2 HE-SIG B 필드(3620)는 구별될 수 있으며 상술한 실시예에 한정되는 것은 아니다.

[675] DL MU PPDU가 제1 HE-SIG B 필드(3610) 및 제2 HE-SIG B 필드(3620)를 포함하는 경우(즉, HE-SIG B 필드를 복수 개 포함하는 경우), HE-SIG A 필드에서 제1 HE-SIG B 필드(3610) 및 제2 HE-SIG B 필드(3620) 각각에 적용된 MCS

레벨에 관한 정보를 모두 제공할 수 있다. 또한, HE-SIG A 필드에서 HE-SIG B 필드의 개수, 기능, 타입 및/또는 용도 등에 대한 정보도 함께 제공할 수 있다.

[676] 도 36에서 제2 HE-SIG B 필드(3620)→제1 HE-SIG B 필드(3610) 순서로 구성된 DL MU PPDU를 예시하여 도시하였으나, 이에 한정되는 것은 아니며 두 HE-SIG B 필드들(3610, 3620) 중에 더 낮은 MCS 레벨을 갖는 HE-SIG B 필드가 우선적으로 위치할 수 있다. 여기서, 더 높은/낮은 MCS 레벨이란 심볼 당 데이터 비트 수가 더 높은/낮은 변조 방식을 지시하는 MCS 레벨을 의미하거나, 또는 변조 방식이 동일한 경우 더 높은/낮은 코드 레이트를 지시하는 MCS 레벨을 의미할 수 있다. MCS 레벨이 낮을수록 강인한(robust) 전송에 유리하다.

[677] 예를 들어, 제1 HE-SIG B 필드(3610)가 BPSK 변조 및 1/2 코드 레이트를 지시하는 MCS 레벨을 가지며, 제2 HE-SIG B 필드(3620)가 QPSK 변조 및 1/2 코드 레이트를 지시하는 MCS 레벨을 갖는 경우를 가정해볼 수 있다. 이 경우, 제1 HE-SIG B 필드(3610)가 제2 HE-SIG B 필드(3620)에 비해 더 낮은 MCS 레벨을 가지므로, 제1 HE-SIG B 필드(3610)→제2 HE-SIG B 필드(3620) 순으로 DL MU PPDU가 구성될 수 있다.

[678] 이 경우, 앞서는 HE-SIG B 필드는 뒤따르는 HE-SIG B 필드의 존재 여부에 관한 정보, 구성 정보, 및 MCS 정보를 제공할 수도 있다. 즉, 본 도면(도 36)의 경우, 제2 HE-SIG B 필드(3620)는 뒤따르는 제1 HE-SIG B 필드(3610)의 존재 여부에 관한 정보, 구성 정보, 및 MCS 정보를 제공할 수 있다.

[679] 데이터 필드는 제1 HE-SIG B 필드(3610)에 포함된 자원 할당 정보에 따라 주파수 다중화 또는 공간 다중화 되어 자원을 할당 받은 적어도 하나의 STA에 할당 및 전송될 수 있다.

[680] AP는 상술한 필드들을 포함한 DL MU PPDU를 적어도 하나의 STA에 DL MU 전송할 수 있다. DL MU PPDU를 수신한 적어도 하나의 STA은 수신한 DL MU PPDU에 기초하여 UL MU PPDU를 AP로 전송할 수 있다. 이 경우, 하나의 DL MU PPDU를 통해 동시에 전송되는 DL MU 프레임 및 트리거 프레임과 유사하게 UL MU 프레임과 ACK 프레임(또는 BA 프레임(frame))도 하나의 UL MU PPDU를 통해 동시에 AP로 전송될 수 있다. 즉, UL MU 프레임 및 ACK 프레임도 캐스케이드 방식으로 하나의 UL MU PPDU에 포함되어 동시에 전송될 수 있다. 이에 관하여 도 37 및 38과 관련하여 상세히 후술하기로 한다.

[681]

[682] 도 37은 본 발명의 일 실시예에 따른 DL MU PPDU 및 상기 DL MU PPDU에 대한 응답으로서 전송되는 UL MU PPDU를 도시한 도면이다. 본 실시예에서 DL MU PPDU의 HE-SIG B 필드는 제1 HE-SIG B 필드(3710)→제2 HE-SIG B 필드(3720) 순으로 구성될 수 있다. 또한, DL MU 자원은 STA 1~4에, UL MU 자원은 STA 5, 6에 각각 할당된 경우를 가정하여 설명하기로 한다. 즉, DL MU 프레임을 수신하는 STA(STA 1~4)과 트리거 정보를 수신하는 STA(STA 5, 6)이 상이한 경우를 가정하여 설명하기로 한다.

[683] 도 37(a)를 참조하면, 제1 HE-SIG B 필드(3710)는 STA 1~4에 대한 DL MU 자원의 할당 정보(또는 사용자 특정 정보)를 포함할 수 있다. 예를 들어, 제1 HE-SIG B 필드(3710)는 STA 1~4에 대한 식별 정보, 주파수 자원 할당 정보 및 공간 자원 할당 정보 중 적어도 하나를 포함할 수 있다. 제2 HE-SIG B 필드(3720)는 STA 5, 6에 대한 UL MU 자원의 할당 정보(또는 UL MU 전송을 위한 트리거 정보)를 포함할 수 있다. 예를 들어, 제2 HE-SIG B 필드(3720)는 STA 5, 6에 대한 식별 정보, UL MU 전송을 위한 공간 자원/주파수 자원 지시 정보 중 적어도 하나를 포함할 수 있다. STA 1~4에 각각 할당된 데이터 필드는 STA 1~4에 각각 수신되는 DL MU 프레임을 포함할 수 있다. 데이터 필드는 주파수 다중화 및/또는 공간 다중화되어 DL MU 전송될 수 있다.

[684] AP는 상술한 필드들을 포함하는 DL MU PPDU를 DL MU 전송할 수 있다. DL MU PPDU를 수신한 STA 1~6은 수신한 DL MU PPDU를 기초로 생성한 UL MU PPDU를 전송할 수 있다.

[685] 보다 상세하게는, 도 37(b)를 참조하면, DL MU 프레임을 수신한 각 STA 1~4는 수신한 DL MU 프레임에 대한 응답으로서 ACK 프레임(또는 BA 프레임(frame))을, 트리거 정보를 수신한 STA 5, 6은 트리거 정보를 기초로 생성한 UL MU 프레임을 하나의 UL MU PPDU에 포함시켜 UL MU 전송할 수 있다. 이 경우, STA 1의 ACK 프레임(또는 BA 프레임(frame))과 STA 5의 UL MU 프레임은 UL MU 전송 STA이 상이하며, 전송 시 이용하는 UL MU 자원도 상이하므로, STA 1의 ACK 프레임은 STA 5의 UL MU 프레임에 피기백되어 전송될 수 없다. 또한, STA 1~4별로 전송하는 ACK 프레임의 길이 역시 상이할 수 있다. 즉, 하나의 DL MU PPDU를 통해 DL MU 프레임을 수신하는 STA과 트리거 정보를 수신하는 STA이 상이한 경우, 수신 STA들이 ACK 프레임과 UL MU 프레임을 하나의 UL MU PPDU를 이용하여 UL MU 전송하는 것은 어려울 수 있다.

[686] 또한, 만일 STA 1~4의 DL MU 프레임의 수신 실패 등의 다양한 원인으로 STA 1~4가 ACK 프레임(또는 BA 프레임(frame))을 UL MU 전송하지 않는 경우, ACK 프레임(또는 BA 프레임(frame)) 전송 부재로 인한 소정의 빈 시간 구간(time hole)이 발생하게 된다. 경쟁 기반의 채널 액세스 방식을 채용하는 시스템에서는 상기 소정의 시간 간격 동안 다른 STA에 의해 매체가 점유될 수 있으며, 그 결과 트리거 정보를 수신한 STA 5, 6의 UL MU 전송이 실패할 수 있다.

[687] 따라서, 이러한 문제를 방지하기 위한 새로운 DL MU PPDU 및 상기 DL MU PPPDU에 대한 응답으로서 전송되는 UL MU PPDU의 구성을 이하 도 38과 참조하여 제안하고자 한다.

[688]

[689] 도 38은 본 발명의 다른 실시예에 따른 DL MU PPDU 및 UL MU PPDU를 도시한 도면이다. 본 실시예에서 DL MU PPDU의 HE-SIG B 필드는 제1 HE-SIG B 필드(3810)→제2 HE-SIG B 필드(3820) 순으로 구성될 수 있다. 또한, DL MU

자원은 STA 1~4에, UL MU 자원은 STA 1, 2에 각각 할당된 경우를 가정하여 설명하기로 한다. 즉, 트리거 정보를 수신하는 STA(STA 1, 2)이 DL MU 프레임을 수신하는 STA(STA 1~4)의 서브셋인 경우를 가정하여 설명하기로 한다.

[690] 도 38(a)를 참조하면, 제1 HE-SIG B 필드(3810)는 STA 1~4에 대한 DL MU 자원의 할당 정보(또는 사용자 특정 정보)를 포함할 수 있다. 예를 들어, 제1 HE-SIG B 필드(3810)는 STA 1~4에 대한 식별 정보, 주파수 자원 할당 정보 및 공간 자원 할당 정보 중 적어도 하나를 포함할 수 있다.

[691] 제2 HE-SIG B 필드(3820)는 STA 1, 2에 대한 UL MU 자원의 할당 정보(또는 UL MU 전송을 위한 트리거 정보)를 포함할 수 있다. 예를 들어, 제2 HE-SIG B 필드(3820)는 STA 1, 2에 대한 식별 정보, UL MU 전송을 위한 공간 자원/주파수 자원 지시 정보 중 적어도 하나를 포함할 수 있다.

[692] 데이터 필드는 DL MU 자원이 할당된 STA 1~4에 각각 수신되는 DL MU 프레임을 포함할 수 있다. 데이터 필드는 주파수 다중화 및/또는 공간 다중화되어 DL MU 전송될 수 있다.

[693] AP는 상술한 필드들을 포함하는 DL MU PPDU를 DL MU 전송할 수 있다. DL MU PPDU를 수신한 STA 1~4는 수신한 DL MU PPDU를 기초로 생성한 UL MU PPDU를 UL MU 전송할 수 있다.

[694] 보다 상세하게는, 도 38(b)를 참조하면, DL MU 프레임과 트리거 정보를 함께 수신한 STA 1, 2는 수신한 DL MU 프레임에 대한 응답인 ACK 프레임(또는 BA 프레임(frame))을, 수신한 트리거 정보에 기초하여 생성한 UL MU 프레임에 피기백(piggy-back)하여 UL MU 전송할 수 있다. 이하에서는 설명의 편의를 위해 ACK 프레임(또는 BA 프레임(frame))이 UL MU 프레임에 피기백된 프레임을 '캐스케이드 UL MU 프레임'이라 지칭할 수 있다. 이러한 캐스케이드 UL MU 프레임은 각 STA 1, 2에 수신된 DL MU 프레임의 전송 시 사용된 DL MU 자원을 동일하게 사용하여 UL MU 전송될 수 있다.

[695] 또한, DL MU 프레임만을 수신한 STA 3, 4는 수신한 DL MU 프레임에 대한 응답인 ACK 프레임(또는 BA 프레임(frame))을 UL MU 전송할 수 있다. 이 경우에도, ACK 프레임(또는 BA 프레임(frame))은 각 STA 3, 4에 수신된 DL MU 프레임의 전송 시 사용된 DL MU 자원을 동일하게 사용하여 UL MU 전송될 수 있다.

[696] 각 STA은 하나의 DL MU PPDU를 통해 수신된 DL MU 프레임의 전송 자원과 동일한 자원을 이용하여 UL MU 전송을 수행하므로, 상술한 캐스케이드 UL MU 프레임과 ACK 프레임(또는 BA 프레임(frame))은 하나의 동일한 UL MU PPDU를 통해 UL MU 전송될 수 있다. 이때, 각 ACK 프레임(또는 BA 프레임(frame))은 UL MU 프레임의 최대 비트 사이즈와 동일한 비트 사이즈를 갖도록 패딩될 수 있다.

[697] 도 38(c)를 참조하면, STA 1, 2에 의해 UL MU 전송된 UL MU PPDU를 수신한 AP는, 수신한 UL MU 프레임에 대한 응답인 ACK 프레임(또는 BA 프레임(frame))을 STA 1, 2로 DL SU 전송할 수 있다. 이 경우, AP는 수신한 UL

MU PPDU의 대역폭과 동일한 대역폭을 갖는 DL SU PPDU를 이용하여 ACK 프레임(또는 BA 프레임(frame))을 DL SU 전송할 수 있다. 또한, ACK 프레임(또는 BA 프레임(frame))은 DL MU PPDU 내에서 20MHz 단위로 복제되어 DL SU 전송될 수 있다.

[698] 본 실시예의 경우, STA 1~4의 ACK 프레임(또는 BA 프레임(frame)) 전송 실패로 인한 소정의 빈 시간 구간(time hole)이 발생하지 않게 되므로(동일한 UL MU PPDU를 통해 전송되므로), 다른 STA의 매체 점유로 인하여 STA 1, 2의 UL MU 프레임 전송이 실패한다는 문제가 발생하지 않는다.

[699]

[700] 도 37 및 38과 관련하여 상술한 내용을 고려해볼 때, 트리거 정보를 수신하는 STA이 DL MU 프레임을 수신하는 STA의 서브셋인 경우에 STA의 UL MU 프레임 전송이 실패하지 않음을 확인할 수 있다. 다시 말하면, DL MU 프레임을 수신하는 STA 중 일부가 UL MU 프레임의 전송을 수행하는 경우에 해당 UL MU 프레임 전송이 실패하지 않음을 확인할 수 있다.

[701] 따라서, 이러한 UL MU 프레임의 전송 실패를 방지하기 위해 AP는 트리거 정보를 수신하는 STA과 DL MU 프레임을 수신하는 STA 사이에 서브셋 조건을 만족하는 경우에 트리거 정보 및 DL MU 프레임이 포함된 DL MU PPDU를 DL MU 전송할 수 있다. 그 결과, DL MU PPDU에 대응하여 UL MU 전송되는 UL MU PPDU에는 캐스케이드 UL MU 프레임이 적어도 하나 존재할 수 있다.

[702] 이외에도 UL MU 프레임의 전송 실패를 방지하고, 자원(주파수, 시간, 공간 자원)을 효율적으로 사용하기 위해 ACK 프레임(또는 BA 프레임(frame))과 UL MU 프레임을 하나의 UL MU PPDU를 이용하여 UL MU 전송하는 또 다른 UL MU PPDU의 구조가 제안될 수 있다. 이 경우, DL MU 수신 STA과 UL MU 전송 STA 사이에 서브셋 조건이 만족되지 않아도 된다. 이에 관하여는 도 42와 관련하여 이하에서 상세히 후술하기로 한다.

[703] 한편, 본 실시예에서 ACK 프레임(또는 BA 프레임(frame))은 802.11a 시스템 또는 802.11ax 시스템에서 정의된 ACK 프레임(또는 BA 프레임(frame)) 포맷이 적용될 수 있다. 다만, UL MU 프레임과 함께 전송되는 경우에는 802.11ax 시스템에서 정의된 ACK 프레임(또는 BA 프레임(frame)) 포맷이 적용될 수 있다.

[704] 이하에서는 설명의 편의를 위해 ACK 프레임과 BA 프레임을 통칭하여 'ACK 프레임'이라 지칭하기로 한다.

[705]

[706] 상술한 실시예에서는 하나의 DL MU PPDU를 통해 수신된 DL MU 프레임의 전송 자원과 동일한 자원을 이용하여 UL MU 전송하는 실시예를 기준으로 설명하였다. 그러나, 캐스케이드 UL MU 프레임 및/또는 UL MU 프레임은 DL MU 프레임의 DL MU 전송 자원과 다른 자원을 이용하여 UL MU 전송될 수 있다. 이 경우, HE-SIG B 필드는 STA이 UL MU 전송할 프레임의 포맷과 각 STA에 할당된 UL MU 전송 자원 등의 지시 정보 등을 별도로 제공할 수도 있다.

이에 관한 상세한 설명은 이하에서 후술하기로 한다.

[707] 1) 제1 옵션

[708] 제1 HE-SIG B 필드(3810)에는 포함되나 제2 HE-SIG B 필드(3820)에 포함되지 않는 STA(또는 ACK 프레임만을 UL MU 전송할 STA)에 우선적으로 UL MU 자원을 할당하고, 남은 UL MU 자원을 캐스케이드 UL MU 프레임 및/또는 UL MU 프레임을 전송할 자원으로서 할당하는 방법이 제안될 수 있다. 이때, 각 ACK 프레임에 우선적으로 할당되는 UL MU 자원의 종류 및 사이즈는 미리 설정되어 있을 수 있으며, 제1 HE-SIG B 필드(3810)에 포함된 DL MU 프레임 수신 STA ID 순서대로 미리 설정된 UL MU 자원을 할당 받을 수 있다.

[709] 예를 들어, 제1 HE-SIG B 필드(3810)에 STA 1~4가 순차적으로 포함되고, ACK 프레임만을 UL MU 전송할 STA이 STA 2, 3인 경우를 가정해볼 수 있다. 또한, ACK 프레임 전송을 위해 할당되는 UL MU 자원은 하나의 26-톤 자원 유닛으로 미리 설정되어 있다고 가정해볼 수 있다. 이 경우, ACK 프레임을 전송할 자원으로서 첫 번째 26-톤 자원 유닛부터 STA 2→STA 3 순으로 하나씩 할당될 수 있다. 각 STA에 할당되고 남는 자원 유닛은 제2 HE-SIG B 필드(3820)에 포함된 수신 STA ID에 할당할 수 있다.

[710] 2) 제2 옵션

[711] 제1 HE-SIG B 필드(3810)에서 DL MU 프레임의 수신 STA별 ACK 프레임 포맷과 전송 자원을 지시하는 방법이 제안될 수 있다. 예를 들어, 제1 HE-SIG B 필드(3810)는 수신 STA별로 ACK 프레임 포맷과 전송 자원을 지시하는 ACK 프레임 지시자를 포함할 수 있다. ACK 프레임 지시자는 대응하는 STA이 ACK 프레임을 전송해야 하는 STA인지, 캐스케이드 UL MU 프레임(ACK 프레임+UL MU 프레임)을 전송해야 하는 STA인지를 지시할 수 있다. 만일, 대응하는 STA이 ACK 프레임을 전송해야 하는 STA인 경우, ACK 프레임 지시자는 ACK 프레임을 전송하는 데 사용할 UL MU 전송 자원에 관한 정보도 추가로 지시할 수 있다.

[712] 예를 들어, ACK 프레임 지시자의 비트 사이즈가 1-bit인 경우를 가정해볼 수 있다.

[713] 이때 만일, ACK 프레임 지시자의 비트 값이 '0'으로 설정된 경우, 해당 ACK 프레임 지시자는 대응하는 STA이 캐스케이드 UL MU 프레임을 전송해야 하는 STA이거나 ACK 프레임을 전송할 필요가 없는 STA임(DL MU 프레임이 No ACK 프레임인 경우)을 지시할 수 있다.

[714] 반대로, ACK 프레임 지시자의 비트 값이 '1'로 설정된 경우, 해당 ACK 프레임 지시자는 대응하는 STA이 ACK 프레임을 전송해야 하는 STA임을 지시할 수 있다.

[715] ACK 프레임을 전송해야 하는 STA은 제1 옵션에서와 같이 제1 HE-SIG B 필드(3810)에 포함된 수신 STA ID 순서대로 할당된 기설정된 사이즈의 UL MU 자원을 이용하여 ACK 프레임을 전송할 수 있다. 또는, 앞서 상술한 바와 같이, ACK 프레임 지시자가 ACK 프레임을 전송하는 데 사용할 UL MU 자원에 관한

정보를 추가로 지시할 수도 있다. 이 경우, STA은 ACK 프레임 지시자가 지시하는 UL MU 자원을 이용하여 ACK 프레임을 UL MU 전송할 수 있다.

[716] 3) 제3 옵션

[717] 제2 HE-SIG B 필드(3820)에서 STA 별로 UL MU 전송할 프레임의 포맷과 해당 프레임의 UL MU 전송 자원에 관한 정보를 제공하는 방법이 제안될 수 있다. 제2 HE-SIG B 필드(3820)는 제1 HE-SIG B 필드(3810)에 포함된 수신 STA(또는 DL MU 프레임을 수신하는 수신 STA) 별로 프레임 포맷으로서 ACK 프레임, 캐스케이드 UL MU 프레임, 또는 UL MU 프레임을 전송할지 여부를 지시할 수 있다. 이 경우, 제2 HE-SIG B 필드(3820)는 제1 HE-SIG B 필드(3810)에 포함된 수신 STA ID을 참조하여(예를 들어, 제1 HE-SIG B 필드(3810)에 포함된 수신 STA ID 순서대로) 각 수신 STA에 대응하는 프레임 포맷을 지시할 수 있다. 나아가, 제2 HE-SIG B 필드(3820)는 각 프레임(ACK 프레임, 캐스케이드 UL MU 프레임, 또는 UL MU 프레임)을 UL MU 전송하는 데 사용할 UL MU 자원의 할당 정보도 STA별로 함께 제공할 수 있다.

[718] 4) 제4 옵션

[719] 캐스케이드 UL MU 프레임 또는 UL MU 프레임을 전송하는 STA들에 대하여 우선적으로 UL MU 자원을 할당하고, 남은 UL MU 자원을 ACK 프레임을 전송하는 STA에 할당하는 방법이 제안될 수 있다. 이러한 STA별 자원 할당 정보는 제2 HE-SIG B 필드(3820)를 통해 제공될 수 있다.

[720] 5) 제5 옵션

[721] 제2 HE-SIG B 필드(3820)에서 트리거 정보와 함께 DL MU 프레임을 수신하는 수신 STA을 비트맵 형식으로 지시하는 방법이 제안될 수 있다. 예를 들어, 제2 HE-SIG B 필드(3820)의 트리거 정보를 수신하는 STA 수가 N이라고 하면, 제2 HE-SIG B 필드(3820) 내에 N-bits를 구성한 후, N-bits 내에서 DL MU 프레임을 추가로 수신하는 STA에 대응하는 위치의 비트 값을 '1'로 설정할 수 있다. 이 경우, 제2 HE-SIG B 필드(3820)는 '1' 값을 갖는 비트 위치에 대응하는 STA들에 캐스케이드 UL MU 프레임을 전송하기 위한 UL MU 자원 할당 정보도 추가로 지시할 수 있다. 반대로, '0' 값을 갖는 비트 위치에 대응하는 STA들에는 ACK 프레임을 전송하기 위한 UL MU 자원 할당 정보를 제1 내지 제4 옵션에서 제안된 방식으로 지시할 수 있다.

[722] 이외에 제2 HE-SIG B 필드(3820)는 UL MU 프레임만 전송하는 STA들이 존재하는 경우, 해당 STA들의 STA ID와 각 STA에 할당된 UL MU 자원을 지시할 수 있다.

[723] 이상으로, 트리거 정보가 DL MU PPDU의 물리 프리앰블(특히, 물리 프리앰블의 HE-SIG B 필드)에 포함되어 전송되는 실시예에 관하여 자세히 상술하였다. 이하에서는 트리거 정보가 포함된 트리거 프레임(즉, 트리거 정보의 MAC 프레임 포맷)이 DL MU PPDU의 데이터 필드에 포함되어 전송되는 실시예에 관하여 이하에서 자세히 후술하기로 한다.

[724]

[725] 트리거 프레임이 MAC 프레임의 구조로 구성되는 경우, 트리거 프레임은 하나의 MPDU로 구성될 수 있다. 이 경우, 트리거 프레임은 MAC 제어 프레임(control frame) 또는 MAC 관리 프레임(management frame)의 타입에 해당될 수 있으며, 이와 상이하게 트리거 프레임 타입이 새롭게 정의될 수도 있다.

[726] 또는, 트리거 프레임은 MAC 헤더 내 HT 제어(HT-Control) 필드를 포함하는 프레임(예를 들어, HT-Control 래퍼(warpper) 프레임)으로 구성될 수 있다.

[727] 이 경우, UL MU 전송을 위한 정보(즉, 트리거 정보)는 해당 프레임 내의 HT-Control 필드에 포함될 수 있다. 또는, 트리거 정보는 802.11ax 시스템에서 HE 포맷으로 새롭게 정의된 HE-Control 필드에 포함될 수도 있다. HE-Control 필드는 기존 HT 포맷에서 정의된 HT-Control 필드와 유사한 방식으로 802.11ax 시스템에서 새로이 정의될 수 있다. 따라서, HE-Control 필드는 앞서 도 6에서 예시한 HT-Control 필드가 MAC 헤더에 포함되는 방식과 유사한 방식으로 MAC 헤더에 포함될 수 있다.

[728] 트리거 프레임은 DL MU PPDU에 포함되는 방식에 따라 다음과 같이 크게 2가지 구조로 구분될 수 있다.

[729] 1) 제2-1 실시예

[730] DL MU 프레임을 수신하는 STA 중 일부가 UL MU 전송을 수행하는 경우(즉, UL MU 전송 STA이 DL MAC 프레임 수신 STA의 서브셋인 경우), DL MU PPDU는 데이터 필드 내에서 A-MPDU를 포함할 수 있으며, 해당 A-MPDU는 트리거 프레임에 해당하는 적어도 하나의 MPDU와 DL MU 프레임에 해당하는 나머지 MPDU로 구성될 수 있다. 이때, UL MU 전송을 위한 정보(즉, 트리거 정보)는 해당 A-MPDU 내 MAC 헤더 또는 MAC 프레임 바디에 포함될 수 있다. 이에 관한 보다 상세한 설명은 도 39와 관련하여 이하에서 후술하기로 한다.

[731] 2) 제2-2 실시예

[732] 또는, DL MU 프레임을 수신하는 STA이 UL MU 전송을 수행하지 않는 경우(즉, UL MU 전송 STA이 DL MAC 프레임 수신 STA의 서브셋(subset)이 아닌 경우), DL MU PPDU는 데이터 필드 내 트리거 프레임에 해당하는 MPDU만을 포함할 수 있다. 이때, UL MU 전송을 위한 정보(즉, 트리거 정보)는 해당 MPDU내 MAC 헤더 또는 MAC 프레임 바디에 포함될 수 있다. 이에 관한 보다 상세한 설명은 도 40과 관련하여 이하에서 후술하기로 한다.

[733]

[734] 도 39는 본 발명의 제2-1 실시예에 따른 DL MU PPDU의 구조를 도시한 도면이다.

[735] 도 39를 참조하면, DL MU 프레임을 수신하는 STA 중 일부가 UL MU 전송을 수행하는 경우(또는, DL MU 프레임과 트리거 프레임을 함께 수신하는 STA이 존재하는 경우), 상기 일부 STA 별로 할당된 데이터 필드는 도 17의 예시와 같이

A-MPDU 포맷으로 구성될 수 있다. 이때, A-MPDU를 구성하는 복수의 MPDU 중 적어도 하나의 MPDU는 트리거 프레임에 해당하며, 나머지 MPDU는 DL MU 프레임에 해당할 수 있다.

[736] 이때, 트리거 정보를 포함하는 MPDU의 위치가 미리 지정될 수 있다. 예를 들어, A-MPDU를 구성하는 복수의 MPDU 중 첫 번째 MPDU는 트리거 프레임에 해당하며, 나머지 MPDU는 DL MU 프레임에 해당할 수 있다. 이 경우, AP는 비콘 프레임(beacon frame) 등을 통해 미리 지정된 MPDU 위치를 STA들에게 알려줄 수 있다.

[737] 그리고 상기 일부 STA을 제외한 나머지 STA에 할당된 데이터 필드는 MPDU 또는 A-MPDU 포맷으로 구성될 수 있으며, 해당 MPDU 또는 A-MPDU는 DL MU 프레임에 해당할 수 있다.

[738] 하나의 A-MPDU에 포함된 트리거 프레임과 DL MU 프레임의 수신 STA는 동일하므로, 트리거 프레임에 대한 수신 STA 정보는 별도로 요구되지 않을 수 있다. 따라서, 트리거 프레임은 UL MU 전송을 수행하는 STA에 관한 정보는 별도로 포함하지 않을 수 있다. 트리거 프레임에 대응하는 MPDU는 해당 MPDU가 트리거 정보를 포함하고 있음을 지시하기 위한 지시자를 포함할 수 있다. 예를 들어, 트리거 정보를 포함하는 MPDU는 MAC 헤더에 포함되어 있는 프레임 서브타입을 이용하여 해당 MPDU가 트리거 프레임에 해당함을 알려줄 수 있다.

[739] 상술한 제2-1 실시예는 UL MU 전송 STA이 DL MU 프레임 수신 STA의 서브셋인 경우에 적용되므로 UL MU 스케쥴링에 있어 일정한 제한이 존재할 수 있다.

[740] 한편, 본 실시예에서 DL MU 전송에 참여하는 STA에게 전송되는 트리거 프레임을 '유니캐스트 트리거 프레임'이라 지칭할 수도 있다.

[741]

[742] 도 40은 본 발명의 제2-2 실시예에 따른 DL MU PPDU의 구조를 도시한 도면이다.

[743] 도 40을 참조하면, DL MU 프레임을 수신하는 STA이 UL MU 전송을 수행하지 않는 경우(또는, 트리거 프레임과 DL MU 프레임을 함께 수신하는 STA이 존재하지 않는 경우), DL MU 프레임을 나르는 DL MU PPDU의 데이터 필드 중 특정 데이터 필드에 트리거 프레임이 포함될 수 있다. 보다 상세하게는, DL MU 프레임을 나르는 DL MU PPDU의 데이터 필드의 전송 자원은 DL OFDMA 및/또는 DL MU-MIMO 방식에 따라 다중화될 수 있으며, 다중화된 데이터 필드 중 특정 데이터 필드를 이용하여 트리거 프레임을 나를 수 있다. 예를 들어, 트리거 프레임을 전달하기 위하여 미리 정해진 서브밴드에 대응하는 데이터 필드 내에 트리거 프레임이 포함될 수 있다.

[744] DL MU 프레임을 나르는 DL MU PPDU의 데이터 필드 중 특정 데이터 필드에 트리거 프레임이 포함되는 경우, 해당 특정 데이터 필드는 트리거 프레임에

해당하는 하나의 MPDU만을 포함할 수 있다. 이때, UL MU 전송을 위한 정보(즉, 트리거 정보)는 해당 MPDU 내 MAC 헤더 또는 MAC 프레임 바디에 포함될 수 있다. 특히, 본 실시예에서 UL MU 전송 STA과 DL MU 수신 STA이 상이하므로, HE-SIG B 필드에 포함되어 있는 DL MU 수신 STA 정보 외에 트리거 정보를 수신하는 STA 정보가 추가로 요구될 수 있다. 따라서, 제2-1 실시예와는 다르게, 제2-2 실시예에서는 트리거 프레임에 대응하는 MPDU 내에 트리거 정보로서 트리거 프레임을 수신하는 STA 정보(또는, UL MU 전송을 수행할 STA 정보)와 각 STA에 할당된 UL MU 자원 할당 정보가 모두 포함되어 있을 수 있다.

[745] 트리거 프레임을 포함한 특정 데이터 필드는 브로드캐스트로 전송될 수 있다. 따라서, 특정 데이터 필드의 AID는 브로드캐스트 AID로 설정될 수 있으며, 특정 데이터 필드의 트리거 프레임에는 UL MU 전송이 트리거되는 STA들의 AID가 포함될 수 있다. 따라서, 특정 데이터 필드에 포함된 하나의 MPDU(또는 해당 MPDU에 포함된 트리거 프레임)를 '브로드캐스트 트리거 프레임'이라 지칭할 수도 있다. 다시 말하면, DL MU 전송에 참여하지 않는 STA에게 전송되는 트리거 프레임을 '브로드캐스트 트리거 프레임'이라 지칭할 수 있다.

[746] DL MU PPDU의 특정 데이터 필드에 트리거 프레임에 대응하는 하나의 MPDU만이 포함되어 있는 경우, STA에게 트리거 프레임을 포함하는 특정 데이터 필드가 존재함을 알려줄 필요가 있다.

[747] 이 경우, 해당 데이터 필드와 대응하는 HE-SIG B 필드에 해당 데이터 필드 내에 트리거 프레임이 포함되어 있음을 지시하는 트리거 지시자가 포함되어 있을 수 있다. 예를 들어, 트리거 정보가 포함된 특정 데이터 필드가 포함되어 있는지 여부를 지시하는 1-bit 사이즈의 트리거 지시자가 특정 데이터 필드의 사용자 특정 정보를 제공하는 HE-SIG B 필드 내에 포함되어 있을 수 있다.

[748] 또는, 앞서 상술한 바와 같이, HE-SIG B 필드는 특정 데이터 필드의 브로드캐스트 전송을 위하여, 해당 데이터 필드에 대한 식별 정보로서 브로드캐스트 AID를 포함할 수 있다. 따라서 STA은 HE-SIG B 필드에 포함된 브로드캐스트 식별 정보를 통해 트리거 프레임이 포함된 특정 데이터 필드가 존재함을 인식할 수 있다.

[749] DL MU 프레임을 나르는 DL MU PPDU의 데이터 필드 중 특정 데이터 필드에 트리거 프레임이 포함되는 경우, 트리거 프레임을 포함하는 데이터 필드의 위치(예를 들어, 서브밴드의 위치, DL MU STA 인덱스 등)는 미리 지정될 수 있다. 이 경우, AP는 비콘 프레임(beacon frame) 등을 통해 미리 지정된 특정 데이터 필드의 위치를 STA들에게 알려줄 수 있다.

[750] 하나의 MPDU를 포함하고 있는 특정 데이터 필드는 다른 데이터 필드(예를 들어, A-MPDU를 포함하는 데이터 필드)보다 비트 사이즈가 작을 수 있다. 따라서, 특정 데이터 필드는 최대 비트 사이즈를 갖는 다른 데이터 필드와 동일한 비트 사이즈를 갖도록(또는, DL MU PPDU의 길이와 동일해지도록) 패딩되어 DL MU PPDU에 포함될 수 있다.

[751] 제2-2 실시예는 UL MU 전송 STA이 DL MU 프레임 수신 STA의 서브셋이 아닌 경우에 적용될 수 있으므로 UL MU 스케줄링이 보다 유리한 효과를 갖는다.

[752] 이상으로 본 발명의 제2 실시예에 따른 DL MU PPDU의 구조에 관하여 상술하였다. 상술한 제2-1 및 제2-2 실시예는 상황에 따라 독립적으로 적용되거나 조합되어 적용될 수 있다. 제2-1 및 제2-2 실시예가 서로 조합되어 적용되는 경우, DL MU PPDU의 특정 데이터 필드는 트리거 프레임에 대응하는 하나의 MPDU만을 포함할 수 있으며, 다른 데이터 필드는 트리거 프레임 및 DL MU 프레임을 A-MPDU 포맷으로서 포함할 수 있다.

[753] 예를 들어, DL MU 수신 STA이 STA 1, 2이고, UL MU 전송 STA이 2, 3인 경우, STA 3에 대한 트리거 프레임은 하나의 MPDU로서 첫 번째 데이터 필드에 포함될 수 있으며, STA 2에 대한 트리거 프레임 및 DL MU 프레임은 A-MPDU 포맷으로서 두 번째 데이터 필드에 포함될 수 있으며, STA 1에 대한 DL MU 프레임은 MPDU 포맷 또는 A-MPDU 포맷으로서 세 번째 데이터 필드에 포함될 수 있다.

[754]

[755] 도 41은 제1 및 제2 실시예의 효과를 비교한 표이다.

[756] 도 41을 참조하면, 제1 실시예는 이하와 같은 장점 및 효과를 갖는다.

[757] - UL MU 스케줄링의 유연성(Flexibility of UL MU scheduling)

[758] - UL MU STA 및 다른 STA들의 자원 및 파워 절약 측면에서 유리(Resource saving/ Power saving of other STAs/UL MU STAs)

[759] 다만, 제1 실시예의 경우 HE-SIG B 필드 내에 ACK 프레임을 지시하기 위한 비트가 추가로 요구된다는 문제점이 존재할 수 있다(제2 옵션 참조). 또한, 제1 실시예의 경우 UL MU 자원 할당 정보를 지시하는 새로운 HE-SIG B 필드(즉, 제2 HE-SIG B 필드)가 추가로 요구된다는 단점이 존재할 수 있다.

[760] 제2-1 실시예의 경우 이하와 같은 장점 및 효과를 갖는다.

[761] - UL MU STA 및 다른 STA들의 자원 및 파워 절약 측면에서 유리(Resource saving/ Power saving of other STAs/UL MU STAs)

[762] - 기존의 DL MU 프레임 포맷을 그대로 사용 가능(Use DL MU frame format as it is)

[763] 다만, 제2-1 실시예의 경우 UL MU 전송 STA이 DL MU 프레임 수신 STA의 서브셋인 경우에 적용될 수 있는 실시예이므로, UL MU 스케줄링에 일정한 제약이 존재한다는 문제점이 존재한다.

[764] 제2-2 실시예의 경우 이하와 같은 장점 및 효과를 갖는다.

[765] - UL MU 그룹을 자유롭게 형성 가능(Free to make UL MU group)(또는, UL MU 스케줄링의 유연성).

[766] 다만, 제2-2 실시예의 경우 트리거 프레임의 존재 여부를 지시하기 위한 비트가 HE-SIG B 필드 내에 추가로 요구된다는 문제점이 존재할 수 있다. 또한, UL MU 전송 STA들과 다른 STA들의 자원 및 파워가 낭비될 수 있다는 문제점이 존재할

수 있다. 이는, 트리거 프레임에 해당하는 MPDU만을 포함한 특정 데이터 필드의 경우 다른 데이터 필드와 동일한 길이를 갖도록 패딩되어 전송되기 때문이다. 따라서, DL MU 자원이 낭비되며, 802.11ax 시스템에 따른 STA들은 트리거 프레임을 디코딩하기 위해 DL MU PPDU의 길이 동안 슬립(sleep)할 수 없다(파워 낭비)는 문제점을 갖는다.

[767] 이하에서는 상술한 제1 및 제2 실시예(제2-1, 및 제2-2 실시예 포함)의 DL MU PPDU에 대응하여 UL MU 전송되는 UL MU PPDU의 구조에 관하여 살펴보기로 한다.

[768]

[769] 도 42는 본 발명의 일 실시예에 따른 UL MU PPDU를 도시한 도면이다. 본 실시예에서 DL MU 프레임은 STA 1, 2에 수신되며, 트리거 프레임은 STA 2, 3에 수신된 경우를 가정하여 설명하기로 한다.

[770] DL MU PPDU를 수신한 STA은 수신한 DL MU PPDU를 기초로 UL MU PPDU를 생성하여 AP로 UL MU 전송할 수 있다. 이 경우, 각 STA은 DL MU PPDU에 포함된 트리거 프레임에 기초하여 UL MU 프레임을 전송할 수 있으며, DL MU 프레임에 대한 응답으로서 ACK 프레임을 전송할 수 있다. 이 경우, UL MU 프레임 및 ACK 프레임을 UL MU 전송하는 방식은 실시예에 따라 다를 수 있다.

[771] 일 실시예로서 도 42(a)를 참조하면, UL MU 프레임과 ACK 프레임을 별도의 UL MU 자원을 이용하여 각각 UL MU 전송될 수 있다. 예를 들어, 주파수 자원은 크게 2가지 영역으로 분리될 수 있으며, 그 중 제1 영역은 ACK 프레임 전송을 위한 주파수 자원으로, 제2 영역은 UL MU 프레임 전송을 위한 주파수 자원으로 사용될 수 있다. 나아가, 제1 영역은 다시 ACK 프레임을 전송하는 STA들에 분리 할당될 수 있으며, 제2 영역 역시 UL MU 프레임 전송을 전송하는 STA들에 분리 할당될 수 있다.

[772] 따라서, ACK 프레임 전송을 위한 제1 영역은 STA 1 및 2에 각각 할당될 수 있으며, UL MU 프레임 전송을 위한 제2 영역은 STA 2 및 3에 각각 할당될 수 있다. 그 결과, STA 1의 ACK 프레임, STA 2의 ACK 프레임, STA 2의 UL MU 프레임, 및 STA 3의 UL MU 프레임은 각각 서로 다른 UL MU 자원을 이용하여 하나의 UL MU PPDU를 통해 UL MU 전송될 수 있다.

[773] 본 실시예의 경우 각 프레임의 UL MU 전송 방식이 단순하다는 장점을 갖는다. 다만, ACK 프레임과 UL MU 프레임을 동시에 전송할 수 있는 STA(상술한 실시예의 경우, STA 2)의 경우 별도의 UL MU 자원을 이용하여 각 프레임을 전송하므로, UL MU 자원이 낭비된다는 문제점이 존재한다. 또한, 해당 UL MU PPDU를 수신한 AP는 2개의 OFDMA 패킷들(STA 2의 ACK 프레임을 포함한 OFDMA 패킷과 STA2의 UL MU 프레임을 포함한 OFDMA 패킷)을 별도로 디코딩해야 한다는 점에서 자원이 낭비된다는 문제점이 존재한다. 이러한 문제점을 해결하기 위해 이하와 같은 UL MU 전송 방식이 제안될 수 있다.

[774] 다른 실시예로서 도 42(b)를 참조하면, 동일한 STA에 의해 전송되는 ACK 프레임은 UL MU 프레임에 피기백되어 전송될 수 있다. 예를 들어, DL MU 프레임과 트리거 프레임을 함께 수신한 STA 2의 경우 해당 DL MU 프레임에 대한 ACK 프레임을 해당 트리거 프레임에 대한 UL MU 프레임에 피기백하여 UL MU 전송할 수 있다. 이 경우, STA 2에 UL MU 전송을 위해 할당된 데이터 필드는 A-MPDU 포맷으로 구성될 수 있으며, A-MPDU를 구성하는 복수의 MPDU들 중 적어도 하나는 ACK 프레임에 대응할 수 있으며, 나머지 MPDU는 UL MU 프레임에 대응할 수 있다.

[775] 본 실시예의 경우, STA 2의 ACK 프레임을 전송하기 위한 UL MU 자원 할당 정보가 별도로 요구되지 않는다. STA 2는 UL MU 프레임에 ACK 프레임을 피기백하여 전송하면 되기 때문이다. 따라서, AP는 DL MU 전송 시, STA 2의 ACK 프레임을 위한 UL MU 자원 할당 정보는 DL MU PPDU의 HE-SIG B 필드에 별도로 포함시키지 않을 수 있다. 또한, ACK 프레임에 적용되는 MCS 레벨의 경우에도 UL MU 프레임과 동일한 MCS 레벨을 적용될 수 있다.

[776] 한편, STA별 UL MU 자원의 할당 방식은 도 37 및 38에 상술한 실시예가 동일하게 적용될 수 있으며, 중복되는 설명은 생략하기로 한다.

[777] 본 실시예의 경우 자원이 절약된다는 효과가 있다. 다만, UL MU 전송 방식이 상술한 전송 방식에 비해 복잡하며, 피기백된 ACK 프레임에는 강인한 전송에 적합한 MCS 레벨(또는 더 낮은 MCS 레벨)을 적용할 수 없다는 문제점이 존재한다(동일한 데이터 필드 내에서 UL MU 프레임과 동일한 MCS 레벨이 적용될 수 있으므로).

[778]

[779] 도 43은 본 발명의 일 실시예에 따른 AP의 DL MU 전송 방법을 나타낸 순서도이다. 상술한 실시예들은 본 순서도와 관련한 설명에 동일하게 적용될 수 있다. 따라서, 이하에서는 중복되는 설명은 생략하기로 한다.

[780] 도 43을 참조하면, AP는 DL MU PPDU를 전송할 수 있다(S4310). 보다 상세하게는, AP는 물리 프리앰블 및 데이터 필드를 포함하는 DL MU PPDU를 DL MU 전송할 수 있다. 이때, DL MU PPDU는 수신 STA의 UL MU 전송을 트리거하기 위한 트리거 정보를 포함하는 트리거 프레임과 DL MU 프레임을 포함한 필드일 수 있다.

[781] 다음으로, AP는 DL MU PPDU를 기초로 생성된 UL MU PPDU를 UL MU 수신할 수 있다(S4320). 이때, UL MU PPDU는 트리거 프레임을 기초로 한 UL MU 프레임 및 DL MU 프레임에 대한 응답인 ACK 프레임을 포함할 수 있다.

[782]

[783] 도 44는 본 발명의 일 실시예에 따른 각 STA 장치의 블록도이다.

[784] 도 44에서, STA 장치(4410)는 메모리(4412), 프로세서(4411) 및 RF 유닛(4413)을 포함할 수 있다. 그리고 상술한 바와 같이 STA 장치는 HE STA 장치로서, AP 또는 non-AP STA가 될 수 있다.

[785] RF 유닛(4413)은 프로세서(4411)와 연결되어 무선 신호를 송신/수신할 수 있다. RF 유닛(4413)은 프로세서(4411)로부터 수신된 데이터를 송수신 대역으로 업컨버팅하여 신호를 전송할 수 있다.

[786] 프로세서(4411)는 RF 유닛(4413)과 연결되어 IEEE 802.11 시스템에 따른 물리 계층 및/또는 MAC 계층을 구현할 수 있다. 프로세서(4411)는 상술한 도면 및 설명에 따른 본 발명의 다양한 실시예에 따른 동작을 수행하도록 구성될 수 있다. 또한, 상술한 본 발명의 다양한 실시예에 따른 STA(4410)의 동작을 구현하는 모듈이 메모리(4412)에 저장되고, 프로세서(4411)에 의하여 실행될 수 있다.

[787] 메모리(4412)는 프로세서(4411)와 연결되어, 프로세서(4411)를 구동하기 위한 다양한 정보를 저장한다. 메모리(4412)는 프로세서(4411)의 내부에 포함되거나 또는 프로세서(4411)의 외부에 설치되어 프로세서(4411)와 공지의 수단에 의해 연결될 수 있다.

[788] 또한, STA 장치(4410)는 한 개의 안테나(single antenna) 또는 다중 안테나(multiple antenna)를 포함할 수 있다.

[789] 도 44의 STA 장치(4410)의 구체적인 구성은, 전술한 본 발명의 다양한 실시예에서 설명한 사항들이 독립적으로 적용되거나 또는 2 이상의 실시예가 동시에 적용되도록 구현될 수 있다.

[790]

[791] 이상에서 설명된 실시예들은 본 발명의 구성요소들과 특징들이 소정 형태로 결합된 것들이다. 각 구성요소 또는 특징은 별도의 명시적 언급이 없는 한 선택적인 것으로 고려되어야 한다. 각 구성요소 또는 특징은 다른 구성요소나 특징과 결합되지 않은 형태로 실시될 수 있다. 또한, 일부 구성요소들 및/또는 특징들을 결합하여 본 발명의 실시예를 구성하는 것도 가능하다. 본 발명의 실시예들에서 설명되는 동작들의 순서는 변경될 수 있다. 어느 실시예의 일부 구성이나 특징은 다른 실시예에 포함될 수 있고, 또는 다른 실시예의 대응하는 구성 또는 특징과 교체될 수 있다. 특허청구범위에서 명시적인 인용 관계가 있지 않은 청구항들을 결합하여 실시예를 구성하거나 출원 후의 보정에 의해 새로운 청구항으로 포함시킬 수 있음은 자명하다.

[792] 본 발명에 따른 실시예는 다양한 수단, 예를 들어, 하드웨어, 펌웨어(firmware), 소프트웨어 또는 그것들의 결합 등에 의해 구현될 수 있다. 하드웨어에 의한 구현의 경우, 본 발명의 일 실시예는 하나 또는 그 이상의 ASICs(application specific integrated circuits), DSPs(digital signal processors), DSPDs(digital signal processing devices), PLDs(programmable logic devices), FPGAs(field programmable gate arrays), 프로세서, 콘트롤러, 마이크로 콘트롤러, 마이크로 프로세서 등에 의해 구현될 수 있다.

[793] 펌웨어나 소프트웨어에 의한 구현의 경우, 본 발명의 일 실시예는 이상에서 설명된 기능 또는 동작들을 수행하는 모듈, 절차, 함수 등의 형태로 구현될 수

있다. 소프트웨어 코드는 메모리에 저장되어 프로세서에 의해 구동될 수 있다. 상기 메모리는 상기 프로세서 내부 또는 외부에 위치하여, 이미 공지된 다양한 수단에 의해 상기 프로세서와 데이터를 주고 받을 수 있다.

[794] 본 발명은 본 발명의 필수적 특징을 벗어나지 않는 범위에서 다른 특정한 형태로 구체화될 수 있음은 당업자에게 자명하다. 따라서, 상술한 상세한 설명은 모든 면에서 제한적으로 해석되어서는 아니 되고 예시적인 것으로 고려되어야 한다. 본 발명의 범위는 첨부된 청구항의 합리적 해석에 의해 결정되어야 하고, 본 발명의 등가적 범위 내에서의 모든 변경은 본 발명의 범위에 포함된다.

산업상 이용가능성

[795] 본 발명의 무선 통신 시스템에서 프레임 전송 방안은 IEEE 802.11 시스템에 적용되는 예를 중심으로 설명하였으나, IEEE 802.11 시스템 이외에도 다양한 무선 통신 시스템에 적용하는 것이 가능하다.

청구범위

[청구항 1] 무선 통신 시스템에서 AP(Access Point) 하향 링크(DL: Downlink) 다중 사용자(MU: Multi-User) 전송 방법에 있어서,
DL MU PPDU(PPDU: Physical Protocol Data Unit)를 전송하는 단계; 로서,
상기 DL MU PPDU는 상향링크(UL: Uplink) MU 전송을 위한 트리거 정보를 포함하는 트리거 프레임 및 DL MU 프레임을 포함함, 및
상기 DL MU PPDU를 기초로 생성된 UL MU PPDU를 UL MU 수신하는 단계; 를 포함하되,
상기 UL MU PPDU는 상기 트리거 프레임을 기초로 한 UL MU 프레임 및 상기 DL MU 프레임에 대한 응답인 ACK(Acknowledge) 프레임을 포함하는, DL MU 전송 방법.

[청구항 2] 제 1 항에 있어서,
상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우,
상기 DL MU 프레임과 상기 트리거 프레임은, 상기 수신 STA에 할당된 데이터 필드에 A-MPDU(Agrregated MAC Protocol Data Unit) 포맷으로 포함되는, DL MU 전송 방법.

[청구항 3] 제 2 항에 있어서,
상기 트리거 프레임의 MAC 헤더(MAC header)는, 상기 트리거 프레임이 상기 트리거 정보를 포함하고 있음을 지시하는 트리거 지시자를 포함하는, DL MU 전송 방법.

[청구항 4] 제 2 항에 있어서,
상기 트리거 프레임은 상기 A-MPDU 포맷에 포함된 MPDU(MAC Protocol Data Unit)들 중 첫 번째 MPDU에 해당하는, DL MU 전송 방법.

[청구항 5] 제 1 항에 있어서,
상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되지 않는 경우,
상기 트리거 프레임은 상기 DL MU PPDU 내의 기설정된 데이터 필드에 MPDU 포맷으로 포함되며,
상기 DL MU 프레임은 상기 DL MU PPDU 내의 다른 데이터 필드에 상기 MPDU 포맷 또는 A-MPDU 포맷으로 포함되는, DL MU 전송 방법.

[청구항 6] 제 5 항에 있어서,
상기 DL MU PPDU 내의 물리 프리앰블은,
상기 DL MU PPDU가 상기 트리거 프레임을 포함하는지 여부를 지시하는 트리거 지시자, 또는 상기 기설정된 데이터 필드를 수신하는 브로드캐스트 AID(Broadcast Association Identifier) 정보를 포함하는, DL MU 전송 방법.

[청구항 7] 제 6 항에 있어서,
상기 트리거 지시자 또는 상기 브로드캐스트 AID 정보는, 상기 물리 프리앰블의 HE-SIG(High Efficiency-Signal) 필드에 포함되는, DL MU 전송 방법.

[청구항 8] 제 1 항에 있어서,
상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우,
상기 ACK 프레임은 상기 UL MU PPDU 내의 기설정된 데이터 필드에 MPDU 포맷으로 포함되며, 상기 UL MU 프레임은 상기 UL MU PPDU 내의 다른 데이터 필드에 상기 MPDU 포맷 또는 A-MPDU 포맷으로 포함되는, DL MU 전송 방법.

[청구항 9] 제 1 항에 있어서,
상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우,
상기 ACK 프레임은 상기 UL MU 프레임에 피기백되어 상기 UL MU PPDU 내의 기설정된 데이터 필드에 포함되는, DL MU 전송 방법.

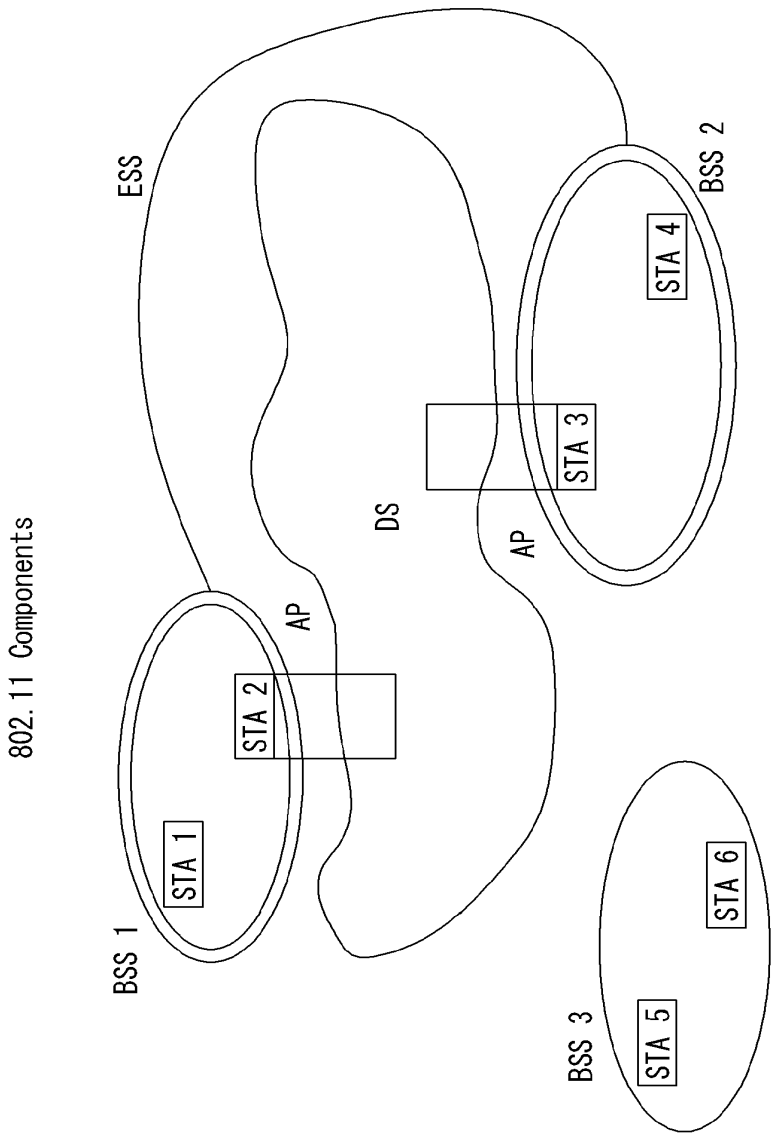
[청구항 10] 제 1 항에 있어서,
상기 트리거 프레임은 UL MU 전송을 수행하는 STA의 AID(Association Identifier) 정보, 상기 UL MU 전송을 위한 공간 자원 지시 정보, 및 상기 UL MU 전송을 위한 주파수 자원 지시 정보 중 적어도 하나를 포함하는, DL MU 전송 방법.

[청구항 11] 무선 통신 시스템의 AP(Access Point) 장치에 있어서,
무선 신호를 송수신하는, RF 유닛; 및
상기 RF 유닛을 제어하는, 프로세서; 를 포함하고,
상기 프로세서는,
DL MU PPDU(PPDU: Physical Protocol Data Unit)를 전송하되, 상기 DL MU PPDU는 상향링크(UL: Uplink) MU 전송을 위한 트리거 정보를 포함하는 트리거 프레임 및 DL MU 프레임을 포함함, 및
상기 DL MU PPDU를 기초로 생성된 UL MU PPDU를 UL MU 수신하되,
상기 UL MU PPDU는 상기 트리거 프레임을 기초로 한 UL MU 프레임 및 상기 DL MU 프레임에 대한 응답인 ACK(Acknowledge) 프레임을 포함하는, AP 장치.

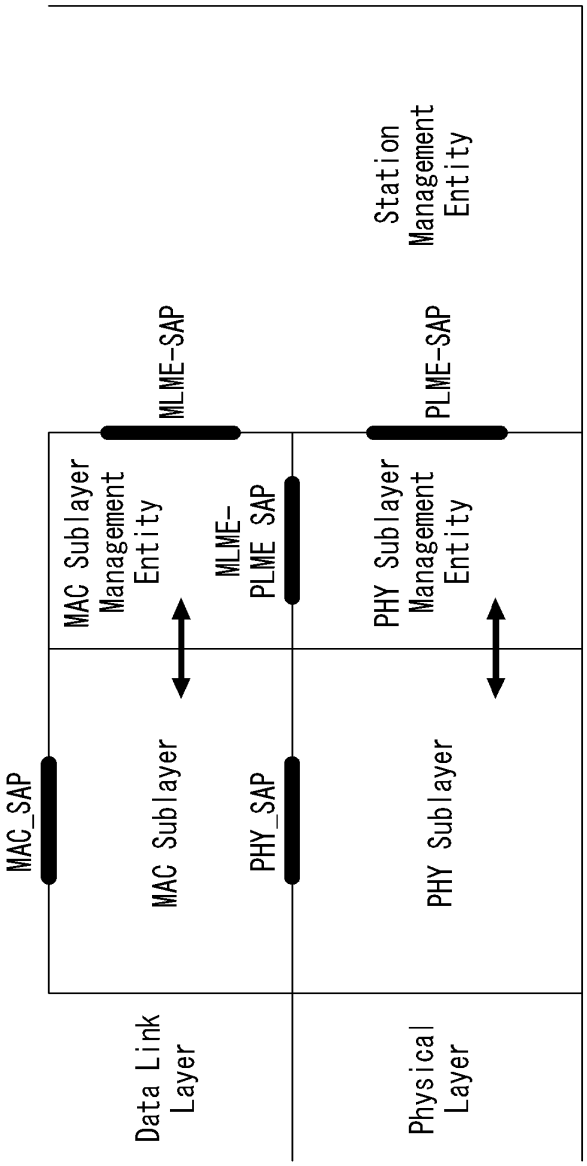
[청구항 12] 제 11 항에 있어서,
상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되는 경우,
상기 DL MU 프레임과 상기 트리거 프레임은, 상기 수신 STA에 할당된 데이터 필드에 A-MPDU(Agrregated MAC Protocol Data Unit) 포맷으로 포함되는, AP 장치.

[청구항 13] 제 12 항에 있어서,
상기 DL MU 프레임을 수신하는 수신 STA(Station)에 상기 트리거 프레임이 함께 전송되지 않는 경우,
상기 트리거 프레임은 상기 DL MU PPDU 내의 기설정된 데이터 필드에 MPDU 포맷으로 포함되며,
상기 DL MU 프레임은 상기 DL MU PPDU 내의 다른 데이터 필드에 상기 MPDU 포맷 또는 A-MPDU 포맷으로 포함되는, AP 장치.

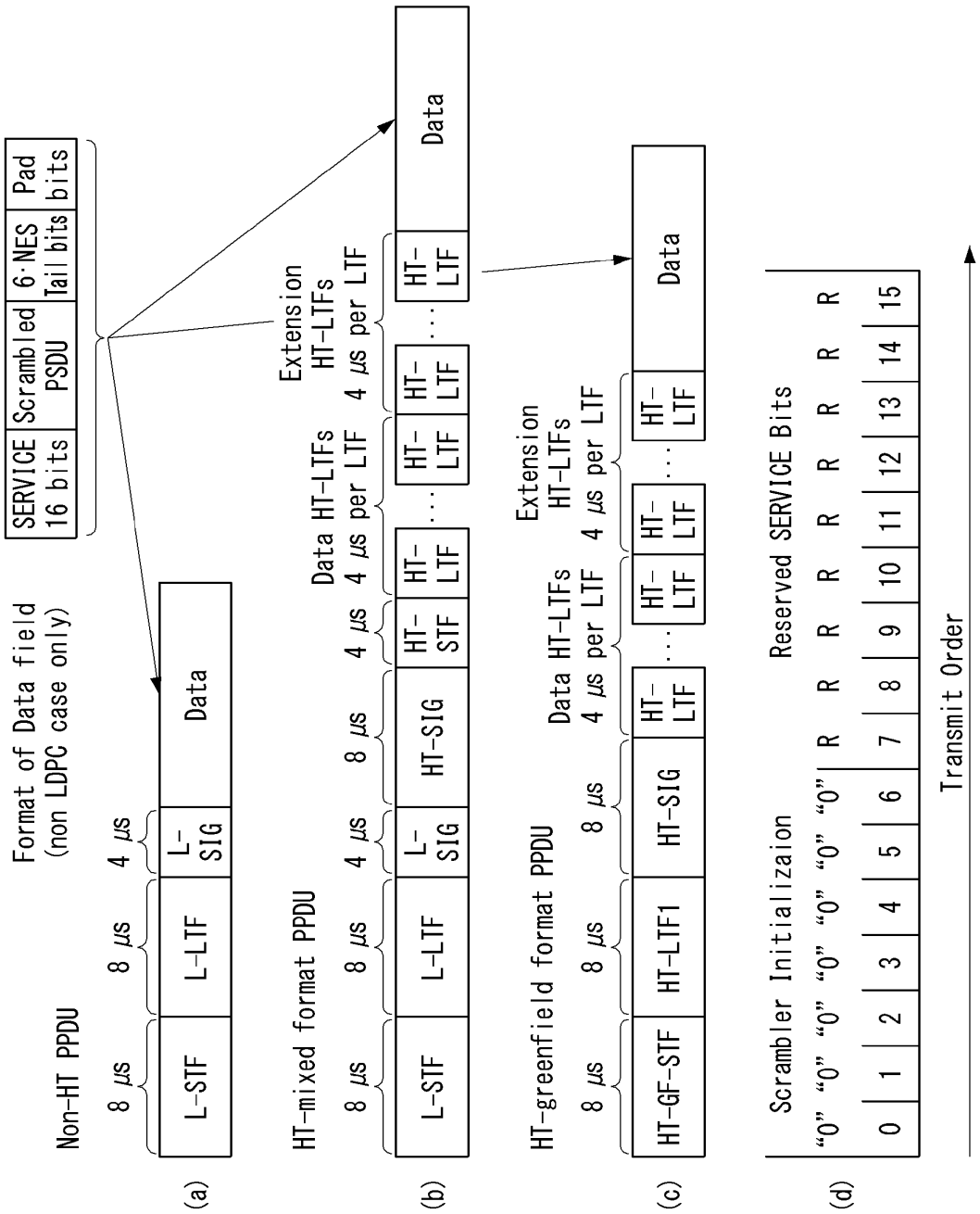
[도1]


802.11 Components
ESS
BSS 1
BSS 2
BSS 3
AP
AP
DS
STA 1
STA 2
STA 3
STA 4
STA 5
STA 6

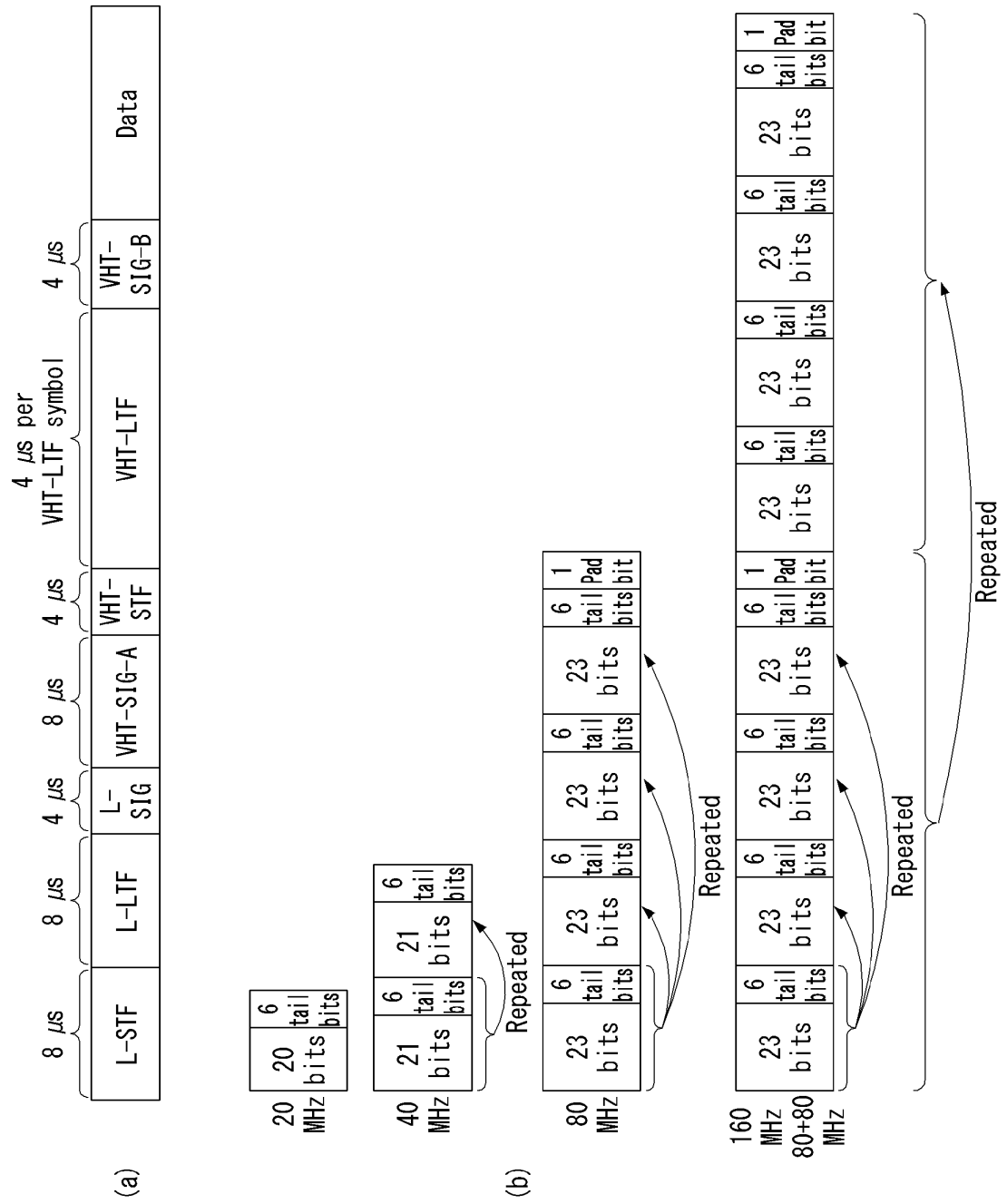
[도2]


Station Management Entity
MLME-SAP
PLME-SAP
MAC Sublayer Management Entity
MLME-PLME SAP
PHY Sublayer Management Entity
MAC_SAP
MAC Sublayer
PHY_SAP
PHY Sublayer
Data Link Layer
Physical Layer

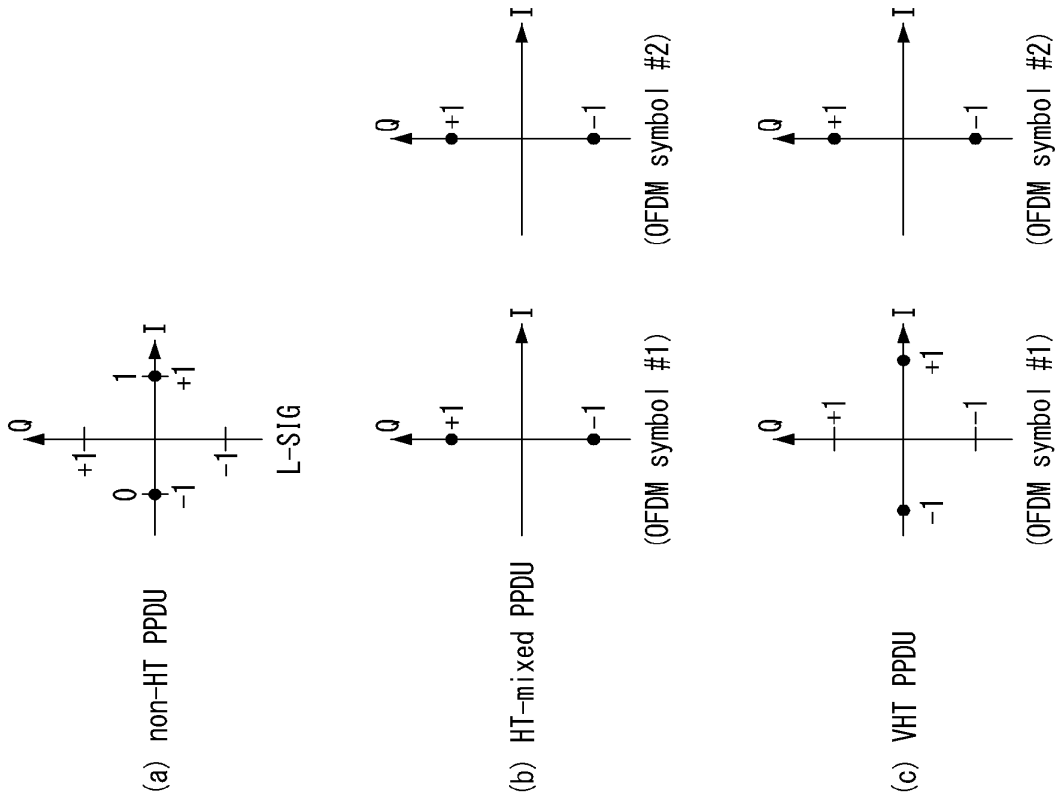
[도3]


Format of Data field
(non LDPC case only)
SERVICE 16 bits
Scrambled PSDU
6·NES tail bits
Pad bits
Non-HT PPDU
8 μs
8 μs
4 μs
L-STF
L-LTF
L-SIG
Data
(a)
HT-mixed format PPDU
8 μs
8 μs
4 μs
8 μs
4 μs
L-STF
L-LTF
L-SIG
HT-SIG
HT-STF
HT-LTF
...
HT-LTF
HT-LTF
...
HT-LTF
Data HT-LTFs
4 μs per LTF
Extension HT-LTFs
4 μs per LTF
Data
(b)
HT-greenfield format PPDU
8 μs
8 μs
8 μs
HT-GF-STF
HT-LTF1
HT-SIG
HT-LTF
...
HT-LTF
HT-LTF
...
HT-LTF
Data HT-LTFs
4 μs per LTF
Extension HT-LTFs
4 μs per LTF
Data
(c)
Scrambler Initializaion
Reserved SERVICE Bits
"0" "0" "0" "0" "0" "0" "0"
R R R R R R R R R
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
(d)
Transmit Order

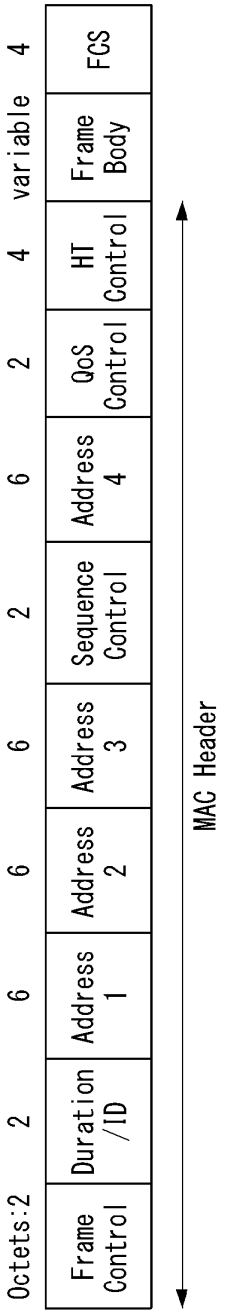
[도4]


(a)
8 μs
L-STF
8 μs
L-LTF
4 μs
L-SIG
8 μs
VHT-SIG-A
4 μs
VHT-STF
4 μs per VHT-LTF symbol
VHT-LTF
4 μs
VHT-SIG-B
Data
(b)
20 MHz
20 bits
6 tail bits
40 MHz
21 bits
6 tail bits
21 bits
6 tail bits
Repeated
80 MHz
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
Repeated
160 MHz 80+80 MHz
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
23 bits
6 tail bits
1 Pad bit
Repeated
Repeated

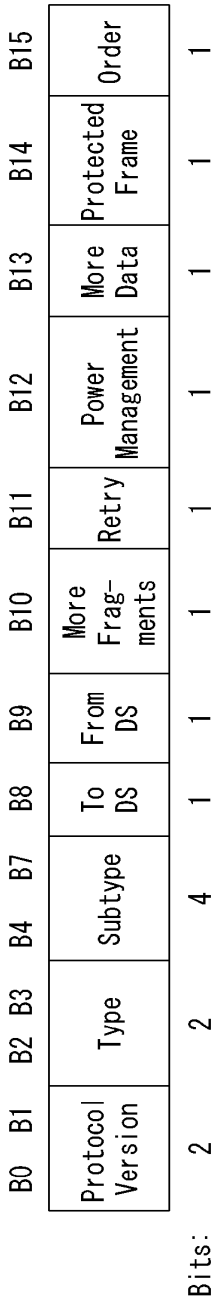
[도5]


(a) non-HT PPDU
(b) HT-mixed PPDU
(c) VHT PPDU
L-SIG
(OFDM symbol #1)
(OFDM symbol #2)
I
Q
+1
-1
0

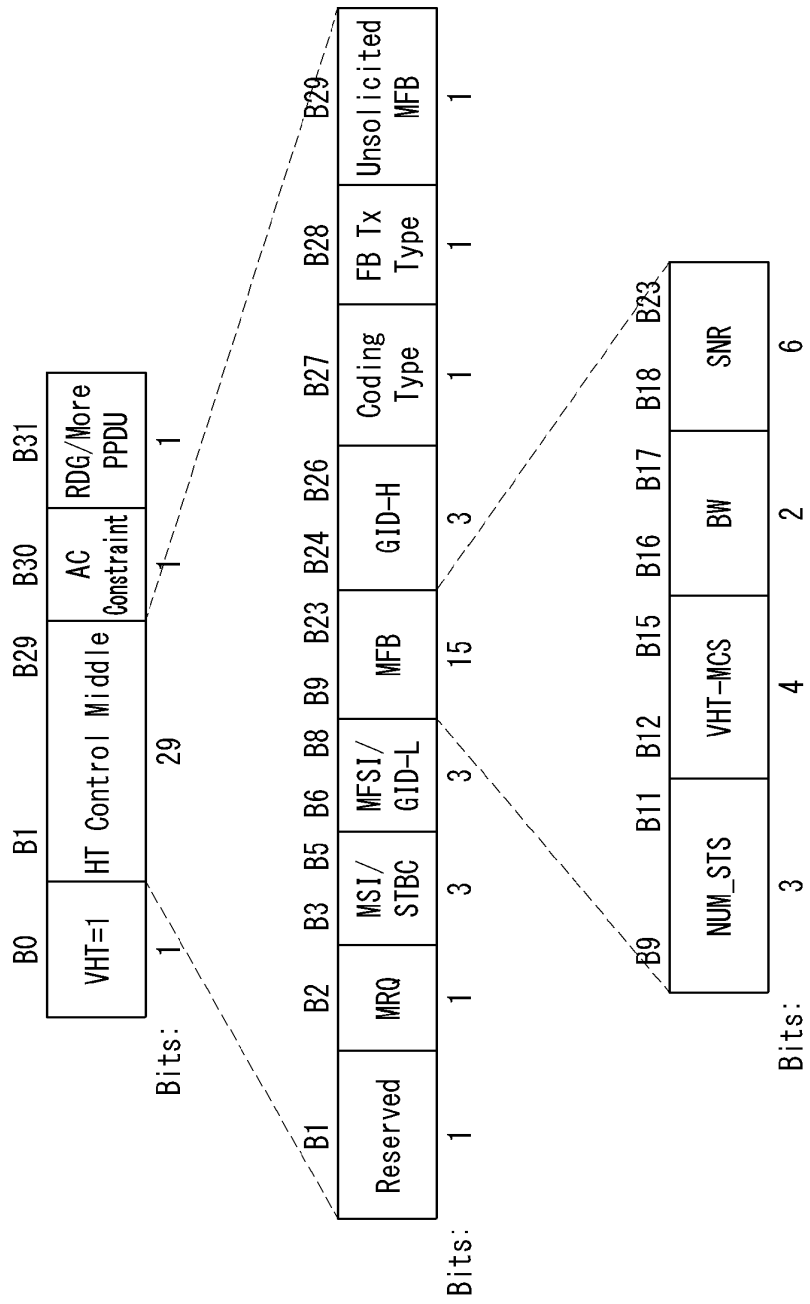
[도6]


Octets:2
2
6
6
6
2
6
2
4
variable
4
Frame Control
Duration /ID
Address 1
Address 2
Address 3
Sequence Control
Address 4
QoS Control
HT Control
Frame Body
FCS
MAC Header

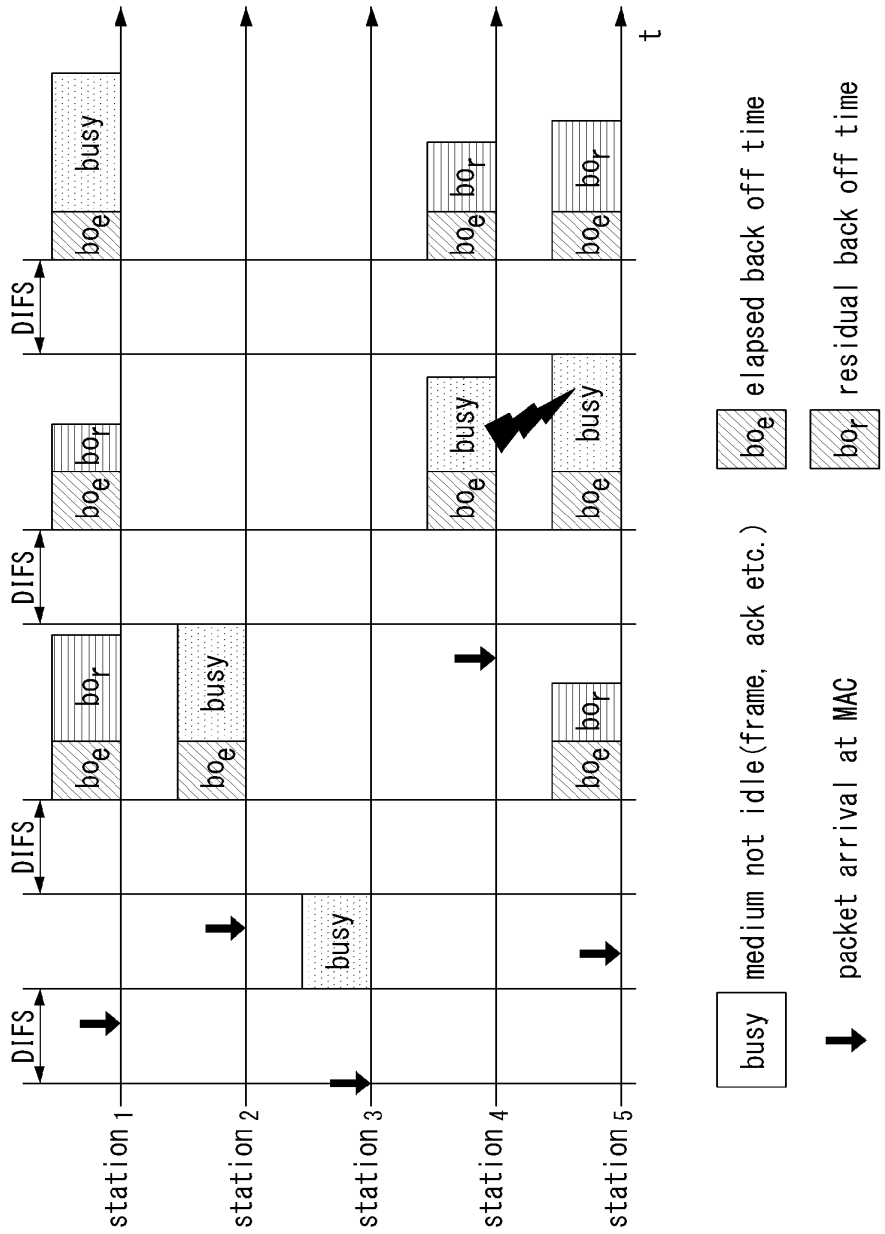
[도7]


B0 B1 B2 B3 B4 B7 B8 B9 B10 B11 B12 B13 B14 B15
Protocol Version
Type
Subtype
To DS
From DS
More Frag- ments
Retry
Power Management
More Data
Protected Frame
Order
Bits: 2 2 4 1 1 1 1 1 1 1 1

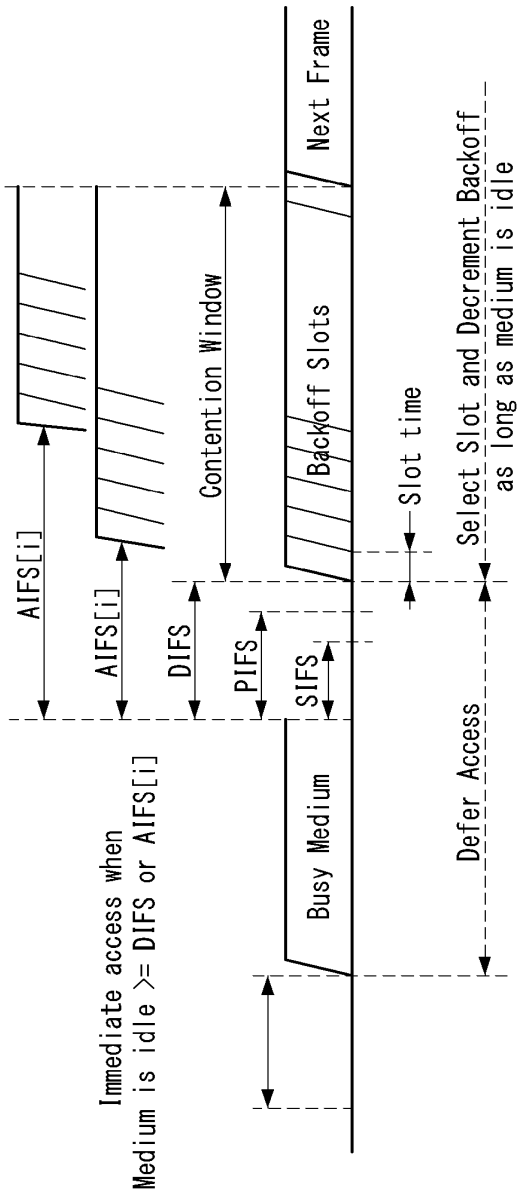
[도8]


B0
B1
B29
B30
B31
VHT=1
HT Control Middle
AC Constraint
RDG/More PPDU
Bits:
1
29
1
1
B1
B2
B3
B5
B6
B8
B9
B23
B24
B26
B27
B28
B29
Reserved
MRQ
MSI/ STBC
MFSI/ GID-L
MFB
GID-H
Coding Type
FB Tx Type
Unsolicited MFB
Bits:
1
1
3
3
15
3
1
1
1
B9
B11
B12
B15
B16
B17
B18
B23
NUM_STS
VHT-MCS
BW
SNR
Bits:
3
4
2
6

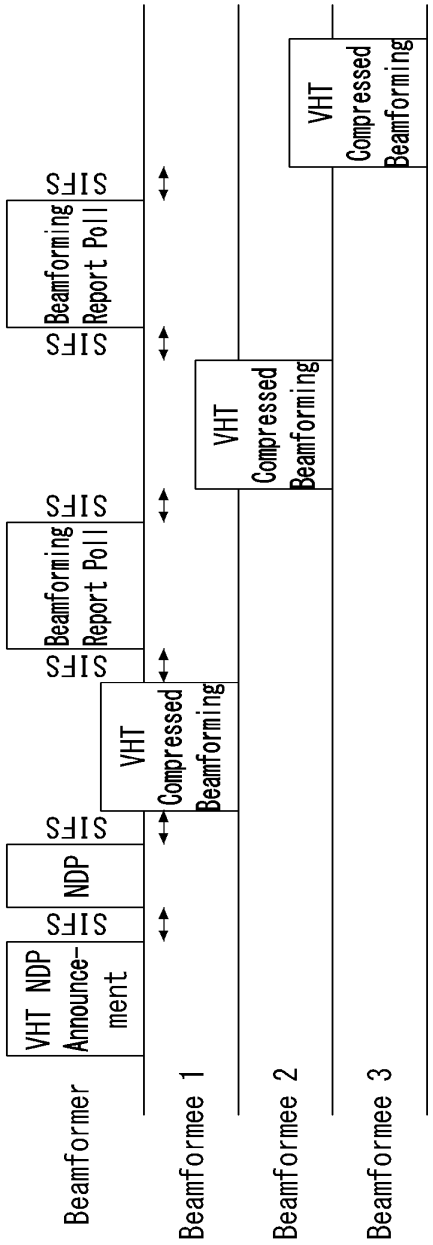
[도9]


station 1
station 2
station 3
station 4
station 5
t
DIFS
busy
bo_e
bo_r
medium not idle(frame, ack etc.)
elapsed back off time
residual back off time
packet arrival at MAC

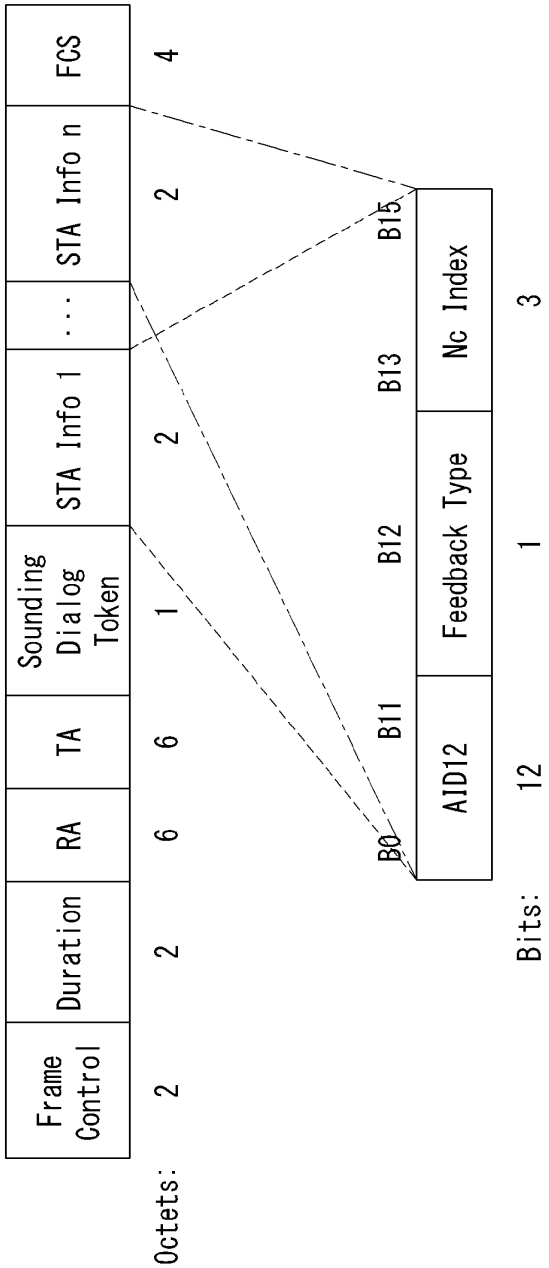
[도10]


Next Frame
Contention Window
Backoff Slots
Slot time
Select Slot and Decrement Backoff as long as medium is idle
AIFS[i]
AIFS[i]
DIFS
PIFS
SIFS
Busy Medium
Defer Access
Immediate access when Medium is idle >= DIFS or AIFS[i]

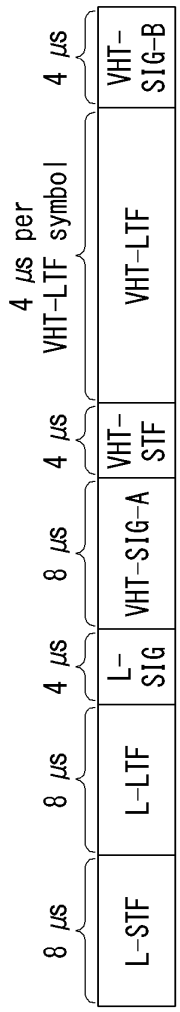
[도11]


Beamformer
Beamformee 1
Beamformee 2
Beamformee 3
VHT NDP Announce-ment
SIFS
NDP
SIFS
VHT Compressed Beamforming
SIFS
Beamforming Report Poll
SIFS
VHT Compressed Beamforming
SIFS
Beamforming Report Poll
SIFS
VHT Compressed Beamforming

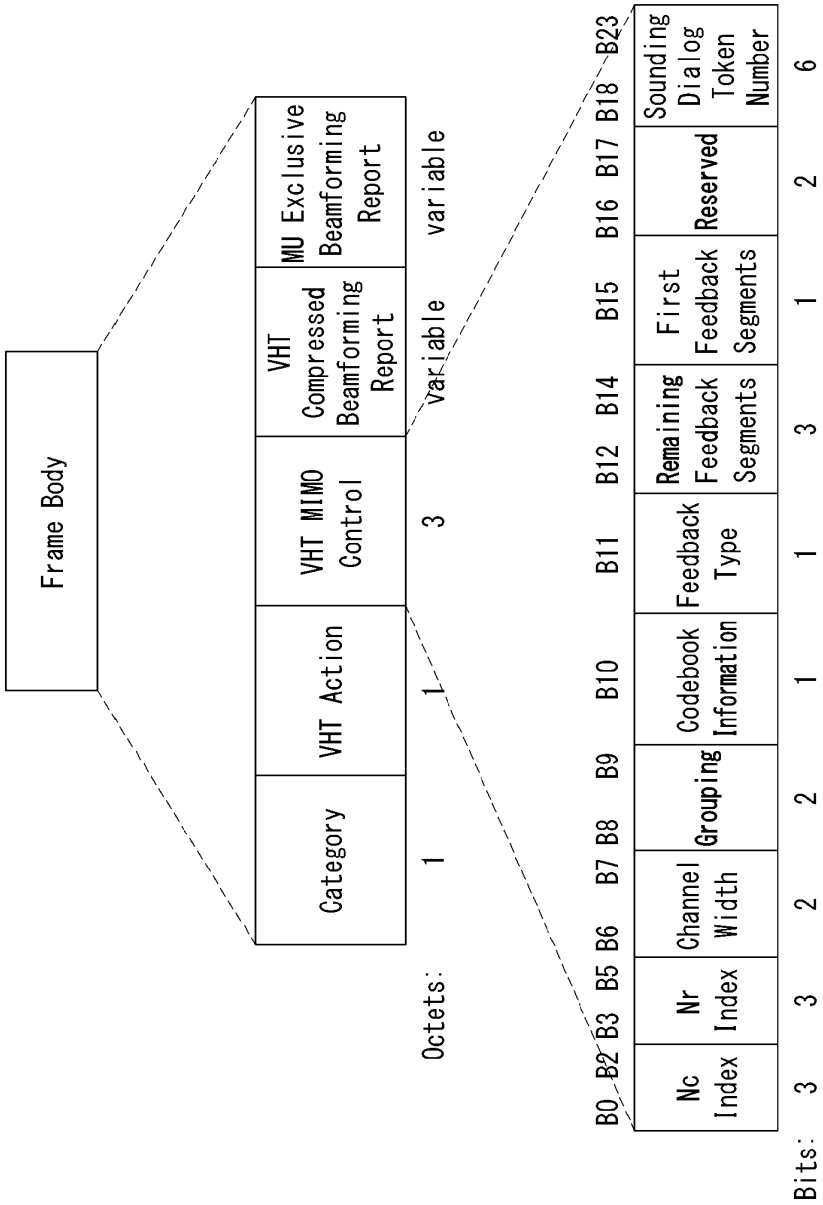
[도12]


Frame Control
Duration
RA
TA
Sounding Dialog Token
STA Info 1
...
STA Info n
FCS
Octets:
2
2
6
6
1
2
2
4
AID12
Feedback Type
Nc Index
Bits:
12
1
3
B0
B11
B12
B13
B15

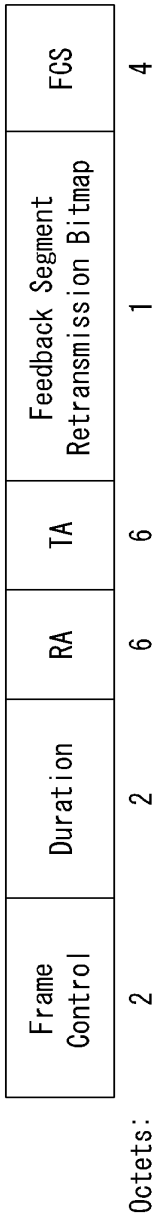
[도13]


L-STF
L-LTF
L-SIG
VHT-SIG-A
VHT-STF
VHT-LTF
VHT-SIG-B
8 μs
8 μs
4 μs
8 μs
4 μs
4 μs per VHT-LTF symbol
4 μs

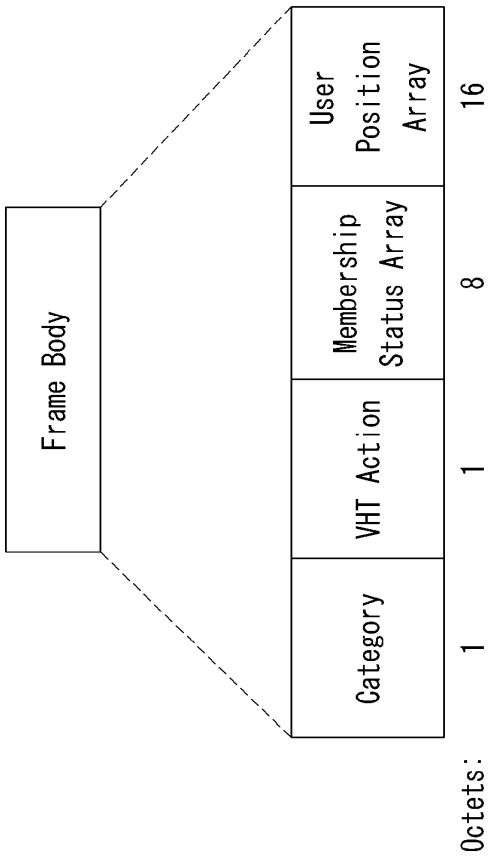
[도14]


Frame Body
Category
VHT Action
VHT MIMO Control
VHT Compressed Beamforming Report
MU Exclusive Beamforming Report
Octets: 1 1 3 variable variable
Nc Index
Nr Index
Channel Width
Grouping
Codebook Information
Feedback Type
Remaining Feedback Segments
First Feedback Segments
Reserved
Sounding Dialog Token Number
B0 B2 B3 B5 B6 B7 B8 B9 B10 B11 B12 B14 B15 B16 B17 B18 B23
Bits: 3 3 2 2 1 1 3 1 2 6

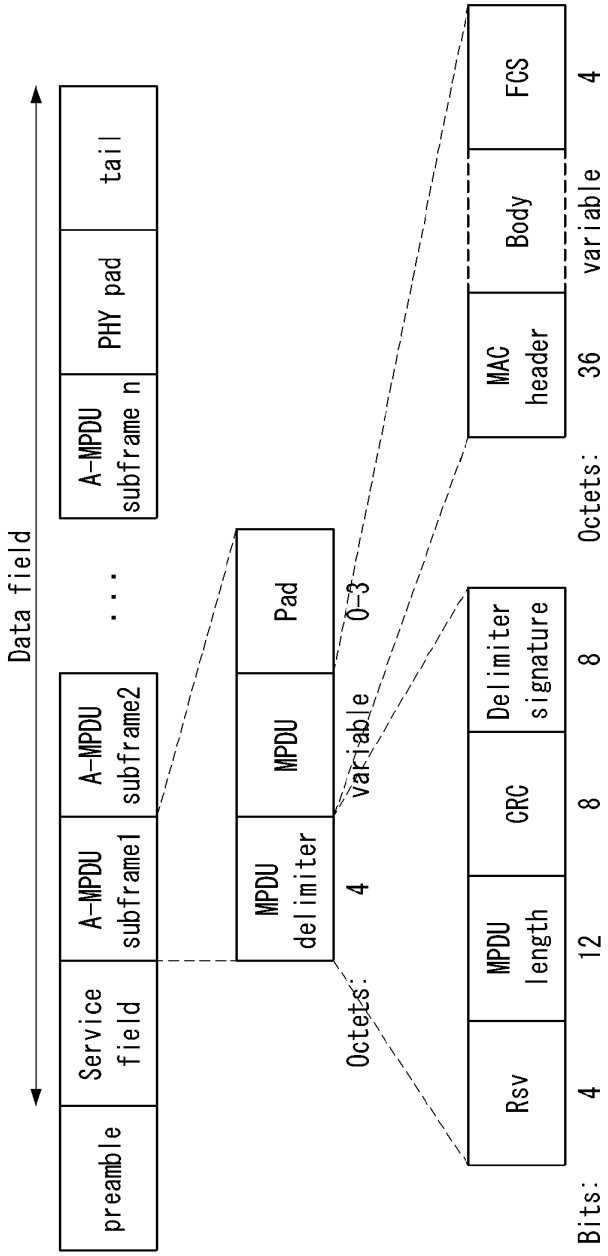
[도15]


Frame Control
Duration
RA
TA
Feedback Segment Retransmission Bitmap
FCS
Octets:
2
2
6
6
1
4

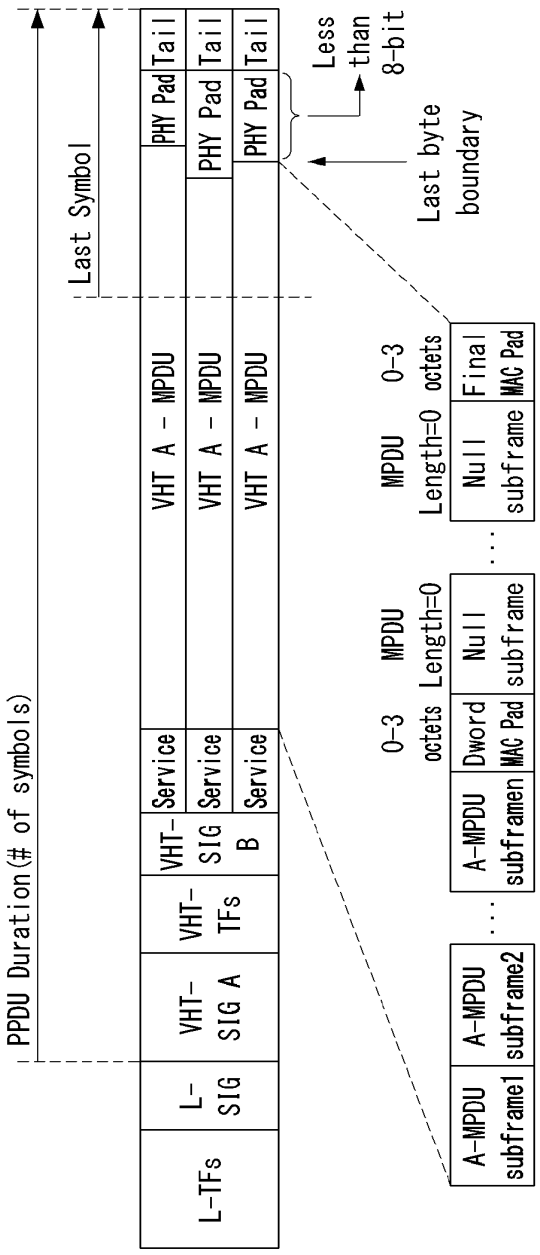
[도16]


Frame Body
Category
VHT Action
Membership Status Array
User Position Array
Octets:
1
1
8
16

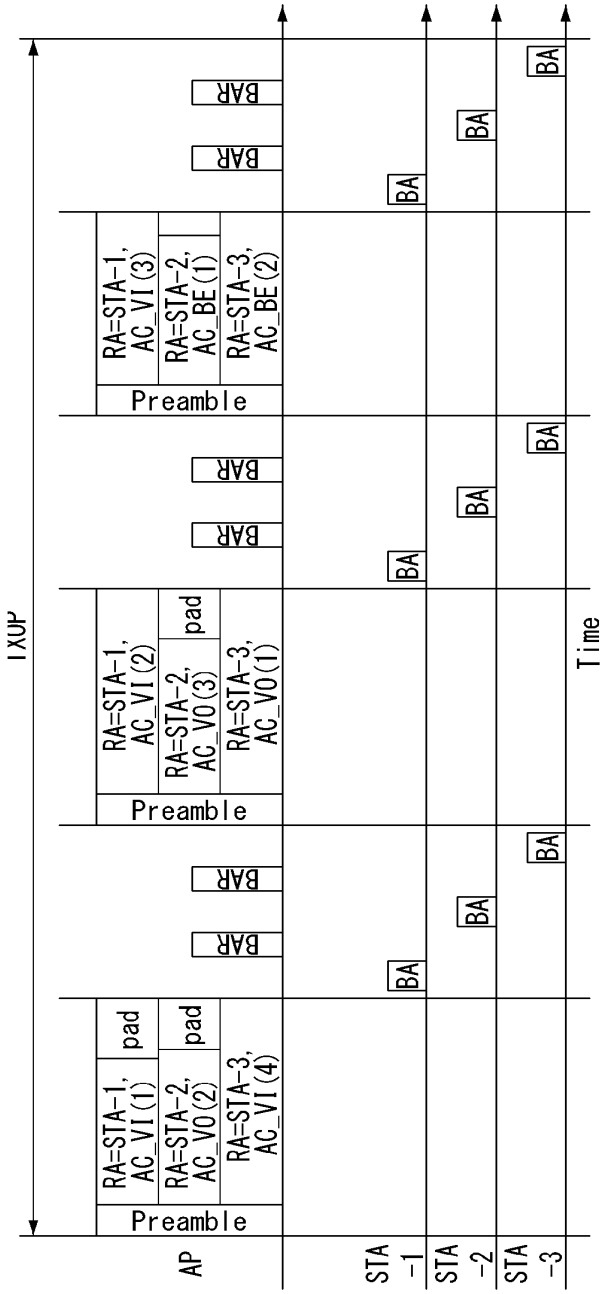
[도17]


Data field
preamble
Service field
A-MPDU subframe1
A-MPDU subframe2
...
A-MPDU subframe n
PHY pad
tail
MPDU delimiter
MPDU
Pad
Octets:
4
variable
0-3
Rsv
MPDU length
CRC
Delimiter signature
Bits:
4
12
8
8
Octets:
MAC header
Body
FCS
36
variable
4

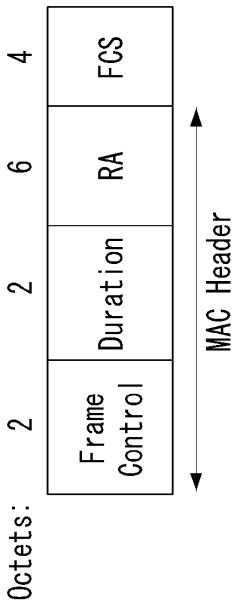
[도18]


PPDU Duration(# of symbols)
Last Symbol
L-TFs
L-SIG
VHT-SIG A
VHT-TFs
VHT-SIG B
Service
VHT A - MPDU
PHY Pad
Tail
Less than 8-bit
Last byte boundary
A-MPDU subframe1
A-MPDU subframe2
A-MPDU subframen
0-3 octets
Dword MAC Pad
MPDU Length=0
Null subframe
MPDU Length=0
0-3 octets
Final MAC Pad

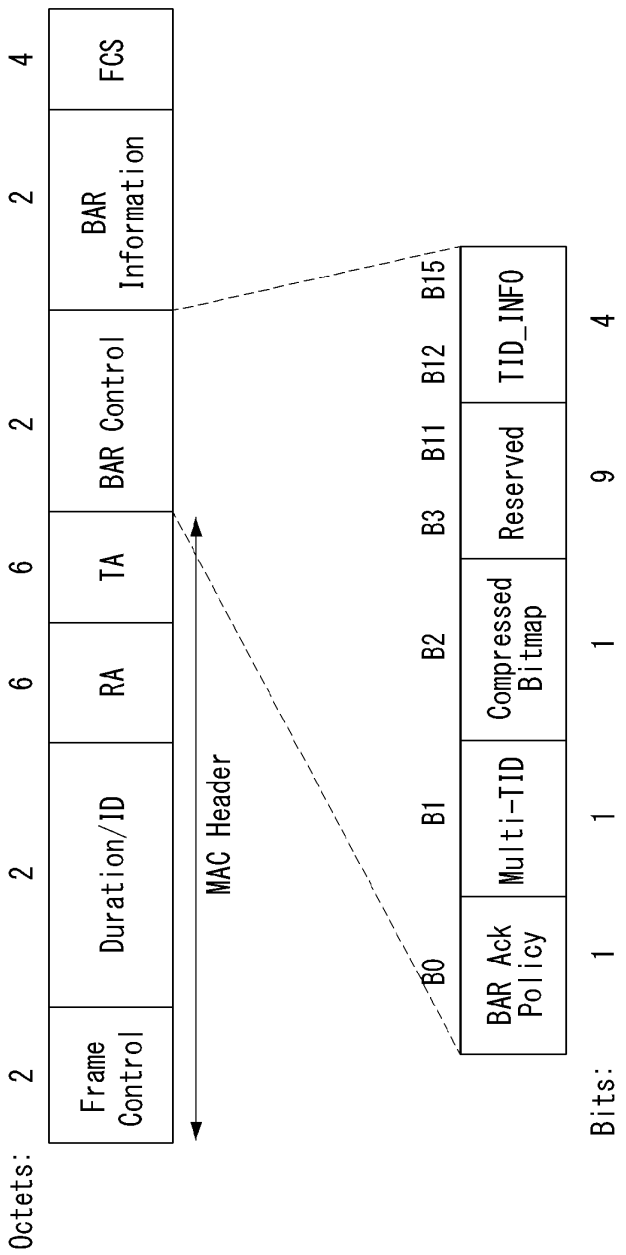
[도19]


AP
STA -1
STA -2
STA -3
Time
Preamble
RA=STA-1, AC_VI(1)
pad
RA=STA-2, AC_VO(2)
RA=STA-3, AC_VI(4)
BAR
BA
Preamble
RA=STA-1, AC_VI(2)
pad
RA=STA-2, AC_VO(3)
RA=STA-3, AC_VO(1)
BAR
BA
Preamble
RA=STA-1, AC_VI(3)
RA=STA-2, AC_BE(1)
RA=STA-3, AC_BE(2)
BAR
BA

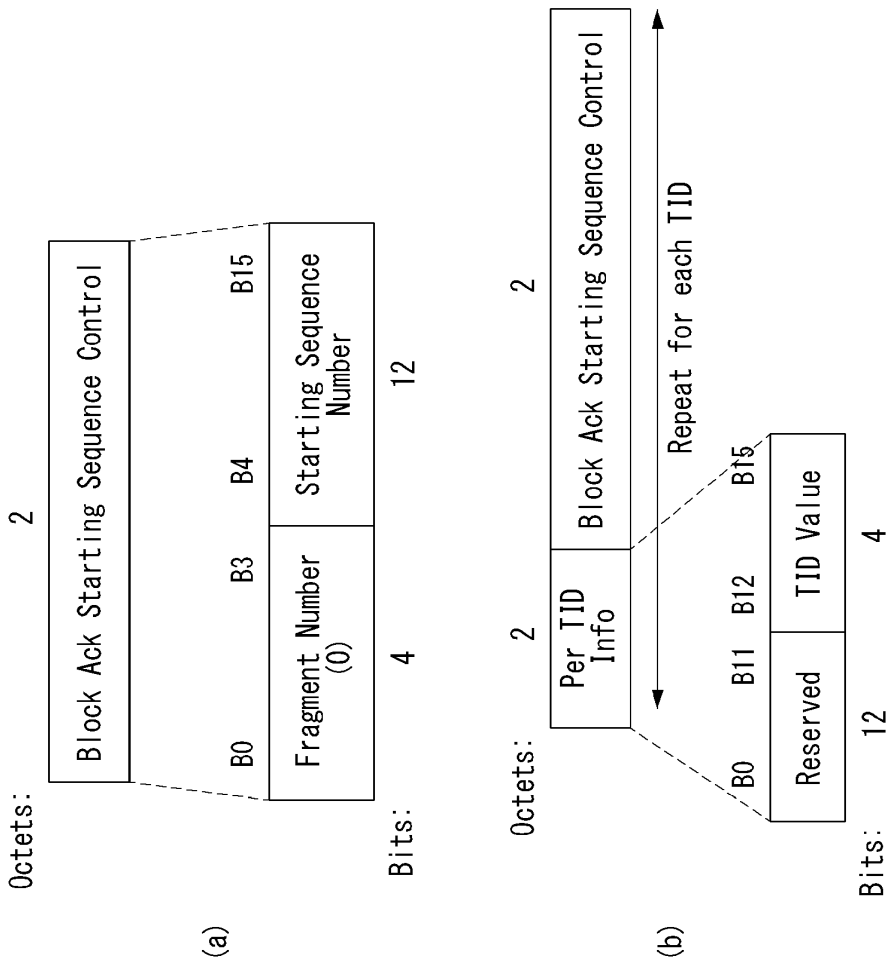
[도20]



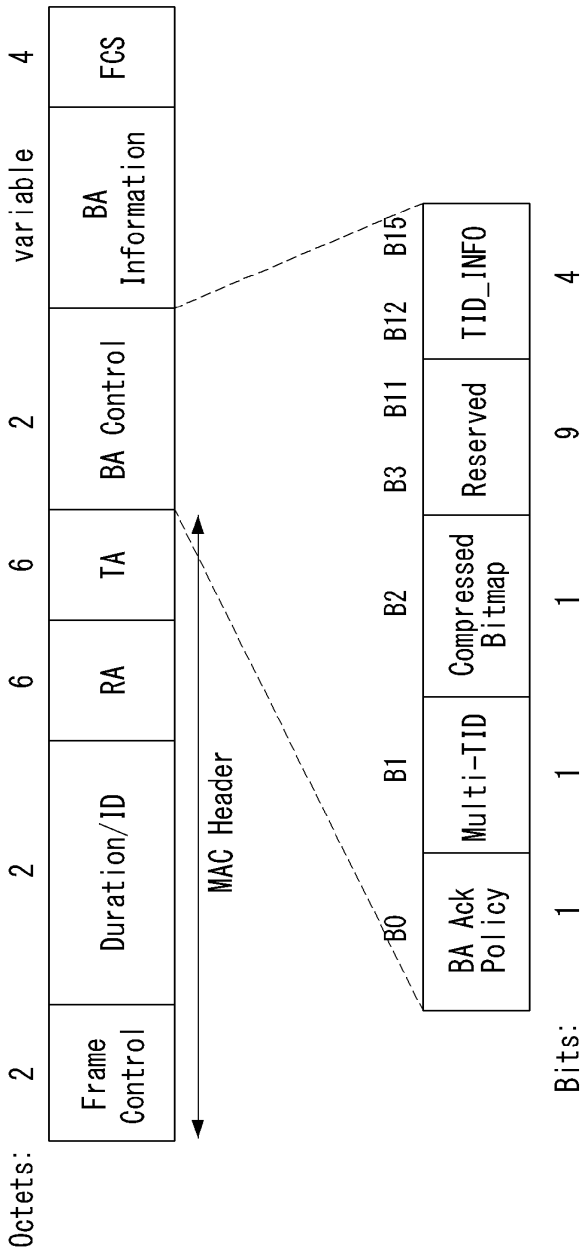
[도21]


Octets:
2
2
6
6
6
2
2
4
Frame Control
Duration/ID
RA
TA
BAR Control
BAR Information
FCS
MAC Header
Bits:
1
1
1
1
9
4
B0
B1
B2
B3
B11
B12
B15
BAR Ack Policy
Multi-TID
Compressed Bitmap
Reserved
TID_INFO

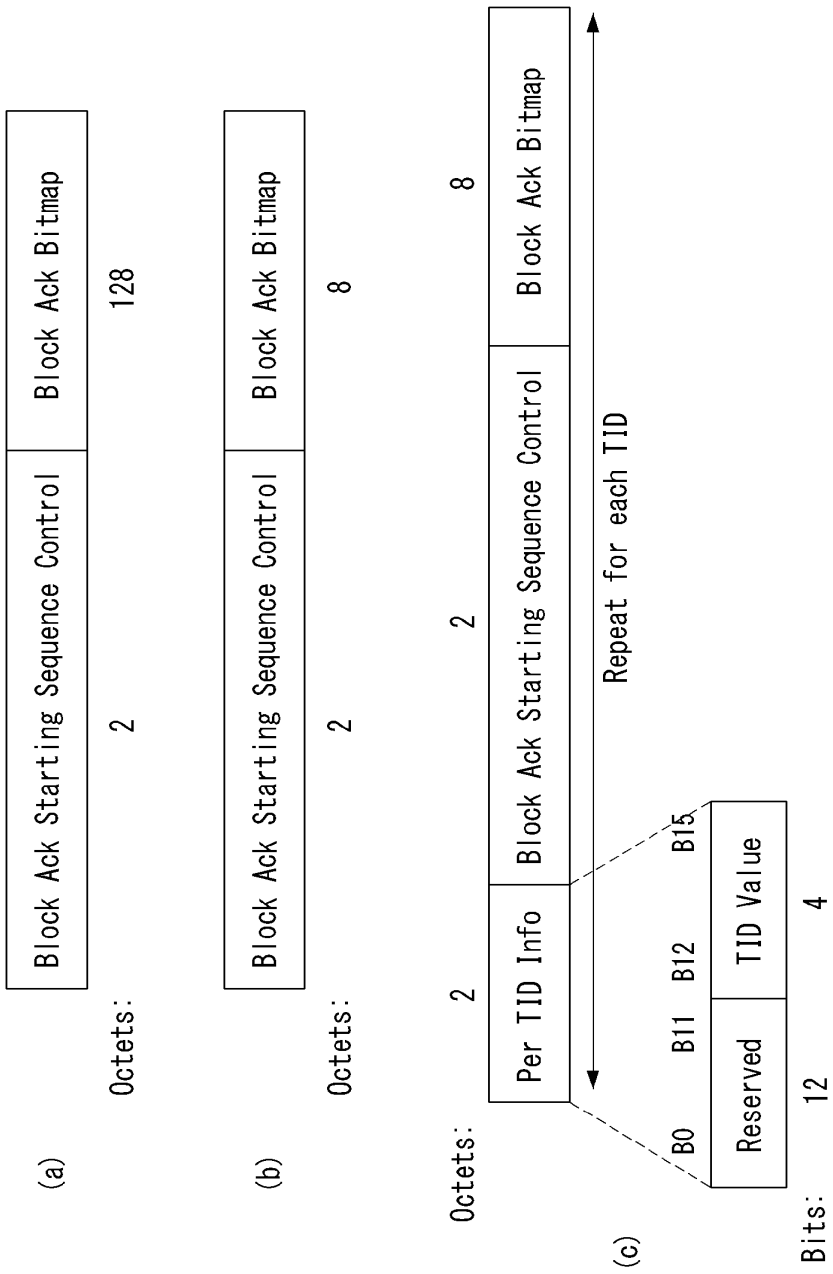
[도22]


Octets:
2
Block Ack Starting Sequence Control
B0
B3
B4
B15
Fragment Number (0)
Starting Sequence Number
Bits:
4
12
(a)
Octets:
2
2
Per TID Info
Block Ack Starting Sequence Control
Repeat for each TID
B0
B11
B12
B15
Reserved
TID Value
Bits:
12
4
(b)

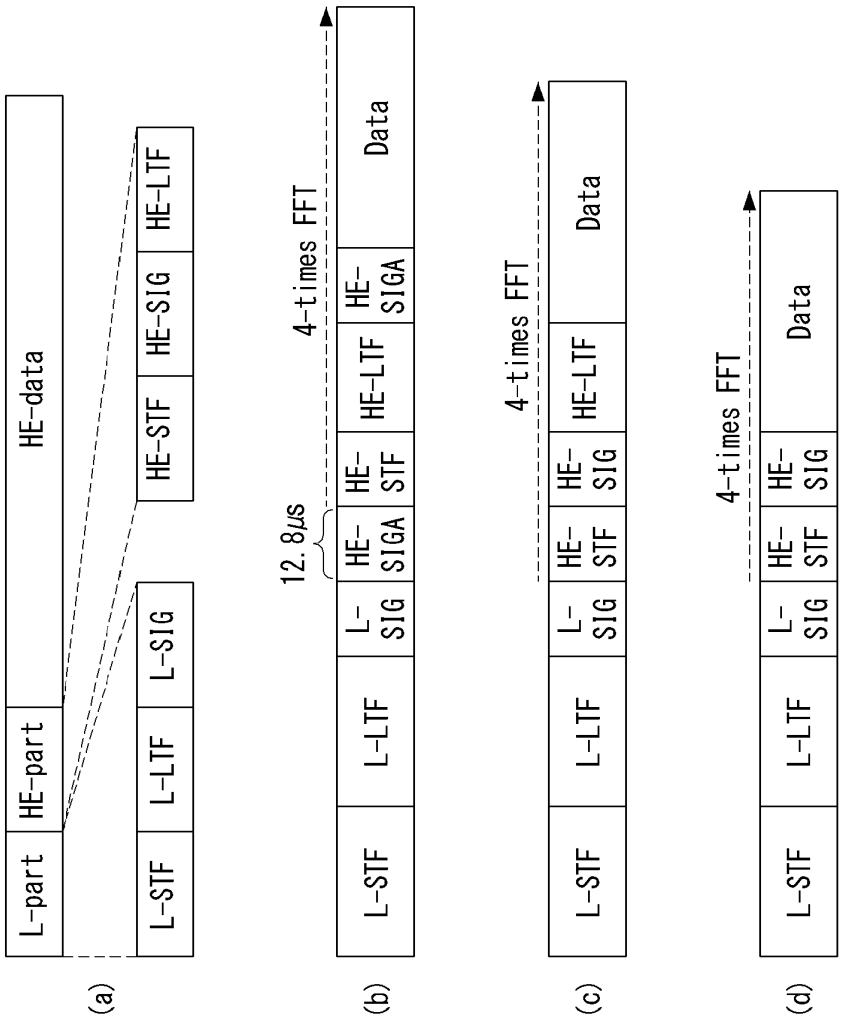
[도23]


Octets:
2
2
6
6
6
2
variable
4
Frame Control
Duration/ID
RA
TA
BA Control
BA Information
FCS
MAC Header
B0
B1
B2
B3
B11
B12
B15
BA Ack Policy
Multi-TID
Compressed Bitmap
Reserved
TID_INFO
Bits:
1
1
1
9
4

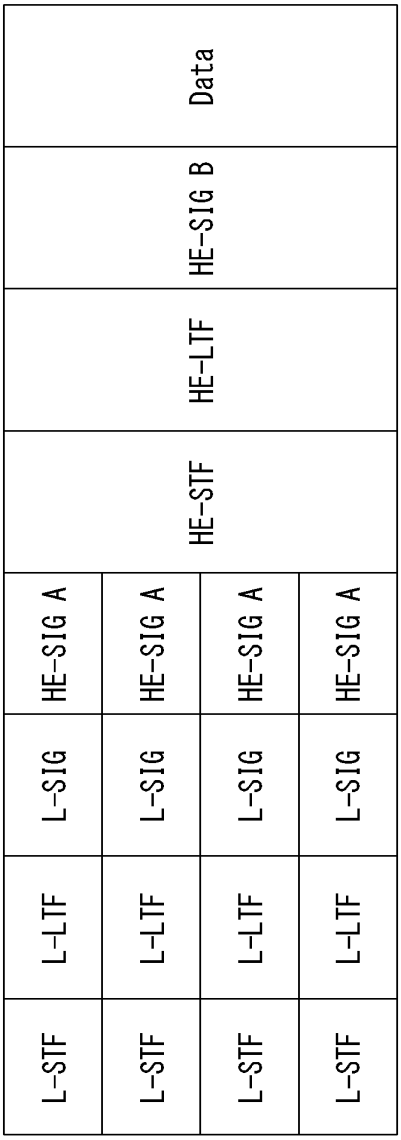
[도24]


(a)
Block Ack Starting Sequence Control
Block Ack Bitmap
Octets:
2
128
(b)
Block Ack Starting Sequence Control
Block Ack Bitmap
Octets:
2
8
(c)
Per TID Info
Block Ack Starting Sequence Control
Block Ack Bitmap
Repeat for each TID
Octets:
2
2
8
B0
B11
B12
B15
Reserved
TID Value
Bits:
12
4

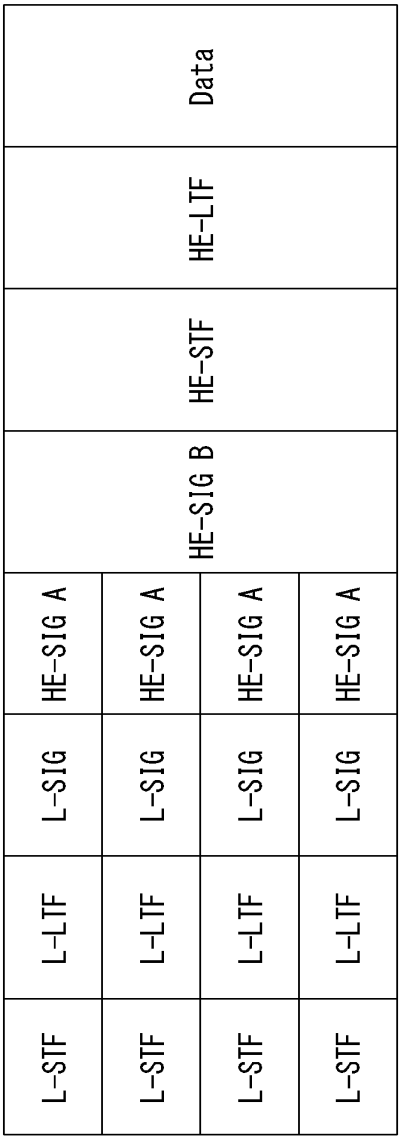
[도25]


L-part
HE-part
HE-data
L-STF
L-LTF
L-SIG
HE-STF
HE-SIG
HE-LTF
(a)
12.8μs
4-times FFT
L-STF
L-LTF
L-SIG
HE-SIGA
HE-STF
HE-LTF
HE-SIGA
Data
(b)
4-times FFT
L-STF
L-LTF
L-SIG
HE-STF
HE-SIG
HE-LTF
Data
(c)
4-times FFT
L-STF
L-LTF
L-SIG
HE-STF
HE-SIG
Data
(d)

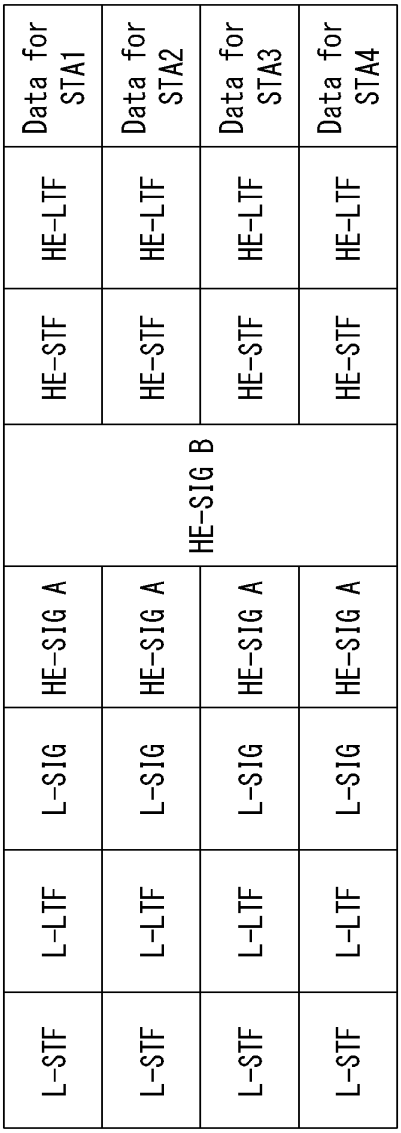
[도26]


Data
HE-SIG B
HE-LTF
HE-STF
L-STF
L-LTF
L-SIG
HE-SIG A
L-STF
L-LTF
L-SIG
HE-SIG A
L-STF
L-LTF
L-SIG
HE-SIG A
L-STF
L-LTF
L-SIG
HE-SIG A

[도27]


Data
HE-LTF
HE-STF
HE-SIG B
L-STF
L-LTF
L-SIG
HE-SIG A
L-STF
L-LTF
L-SIG
HE-SIG A
L-STF
L-LTF
L-SIG
HE-SIG A
L-STF
L-LTF
L-SIG
HE-SIG A

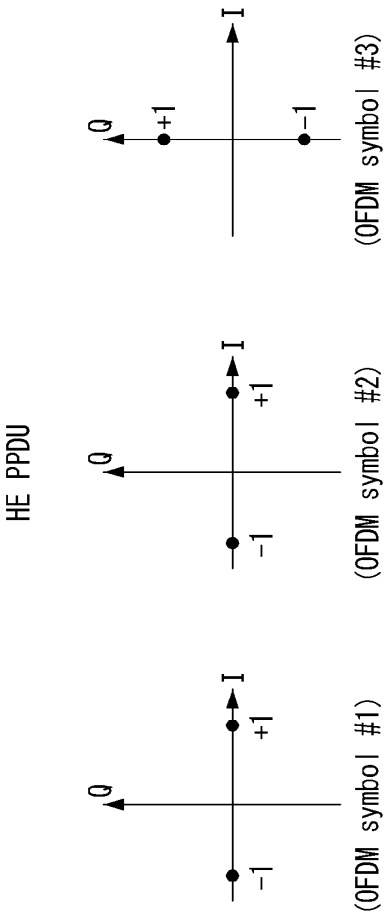
[도28]


L-STF
L-LTF
L-SIG
HE-SIG A
HE-SIG B
HE-STF
HE-LTF
Data for STA1
Data for STA2
Data for STA3
Data for STA4

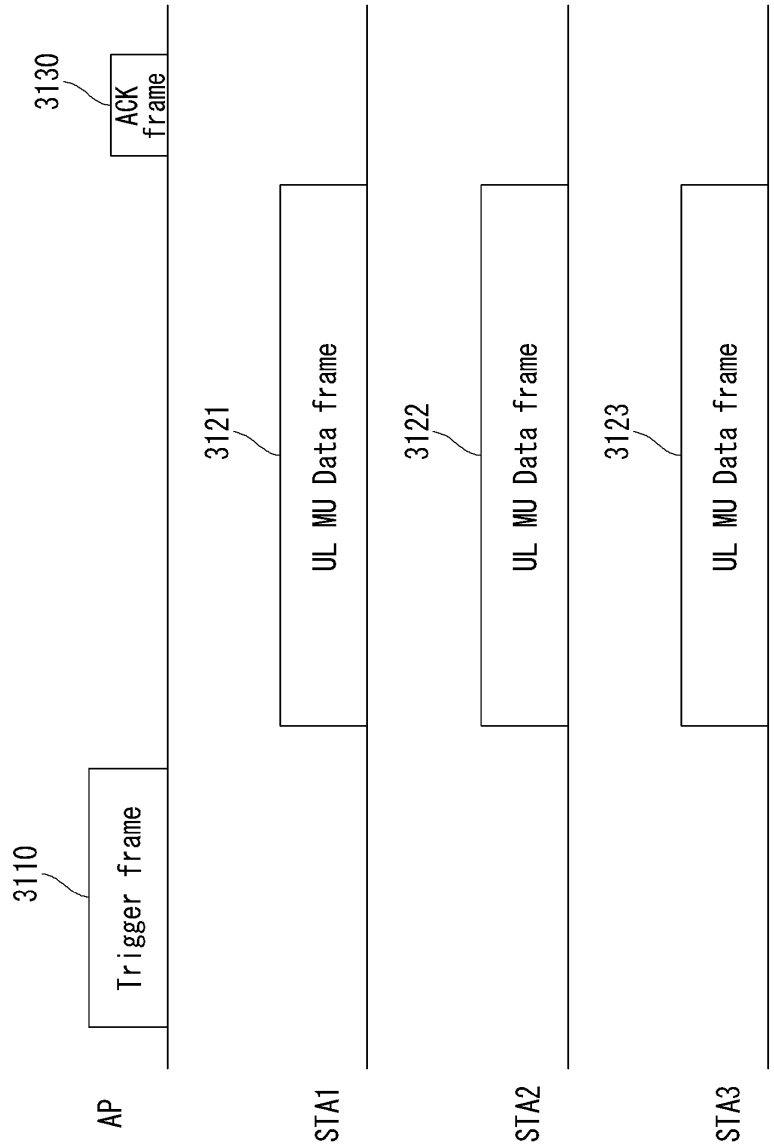
[도29]

L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA1
L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA2
L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA3
L-STF	L-LTF	L-SIG	HE-SIG A	HE-SIG B	HE-STF	HE-LTF	Data for STA4

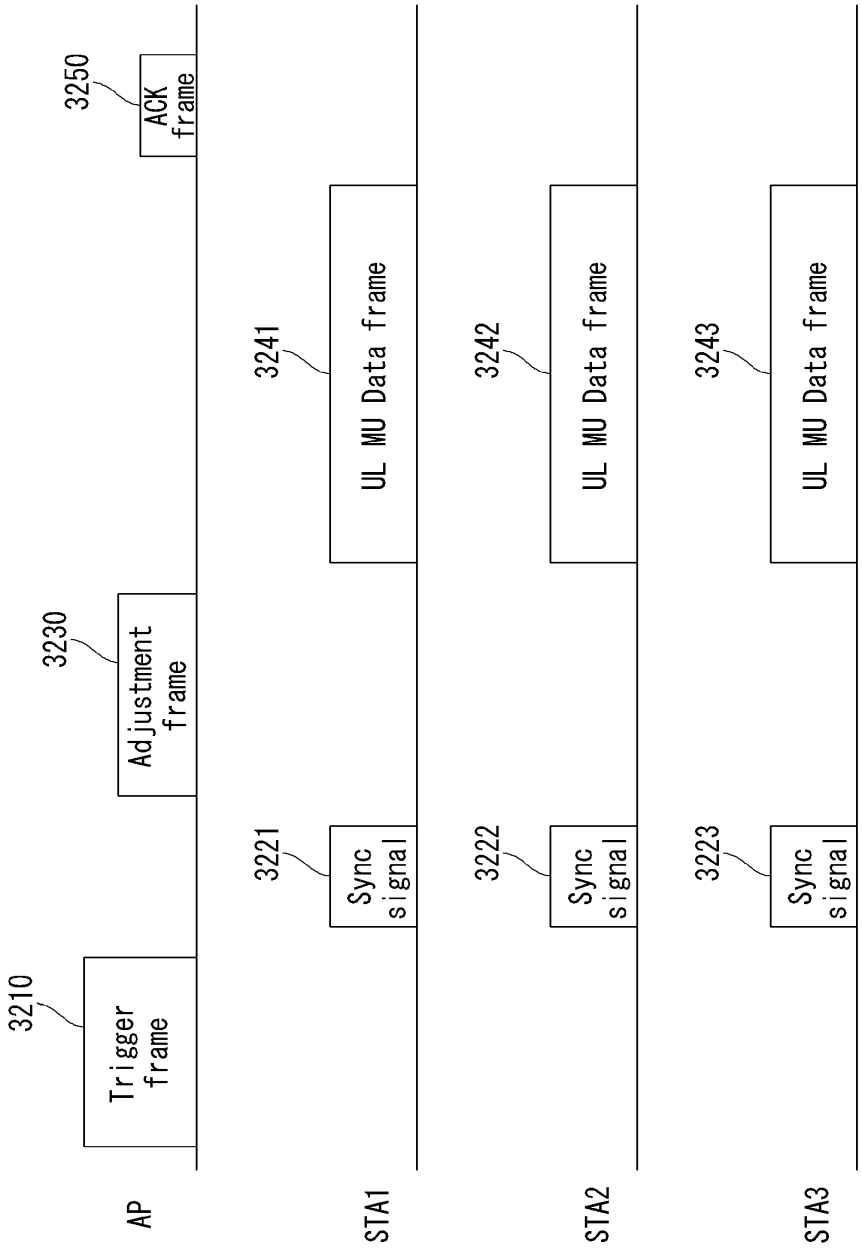
[도30]



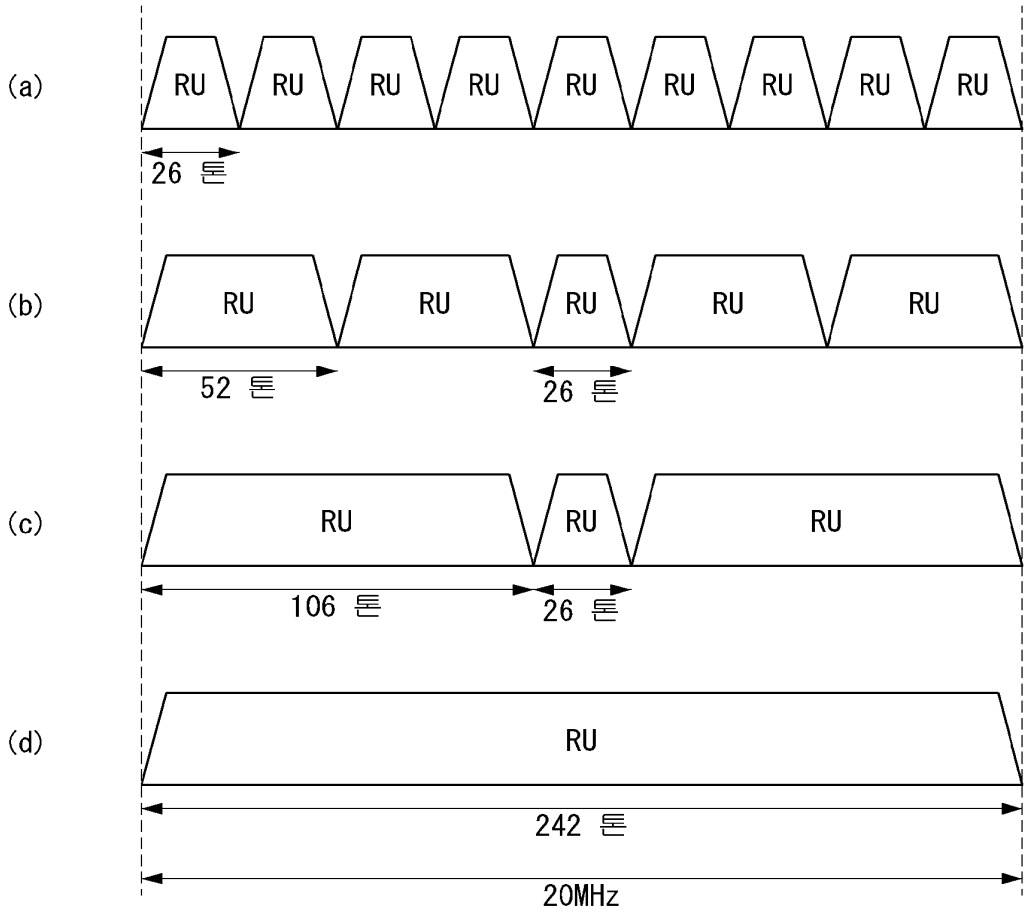
[도31]


3130
ACK frame
3121
UL MU Data frame
3122
UL MU Data frame
3123
UL MU Data frame
3110
Trigger frame
AP
STA1
STA2
STA3

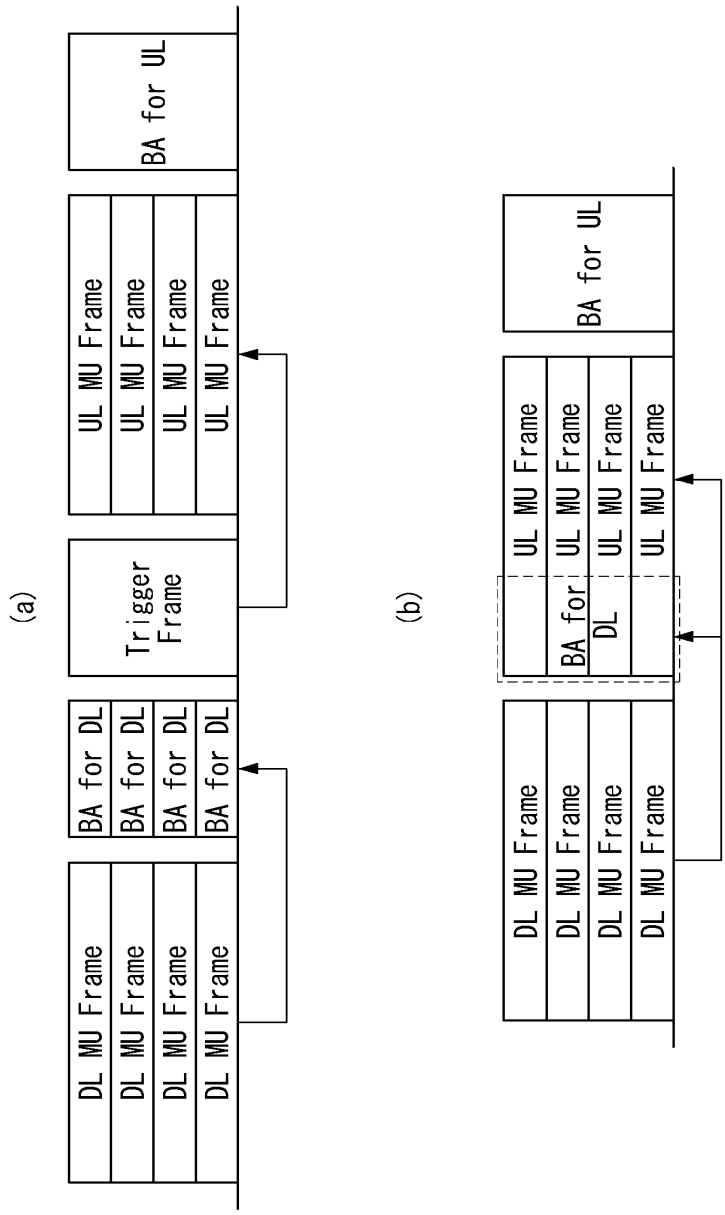
[도32]


AP
STA1
STA2
STA3
3210
Trigger frame
3230
Adjustment frame
3250
ACK frame
3221
Sync signal
3222
Sync signal
3223
Sync signal
3241
UL MU Data frame
3242
UL MU Data frame
3243
UL MU Data frame

[도33]

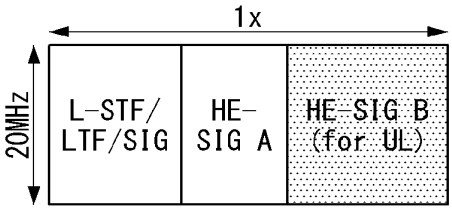

(a)
RU
RU
RU
RU
RU
RU
RU
RU
RU
26 톤
(b)
RU
RU
RU
RU
RU
52 톤
26 톤
(c)
RU
RU
RU
106 톤
26 톤
(d)
RU
242 톤
20MHz

[도34]

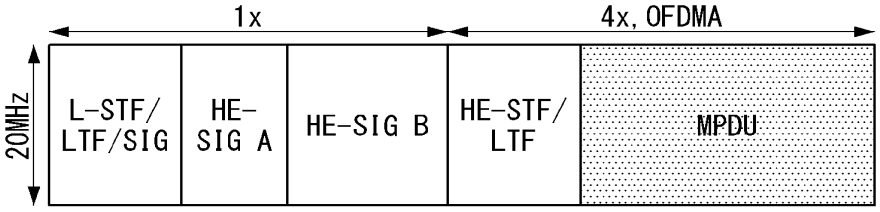

(a)
DL MU Frame
DL MU Frame
DL MU Frame
DL MU Frame
BA for DL
BA for DL
BA for DL
BA for DL
Trigger Frame
UL MU Frame
UL MU Frame
UL MU Frame
UL MU Frame
BA for UL
(b)
DL MU Frame
DL MU Frame
DL MU Frame
DL MU Frame
BA for DL
UL MU Frame
UL MU Frame
UL MU Frame
UL MU Frame
BA for UL

[도35]

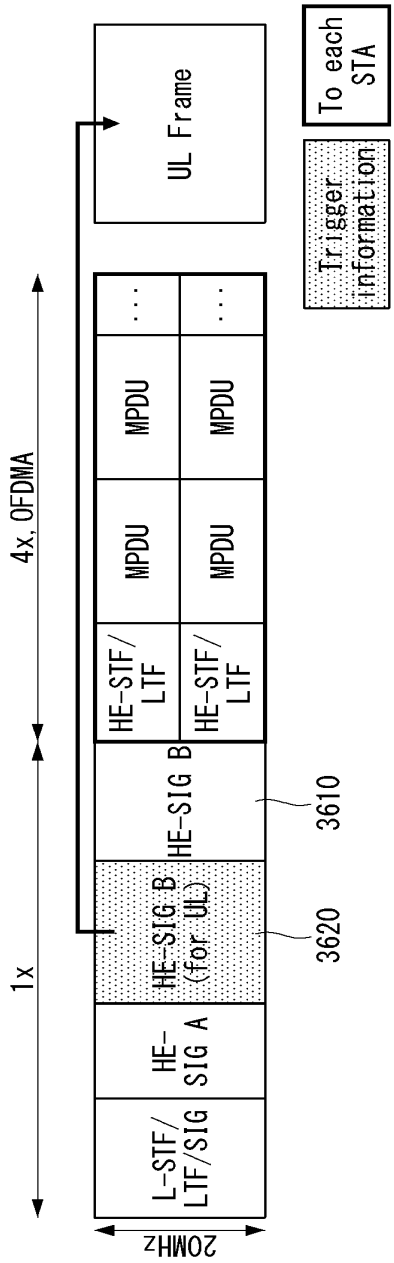
(a)


1x
20MHz
L-STF/ LTF/SIG
HE- SIG A
HE-SIG B (for UL)

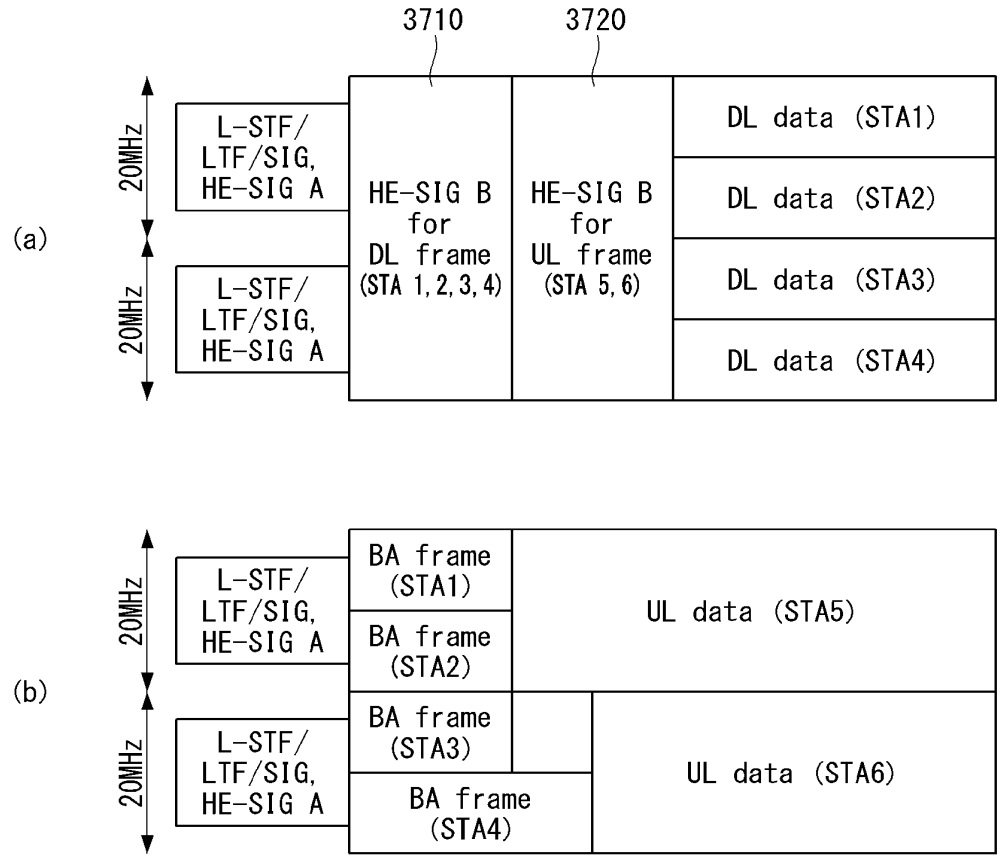
(b)


1x
4x, OFDMA
20MHz
L-STF/ LTF/SIG
HE- SIG A
HE-SIG B
HE-STF/ LTF
MPDU

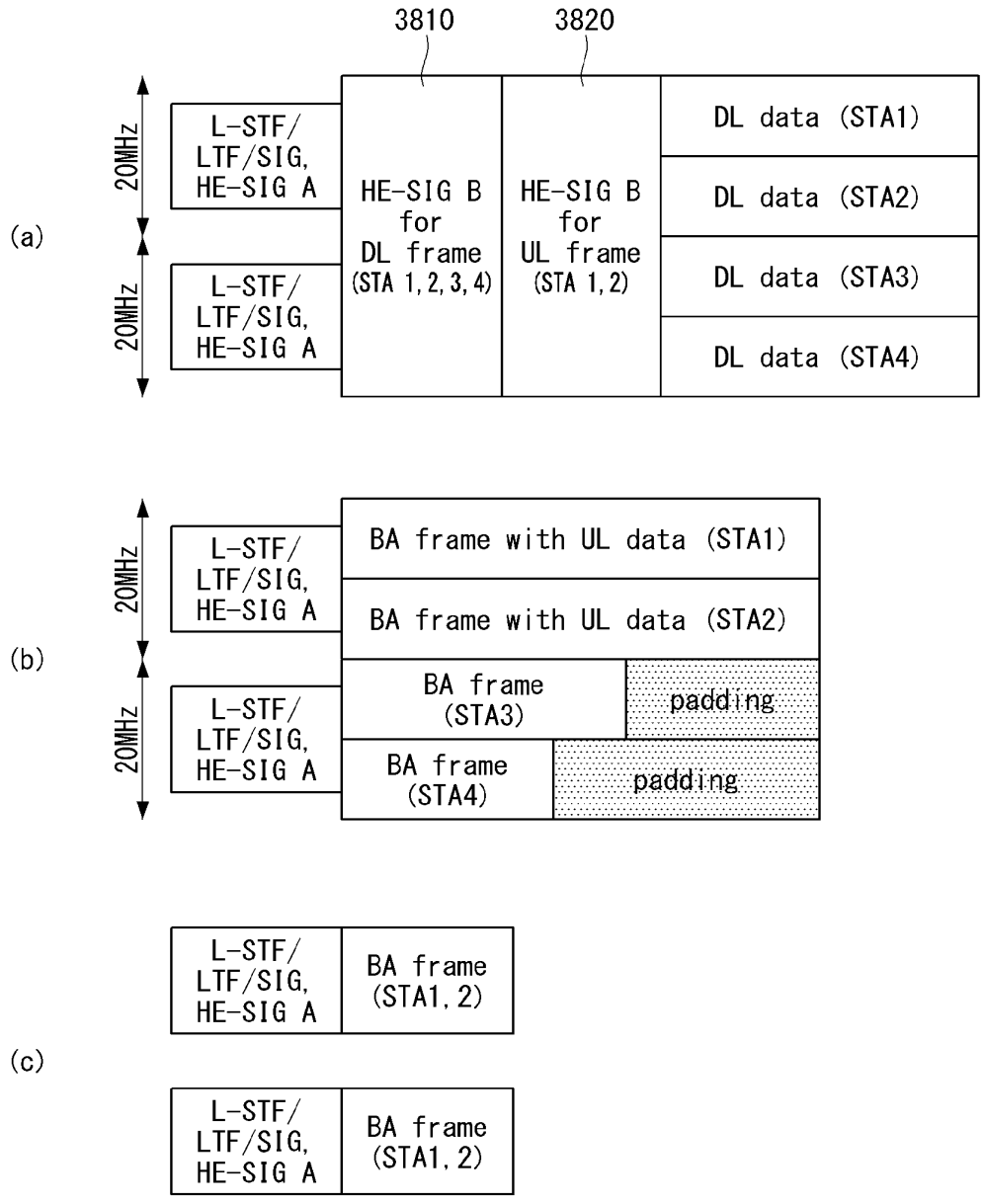
[도36]


To each STA
Trigger information
UL Frame
20MHz
1x
4x, OFDMA
L-STF/ LTF/SIG
HE-SIG A
HE-SIG B (for UL)
HE-SIG B
HE-STF/ LTF
HE-STF/ LTF
MPDU
MPDU
MPDU
MPDU
...
...
3610
3620

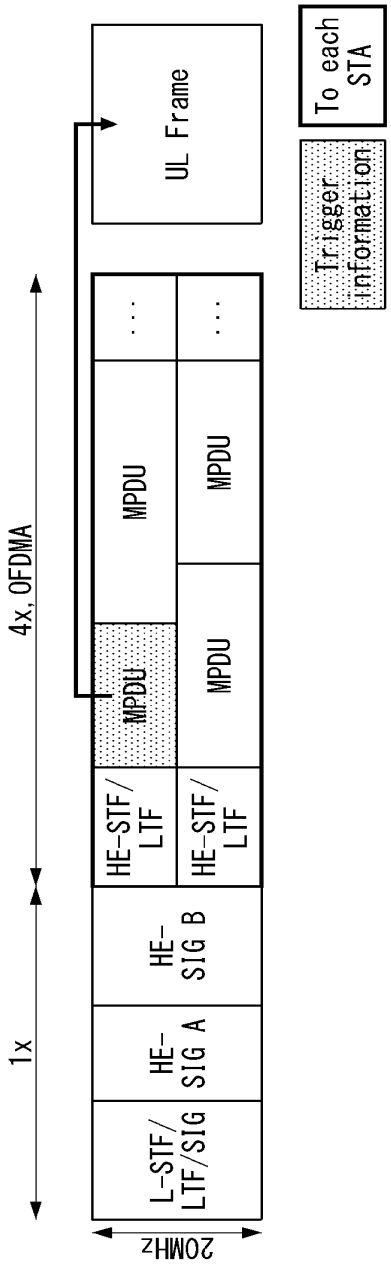
[도37]


3710
3720
(a)
20MHz
L-STF/ LTF/SIG, HE-SIG A
20MHz
L-STF/ LTF/SIG, HE-SIG A
HE-SIG B for DL frame (STA 1,2,3,4)
HE-SIG B for UL frame (STA 5,6)
DL data (STA1)
DL data (STA2)
DL data (STA3)
DL data (STA4)
(b)
20MHz
L-STF/ LTF/SIG, HE-SIG A
20MHz
L-STF/ LTF/SIG, HE-SIG A
BA frame (STA1)
BA frame (STA2)
BA frame (STA3)
BA frame (STA4)
UL data (STA5)
UL data (STA6)

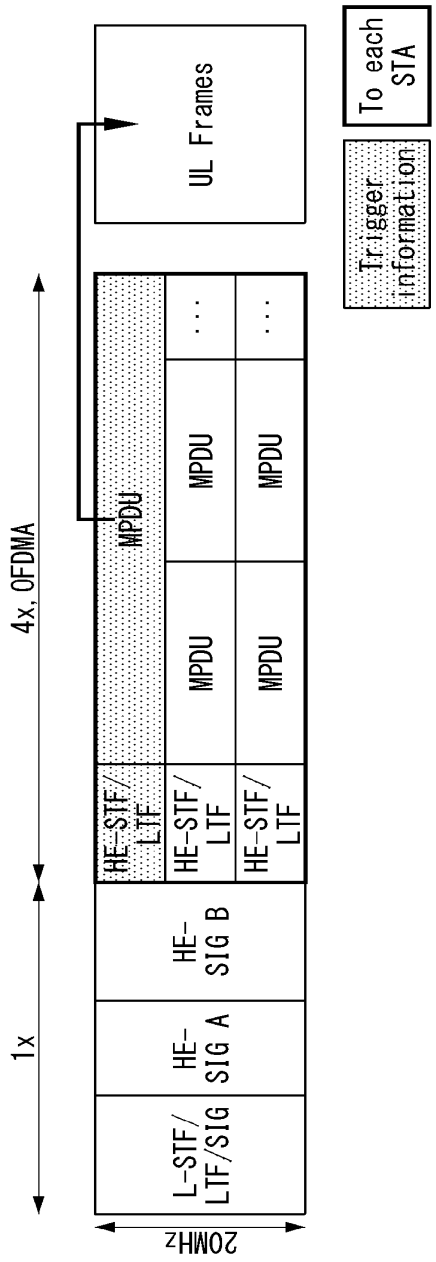
[도38]


3810
3820
(a)
20MHz
20MHz
L-STF/ LTF/SIG, HE-SIG A
L-STF/ LTF/SIG, HE-SIG A
HE-SIG B for DL frame (STA 1,2,3,4)
HE-SIG B for UL frame (STA 1,2)
DL data (STA1)
DL data (STA2)
DL data (STA3)
DL data (STA4)
(b)
20MHz
20MHz
L-STF/ LTF/SIG, HE-SIG A
L-STF/ LTF/SIG, HE-SIG A
BA frame with UL data (STA1)
BA frame with UL data (STA2)
BA frame (STA3)
padding
BA frame (STA4)
padding
(c)
L-STF/ LTF/SIG, HE-SIG A
BA frame (STA1,2)
L-STF/ LTF/SIG, HE-SIG A
BA frame (STA1,2)

[도39]


To each STA
Trigger information
UL Frame
20MHz
1x
4x, OFDMA
L-STF/ LTF/SIG
HE- SIG A
HE- SIG B
HE-STF/ LTF
HE-STF/ LTF
MPDU
MPDU
MPDU
MPDU
...
...

[도40]

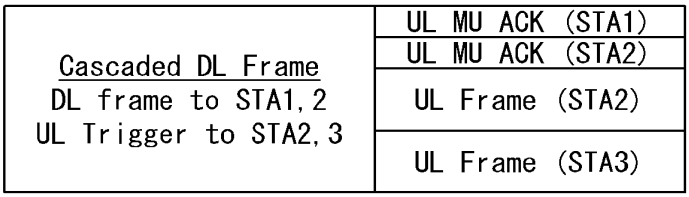

L-STF/ LTF/SIG
HE- SIG A
HE- SIG B
HE-STF/ LTF
MPDU
HE-STF/ LTF
MPDU
HE-STF/ LTF
MPDU
...
...
MPDU
1x
4x, OFDMA
20MHz
UL Frames
To each STA
Trigger information

[도41]

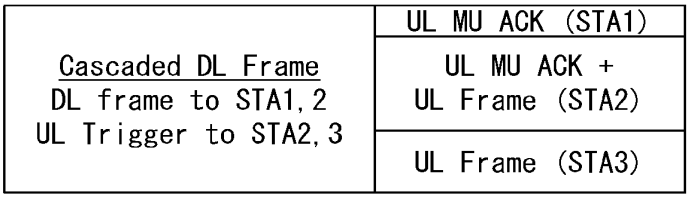
	제1 실시예	제2-1 실시예	제2-2 실시예
Pros	· UL MU 스케줄링의 유연성이 존재 (Flexibility of UL MU scheduling) · UL MU STA 및 다른 STA들의 자원 및 파워 절약 측면에서 유리 (Resource saving/ Power saving of other STAs/ UL MU STAs)	· UL MU STA 및 다른 STA들의 자원 및 파워 절약 측면에서 유리 (Resource saving/ Power saving of other STAs/ UL MU STAs) · 기존의 DL MU 프레임 포맷을 그대로 사용 가능(Use DL MU frame format as it is)	· UL MU 그룹을 자유롭게 형성 가능 (Free to make UL MU group)

[도42]

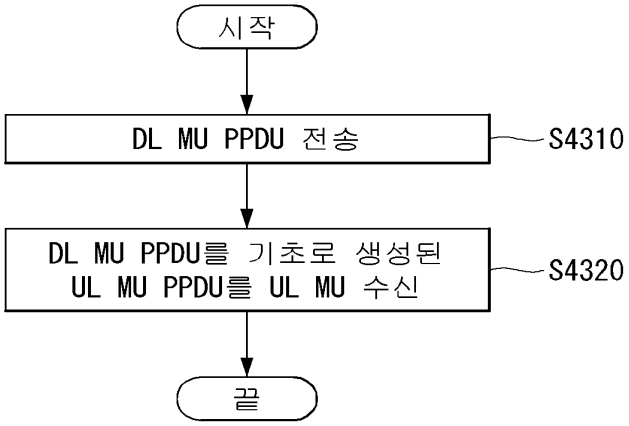
(a)



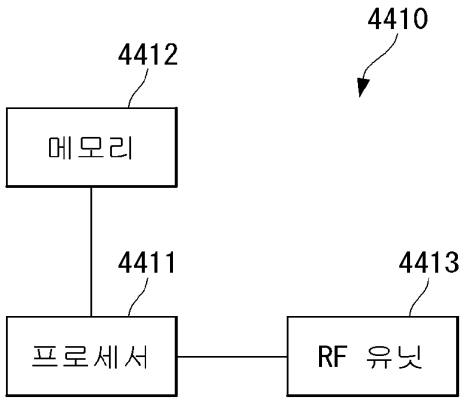
(b)



[도43]



[도44]



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Central, Docket
	Art Unit: OPAP
Serial No.: 17/157,978	Conf. No.: 2451
Filing Date: January 25, 2021	Our Ref: B-10005CON1 633016-0
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Re: ***Information Disclosure Statement***
Date: March 15, 2022	

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[ ] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[x] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

[ ] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

- [ ] accompanied by the fee set forth in § 1.17(p), or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

[ ] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

Additional Information

[x] Translations of the foreign-language documents are also enclosed as machine-translations, human-translations, or counterpart applications as noted. Machine translations were provided by the Japanese Patent Office, ESPACENET, Google Documents, Patent Fetcher® /ESPACENET, Google Translate or Google Translator Toolkit as noted and with OCR by Adobe Acrobat 9 or ABBYY PDF Transformer 3 if needed.

[x] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

March 15, 2022
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

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Los Angeles, CA 90010
(323) 934-2300 voice

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. OPAP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	2014/0254552	Sep. 11, 2014	HAYES et al.			
	2.	2016/0127020	May 5, 2016	Abraham et al.			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	3.	104321995	Jan. 28, 2015	CN			Espacenet
	4.	103563457	Feb. 5, 2014	CN			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	5.	Office Action dated December 27, 2021 for Indian Patent Application No. 202128005900
	6.	Office Action dated December 9, 2021 for Chinese Patent Application No. 201780041848.0 and its English translation provided by Applicant's foreign counsel
	7.	Notice of Allowance dated December 13, 2021 for European Patent Application No. 17 824 568.4

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

Espacenet

Bibliographic data: CN104321995 (A) — 2015-01-28

Method and apparatus for transmitting acknowledgements in response to received frames

Inventor(s): WANG XIAOFEI; LOU HANQING; GHOSH MONISHA; GRANDHI SUDHEER A ± (WANG XIAOFEI, ; LOU HANQING, ; GHOSH MONISHA, ; GRANDHI SUDHEER A)

Applicant(s): INTERDIGITAL PATENT HOLDINGS ± (INTERDIGITAL PATENT HOLDINGS, INC)

Classification: **- international:** ***H04L1/00; H04L1/16; H04L1/18***
- cooperative: **H04L1/16 (KR); H04L1/1607 (EP, CN, KR, US); H04L1/1671 (EP, CN, US); H04L1/18 (KR); H04L1/1854 (EP, CN, US); H04L1/1864 (EP, CN, US); H04L5/0055 (US);** H04L2001/0093 (EP, US)

Application number: CN20138024671 20130510 Global Dossier

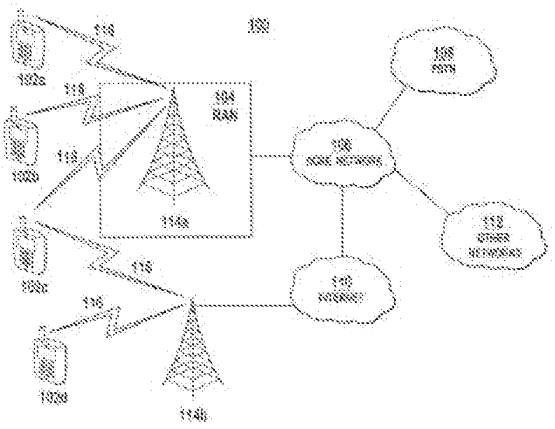
Priority number(s): WO2013US40529 20130510 ; US201261646040P 20120511 ; US201261669390P 20120709 ; US201261699531P 20120911 ; US201261724466P 20121109

Also published as: CN112291045 (A) EP2847909 (A1) JP2015525017 (A) JP2017073791 (A) JP2019071618 (A) more

Abstract of CN104321995 (A)

A method and apparatus for transmitting acknowledgements in response to data packets in wireless communication are disclosed. A recipient may receive a plurality of data packets from a plurality of stations and transmit acknowledgements for the data packets to the originating stations in a single transmission. The acknowledgements may be transmitted using multi-user multiple -input multiple -output (MU-MIMO). Alternatively, the acknowledgements may be aggregated and transmitted in the single transmission. A short acknowledgement (ACK) frame may be sent in response to a received frame. The short ACK frame may include an ACK sequence corresponding to a sequence identity (ID) included in the received frame. The short ACK frame may include a short training field (STF) and the ACK sequence. The short ACK frame may

be transmitted with a short ACK indication. The short ACK frame may be sent in response to an indication included in the received frame.



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CLAIMS CN104321995A

1.

A method for use in a station for transmitting an acknowledgment in wireless communication in response to a data packet, the method comprising:

receive data packets from multiple stations;

generating an acknowledgment for the data packet;

obtain a transmission opportunity; and

The acknowledgments for the data packets are transmitted to the plurality of stations in a single transmission.

2.

The method of claim 1, wherein the acknowledgment is transmitted using multi-user multiple-input multiple-output (MU-MIMO).

3.

The method of claim 2, wherein the acknowledgment is transmitted after a predetermined time from receipt of the data packet.

4.

4. The method of claim 3, wherein the acknowledgment is transmitted based on an agreed schedule, based on a request by one of the plurality of stations, or upon receipt of a predetermined number of data packets.

5.

The method of claim 1, wherein generating an acknowledgment for the data packet comprises:

generating confirmation packets; and

The acknowledgment packets are aggregated, and wherein transmitting the acknowledgment includes transmitting the aggregated acknowledgment packets to the plurality of stations in the single transmission.

6.

6. The method of claim 5, wherein the acknowledgment packet is in a Medium Access Control (MAC) Service Data Unit, in a MAC Protocol Data Unit, or in a Physical Layer Convergence Protocol (PLCP) Protocol Data Unit (PPDU) aggregated in.

7.

A method for use in a station for transmitting an acknowledgment in wireless communication, the method comprising:

receiving a frame indicating a sequence identification (ID); and

A short acknowledgement (ACK) frame is transmitted in response to the received frame, wherein the short ACK frame includes an ACK sequence corresponding to the sequence ID.

8.

8. The method of claim 7, wherein the short ACK frame includes a short training field (STF) and the ACK sequence.

9.

The method of claim 7, wherein the short ACK frame is transmitted with a short ACK indication.

10.

8. The method of claim 7, wherein the short ACK frame is transmitted in response to an indication included in the frame.

11.

A wireless transmit/receive unit (WTRU) for transmitting acknowledgments in wireless communications in response to data packets, the WTRU comprising:

A processor configured to receive data packets from a plurality of stations, generate acknowledgments for the data packets, and transmit the acknowledgments for the data packets to the plurality of stations in a single transmission.

12.

The WTRU of claim 11 wherein the processor is configured to transmit the acknowledgment using multi-user multiple-input multiple-output (MU-MIMO).

13.

13. The WTRU of claim 12 wherein the processor is configured to transmit the acknowledgment after a predetermined time from receipt of the data packet.

14.

14. The WTRU of claim 13 wherein the processor is configured to transmit the data packets based on an agreed schedule, or based on a request by one of the plurality of stations, or upon receipt of a predetermined number of data packets, to confirm.

15.

The WTRU of claim 11 wherein the processor is configured to generate acknowledgment packets, aggregate the acknowledgment packets, and transmit the aggregated acknowledgment packets to the plurality of stations in the single transmission.

16.

16. The WTRU of claim 15 wherein the processor is configured in a Medium Access Control (MAC) service data unit, in a MAC protocol data unit, or in a Physical Layer Convergence Protocol (PLCP) protocol data unit (PPDU)) to aggregate the acknowledgment packets.

17.

A wireless transmit/receive unit (WTRU) for transmitting acknowledgements in wireless communications, the WTRU comprising:

a processor configured to receive a frame and transmit a short acknowledgment (ACK) frame in response to the received frame, wherein the received frame indicates a sequence identification (ID), and the short ACK frame includes a frame corresponding to the ACK sequence for sequence ID.

18.

The WTRU of claim 17 wherein the short ACK frame includes a short training field (STF) and the ACK sequence.

19.

18. The WTRU of claim 17 wherein the short ACK frame is transmitted with a short ACK indication.

20.

The WTRU of claim 17 wherein the short ACK frame is transmitted in response to an indication included in the frame.

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DESCRIPTION CN104321995A

Method and apparatus for transmitting acknowledgment in response to received frame

[0001]

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002]

This application claims US Provisional Application No. 61/646,040, filed on May 11, 2012, US Provisional Application No. 61/669,390, filed on July 9, 2012, and US Provisional Application No. 61/669,390, filed on September 11, 2012. 61/699,531 and the benefit of US Provisional Application No. 61/724,466, filed November 9, 2012, the contents of which are incorporated herein by reference.

[0003]

Background technique

[0004]

A wireless local area network (WLAN) in infrastructure basic service set (BSS) mode has an access point (AP) for the BSS, and one or more stations (STA) associated with the AP.

The AP typically has access or interface to a Distribution System (DS) or another type of wired or wireless network that brings traffic in and out of the BSS.

Traffic originating outside the BSS to the STA arrives through the AP and is delivered to the STA.

Traffic originating from the STA to destinations outside the BSS is sent to the AP to be delivered to the respective destinations. Traffic between STAs within the BSS can also be sent through the AP, where the source STA sends the traffic to the AP, and the AP delivers the traffic to the target STA. This kind of traffic between STAs within a BSS is actually a peer-to-peer traffic. Peer-to-peer traffic can be sent directly between source and target STAs with Direct Link Setup (DLS) using IEEE 802.11e DLS or IEEE 802.11z Tunneled DLS (TDLS). A WLAN in independent BSS mode (IBSS) does not have APs and STAs that communicate directly with each other.

[0005]

In the current IEEE 802.11 infrastructure mode of operation, the AP transmits beacons on a channel called the primary channel.

The width of the main channel is 20 MHz, and the main channel is the operating channel of the BSS. This channel is also used by STAs to establish connections with APs. 802.11The channel access mechanism in the system is Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). In this mode of operation, each STA (including the AP) will sense the primary channel, and if the channel is detected to be busy, the STA and AP will back off. Thus, one STA (including AP) can transmit at any given time in a given BSS.

[0006]

In IEEE 802.11n, high throughput (HT) STAs can also use 40MHz wide channels for communication.

This can be achieved by combining the main 20MHz channel with another adjacent 20MHz channel to form a 40MHz wide channel.

[0007]

In IEEE 802.11ac, Very High Throughput (VHT) STAs are capable of supporting 40MHz, 80MHz and 160MHz wide channels.

While 40MHz and 80MHz channels can be formed by combining consecutive 20MHz channels (similar to IEEE 802.11n), a 160MHz channel can be formed by combining 8 consecutive 20MHz channels or two non-consecutive 80MHz channels (80+80 configuration) form.

[0008]

The channel operating bandwidth may be reduced for the sub-1 GHz mode of operation, which is supported in IEEE 802.11af and IEEE 802.11ah.

802.11af supports 2MHz, 4MHz and 8MHz bandwidths for operation in TV white space (TVWS). 802.11ah supports 1MHz, 2MHz, 4MHz, 8MHz and 16MHz bandwidths for operation in non-TVWS. 802.11Some STAs in ah are considered sensors with limited capabilities and can support 1MHz transmission mode.

[0009]

SUMMARY OF THE INVENTION

[0010]

Methods and apparatus are disclosed for transmitting acknowledgments in wireless communications in response to data packets.

The recipient may receive multiple data packets from multiple stations and transmit acknowledgments for the data packets to the originating station in a single transmission.

Acknowledgments may be transmitted using multi-user multiple-input multiple-output (MU-MIMO). The acknowledgment may be delayed in time after the data packet is received. The acknowledgment may be transmitted based on an agreed schedule, requested by the station, or transmitted without a request upon receipt of a predetermined number of data packets.

[0011]

Alternatively, the acknowledgements may be aggregated and transmitted in a single transmission.

The acknowledgement may be aggregated in the Medium Access Control (MAC) Service Data Unit field, in the MAC Protocol Data Unit field, or in the Physical Layer Convergence Protocol (PLCP) Protocol Data Unit (PPDU) field.

[0012]

A short acknowledgement (ACK) frame may be sent in response to a received frame.

The short ACK frame may include an ACK sequence corresponding to the sequence ID included in the received frame. The

short ACK frame may include a short training field (STF) and an ACK sequence. The short ACK frame may be transmitted with a short ACK indication. A short ACK frame may be sent in response to an indication included in the received frame.

[0013]

Description of drawings

[0014]

A more detailed understanding can be obtained from the following description of examples given in conjunction with the accompanying drawings, wherein:

[0015]

1A is a system diagram of an example communication system in which one or more disclosed embodiments may be implemented;

[0016]

1B is a system diagram of an example wireless transmit/receive unit (WTRU) that may be used within the communication system shown in FIG. 1A;

[0017]

1C is a system diagram of an example radio access network and an example core network that may be used within the communication system shown in FIG. 1A;

[0018]

Figure 2 shows a regular acknowledgement (ACK) frame;

[0019]

Figure 3 shows an example message exchange sequence of a data frame and a short ACK frame;

[0020]

4 illustrates an example Physical Layer Convergence Protocol (PLCP) Protocol Data Unit (PPDU) data frame format;

[0021]

Figure 5 shows a standard PPDU and an example short ACK frame with short ACK indication;

[0022]

Figure 6 shows a standard PPDU and an example short ACK frame with an extended short training field (STF);

[0023]

Figure 7 shows a conventional medium access control (MAC) frame format;

[0024]

8 shows an example of a PPDU frame structure for MU-MIMO block ACK;

[0025]

9 illustrates an example message exchange sequence for delaying MU-MIMO block ACK;

[0026]

Figure 10 shows a block ACK request (BAR) frame format;

[0027]

11 shows an example PPDU structure for an aggregated multi-user ACK (A-MU-ACK) frame;

[0028]

Figures 12 and 13 show examples of ACK or block ACK (BA) MAC protocol data units (MPDUs) aggregated into multi-user ACK frames encoded with a separate modulation and coding scheme (MCS);

[0029]

Figure 14 shows an example of aggregated multi-user ACKs with separate long training fields (LTFs) for each user to implement various MIMO schemes for users;

[0030]

Figure 15 shows an example of a single-user piggyback ACK;

[0031]

Figure 16 shows an example of single-user piggybacked ACK aggregated at the MSDU level;

[0032]

Figure 17 shows an example of piggyback ACK in the MPDU level;

[0033]

Figure 18 shows an example of piggybacked ACK in the PPDU level;

[0034]

Figure 19 shows an example of a multi-user piggybacked ACK;

[0035]

Figure 20 shows the conventional ADDBA request frame action field format;

[0036]

Figure 21 shows the conventional ADDBA response frame action field format;

[0037]

Figure 22 shows a conventional DELBA frame;

[0038]

Figure 23 shows an example of an ACK field in a delayed multi-user ACK frame for a pre-arranged STA group;

[0039]

Figure 24 shows an example of an ACK field in a delayed multi-user ACK frame for an ad hoc STA group;

[0040]

Figure 25 shows a conventional short ACK frame format;

[0041]

Figure 26 shows an example of a short ACK response;

[0042]

Figures 27 and 28 illustrate example procedures for speed frame exchange for downlink and uplink data, respectively;

[0043]

Figure 29 shows an example of speed frame exchange using short ACK frames (or short BA frames) for downlink data;

[0044]

Figure 30 shows an example of speed frame exchange using short ACK (or short BA) frames for uplink data; and

[0045]

Figure 31 shows an example of speed frame exchange using a short PS-Poll frame and a short ACK (or short BA) frame.

[0046]

detailed description

[0047]

Figure 1A is an illustration of an example communication system 100 in which one or more disclosed embodiments may be implemented.

Communication system 100 may be a multiple access system that provides content (eg, voice, data, video, messaging, broadcast, etc.) to multiple wireless users.

Communication system 100 may enable multiple wireless users to access the content through the sharing of system resources, including wireless bandwidth.

For example, the communication system 100 may use one or more channel access methods, such as code division multiple access (CDMA), time division multiple access (TDMA), frequency division multiple access (FDMA), orthogonal FDMA (OFDMA), single carrier FDMA (SC-FDMA) and so on.

[0048]

As shown in FIG. 1A, the communication system 100 may include wireless transmit/receive units (WTRUs) 102a, 102b, 102c, 102d, a radio access network (RAN) 104, a core network 106, a public switched telephone network (PSTN) 108, the Internet 110 and other networks 112, although it should be understood that the disclosed embodiments contemplate any number of WTRUs, base stations, networks, and/or network elements.

Each of the WTRUs 102a, 102b, 102c, 102d may be any type of device configured to operate and/or communicate in a wireless environment.

By way of example, WTRUs 102a, 102b, 102c, 102d may be configured to transmit and/or receive wireless signals and may include user equipment (UE), mobile stations, fixed or mobile subscriber units, pagers, cellular telephones, personal digital assistants (PDAs), smartphones, laptops, netbooks, personal computers, wireless sensors, consumer electronics, and more.

[0049]

The communication system 100 may also include a base station 114a and a base station 114b.

Each of the base stations 114a, 114b may be configured to wirelessly interface with at least one of the WTRUs 102a, 102b, 102c, 102d to facilitate access to one or more communication networks (eg, the core network 106, the Internet 110 and/or or other network 112) devices of any type.

By way of example, base stations 114a, 114b may be base transceiver stations (BTS), NodeBs, eNodeBs, home NodeBs, home eNodeBs, site controllers, access points (APs), wireless routers, and the like.

Although base stations 114a, 114b are each described as separate elements, it should be understood that base stations 114a, 114b may include any number of interconnected base stations and/or network elements.

[0050]

Base station 114a may be part of RAN 104, which may also include other base stations and/or network elements (not shown), such as base station controllers (BSCs), radio network controllers (RNCs), relay nodes, etc. .

Base station 114a and/or base station 114b may be configured to transmit and/or receive wireless signals within a particular geographic area, which may be referred to as a cell (not shown).

The cells may be further divided into cell sectors.

For example, the cell associated with base station 114a may be divided into three sectors.

Thus, in one embodiment, base station 114a may include three transceivers, one for each sector of the cell.

In another embodiment, the base station 114a may use multiple-input multiple-output (MIMO) technology, and thus may use multiple transceivers for each sector of the cell.

[0051]

The base stations 114a, 114b may communicate with one or more of the WTRUs 102a, 102b, 102c, 102d over an air interface 116, which may be any suitable wireless communication link (eg, radio frequency (RF), microwave, infrared (IR), ultraviolet (UV), visible light, etc.).

Air interface 116 may be established using any suitable radio access technology (RAT).

[0052]

More specifically, as described above, the communication system 100 may be a multiple access system and may use one or more channel access schemes, such as CDMA, TDMA, FDMA, OFDMA, SC-FDMA, and the like.

For example, the base station 114a and the WTRUs 102a, 102b, 102c in the RAN 104 may implement a radio technology such as Universal Mobile Telecommunications System (UMTS) Terrestrial Radio Access (UTRA), which may use Wideband CDMA (WCDMA) to establish the air interface 116.

WCDMA may include communication protocols such as High Speed Packet Access (HSPA) and/or Evolved HSPA (HSPA+).

HSPA may include High Speed Downlink Packet Access (HSDPA) and/or High Speed Uplink Packet Access (HSUPA).

[0053]

In another embodiment, the base station 114a and the WTRUs 102a, 102b, 102c may implement a radio technology such as Evolved UMTS Terrestrial Radio Access (E-UTRA), which may use Long Term Evolution (LTE) and/or LTE Advanced (LTE) -A) to establish the air interface 116.

[0054]

In other embodiments, the base station 114a and the WTRUs 102a, 102b, 102c may implement, for example, IEEE 802.16 (ie, Worldwide Interoperability for Microwave Access (WiMAX)), CDMA2000, CDMA2000 IX, CDMA2000 EV-DO, Interim Standard 2000 (IS -2000), Interim Standard 95 (IS-95), Interim Standard 856 (IS-856), Global System for Mobile Communications (GSM), Enhanced Data Rates for GSM Evolution (EDGE), GSM EDGE (GERAN), etc. of radio technology.

[0055]

Base station 114b in FIG. 1A may be a wireless router, home NodeB, home eNodeB, or access point, for example, and may use any suitable RAT to facilitate wireless connectivity in localized areas, such as business premises, residences, vehicles, campus, etc.

In one embodiment, the base station 114b and the WTRUs 102c, 102d may implement a radio technology such as IEEE 802.11 to establish a wireless local area network (WLAN).

In another embodiment, the base station 114b and the WTRUs 102c, 102d may implement a radio technology such as IEEE 802.15 to establish a wireless personal area network (WPAN).

In still another embodiment, the base station 114b and the WTRUs 102c, 102d may use a cellular-based RAT (e.g., WCDMA, CDMA2000, GSM, LTE, LTE-A, etc.) to establish a pico or femto cell.

As shown in FIG. 1A, base station 114b may have a direct connection to Internet 110.

Thus, the base station 114b may not necessarily have access to the Internet 110 via the core network 106.

[0056]

The RAN 104 may communicate with a core network 106, which may be configured to provide voice, data, applications, and/or voice over Internet protocol (VoIP) service of any type of network.

For example, the core network 106 may provide call control, billing services, mobile location-based services, prepaid calling, Internet connectivity, video distribution, etc., and/or perform advanced security functions such as user authentication.

Although not shown in FIG. 1A, it should be understood that the RAN 104 and/or the core network 106 may communicate directly or indirectly with other RANs using the same RAT as the RAN 104 or a different RAT.

For example, in addition to being connected to the RAN 104 that is using the E-UTRA radio technology, the core network 106 may also communicate with another RAN (not shown) that is using the GSM radio technology.

[0057]

The core network 106 may also act as a gateway for the WTRUs 102a, 102b, 102c, 102d to access the PSTN 108, the Internet 110, and/or other networks 112.

PSTN 108 may include a circuit-switched telephone network that provides Plain Old Telephone Service (POTS).

Internet 110 may include a global system of interconnected computer networks and devices using common communication protocols, such as Transmission Control Protocol (TCP), User Datagram Protocol (UDP), and Internet Protocol (IP) in the TCP/IP Internet Protocol suite.).

Network 112 may include wired or wireless communication networks owned and/or operated by other service providers.

For example, network 112 may include another core network connected to one or more RANs, which may use the same RAT as RAN 104 or a different RAT.

[0058]

Some or all of the WTRUs 102a, 102b, 102c, 102d in the communication system 100 may include multi-mode capabilities, ie, the WTRUs 102a, 102b, 102c, 102d may include multiple transceiver.

For example, the WTRU 102c shown in FIG. 1A may be configured to communicate with a base station 114a, which may use cellular-based radio technology, and with a base station 114b, which may use an IEEE 802 radio technology.

[0059]

FIG. 1B is a system diagram of an example WTRU 102.

As shown in FIG. 1B , WTRU 102 may include processor 118 , transceiver 120 , transmit/receive elements 122 , speaker/microphone 124 , keyboard 126 , display/touchpad 128 , non-removable memory 130 , removable memory 132 , power supply 134 , global positioning system (GPS) chipset 136 and other peripherals 138 .

It should be understood that the WTRU 102 may include any subcombination of the foregoing elements while remaining consistent with an embodiment.

[0060]

The processor 118 may be a general purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), multiple microprocessors, one or more microprocessors associated with a DSP core, a controller, a microcontroller devices, application specific integrated circuits (ASICs), field programmable gate array (FPGA) circuits, any other type of integrated circuits (ICs), state machines, and the like.

The processor 118 may perform signal encoding, data processing, power control, input/output processing, and/or any other function that enables the WTRU 102 to operate in a wireless environment.

Processor 118 may be coupled to transceiver 120 , which may be coupled to transmit/receive element 122 .

Although Figure 1B depicts processor 118 and transceiver 120 as separate components, it should be understood that processor 118 and transceiver 120 may be integrated together in an electronic package or chip.

[0061]

Transmit/receive element 122 may be configured to transmit and receive signals to and from base stations (eg, base station 114a) over air interface 116 .

For example, in one embodiment, transmit/receive element 122 may be an antenna configured to transmit and/or receive RF signals.

In another embodiment, transmit/receive element 122 may be an emitter/detector configured to transmit and/or receive, for example, IR, UV, or visible light signals.

In yet another embodiment, transmit/receive element 122 may be configured to transmit and receive both RF and optical signals.

It should be understood that the transmit/receive element 122 may be configured to transmit and/or receive any combination of wireless signals.

[0062]

Furthermore, although the transmit/receive elements 122 are depicted in FIG. 1B as separate elements, the WTRU 102 may include any number of transmit/receive elements 122.

More specifically, the WTRU 102 may use MIMO technology.

Thus, in one embodiment, the WTRU 102 may include two or more transmit/receive elements 122 (eg, multiple antennas) for transmitting and receiving wireless signals over the air interface 116.

[0063]

Transceiver 120 may be configured to modulate signals to be transmitted by transmit/receive element 122 and to demodulate signals received by transmit/receive element 122.

As mentioned above, the WTRU 102 may have multi-mode capability.

Accordingly, the transceiver 120 may include multiple transceivers that enable the WTRU 102 to communicate via multiple RATs, such as UTRA and IEEE 802.11.

[0064]

The processor 118 of the WTRU 102 may be coupled to, and may receive user input data from, a speaker/microphone 124, a keyboard 126, and/or a display/touchpad 128 (eg, a liquid crystal display (LCD) display unit) or Organic Light Emitting Diode (OLED) display units).

Processor 118 may also output user data to speaker/microphone 124, keyboard 126, and/or display/touchpad 128.

Further, processor 118 may access information from, and may store data in, any type of suitable memory, such as non-removable memory 130 and/or removable memory 132, for example.

Non-removable memory 130 may include random access memory (RAM), read only memory (ROM), hard disk, or any other type of memory storage device.

Removable memory 132 may include a Subscriber Identity Module (SIM) card, a memory stick, a Secure Digital (SD) memory card, and the like.

In other embodiments, the processor 118 may access information from, and may store data in, memory that is not physically located on the WTRU 102 (eg, on a server or home computer (not shown)).

[0065]

The processor 118 may receive power from the power source 134 and may be configured to distribute and/or control power to other components in the WTRU 102.

Power supply 134 may be any suitable device for powering WTRU 102.

For example, power source 134 may include one or more dry cells (eg, nickel cadmium (NiCd), nickel zinc (NiZn), nickel metal hydride (NiMH), lithium ion (Li-ion), etc.), solar cells, fuel battery etc.

[0066]

The processor 118 may also be coupled to a GPS chipset 136, which may be configured to provide location information (e.g., longitude and latitude) regarding the current location of the WTRU 102.

In addition to or instead of information from the GPS chipset 136, the WTRU 102 may receive location information from the base stations (eg, base stations 114a, 114b) over the air interface 116, and/or based on information received from two or more neighboring base stations signal timing to determine its location.

It should be understood that the WTRU 102 may obtain location information through any suitable method of location determination while maintaining consistency of implementation.

[0067]

The processor 118 may be further coupled to other peripheral devices 138, which may include one or more software and/or hardware modules that provide additional features, functionality, and/or wired or wireless connectivity.

For example, peripherals 138 may include accelerometers, electronic compasses, satellite transceivers, digital cameras (for photos or videos), universal serial bus (USB) ports, vibration devices, television transceivers, hands-free headphones, Bluetooth modules, frequency modulation (FM) radio units, digital music players, media players, video game console units,

Internet browsers, and more.

[0068]

Figure 1C is a system diagram of the RAN 104 and core network 106 according to an embodiment.

As described above, the RAN 104 may use E-UTRA radio technology to communicate with the WTRUs 102a, 102b, 102c over the air interface 116.

RAN 104 may also communicate with core network 106.

[0069]

The RAN 104 may include eNodeBs 140a, 140b, 140c, but it should be understood that the RAN 104 may include any number of eNodeBs while remaining consistent with an embodiment.

Each of the eNodeBs 140a, 140b, 140c may include one or more transceivers for communicating with the WTRUs 102a, 102b, 102c over the air interface 116.

In one embodiment, the eNodeBs 140a, 140b, 140c may implement MIMO techniques. Thus, eNodeB 140a, for example, may use multiple antennas to transmit and receive wireless signals to and from WTRU 102a.

[0070]

Each of the eNodeBs 140a, 140b, 140c may be associated with a particular cell (not shown) and may be configured to handle radio resource management decisions, handover decisions, users in the uplink and/or downlink scheduling and so on.

As shown in Figure 1C, the eNodeBs 140a, 140b, 140c may communicate with each other through the X2 interface.

[0071]

The core network 106 shown in FIG. 1C may include a mobility management gateway (MME) 142 , a serving gateway 144 , and a packet data network (PDN) gateway 146 .

While each of the foregoing elements are described as being part of the core network 106, it should be understood that any of these elements may be owned and/or operated by entities other than the core network operator.

[0072]

The MME 142 may connect to each of the eNodeBs 140a, 140b, 140c in the RAN 104 via the S1 interface and may function as a control node.

For example, the MME 142 may be responsible for authenticating users of the WTRUs 102a, 102b, 102c, bearer activation/deactivation, selecting a particular serving gateway during initial attach of the WTRUs 102a, 102b, 102c, and the like. MME 142 may also provide control plane functions for handover between RAN 104 and other RANs (not shown) using other radio technologies such as GSM or WCDMA.

[0073]

The serving gateway 144 may connect to each of the eNodeBs 140a, 140b, 140c in the RAN 104 via the S1 interface.

The serving gateway 144 may generally route and forward user data packets to/from the WTRUs 102a, 102b, 102c. The serving gateway 144 may also perform other functions such as anchoring the user plane during inter-eNodeB handovers, triggering paging when downlink data is available for the WTRUs 102a, 102b, 102c, and managing and storing the context, etc.

[0074]

The serving gateway 144 may also be connected to a PDN gateway 146, which may provide the WTRUs 102a, 102b, 102c with access to a packet-switched network (eg, the Internet 110) to facilitate the WTRUs 102a, 102b, 102c and IP-enabled

Communication between devices.

[0075]

Core network 106 may facilitate communication with other networks.

For example, the core network 106 may provide the WTRUs 102a, 102b, 102c with access to a circuit-switched network (eg, the PSTN 108) to facilitate communications between the WTRUs 102a, 102b, 102c and conventional landline communication equipment.

For example, core network 106 may include, or communicate with, an IP gateway (e.g., an IP Multimedia Subsystem (IMS) server) that acts as an interface between core network 106 and PSTN 108. In addition, the core network 106 may also provide the WTRUs 102a, 102b, 102c with access to a network 112, which may include other wired or wireless networks owned and/or operated by other service providers.

[0076]

Other networks 112 may also be connected to an IEEE 802.11 based wireless local area network (WLAN) 160.

The WLAN 160 may include an access router 165. Access routers may include gateway functionality. The access router 165 may communicate with a plurality of access points (APs) 170a, 170b. Communication between the access router 165 and the APs 170a, 170b may be via wired Ethernet (IEEE 802.3 standard), or any type of wireless communication protocol. AP 170a communicates wirelessly with WTRU 102d over the air interface.

[0077]

In the following, the terms "short frame" and "null data packet" (NDP) will be used interchangeably.

A short frame (e.g., short ACK, short block ACK, short clear to send (CTS), short probe request, etc.) is a physical layer convergence protocol (PLCP) protocol data unit (PPDU) that does not carry a data field. Hereinafter, the term "STA" (eg, WTRU) may include non-AP stations or AP stations. The embodiments disclosed herein may be implemented by non-AP STAs or AP stations (APs). The embodiments disclosed hereinafter are applicable to any IEEE 802.11 system and any other wireless communication system.

[0078]

Wireless transmissions may be erroneous even though protection mechanisms such as channel coding and interleaving are used to protect the transmission.

Therefore, mechanisms for acknowledging correct packet reception have been introduced in WLAN systems. A STA/AP that successfully receives a data frame addressed to itself sends a positive acknowledgment. If the STA/AP transmitting the frame does not receive an ACK within a specified amount of time, it may assume that the data frame was not received correctly and retransmit the data frame. Not all data frames can be acknowledged in this way. The 802.11 standard also supports "no ACK" when the initiator explicitly indicates that no acknowledgment is expected from the recipient of the data frame.

[0079]

802.11

Block ACK was introduced in the e Amendment. Block ACK improves system efficiency by allowing recipients of multiple frames to transmit a single block ACK to acknowledge a block of data frames. The block ACK can be an immediate block ACK or a delayed block ACK.

[0080]

FIG. 2 shows a conventional ACK frame 200.

The regular ACK frame 200 has a PLCP preamble, which includes a short training field (STF) 202 and a long training field (LTF)

204, a signal (SIG) field 206 and an ACK body frame 208. The ACK body frame 208 has a 2-byte frame control field 210, a 2-byte duration field 212, a 6-byte receiver address (RA) field 214, and a 4-byte frame check sequence (FCS) 216. The information carried by the frame control field 210 indicates that this is an ACK frame. The RA field 214 indicates the initiator of the data exchange session.

[0081]

A short ACK frame can be used to acknowledge a data frame (or any other frame) from the initiator.

Figure 3 shows an example message exchange sequence for data frames and short ACK frames. Figure 3 also shows an example PPDU frame structure for a short ACK frame according to one embodiment. The initiator transmits a data frame 310 to the receiver, which decodes the data frame 310, and transmits a short ACK frame 320 to the initiator to indicate successful or unsuccessful decoding of the data frame. In data frame 310, the originator may indicate that the expected ACK transmission will be a short ACK. The originator may explicitly or implicitly identify the ACK sequence ID in the data frame 310 . The receiver then includes the corresponding ACK sequence in the ACK sequence field 324 of the short ACK frame 320 .

[0082]

Short ACK frame 320 includes STF 322 and ACK sequence field 324.

STF 322 can be used for automatic gain control (AGC) and coarse time-frequency offset estimation. Short ACK frame 320 may be identified by STF 322 from other frames.

[0083]

The ACK sequence corresponding to the ACK sequence ID indicated by the data frame 310 indicates the corresponding data frame 310.

The ACK sequence can be modulated in the frequency domain or the time domain. For example, a predefined set of sequences with constant amplitude zero autocorrelation (CAZAC) properties can be used as the ACK sequence. For example, a Generic Chirp (GCL) sequence can be used. Zadoff-Chu (ZC) sequences are special cases of GCL sequences. Each sequence has a sequence ID. The originator assigns this sequence ID either implicitly or explicitly in the transmitted data frame 310. The receiver includes the corresponding sequence in the short ACK frame 320. Due to the choice of orthogonal sequences, the short ACK frame 320 can be used to synchronize multi-user access.

[0084]

The initiator demodulates the received short ACK frame by correlating it with the assigned ACK sequence in the frequency or time domain.

Once the initiator correctly demodulates the short ACK, the initiator knows that this is an acknowledgment of a previously transmitted data packet. Error detection is possible. However, the probability of false detection can be reduced by increasing the number of ACK sequences.

[0085]

When unintended STAs demodulate data packets 310 transmitted from the originator, they may set their Network Allocation Vector (NAV).

The duration field carried by data packet 310 may be set to take into account the fact that the next ACK will be a short ACK. If the unintended STA fails to demodulate the data packet 310, but detects a short ACK STF field, the unintended STA determines that this is a short ACK frame and therefore defers access to the medium.

[0086]

Extended Interframe Space (EIFS) may be used for delay in cases where a frame is detected but not correctly received.

In current 802.11, EIFS=aSIFSTime+ACKTxTime+DIFS. If the system uses short ACK for all ACK transmissions, or if the STA

knows that short ACK is being used, the STA may use the redefined EIFS or the newly defined EIFS_SACK for delay. For example, EIFS_SACK=aSIFSTime+SACKTxTime+DIFS, where SACKTxTime is the time required to transmit the S-ACK frame at the lowest data rate.

[0087]

The initiator may assign an ACK sequence ID to the short ACK frame in the data packet.

The ACK sequence ID may be indicated implicitly. For example, the ACK sequence ID may be determined from one or any (full or partial) combination of the following parameters: scrambler seed (6 bits), FCS (4 bytes), CRC (4 bits) in the SIG field , the Length field (9-21 bits) in the SIG field, and/or the Basic Service Set Identification (BSSID) (6 bytes).

[0088]

Alternatively, the ACK sequence ID may be explicitly indicated.

For example, the ACK sequence ID can be indicated by using the service field in the data frame. Figure 4 shows an example PPDU data frame format. PPDU 400 includes preamble 410, SIG field 420, and data field 430. Data field 430 includes service field 432, MPDU 434, and trailer and padding bits 436. The service field 432 is a 16-bit field. The first 7 bits of the service field 432 are the scrambler initialization bits, which are used to synchronize the descrambler and are normally set to zero. The remaining 9 bits of service field 432 are currently reserved. The 9 bits reserved in the service field 432 may be used to explicitly assign the ACK sequence ID.

[0089]

The initiator may indicate in its data packet that it expects a short ACK frame in response to the data packet.

The indication may be through the use of the SIG field 420 (eg, using 1 bit in the SIG field 420 to indicate that a short ACK frame is expected or acceptable) or the service field 432 (eg, using 1 bit in the service field 432 (eg, using 1 bit in the service field 432). bit 7) to indicate whether a short ACK frame is expected or acceptable) is provided.

[0090]

In another embodiment, the recipient may respond to the data frame with a short ACK frame, and the short ACK indication may be included in the short ACK frame, either explicitly or implicitly.

APs and STAs (intended and unintended) may identify frames as short ACK frames based on the short ACK indication. Due to the simple structure of the short ACK frame, the receiving STA can determine that it is a short ACK frame before starting the correlation detection of the ACK sequence.

[0091]

A short ACK indication may be included in the STF field.

The STF includes several repeated sequences. For example, most 802.11 systems include 10 repeating STF sequences, while the 802.11ah STF for 1 MHz has 20 repeats. In one embodiment, the symbols of one or more repeated STF sequences may be flipped to indicate that the frame is a short ACK frame. Figure 5 shows a standard PPDU 510 and an example short ACK frame 520 with a short ACK indication. In Figure 5, the symbols of the last two STF sequences 522 may be flipped to indicate that the frame is a short ACK frame. This will change the autocorrelation behavior so that the receiver can detect that this is a short ACK frame.

[0092]

In another embodiment, an STF sequence with extended repetitions may be used to indicate a short ACK frame.

FIG. 6 shows a standard PPDU 610 and an example short ACK frame 620 with an extended STF 622. Once the receiver detects a longer than standard STF or autocorrelation platform, it can determine that the frame is a short ACK frame.

[0093]

ACK frames are modulated and encoded in the physical layer prior to transmission.

The modulation and coding scheme (MCS) may be the highest rate in the BSS Basic Rate Set (BSSBasicRateSet) parameter, which is less than or equal to the rate (MCS) of the previously received data frame. In this way, STAs in the BSS have the ability to detect ACK frames.

[0094]

To reduce overhead from ACK, a higher MCS may be more promising, as it may require transmission of a lower number of OFDM symbols.

In some 802.11 standards, the ACK indication field is defined in the SIG field and transmitted by the initiator. The ACK indication is used to indicate information about the subsequent ACK frame. For example, in 802.11ah, the ACK indication has the following definitions (00: ACK; 01: BA; 10: no ACK; 11: frame that is not ACK, BA or CTS). Due to the ACK indication, the unplanned STA can determine whether the following frame is an ACK frame. Thus, there is no need for the STA to have to understand the body of the ACK frame. In one embodiment, the requirement to select the MCS for the ACK frame in the BSSBasicRateSet may be relaxed when the ACK indication is used in the SIG field. In the absence of an ACK indication transmitted in the SIG field from the originator, an unintended STA must decode the ACK frame to conclude that this is an ACK frame. Thus, the ACK frame should use a base MCS that all STAs can understand. It must be the MCS defined in BSSBasicRateSet. With an ACK indication in the SIG field from the originator, an unintended STA may detect the SIG field and notice that an ACK frame is coming and delay for a certain duration. In this way, other STAs do not need to decode the ACK frame at all, so the ACK frame can use any MCS other than the MCS defined in the BSSBasicRateSet.

[0095]

In another embodiment, the initiator may allocate MCS and/or bandwidth for the ACK frame, and the receiver may transmit the ACK frame with the pre-allocated MCS and/or bandwidth.

[0096]

In 802.11ah, the receiver should support both 1MHz and 2MHz reception, while 1MHz needs to be supported on the transmitter side.

Therefore, it may happen that the AP transmits a 2MHz packet to the STA and indicates either explicitly or implicitly in the data packet that the subsequent ACK will be transmitted at 1MHz.

Alternatively, the STA may transmit 1MHz packets to the AP, and the AP operating on the 2MHz channel may choose to reply with a 1MHz or 2MHz ACK. Using 2MHz to transmit ACK can reduce the ACK overhead. In the above example, the STA may indicate the bandwidth used by the AP for ACK transmission.

[0097]

In another example, a STA may have two receive radio frequency (RF) chains and one transmit RF chain.

Once the STA transmits a data stream packet to the AP, according to current standards, the AP may transmit an ACK to a data stream. However, if the channel conditions are very good, it may be more efficient to allow the AP to send ACKs to both data streams. In one embodiment, the STA may detect channel conditions when it receives the previous two data stream packets from the AP and determine if it is suitable for the AP to transmit ACKs to both data streams.

[0098]

When an initiator transmits a data packet to a receiver, if the initiator has some knowledge of the channel from the receiver to the initiator, and knows asymmetric transmit and receive capabilities, the initiator can determine a specific MCS to use for the ACK frame and/or bandwidth and indicate it in the data frame.

Otherwise, the initiator may choose an MCS that is equal to or lower than the MCS used in the previous data packet, and select the bandwidth according to the capabilities of the initiator and receiver.

[0099]

The selected MCS and bandwidth for the subsequent ACK frame may be indicated in the MAC header of the data packet.

Figure 7 shows a conventional MAC frame format. In the current 802.11 standard, the ACK policy subfield is defined in the QoS control field 710 of the MAC header. The ACK Policy subfield is 2 bits long and identifies the acknowledgment policy immediately following the delivery of the MPDU. In one embodiment, the ACK policy subfield may be extended for the MCS and bandwidth indication. The number of bits required for MCS and bandwidth information may vary depending on the standard. For example, for 802.11ah, 2 bits can be used to indicate the bandwidth, as shown in Table 1.

[0100]

Table 1

[0102]

Alternatively, the MCS and bandwidth for the ACK frame may be explicitly indicated in the SIG field.

For example, several bits may be added to the SIG field to indicate the MCS and bandwidth for the ACK frame.

[0103]

Alternatively, the MCS and bandwidth for the ACK frame may be indicated implicitly by setting the duration field 720 in the MAC header.

The duration field 720 in the MAC header may be set to the time value required to transmit the pending packet plus an ACK or block ACK plus a short interframe space (SIFS) interval.

The duration value of the ACK or block ACK can be calculated with the pre-allocated MCS and bandwidth.

[0104]

When transmitting the ACK frame with the pre-allocated MCS and bandwidth, the NAV setting can be modified accordingly.

The duration field 720 of the MAC frame transmitted by the originator holds a time value indicating the duration for which the originator expects the medium to be busy.

By convention, the initiator does not assign MCS to subsequent ACK frames. Thus, the originator estimates the duration of subsequent ACK transmissions based on the lowest MCS supported by the system. With a pre-assigned MCS according to embodiments disclosed herein, the originator can use the assigned MCS to estimate subsequent ACK transmissions and give a more precise time value in the duration field 720. In this way, an unintended STA can set the NAV more precisely.

[0105]

Once the receiver demodulates the data packet correctly, it prepares the ACK packet accordingly.

When using an explicit indication, the receiver may transmit the ACK frame with the pre-allocated MCS and bandwidth. When using the implicit indication, the receiver can complete the MCS and bandwidth of the ACK transmission within the specified duration to transmit the ACK frame. The MCS and bandwidth used by the receiver may not be required to be the same as those chosen by the initiator. However, the ACK PPDU duration needs to conform to the duration value set by the initiator in the MAC header.

[0106]

ACKs or BAs for multiple users (e.g., STAs) may be transmitted via a single ACK or BA transmission.

ACKs (or BAs) for multiple users can be aggregated in the spatial domain and transmitted using multi-user multiple-input multiple-output (MU-MIMO), or aggregated in the time domain and transmitted using aggregated multi-user ACKs send.

[0107]

In one embodiment, the MU-MIMO PPDU format may be used to transmit delayed multi-user ACK or block ACK.

Figure 8 shows an example of a PPDU frame structure for MU-MIMO block ACK. The PPDU includes an omni section 810 and an MU section 820 . The omnidirectional portion 810 is transmitted for all users, while the MU portion 820 is transmitted via each spatial stream of the MU-MIMO transmission. Omnidirectional section 810 includes STF, LTS, and SIG fields (SIGA). MU portion 820 includes STF, LTF and ACK body frame 822. The ACK body frame 822 shown in FIG. 8 is the BA frame 830. Alternatively, the ACK body frame 822 may be a standard ACK frame. Multi-user block ACK may be applied to delayed multi-user block ACK.

[0108]

Figure 9 shows an example message exchange sequence for delaying MU-MIMO block ACK.

STA1 acquires the channel and negotiates with the AP in a small message exchange 910 to establish a block ACK session with the AP with a delayed block ACK policy. The initiator (STA1 in this example) transmits data followed by a block ACK request (BAR) 914. The BAR frame 914 requests an ACK frame 916 from the recipient (AP in this example). Figure 10 shows the BAR frame format. BAR frame 914 includes BAR control field 1002. If the BAR ACK policy field in the BAR control field 1002 is set to '1', the receiver returns an ACK immediately upon receiving the BAR frame 914. If the BAR ACK policy field in the BAR control field 1002 is set to '0', the receiver does not send an ACK upon receiving the BAR frame 914. In the example shown in FIG. 9, the AP sends an ACK 916 in response to the BAR frame 914. During each BA session, unintended STAs (all STAs except the initiator (STA2-STA4 in this example) and receiver (AP in this example)) may set their nav. AP will reserve BA for STA1 and wait for delayed transmission.

[0109]

Afterwards, STA2 acquires the channel and exchanges messages 920 to establish a BA session with the AP and transmit data frames 922 and BAR frames 924 to the AP, and receive ACK frames 926 from the AP.

Afterwards, STA3 acquires the channel and exchanges messages 930 to establish a BA session with the AP, and transmits data frames 932 and BAR frames 934 to the AP, and receives ACK frames 936 from the AP. Afterwards, STA4 acquires the channel and exchanges messages 940 to establish a BA session with the AP, and transmits data frames 942 and BAR frames 944 to the AP, and receives an ACK frame 946 from the AP.

[0110]

The AP may group several block ACKs (BA1-BA4 in this example) and transmit them using MU-MIMO transmission (i.e., delayed MU-MIMO BA).

The AP may group multiple block ACKs for MU-MIMO block ACK transmission according to some grouping criteria (e.g., with similar access class (AC), or good spatial channel correlation).

[0111]

The AP can modulate the BAs with different MU-MIMO weights and transmit them simultaneously.

Within a MU-MIMO BA frame, the BA ACK Policy field in the BA Control field indicates whether ACK is requested in response to a BA frame. The BA ACK policy field may be set to '0' or '1' for all users. If the BA ACK policy field is set to '1', the BA frame 950 will not request an ACK response from the initiator (STA1-STA4 in this example). If the BA ACK policy field is set to '0', the BA frame 950 requests an ACK response from the initiator (STA1-STA4 in this example), as shown in Figure 9.

[0112]

The ACK response 960 from the STA in response to the MU-MIMO BA 950 may be simultaneously transmitted by the STA using

MU-MIMO.

Alternatively, the STAs may transmit ACKs sequentially, e.g. according to an array of user locations defined in the group ID. The group ID may be included in the SIG field.

[0113]

All APs/STAs involved in the delayed MU-MIMO ACK sequence may declare support for delayed block ACK and MU-MIMO.

[0114]

In another embodiment, instead of transmitting ACK or BA to multiple users in MU-MIMO, the ACK or BA may be aggregated in the time domain and transmitted in sequence (ie, aggregated multi-user ACK (A-MU- ACK)).

The receiver (STA or AP) receives the data packets and generates acknowledgment packets in response to the received data packets, and may aggregate the acknowledgment packets and transmit the aggregated acknowledgment packets in a single transmission.

[0115]

Figure 11 shows an example PPDU structure for an A-MU-ACK frame.

In Figure 11, ACKs are aggregated at the MPDU level.

Aggregated ACKs can be block ACKs or standard ACKs. The PPDU for A-MU-ACK 1100 includes a preamble 1110, a SIG field 1120, and a data field 1130. Within the data field 1130, an A-MU-ACK frame 1132 is included. A-MU-ACK frame 1132 includes ACK (or BA) MPDUs 1142 for one or more users (ACK1, ACK2, ACK3 in this example) separated by ACK delimiter 1144. The ACK/BA MPDUs 1142 are aggregated at the MAC level, and the A-MU-ACK frame 1132 is passed to the physical layer as an aggregated MPDU packet so that the physical layer can encode and modulate the A-MU-ACK frame 1132 as an entire packet. The lowest MCS can be used for A-MU-ACK.

[0116]

An ACK delimiter 1144 may be inserted at the beginning of each ACK/BA MPDU 1142.

The ACK delimiter 1144 may be 32 bits or 8 bits long. 32The bit ACK delimiter may include a length field, a CRC and an 8-bit signature field. The length field may be used to indicate the length of the subsequent ACK/BA MPDU. The signature field can be used to detect ACK delimiters when scanning for delimiters. 8The bit ACK delimiter may include an 8-bit signature field, which is used to detect ACK delimiters when scanning for delimiters.

[0117]

The aggregated multi-user ACK packet may be broadcast or multicast to more than one user (eg, STA).

Because different users have different radio link qualities due to path loss, channel conditions, receiver sensitivity, etc., it may be simple, but not efficient, to use the same MCS for all users in the same aggregated multi-user ACK packet . Furthermore, if a relatively low MCS is selected, all users cannot correctly decode the aggregated multi-user ACK frame.

[0118]

The ACK or BAMPDU aggregated into a multi-user ACK frame may be encoded with a separate MCS, as shown in Figures 12 and 13.

In the examples shown in Figures 12 and 13, the three ACK/BA MPDUs included in the aggregated multi-user ACK frame can be individually encoded with three MCSs (which may or may not be the same). The length and MCS of each MPDU may be indicated in the SIG field. In Figure 12, the aggregated multi-user ACK frame includes a common SIG field 1220 for the three ACK MPDUs 1210a-1210c. In Figure 13, a separate SIG field 1320a-1320c is included for each ACK/BA MPDU 1310a-1310c.

[0119]

Multi-user aggregation may be performed after constellation mapping and before inverse discrete Fourier transform (IDFT).

Thus, for all coded ACK frames except the last frame, a padding and tail bit field may be added. There is no need to insert more padding bits to carry over to an integer number of OFDM symbols. For the last encoded ACK frame, tail and padding bits are inserted if necessary. In the case of this scheme, the length field in the SIG field may explicitly indicate the length in bytes of each ACK body frame.

[0120]

Alternatively, multi-user aggregation may be performed after IDFT (i.e., aggregation is in units of OFDM symbols).

Each encoded ACK frame may occupy an integer number of OFDM symbols. Therefore, tail bits and OFDM symbol padding bits may be added for each encoded ACK frame. The length field in the SIG field may indicate the length of each ACK body frame in bytes or OFDM symbols.

[0121]

12 shows an example of an aggregated multi-user ACK with a common SIG field 1220.

FIG. 13 shows an example of an aggregated multi-user ACK with a separate SIG field 1320. In Figures 12 and 13, each ACK/BA MPDU can be encoded with a separate MCS.

[0122]

In the examples shown in Figures 12 and 13, all users can use a common preamble 1230, 1330 for channel estimation.

Therefore, the use of the MIMO scheme may be limited. For example, if a space-time block coding (STBC) scheme is used, STBC is available for all users in the group, and a different MIMO scheme is not available for some users.

[0123]

In another embodiment, various MIMO schemes may be used for the transmission of aggregated multi-user ACK frames, for example, using the PPDU structure shown in Figure 14.

Figure 14 shows an example of aggregated multi-user ACKs with separate LTFs for each user to implement various MIMO schemes for users. In Figure 14, dedicated LTFs 1402 (LTF1, LTF2, LTF3 in this example) are included for each user for AGC adjustment and channel estimation. The length of the dedicated LTF for each user may depend on the number of data streams transmitted and whether AGC is required. Due to the separate LTFs, different MIMO schemes can be used for different users (in this example, beamforming for user 1 and user 3, and STBC for user 2).

[0124]

In another embodiment, hierarchical modulation may be used to transmit ACKs simultaneously for different users located in different constellations of the same OFDM symbol.

Hierarchical modulation enables multiplexing of multiple data streams (e.g., for different users) into a single stream of symbols, where base layer symbols and enhancement layer symbols are simultaneously overplayed prior to transmission.

[0125]

Acknowledgments may be piggybacked in data packets (ie, piggybacked ACKs).

With piggybacked ACKs, the data frame is overloaded with acknowledgments of previously received MAC Protocol Data Units (MPDUs) and/or polling of the STA to which the frame is directed. The piggybacked ACK is used to reduce the overhead required for acknowledged feedback.

[0126]

ACKs and data piggybacked with ACKs may be directed to a single user (ie, single user piggybacked ACK).

Figure 15 shows an example of single-user piggybacked ACK. The initiator transmits a data packet 1510 to the recipient. If the data is not time sensitive, piggyback ACK can be used. The initiator may indicate (e.g., in the data packet) that piggyback ACK is allowed. If the recipient has a data payload 1530 directed to the initiator, the recipient may piggyback the ACK 1520 with the data packet 1530. The piggyback ACK can be immediate or delayed. If the receiver does not have a data payload to the initiator, the receiver may delay the ACK (i.e., piggyback the ACK with data later).

[0127]

Single-user piggyback ACK may be performed at the MSDU level.

Figure 16 shows an example of single-user piggybacked ACK aggregated at the MSDU level. ACK (or BA) MSDU 1610 and data MSDU 1620 may be aggregated, and a modified MAC header 1630 may be added to the aggregated ACK and data MSDU. The MAC header 1630 may indicate that the subtype of the frame is a data frame with piggybacked ACK or BA. Once the subtype field in the frame control field in the MAC header indicates that the frame is a data frame with piggybacked ACK or BA, the sequence control field in the MAC header may be extended to cover the sequence numbers of the data MSDU and ACK. If BA is used, the BA control field may be included in the MAC header.

[0128]

Single-user piggybacked ACK may be performed at the MPDU level.

Figure 17 shows an example of piggybacked ACK in the MPDU level. The ACK MPDU 1710 and the data MPDU 1720 may be aggregated and passed to the physical layer. Common PLCP headers and preambles may be added to aggregated packets to form PPDU 1700. In this scheme, ACK MPDU 1710 and data MPDU 1720 can be encoded and modulated with the same MCS. ACK and data may be included into separate MPDUs with separate MAC headers, and the MPDUs are separated by an MPDU delimiter.

[0129]

Single-user piggyback ACK may be performed at the PPDU level.

Figure 18 shows an example of piggyback ACK in the PPDU level. ACK and data are included in separate MPDUs, and MPDUs can be independently modulated and encoded. A separate MCS can be used for MPDUs. As shown in Figure 18, the common SIG field in which the MCS for ACK and data is defined may be used. Alternatively, a separate SIG field may be included.

[0130]

A single-user piggyback packet may include more than one data packet and/or more than one ACK/BA packet.

[0131]

ACK and data can be directed to different users (ie, multi-user piggybacked ACK).

The piggyback ACK can be immediate or delayed.

FIG. 19 shows an example of multi-user piggybacked ACK. The initiator transmits a data packet 1910 to the recipient. If the data is not time sensitive, the initiator MAY allow piggyback ACKs. In this case, the initiator may indicate (eg, in the data packet) that piggyback ACK is allowed. The recipient may choose to piggyback the ACK 1920 with the data packet 1930 directed to the third STA.

[0132]

Multi-user piggybacked ACK may be performed at the MPDU level.

In this case, ACK and data MPDUs are aggregated and passed to the physical layer. The MAC header of each MPDU packet

has its own receiver address (RA) information. Common PLCP headers and preambles are added to aggregated packets to form PPDUs. In this scheme, ACK and data MPDUs can be encoded and modulated with the same MCS. Similar to single-user piggyback ACK, multi-user piggyback in the MPDU domain can use the frame format shown in Figure 17.

[0133]

Multi-user piggyback ACK may be performed in the PPDU domain.

In this case, the ACK and data are in separate MPDUs and can be modulated and encoded independently. The common SIG in which the MCS for ACK and data is defined may be used. Alternatively, a separate SIG may be used.

[0134]

A multi-user piggybacked ACK packet may include more than one data packet and/or more than one ACK or BA packet.

[0135]

Embodiments for delayed multi-user ACK (DMA) establishment are set forth below.

DMA can be an efficient ACK mechanism that can effectively reduce the overhead of data packets by acknowledging packets from multiple users simultaneously.

[0136]

A STA may indicate to the AP that the STA is capable of receiving delayed multi-user ACKs during association or at any other time.

To facilitate delayed multi-user ACK, three new action frames can be defined: add delayed multi-user ACK request action frame (ADDDMA request), add delayed multi-user ACK response action frame (ADDDMA response), and remove delayed multi-user User ACK frame (DELDMA).

[0137]

ADDDMA frames may be used to establish or modify delayed multi-user ACKs for a specific Traffic Class (TC) or Traffic Stream (TS).

In response to the ADDDMA request frame, an ADDDMA response frame is sent.

DELDMA frames can be sent by either the initiator or the receiver to terminate delayed multi-user ACK participation.

[0138]

The three new action frames may be implemented, for example, using regular block ACK action frames.

Table 2 shows example block ACK action field values for ADDDMA request, ADDDMA response, and DELDMA frames.

[0139]

Table 2

[0142]

The ADDBA request frame can be used as the format of the ADDDMA request frame.

Figure 20 shows a conventional ADDBA request frame action field format.

The block ACK action field 2002 may be set to '3' to indicate that this is an ADDDMA request frame.

The block ACK policy bits in the block ACK parameter set 2004 may be interpreted as: if set to '0', it is a regular delayed multi-

user ACK for STAs, not for a specific traffic class (TC) or traffic flow (TS).), and if set to '1', is the delayed multi-user ACK for the STA for the specific TC or TS specified by the Traffic Identifier (TID) field in the Block ACK parameter set 2004.

Several bits in the Block ACK Timeout Value field 2006 or other fields may be used to indicate delayed multi-user ACK options: scheduled delayed multi-user ACK, unsolicited delayed multi-user ACK, or requested delayed multi-user ACK.

[0143]

The ADDBA response frame can be used as the format of the ADDDMA response frame.

Figure 21 shows the conventional ADDBA response frame action field format. The block ACK action field 2102 may be set to '4' to indicate that this is an ADDDMA response frame. The block ACK policy bits in the block ACK parameter set 2104 can be interpreted as: if set to '0', it is for regular delayed multi-user ACK for STAs, not for a specific TC or TS, and if set to '1' ", is the delayed multi-user ACK for the STA for the specific TC or TS specified by the TID field in the block ACK parameter set 2104. Several bits in the block ACK timeout value field 2106 or other fields may be used to indicate delayed multi-user ACK options: scheduled delayed multi-user ACK, unsolicited delayed multi-user ACK, or requested delayed multi-user ACK.

[0144]

A DELBA frame can be used as the format for a DELDMA frame.

Figure 22 shows a conventional DELBA frame. The block ACK action field 2202 may be set to '5' to indicate that this is a DELDMA frame. One of the reserved bits of the DELBA parameter set field 2204 (bits 0-10) may be interpreted as: if set to '0', delete the delayed multi-user ACK for STA but not for a specific TC or TS , whereas if set to "1", the delayed multi-user ACK for the STA for the specific TC or TS specified by the TID field in the DELBA parameter set 2204 is removed.

[0145]

The STA may indicate that the receiving STA or AP is able and willing to use the delayed multi-user ACK mechanism by sending an ADDDMA request frame to the receiving STA/AP.

The STA may indicate the receiving STA/AP that it is initiating a delayed multi-user ACK for only one TS or TC originating from itself by sending an ADDDMA request frame, with the block ACK policy bit set to '1', and the TID field set is the TID of the TS or TC.

[0146]

The receiving STA/AP may respond by sending an ADDDMA response frame.

The receiving STA/AP may log received packets after receiving packets from the STA and other STAs with which delayed multi-user ACKs have been established. The receiving STA/ The AP may send the delayed multi-user ACK frame later.

[0147]

Transmitting and receiving STAs or APs can delete the delayed multi-user ACK arrangement by transmitting DELDMA frames, which can be immediately acknowledged by the other party in the delayed multi-user ACK.

[0148]

After a STA transmits its packet, the packet may not be acknowledged immediately by the receiving STA/AP because the receiving STA/AP may accumulate packets from more STAs and then acknowledge them simultaneously using delayed multi-user ACK frames.

[0149]

Since the STA is battery powered, it is expected that the STA transmits its packets, enters a doze state, and wakes up at a predetermined time to receive delayed multi-user ACK frames from the receiver (eg, AP).

In the case of a scheduled delayed multi-user ACK, an initiator (eg, a STA) that has established a DMA arrangement with the receiver may enter a doze state immediately after its own transmission, and a delayed multi-user ACK after its own transmission Transmission interval wake-up to receive delayed multi-user ACK frames from the receiver.

The recipient may indicate a delayed multi-user ACK transmission interval in a beacon, or in a short beacon or other type of management, control, or action frame.

[0150]

If, by evaluating the delayed multi-user ACK frame, the initiator finds that its packet was not successfully received by the receiver, the initiator may immediately retransmit the packet that was not positively acknowledged, or may retransmit at a later point in time.

[0151]

In the case of an unsolicited delayed multi-user ACK, the receiver (eg, AP) can decide that it has received a sufficient number of packets from the initiator (eg, STA) that has established a DMA arrangement with the receiver, and can A delayed multi-user ACK frame is transmitted to acknowledge all received packets.

[0152]

In the case of a requested delayed multi-user ACK, an initiator (e.g., a transmitting STA) that has established a DMA arrangement with the recipient may transmit DMA request frames to the recipient at some predetermined or random intervals.

The receiver may then transmit delayed multi-user ACK frames to acknowledge all received packets after receiving one or more DMA request frames requesting delayed multi-user ACK frames.

[0153]

A DMA request frame may be implemented, for example, by using a block ACK action frame or any other management or control frame.

If implemented as a block ACK action frame, the block ACK action field value may be set to '6' to indicate that this is a DMA request frame.

The DMA request frame may include a DMA request options field to indicate whether the DMA request is for the entire group or for an individual STA, and/or to indicate whether the DMA request is for regular ACK only or block ACK DMA option field.

[0154]

STAs can be pre-arranged into groups automatically, or pre-arranged into groups by the AP.

For example, the AP may use a group ID management frame or any other management or control frame to announce STA group membership.

The receiver address in the MAC header of the delayed multi-user ACK frame for the STA group may be a broadcast or multicast MAC address mutually agreed upon by the STA and the AP.

[0155]

Delayed multi-user ACK frames for pre-scheduled groups of STAs may be implemented using block ACK action frames or any management or control frames.

If implemented as a block ACK action frame, the block ACK action field value may be set to '7' to indicate that this is a delayed multi-user ACK frame for the pre-scheduled STA group.

[0156]

The delayed multi-user ACK frame for the pre-scheduled STA group may include an ACK option field to indicate whether the DMA is for the pre-scheduled STA group and whether the ACK is a standard ACK or a block ACK.

Delayed multi-user ACK frames for pre-scheduled STA groups may also include a block ACK option field to indicate whether the block ACK for each member of the pre-scheduled group is a multi-TID (multiple TIDs) for pre-scheduled Whether the block ACK for each member of the group is multi-TID and the number K of TIDs per STA acknowledged (number of TIDs per STA), and/or per TID for each member of the pre-arranged group And the number of acknowledged frames N (number of acknowledged frames per TID).

[0157]

The delayed multi-user ACK frame for the pre-scheduled STA group may include a field indicating the number of ACK fields.

The delayed multi-user ACK frame for the pre-scheduled STA group includes an ACK field.

Figure 23 shows an example of an ACK field in a delayed multi-user ACK frame for a pre-scheduled group of STAs. The ACK fields may be arranged in the same order as the order of the STAs in the pre-arranged group. Each ACK field may include K(TID+TIDACK) fields. The number K is specified by the number of TIDs per STA in the Block ACK Options field. The TID ACK field may include a starting sequence number and a bitmap of N bits, each bit indicating an ACK for the frame of the associated TID.

[0158]

Delayed multi-user ACK frames for ad-hoc groups of STAs may be implemented using block ACK frames or any management or control frames.

A delayed multi-user ACK frame for an ad-hoc STA group may include a flag, which is a field indicating that this is a DMA frame. If implemented as a block ACK action frame, the block ACK action field value may be set to 7.

[0159]

Delayed multi-user ACK frames for ad-hoc STA groups may include a DA field.

The destination address in the MAC header in the DMA can be a multicast or broadcast address mutually agreed upon by the STA and the AP. Delayed multi-user ACK frames for ad-hoc STA groups may include an ACK option field. The ACK options field may indicate whether the DMA is for ad hoc groups, and may indicate whether the ACK is a standard ACK or a block ACK.

[0160]

A delayed multi-user ACK frame for an ad-hoc group of STAs may include a block ACK option to indicate whether the block ACK for each member of the ad hoc group is a multi-TID (multiple TIDs) for each Whether the block ACK for each member is multi-TID and the number K of TIDs per STA acknowledged (number of TIDs per STA), and the number of frames acknowledged per TID for each member of the ad hoc group N (number of acknowledged frames per TID).

[0161]

The delayed multi-user ACK frame for the ad-hoc STA group may include a field (ACK field number) for indicating the number of ACK fields included in the current DMA frame.

Delayed multi-user ACK frames for ad-hoc STA groups include the ACK field.

Figure 24 shows an example of an ACK field in a delayed multi-user ACK frame for an ad hoc STA group. Each ACK field is for each member of the ad hoc group. Each ACK field begins with an ID field that includes the ID of the member of the ad hoc group. The ID may be a MAC address, an association ID (AID) or other form of ID agreed upon by the STA and the AP. Each ACK field includes K(TID+TIDACK) fields. The number K may be specified by the number of TIDs per STA in the block ACK option field. The TID ACK field may include a starting sequence number and a bitmap of N bits, each bit indicating an ACK for the frame of the associated TID.

[0162]

A short ACK frame is a shortened version of an ACK frame that has no MAC layer fields.

A short BA frame is a shortened version of a BA frame, which has no MAC layer fields. Figure 25 shows a conventional short ACK frame format. A regular short ACK frame includes an STF field 2502, an LTF field 2504, and a SIG field 2506. The SIG field 2506 of the short ACK frame has an indication that the frame is a short ACK frame, as well as other indications and signaling to indicate the intended recipient of the short ACK, a more data field, and a duration field for NAV settings (e.g. ACK ID). The short BA frame has the same structure as the short ACK frame. The short BA frame includes the STF field, the LTF field, and the SIG field. The SIG field of the short BA frame has an indication that the frame is a short BA frame, as well as other indications and signaling (e.g., block ACK ID) required by the short BA frame to indicate the intended recipient of the BA, start sequence control, and block bitmaps.).

[0163]

802.11

The ah standard provides a mechanism for early ACK indication. The SIG field includes ACK indication bits (2 bits) to indicate the type of acknowledgment expected as a response to the frame to be acknowledged. The ACK indication bit may be set to "00" for ACK, to "01" for BA, and to "10" for no ACK, and "11" is currently reserved.

[0164]

If the STA skips decoding the packets after the PHY preamble to save power, or it cannot decode the remaining packets correcily, the STA cannot obtain the duration value from the MAC header to update its NAV for medium access purposes.

In this case, the STA may defer medium access for the duration of EIFS or EIFS-DIFS+AIFS[AC] after detecting that the medium is idle. DIFS is the DCF Interframe Space and AIFS is the Arbitration Interframe Space (used by QoS devices for a given access class). EIFS is defined as EIFS = SIFS + DIFS + ACK time, where ACK time is the time required to transmii an ACK frame at the lowest physical layer supported rate.

[0165]

In one embodiment, the initiator (STA or AP) may request or instruct the receiver (AP or STA) to send a short ACK or short BA (regular format or according to one embodiment above) in response to the frame as shown in FIG. 2 out format) instead of regular ACK or BA.

The MAC protocol can be enhanced to provide greater efficiency when using short ACKs or short BAs, respectively, instead of regular ACKs or regular BAs. Figure 26 shows an example of a short ACK response. The initiator sends the data frame 2602 along with the short ACK indication in the data frame 2602 to the receiver, and the receiver sends a short ACK 2604 in response. The short ACK indication can be extended to a short BA indication. The initiator may send a block ACK request (BAR) or an aggregated MPDU with an immediate BAR (AMPDU) with the short BA indication, and the receiver sends a short BA in response.

[0166]

The initiator may communicate a short ACK indication or a short BA indication (hereinafter collectively referred to as "short ACK indication") by using the "10" value of the ACK indication bit in the SIG field.

An ACK indication value of "10" is also used to convey a "no ACK" response. These two indications may be combined in the "10" value of the ACK indication as follows. "Short EIFS" may be specified instead of EIFS for two cases. For both cases, an unintended STA without a duration value from the MAC header to update its NAV may defer medium access for the duration of the short EIFS after detecting that the medium is idle. Short EIFS can be defined as short EIFS = SIFS + DIFS + short ACK time, where short ACK time is the time required to transmit a short ACK frame. The short ACK time can be defined as the sum of the time lengths of its fields (eg, the time lengths of the STF, LTF and SIG fields are added together for 1MHz or 2MHz and higher bandwidth modes, as the case may be) . Alternatively, the short ACK time may be calculated as the time required to transmit the contents of the short ACK frame at the lowest PHY supported rate. Short EIFS can also be defined as short EIFS = SIFS + DIFS + short BA time, where short BA time is the time required to transmit a short BA frame.

[0167]

Alternatively, the originator of the frame may communicate a short ACK indication in any part of the physical layer portion of the frame (eg, in a preamble using one or more bits or subfields in the SIG field).

[0168]

Alternatively, the initiator may communicate a short ACK indication in the MAC portion of the frame (eg, in the MAC header).

For example, the short ACK indication may be indicated in the control field of the MAC header, or by reusing any existing fields or bits in the MAC header.

[0169]

A device (STA or AP) that receives a frame addressed to it (with an indication that a short ACK or short BA needs to be sent in response) may respond with a short ACK frame or a short BA frame, respectively.

The short ACK frame or short BA frame may be sent after receiving the SIFS of the frame with the short ACK or short BA indication.

[0170]

STAs and APs may, for example, use existing or new IEs, fields, subfields in the Association Request and Association Response frames during the association procedure to indicate their abilliy and preference to use short ACKs or short BAs to acknowledge packets.

[0171]

Alternatively, a short ACK or short BA may be an allowed acknowledgement response (ie, a short ACK or short BA may be used instead of a standard ACK or standard BA frame).

[0172]

When using standard ACK or standard BA, the value in the frame's duration field is typically estimated by the transmitter using the lowest MCS supported by the system.

This tends to overestimate the duration and therefore invalidates the use of the medium, since the duration field is used by unintended STAs in the system to set the NAV for medium access.

When short ACK or short BA is to be used, the transmitter (STA or AP) can set the duration value in the duration field of the MAC header more precisely by using the time required to transmit the short ACK frame or short BA frame.

This will result in a more precise duration value, and thus, effective medium usage, since the duration field is used by unintended STA recipients in the system to set their NAVs for medium access.

[0173]

Short ACK or short BA mechanisms can be applied to aggregated transmissions.

AMPDUs are aggregated MAC PDUs.

Regular ACK frames or regular BA frames may be transmitted in AMPDUs. A short ACK or short BA cannot be transmitted by a STA or AP as part of an AMPDU. Short ACKs or short BAs may be transmitted by a STA or AP as part of an aggregated PPDU, where several physical layer packets are aggregated to increase the efficiency of medium usage in reduced interframe space (RIFS) bursts, where more than one packet is grouped in The RIFS interval between is transmitted continuously. RIFS is smaller than SIFS.

[0174]

A short CTS frame is a shortened version of a CTS frame that has no MAC layer fields.

The short CTS frame includes the STF field, the LTS field, and the SIG field. The SIG field of the short CTS frame includes an indication that the frame is a short CTS frame, and other indications and signaling (e.g., CTS ID) to indicate the intended receiver of the CTS frame, bandwidth, and duration for NAV settings.

[0175]

The transmitter (STA or AP) (ie, the initiator) of a request-to-send (RTS) frame may request or indicate that the short CTS frame should be responded to the RTS frame by the intended recipient (AP or STA) (ie, the responder) of the RTS frame to be sent.

[0176]

In one embodiment, this short CTS indication may be conveyed within the RTS frame by reusing the "10" value of the ACK indication bit in the SIG field.

The ACK indication bit "10" is also used to convey a "no ACK" response.

These two indications or conditions may be combined into the "10" value of the ACK indication bit as follows. "Short EIFS" may be specified for both cases, instead of EIFS. For both cases, an unintended STA without a duration value from the MAC header to update its NAV may defer medium access for the duration of the short EIFS after detecting that the medium is idle. Short EIFS is defined as short EIFS = SIFS + DIFS + short CTS time. The short CTS time can be defined as the sum of the time lengths of its fields (i.e., the time lengths of the STF, LTF and SIG fields are added together for 1MHz and 2MHz and higher bandwidth modes). Alternatively, the short CTS time may be calculated as the time required to transmit the content of the short CTS frame at the lowest physical layer supported rate. The short ACK time may be the same as the short CTS time, and the short ACK time may be used in place of the short CTS time, since the short ACK frame and the short CTS frame have the same format and length, even though they carry some content that is different.

[0177]

Alternatively, the transmitter (ie, the originator) of the RTS frame of the frame may communicate the short CTS indication in any part of the physical layer portion of the frame (eg, in a message using one or more bits or subfields in the SIG field), in the preamble).

[0178]

Alternatively, the transmitter (i.e., originator) of the RTS frame may communicate the short CTS indication in the MAC portion of the frame (e.g., in the MAC header).

For example, the short CTS indication may be indicated in the control field of the MAC header, or by reusing any existing fields or bits in the MAC header.

[0179]

A device (STA or AP) that receives an RTS frame directed to it (with an indication that a short CTS needs to be sent in response) may respond with a short CTS frame.

The short CTS frame may be sent after receiving the SIFS of the RTS frame with the short CTS indication.

[0180]

STAs and APs may, for example, use any existing or new IEs, fields, subfields in the Association Request and Association Response frames during the association procedure to indicate their ability and preference to use short CTS frames in response to RTS frames.

[0181]

Alternatively, a short CTS may be a response allowed for RTS frames (ie, a short CTS may be used instead of a regular CTS frame).

[0182]

When an RTS frame is sent by a device (AP or STA), the device can set the NAV for the devices in its neighbors.

However, the response CTS cannot be received by the neighboring device.

For example, the intended recipient (STA/AP) of the RTS frame may not be able to respond with the CTS frame, or the reception of the CTS frame may fail.

According to the 802.11 standard, a STA that made its last NAV update based on the reception of an RTS frame may reset its NAV after a CTS timeout interval from the end of reception of the RTS frame, if no reception is detected during the CTS timeout interval.

The CTS timeout interval is calculated as (2 x SIFS) + (CTS time) + receiver start delay + (2 x slot time), where SIFS and slot time are system parameters. The CTS time is calculated using the length of the CTS frame and the data rate at which the RTS frame is received.

[0183]

In one embodiment, when the device (STA or AP) transmitting the RTS frame indicates that its response frame is a short CTS frame or if the short CTS frame is a response allowed for the RTS frame, the short CTS timeout interval may be used instead of CTS timeout interval.

For example, a short CTS timeout interval can be obtained as (2 x SIFS) + (short CTS time) + receiver start delay + (2 x slot time), where SIFS and slot time are system parameters. The short CTS time can be defined as the sum of the time lengths of its fields (e.g., the time lengths of the STF, LTF and SIG fields are added together). Alternatively, the short CTS time may be calculated as the time required to transmit the contents of the short CTS frame at the lowest physical layer supported rate.

[0184]

When the device (STA or AP) transmitting the RTS frame indicates that its response frame should be a short CTS frame or if the short CTS frame is the response allowed for the RTS frame, the above short CTS time can be used to estimate the duration of the RTS frame/ The time set in the ID field.

[0185]

802.11

The ah standard has introduced a speed frame exchange protocol, which is enabled by using more data fields and response frame fields.

The More Data field is a 1-bit field that indicates whether there is more data to send. More data fields allow the responding STA to set the response frame field appropriately. The Response Frame field (or ACK indication bit) is a 2-bit field that indicates the type of the following frame. The Response Frame field may be set to "00" for ACK, to "01" for BA, to "10" for no ACK, and to "10" for frames that are not ACK, CTS, or BA. Set to "11" (ie, it indicates that the response frame is a data frame).

[0186]

Figures 27 and 28 illustrate example procedures for speed frame exchange for downlink and uplink data, respectively.

In Figure 27, the STA sends a PS-Poll frame 2702 to the AP to fetch data. The AP responds with an ACK 2704 with the More Data field set to '1' and the Response Frame field set to '11'. The AP then sends a data frame 2706 with more data fields set to '0' and a response frame set to '00'. The STA receives the data frame 2706 and sends an ACK frame 2708 with the More Data field set to '0' and the Response Frame field set to '10'.

[0187]

In Figure 28, the STA sends a data frame 2802 to the AP with the More Data field set to '1' and the Response Frame field set to '00'.

The AP then sends an ACK frame 2804 with the More Data field set to '0' and the Response Frame field set to '11'. The STA then sends another data frame 2806 with the More Data field set to '0' and the Response Frame field set to '00'. The AP then sends an ACK frame 2808 with the More Data field set to '0' and the Response Frame field set to '10'.

[0188]

In one embodiment, short ACK frames and short BA frames may be used in speed frame exchanges.

A short ACK can be used in response to a PS-Poll frame or a data frame. Short BA frames may be used in response to AMPDUs. The SIG field of the short ACK frame and the short BA frame may include a response frame field (or ACK indication field) and/or more data fields. The response frame field (or ACK indication field) can be used for speed frame exchange in conjunction with more data fields of the short ACK frame or short BA frame.

[0189]

Figure 29 shows an example of speed frame exchange using short ACK frames (or short BA frames) for downlink data.

The STA sends a PS-Poll frame 2902 to get data from the AP. The AP responds with a short ACK frame 2904 with the More Data field set to '1' and the Response Frame field set to '11'. The AP sends a data frame 2906 (or AMPDU) with a More Data field set to '0' and a Response Frame field set to "Short ACK" for non-aggregated data frames or to "Short BA" for aggregated data frames). The STA then responds with a short ACK (or short BA) 2908 with the More Data field set to '0' and the Response Frame field set to '10' depending on the type of data received.

[0190]

Figure 30 shows an example of speed frame exchange using short ACK (or short BA) frames for uplink data.

The STA sends a data frame 3002 (or AMPDU) with more data fields set to '1' and a response frame field set to "Short ACK" or "Short BA" depending on the data type. The AP then sends a short ACK frame 3004 (or short BA) with the more data field set to '0' and the response frame field set to '11'. The STA then sends another data frame 3006 (or AMPDU) with the more data field set to '0' and the response frame field set to "Short ACK" or "Short BA". The AP then sends a short ACK frame 3008 (or short BA) with the more data field set to '0' and the response frame field set to '10'.

[0191]

As an example, the response frame field (or ACK indication field) value may be set to "00" to indicate a short ACK, and to "01" to indicate a short BA, or alternatively, to "10" to indicate Short ACK and short BA.

[0192]

In another embodiment, short PS-poll frames may be used in speed frame exchanges.

The SIG field of the short PS-poll frame may include one or both of a response frame field (or ACK indication field) or more data fields.

The short PS-Poll indication response from the STA is a short ACK frame and also indicates that more data is to be transmitted.

[0193]

Figure 31 shows an example of speed frame exchange using a short PS-Poll frame and a short ACK (or short BA) frame.

The STA sends a short PS-Poll frame 3102 with the More Data field set to '1' and the Response Frame field set to "Short ACK" to fetch data from the AP. The AP responds with a short ACK frame 3104 with the More Data field set to '0' and the Response

Frame field set to '11'. The STA sends a data frame 3106 (or AMPDU). The AP then responds with a short ACK 3108 (or short BA) with the More Data field set to '0' and the Response Frame field set to '10', depending on the type of data received.

[0194]

More data fields may be set based on whether the STA has uplink data.

If the short PS-Poll frame is sent by the STA in an unscheduled wake-up event, the Response Frame field may be set to indicate a short ACK, since the AP will most likely send an acknowledgment, not data.

[0195]

In a regular MAC frame, the duration field in the MAC header is used to set the NAV for the unintended recipient of the frame.

However, short frames (e.g., short ACK, short BA, short CTS) may not have a duration field and may not carry duration information.

[0196]

In the case where a STA wakes up from a sleep state and monitors the medium to receive a sequence of frames to set its NAV, the STA may continue to perform Clear Channel Assessment (CCA) until a regular frame (not a short frame) with a duration field is detected , a short frame with duration information is detected, or the lapse of a time period equal to the sounding delay specified as a system parameter.

If a short frame is received, and if it contains a duration field or information in the SIG field, the STA may use this to set its NAV. If a short frame is received, and if it does not contain a duration field or information, the STA may set the purpose for NAV to ignore the frame.

[0197]

In the event that an unintended STA receives a short frame and the short frame does not include a duration field or information, the unintended STA may not update its NAV, but maintain its existing NAV setting.

Existing NAV setups may have been replaced by frames earlier in the sequence of frames (eg, sequence of sounding frames in the case of short beamforming report (BR) polling, sequence of data and ACK frames in the case of short BA) The duration setting of is triggered.

[0198]

If the short frame has a duration field or information, if the new NAV value is greater than the current/existing NAV value, the unplanned STA may update its NAV based on the duration field or information.

[0199]

In the event that an unintended STA receives a short PS-Poll frame, if the new NAV value is greater than the current NAV value, the unintended STA may use a transmit response frame (eg, data, ACK, short ACK) The desired duration plus a SIFS interval to update its NAV settings.

Alternatively, if no response frame is indicated in the short PS-Poll frame, the unintended STA may update its NAV setting using the default response frame or the response frame duration specified in the system.

Alternatively, if the new NAV value is greater than the current NAV value, the unintended STA may use the duration required to transmit the response frame (eg, data, ACK, short ACK) indicated in the short PS-Poll frame plus A SIFS interval to update its NAV settings. Unplanned STAs may include any required overhead frames or additional response frames (e.g., ACK frames) in the duration calculation to the response frames indicated in the short PS-poll frame and associated SIFS interval.

[0200]

In one embodiment, short frames (eg, short BA, short BR poll and short probe request) may include a duration field or information in the SIG field for NAV setup.

The size of the SIG field can be increased, for example, by using a higher MCS.

[0201]

When a STA initiates communication with an AP using an initiation or trigger frame (eg, PS-Poll frame or data frame), the STA may set the duration field of its frame and thereby the NAV of the unintended recipient/STA to initiate communication with the AP. Establish its transmission opportunity (TXOP) duration.

In a speed frame exchange when there is downlink data transmitted by the AP and the STA is the TXOP holder or TXOP initiator, the STA may initially estimate the duration for the entire TXOP (the entire sequence of multiple frames) and use This duration is used to set the duration field in the frame it transmits to set the NAV. For example, the estimation may be based on one or more of: arbitrary data to be transmitted, expected data to be received, expected MCS and interframe spacing (e.g., SIFS) to be used. The STA may use the CF end frame to truncate any remaining unused TXOP duration.

[0202]

Alternatively, a STA may estimate the duration for its initiation or trigger frame, any required response frames, overhead frames, and interframe spacing (eg, SIFS), and set the duration in its initiation/trigger frame based on the estimate. time field.

Then, the STA may extend the TXOP duration whenever the AP indicates that there is more data (more data field=1). A STA may not extend the TXOP duration beyond the specified TXOP duration limit for a given QoS transmission (e.g., as specified by EDCA rules).

[0203]

A STA may use the CF end frame to truncate the medium reservation or TXOP duration for speed frame exchange when there is no data to send or receive.

[0204]

The AP sets the duration value in the frame it transmits based on the duration value in the frame it receives from the STA.

[0205]

In the event that the unscheduled STA receives the PS-Poll frame, if the new NAV value is greater than the current NAV value, the unscheduled STA may use the required transmission response frame (eg, data, ACK, short ACK) duration plus a SIFS interval to update its NAV.

Alternatively, if no response frame is indicated in the PS-Poll frame, an unintended STA may set its NAV setting using the default response frame or the response frame duration specified in the system.

Alternatively, if the new NAV value is greater than the current NAV value, the unintended STA may use the duration required to transmit the response frame (eg, data, ACK, short ACK) indicated in the PS-Poll frame plus A SIFS interval to set its NAV settings.

Unplanned STAs may include any required overhead frames or additional response frames (e.g., ACK frames) in the duration calculation to the response frames indicated in the PS-Poll frame and associated SIFS interval.

[0206]

When a station needs to obtain information from another station, the station sends a probe request frame.

Instead of regular probe request frames, short probe request frames can be used. The short probe request frame includes an STF field, an LTF field and a SIG field. The SIG field of the short probe request frame includes an indication that the frame is a short probe request frame, among other indications and signaling required (eg, access network options, partial SSID), and

whether a probe response or short beacon is expected As an indication of a response to a short probe request frame.

[0207]

When a STA receives a short beacon with a change sequence different from the STA's stored change sequence, the STA needs to update its system information.

The system information update can be accomplished using a probe request frame that carries a change sequence to trigger the AP to send an optimal probe response frame, the probe response frame including the system information element and the change sequence that need to be updated by the STA.

[0208]

Due to the smaller size, using NDP probe request frames is more efficient than using regular probe request frames, which will take up more media time, especially when there are a large number of STAs wishing to update system information.

Power consumption at the STA is also reduced by using NDP probe request frames. This is especially useful when full beacons are transmitted infrequently or when short beacons are used in the BSS.

[0209]

In one embodiment, the NDP probe request frame may include a sequence of changes stored in the STA.

This can be done, for example, by using a sequence of small size changes (e.g., a 4-bit sequence instead of an 8-bit sequence) that can be accommodated within the limited bits available in the SIG field.

[0210]

The NDP probe request frame may indicate what system information elements (e.g., a bitmap representing a subset of system information elements) are required by the STA.

The NDP probe request frame may indicate that the sequence of changes in the last received short beacon is different from the sequence of changes stored in the STA.

[0211]

The NDP probe request frame may indicate which predefined set of system information elements is required by the STA.

A set of predefined system information elements may be indexed, and an index representing the set of system information may be signaled in the NDP probe request frame. For example, a predefined set of system information elements may be a set of system information elements or fields containing mandatory information, such as timestamps, beacon intervals, and capabilities; a set of system information elements or fields containing other information, such as other information such as EDCA parameters, static elements, BBS payload, channel switch announcements, HT operation elements, VHT operation elements; or a set of system information elements or fields containing any combination of mandatory information and other information. For example, the above signaling may be implemented using one or more of the reserved bits in the SIG field of the NDP probe request frame.

[0212]

When the STA sends the NDP probe request frame including the change sequence stored in the STA, the AP may send the optimal probe response frame including the system information element that needs to be updated by the STA and the change sequence.

The AP can do this by storing the previous sequence of changes and the IDs of the corresponding changed System Information Elements. The AP discovers the update information to send by comparing the change sequence received from the STA with its stored previous change sequence.

[0213]

When the STA sends an NDP probe request frame indicating what system information elements are required, the AP may send an optimal probe response frame including the system information elements that need to be updated by the STA and the change sequence.

[0214]

When a STA sends an NDP probe request frame indicating which predefined set of system information elements is required, the AP may send an optimal probe response frame including the indicated predefined set of system information elements and change sequences.

[0215]

When the STA sends an NDP probe request frame indicating that the change sequence in the last received short beacon is different from the change sequence stored in the STA, the AP may send a set of predefined or basic system information elements that includes the need to be updated by the STA and the change sequence the optimal probe response frame.

[0216]

In any of the above embodiments, the response to the NDP probe request frame may be a short probe response frame that includes the information requested or indicated in the NDP probe request frame.

[0217]

The NDP PS-Poll frame can be used for active polling.

The NDP PS-Poll frame includes an STF field, an LTF field, and a SIG field.

The SIG field of the short PS-poll frame has an indication that the frame is a short PS-poll frame, and other indications or signaling required by the short PS-poll frame, such as the AID or part of the AID of the transmitting STA in which the STA is associated with the BSS's The BSSID or part of the BSSID, and the preferred MCS of the STA for receiving data from the AP.

[0218]

The NDP PS-Poll frame may include signaling to request the BSS change sequence and/or the current timestamp.

The signaling may be included in the SIG field of the NDP PS-Poll frame.

One or more bits of the SIG field may be used to indicate a change sequence request and/or a current timestamp request from the AP.

One or more bits of the SIG field may be used to indicate whether one or more of the following fields are included: Preferred MCS, Change Sequence Request, and Current Timestamp Request.

[0219]

When a STA sends an NDP PS-Poll frame containing a request for a BSS change sequence, the AP may send the BSS change sequence immediately in the response frame, or indicate the STA in the response frame that it should check the beacon.

When the STA sends an NDP PS-Poll frame containing a request for the current timestamp, the AP may send the current timestamp immediately in the response frame, or indicate in the response frame that it should check the beacon.

[0220]

Any frame (e.g., ACK or data) from the AP that is transmitted in response to the PS-Poll frame may carry request information from the AP.

Alternatively, a new response frame from the AP can be defined for the PS-Poll frame to carry the request information from the

AP.

The frame can be of any type, eg management, control or data.

[0221]

Although the embodiments are described herein with reference to the IEEE 802.11 protocol, it should be understood that the embodiments are applicable to any wireless communication system.

While SIFS is used as the interframe space in various implementations, all other interframe spaces (such as RIFS or other agreed-upon time intervals) may also be used.

[0222]

Example

[0223]

1.A method used in a station for transmitting acknowledgments in wireless communications in response to data packets.

[0224]

2.According to the method of embodiment 1, the method includes receiving data packets from a pluralily of stations.

[0225]

3.According to the method of embodiment 2, the method includes generating an acknowledgment for the data packet.

[0226]

4.According to the method of embodiment 3, the method includes obtaining a transmission opportunity.

[0227]

5.The method of embodiment 4, the method comprising transmitting acknowledgments for data packets to multiple stations in a single transmission.

[0228]

6.The method of embodiment 5, wherein the acknowledgment is transmitted using MU-MIMO.

[0229]

7.The method of any of embodiments 5-6, wherein the acknowledgment is transmitted after a predetermined time from receipt of the data packet.

[0230]

8.The method of any of embodiments 5-7, wherein the acknowledgment is based on an agreed schedule, or upon a request by one of the stations, or upon receipt of a predetermined number of data packets transmitted.

[0231]

9.The method of embodiment 4, wherein generating an acknowledgment for the data packet comprises generating an acknowledgment packet for the data packet, and aggregating the acknowledgment packets.

[0232]

10.The method of embodiment 9, wherein transmitting the acknowledgment comprises transmitting the aggregated acknowledgment packets in a single transmission.

[0233]

11.The method of embodiment 10, wherein the acknowledgment packet is aggregated in a MAC service data unit, in a MAC protocol data unit, or in a PPDU.

[0234]

12.A method used in a station for transmitting acknowledgments in wireless communications.

[0235]

13.The method of embodiment 12 comprising receiving a frame indicating a sequence ID.

[0236]

14.The method of embodiment 13 comprising transmitting a short ACK frame in response to a received frame, wherein the short ACK frame includes an ACK sequence corresponding to a sequence ID.

[0237]

15.The method of embodiment 14, wherein the short ACK frame includes an STF and an ACK sequence.

[0238]

16.The method of any of embodiments 14-15, wherein the short ACK frame is transmitted with the short ACK indication.

[0239]

17.The method of any of embodiments 14-16, wherein the short ACK frame is transmitted in response to an indication included in the frame.

[0240]

18.A WTRU for transmitting acknowledgments in wireless communications in response to data packets.

[0241]

19.According to the WTRU of embodiment 18, the WTRU includes a processor configured to receive data packets from a plurality of stations.

[0242]

20.The WTRU of embodiment 19 wherein the processor is configured to generate an acknowledgment for a data packet.

[0243]

21.The WTRU of embodiment 19 wherein the processor is configured to transmit an acknowledgment for the data packet to the station in a single transmission.

[0244]

22.The WTRU of embodiment 21 wherein the processor is configured to transmit an acknowledgement using MU-MIMO.

[0245]

23.The WTRU of any of embodiments 21-22 wherein the processor is configured to transmit an acknowledgment after a predetermined time from receipt of the data packet.

[0246]

24.The WTRU of any one of embodiments 21-23 wherein the processor is configured to be based on an agreed schedule, or based on a request by one of a plurality of stations, or upon receipt of a predetermined number of data packets case, send confirmation.

[0247]

25.The WTRU of embodiment 21 wherein the processor is configured to generate acknowledgment packets for data packets and aggregate the acknowledgment packets, wherein the aggregated acknowledgment packets are transmitted in a single transmission.

[0248]

26.The WTRU of embodiment 25 wherein the processor is configured to aggregate acknowledgement packets in MAC service data units, in MAC protocol data units, or in PPDUs.

[0249]

27.A WTRU for transmitting acknowledgements in wireless communications.

[0250]

28.The WTRU of embodiment 27, the WTRU comprising a processor configured to receive frames.

[0251]

29.The WTRU of embodiment 28 wherein the processor is configured to transmit a short ACK frame in response to the received frame.

[0252]

30.The WTRU of embodiment 29 wherein the received frame includes a sequence ID and the short ACK frame includes an ACK sequence corresponding to the sequence ID.

[0253]

31.The WTRU as in any one of embodiments 29-30 wherein the short ACK frame includes an STF and an ACK sequence.

[0254]

32.The WTRU as in any one of embodiments 29-31 wherein the short ACK frame is transmitted with the short ACK indication.

[0255]

33.The WTRU as in any one of embodiments 29-32 wherein the short ACK frame is transmitted in response to an indication

included in the frame.

[0256]

Although features and elements are described above in specific combinations, it will be understood by those of ordinary skill in the art that each feature or element can be used alone or in combination with other features and elements.

Furthermore, the methods described herein can be implemented in a computer program, software or firmware incorporated into a computer readable medium and executed by a computer or processor.

Examples of computer-readable media include electrical signals (transmitted over wired or wireless connections) and computer-readable storage media.

Examples of computer-readable storage media include, but are not limited to, read only memory (ROM), random access memory (RAM), registers, buffer memory, semiconductor memory devices, magnetic media such as internal hard disks and removable disks, Magneto-optical media and optical media such as CD-ROM discs and digital versatile discs (DVDs).

A processor in association with software may be used to implement a radio frequency transceiver for use in a WTRU, UE, terminal, base station, RNC or any host computer.

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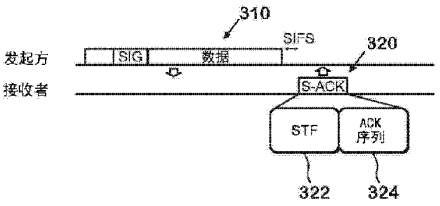
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(54)发明名称

用于响应于接收到的帧而传送确认的方法和装置

(57)摘要

公开了用于在无线通信中传送响应于数据分组的确认的方法和装置。接收者可从多个站接收多个数据分组，并在单次传输中传送对所述数据分组的确认至发起站。可使用多用户多输入多输出(MU-MIMO)来传送确认。可替换地，所述确认可被聚合并在单次传输中被传送。响应于接收到的帧，可发送短确认(ACK)帧。所述短ACK帧包括对应于被包括在接收到的帧中的序列标识(TD)的ACK序列。所述短ACK帧可包括短训练字段(STF)和ACK序列。所述短ACK帧可随短ACK指示来被传送。响应于被包括在接收到的帧中的指示，可发送短ACK帧。



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1. 一种在站中使用的用于在无线通信中传送响应于数据分组的确认的方法，该方法包括：

从多个站接收数据分组；

生成对所述数据分组的确认；

获得传输时机；以及

在单次传输中向所述多个站传送对所述数据分组的所述确认。

2. 根据权利要求 1 所述的方法，其中所述确认是使用多用户多输入多输出 (MU-MIMO) 来被传送的。

3. 根据权利要求 2 所述的方法，其中所述确认是在从接收到所述数据分组起的预定时间之后被传送的。

4. 根据权利要求 3 所述的方法，其中所述确认是基于约定的调度、基于所述多个站中的一个站的请求、或在接收到预定数量的数据分组的情况下被传送的。

5. 根据权利要求 1 所述的方法，其中生成对所述数据分组的确认包括：

生成确认分组；以及

聚合所述确认分组，并且其中传送所述确认包括在所述单次传输中向所述多个站传送所聚合的确认分组。

6. 根据权利要求 5 所述的方法，其中所述确认分组是在媒介接入控制 (MAC) 服务数据单元中、在 MAC 协议数据单元中、或在物理层会聚协议 (PLCP) 协议数据单元 (PPDU) 中被聚合的。

7. 一种在站中使用的用于在无线通信中传送确认的方法，该方法包括：

接收指示序列标识 (ID) 的帧；以及

响应于所接收到的帧而传送短确认 (ACK) 帧，其中所述短 ACK 帧包括对应于所述序列 ID 的 ACK 序列。

8. 根据权利要求 7 所述的方法，其中所述短 ACK 帧包括短训练字段 (STF) 和所述 ACK 序列。

9. 根据权利要求 7 所述的方法，其中所述短 ACK 帧是随短 ACK 指示被传送的。

10. 根据权利要求 7 所述的方法，其中所述短 ACK 帧是响应于被包括在所述帧中的指示而被传送的。

11. 一种用于在无线通信中传送响应于数据分组的确认的无线发射 / 接收单元 (WTRU)，该 WTRU 包括：

处理器，被配置成从多个站接收数据分组，生成对所述数据分组的确认，以及在单次传输中向所述多个站传送对所述数据分组的所述确认。

12. 根据权利要求 11 所述的 WTRU，其中所述处理器被配置成使用多用户多输入多输出 (MU-MIMO) 传送所述确认。

13. 根据权利要求 12 所述的 WTRU，其中所述处理器被配置成在从接收到所述数据分组起的预定时间之后传送所述确认。

14. 根据权利要求 13 所述的 WTRU，其中所述处理器被配置成基于约定的调度、或基于所述多个站中的一个站的请求、或在接收到预定数量的数据分组的情况下传送所述确认。

15. 根据权利要求 11 所述的 WTRU，其中所述处理器被配置成生成确认分组，聚合所述

确认分组，以及在所述单次传输中向所述多个站传送所聚合的确认分组。

16. 根据权利要求 15 所述的 WTRU，其中所述处理器被配置成在媒介接入控制 (MAC) 服务数据单元中、在 MAC 协议数据单元中或在物理层会聚协议 (PLCP) 协议数据单元 (PPDU) 中聚合所述确认分组。

17. 一种用于在无线通信中传送确认的无线发射 / 接收单元 (WTRU)，该 WTRU 包括：

处理器，被配置成接收帧，以及响应于所接收到的帧而传送短确认 (ACK) 帧，其中所接收到的帧指示序列标识 (ID)，并且所述短 ACK 帧包括对应于所述序列 ID 的 ACK 序列。

18. 根据权利要求 17 所述的 WTRU，其中所述短 ACK 帧包括短训练字段 (STF) 和所述 ACK 序列。

19. 根据权利要求 17 所述的 WTRU，其中所述短 ACK 帧是随短 ACK 指示被传送的。

20. 根据权利要求 17 所述的 WTRU，其中所述短 ACK 帧是响应于被包括在所述帧中的指示而被传送的。

用于响应于接收到的帧而传送确认的方法和装置

[0001] 相关申请的交叉引用

[0002] 本申请要求2012年5月11日提交的美国临时申请No.61/646,040、2012年7月9日提交的美国临时申请No.61/669,390、2012年9月11日提交的美国临时申请No.61/699,531和2012年11月9日提交的美国临时申请No.61/724,466的权益，这些申请的内容通过引用结合于此。

背景技术

[0003] 基础设施基础服务集(BSS)模式中的无线局域网(WLAN)具有用于BSS的接入点(AP)，和与AP相关联的一个或多个站(STA)。所述AP通常具有到分配系统(DS)或将业务带入和带出BSS的另一种类型的有线或无线网络的接入或接口。源自BSS外部的到STA的业务通过AP到达，并被传递到STA。从STA发起的到BSS外部的目的地的业务被发送到AP，以被传递到各自的目的地。BSS内的STA之间的业务还可通过AP发送，其中源STA发送业务到AP，以及该AP传递所述业务到目标STA。BSS内的STA之间的这种业务实际上是对等业务。可在具有直接链路建立(DLS)的源与目标STA之间使用IEEE 802.11e DLS或IEEE 802.11z隧道DLS(TDLS)来直接发送对等业务。独立BSS模式(IBSS)中的WLAN没有直接相互通信的AP和STA。

[0004] 在当前的IEEE 802.11基础设施操作模式中，AP在被称作主信道的信道上传送信标。主信道的宽是20MHz，并且该主信道是BSS的操作信道。该信道也由STA使用来与AP建立连接。802.11系统中的信道接入机制是具有冲突避免的载波监听多路访问(CSMA/CA)。在该操作模式中，每个STA(包括AP)将感测主信道，并且如果检测到信道是繁忙的，STA和AP会退避。因此，一个STA(包括AP)能在给定BSS中在任何给定时间进行传送。

[0005] 在IEEE 802.11n中，高吞吐量(HT)STA也可使用40MHz宽的信道来进行通信。这可通过将主20MHz信道与另一个邻近的20MHz信道合并起来以形成40MHz宽的信道来实现。

[0006] 在IEEE 802.11ac中，极高吞吐量(VHT)STA能够支持40MHz、80MHz和160MHz宽的信道。虽然40MHz和80MHz的信道可通过合并连续的20MHz信道来形成(类似于IEEE 802.11n)，但是160MHz信道可通过结合8个连续的20MHz信道或两个非连续的80MHz信道(80+80配置)来形成。

[0007] 针对子1GHz操作模式，信道操作带宽可被降低，该子1GHz操作模式在IEEE 802.11af和IEEE 802.11ah中被支持。802.11af支持用于在TV白空间(TVWS)中操作的2MHz、4MHz和8MHz带宽。802.11ah支持用于在非TVWS中操作的1MHz、2MHz、4MHz、8MHz和16MHz带宽。802.11ah中的一些STA被认为是具有有限能力的传感器，并且可支持1MHz传输模式。

发明内容

[0008] 公开了用于在无线通信中传送响应于数据分组的确认的方法和装置。接收者可从

多个站接收多个数据分组，并在单次传输中传送对所述数据分组的确认至发起站。可使用多用户多输入多输出 (MU-MIMO) 来传送确认。在接收到数据分组之后，所述确认可在时间上有所延迟。所述确认可基于约定的调度来被传送，由站请求，或者一旦接收到预定数量的数据分组就被传送，而无需请求。

[0009] 可替换地，所述确认可被聚合，并在单次传输中被传送。所述确认可在媒介接入控制 (MAC) 服务数据单元域中、在 MAC 协议数据单元域中、或在物理层会聚协议 (PLCP) 协议数据单元 (PPDU) 域中被聚合。

[0010] 响应于接收到的帧可发送短确认 (ACK) 帧。所述短 ACK 帧可以包括对应于被包括在接收到的帧中的序列 ID 的 ACK 序列。所述短 ACK 帧可以包括短训练字段 (STF) 和 ACK 序列。所述短 ACK 帧可随短 ACK 指示被传送。响应于被包括在接收到的帧中的指示，短 ACK 帧可以被发送。

附图说明

[0011] 更详细的理解可以从下述结合附图给出的示例的描述中得到，其中：

[0012] 图 1A 是可在其中实施一个或多个公开的实施方式的示例通信系统的系统图；

[0013] 图 1B 是可在图 1A 中示出的通信系统内使用的示例无线发射 / 接收单元 (WTRU) 的系统图；

[0014] 图 1C 是可在图 1A 中示出的通信系统内使用的示例无线电接入网和示例核心网的系统图；

[0015] 图 2 示出了常规确认 (ACK) 帧；

[0016] 图 3 示出了数据帧与短 ACK 帧的示例消息交换序列；

[0017] 图 4 示出了示例物理层会聚协议 (PLCP) 协议数据单元 (PPDU) 数据帧格式；

[0018] 图 5 示出了标准 PPDU 和具有短 ACK 指示的示例短 ACK 帧；

[0019] 图 6 示出了标准 PPDU 和具有扩展的短训练字段 (STF) 的示例短 ACK 帧；

[0020] 图 7 示出了常规媒介接入控制 (MAC) 帧格式；

[0021] 图 8 示出了用于 MU-MIMO 块 ACK 的 PPDU 帧结构的示例；

[0022] 图 9 示出了用于延迟 MU-MIMO 块 ACK 的示例消息交换序列；

[0023] 图 10 示出了块 ACK 请求 (BAR) 帧格式；

[0024] 图 11 示出了用于聚合多用户 ACK(A-MU-ACK) 帧的示例 PPDU 结构；

[0025] 图 12 和 13 示出了被聚合到用单独调制和编码方案 (MCS) 编码的多用户 ACK 帧中的 ACK 或块 ACK(BA)MAC 协议数据单元 (MPDU) 的示例；

[0026] 图 14 示出了为实施用户的各种 MIMO 方案，对于每个用户的具有单独长训练字段 (LTF) 的聚合多用户 ACK 的示例；

[0027] 图 15 示出了单用户搭载 (piggyback)ACK 的示例；

[0028] 图 16 示出了在 MSDU 级中聚合的单用户搭载 ACK 的示例；

[0029] 图 17 示出了 MPDU 级中的搭载 ACK 的示例；

[0030] 图 18 示出了 PPDU 级中的搭载 ACK 的示例；

[0031] 图 19 示出了多用户搭载 ACK 的示例；

[0032] 图 20 示出了常规 ADDBA 请求帧动作字段格式；

[0033] 图 21 示出了常规 ADDBA 响应帧动作字段格式；

[0034] 图 22 示出了常规 DELBA 帧；

[0035] 图 23 示出了用于预先安排的 STA 组的延迟多用户 ACK 帧中的 ACK 字段的示例；

[0036] 图 24 示出了用于 ad hoc STA 组的延迟多用户 ACK 帧中的 ACK 字段的示例；

[0037] 图 25 示出了常规短 ACK 帧格式；

[0038] 图 26 示出了短 ACK 响应的示例；

[0039] 图 27 和 28 分别示出了针对下行链路和上行链路数据的速度帧交换的示例过程；

[0040] 图 29 示出了针对下行链路数据使用短 ACK 帧（或短 BA 帧）进行速度帧交换的示例；

[0041] 图 30 示出了针对上行链路数据使用短 ACK（或短 BA）帧进行速度帧交换的示例；以及

[0042] 图 31 示出了使用短 PS 轮询帧和短 ACK（或短 BA）帧进行速度帧交换的示例。

具体实施方式

[0043] 图 1A 是可以在其中实施一个或多个公开的实施方式的示例通信系统 100 的图示。通信系统 100 可以是向多个无线用户提供内容（例如语音、数据、视频、消息、广播等等）的多接入系统。通信系统 100 可以使多个无线用户通过系统资源（包括无线带宽）的共享来访问所述内容。例如，通信系统 100 可使用一个或多个信道接入方法，例如码分多址 (CDMA)、时分多址 (TDMA)、频分多址 (FDMA)、正交 FDMA(OFDMA)、单载波 FDMA(SC-FDMA) 等等。

[0044] 如图 1A 所示，通信系统 100 可以包括无线发射 / 接收单元 (WTRU)102a、102b、102c、102d，无线电接入网 (RAN)104，核心网 106，公共交换电话网 (PSTN)108，因特网 110 和其他网络 112，不过应该理解的是，公开的实施方式考虑到了任何数量的 WTRU、基站、网络和 / 或网络元件。WTRU102a、102b、102c、102d 中的每一个可以是被配置为在无线环境中进行操作和 / 或通信的任何类型设备。作为示例，WTRU 102a、102b、102c、102d 可以被配置为传送和 / 或接收无线信号，并且可以包括用户设备 (UE)、移动站、固定或移动用户单元、寻呼机、蜂窝电话、个人数字助理 (PDA)、智能手机、膝上型计算机、上网本、个人计算机、无线传感器、消费类电子产品等等。

[0045] 通信系统 100 还可以包括基站 114a 和基站 114b。基站 114a、114b 中的每一个可以是被配置为与 WTRU 102a、102b、102c、102d 中的至少一者无线对接，以促进接入一个或多个通信网络（例如核心网 106、因特网 110 和 / 或其他网络 112）的任何类型设备。作为示例，基站 114a、114b 可以是基站收发信台 (BTS)、节点 B、e 节点 B、家用节点 B、家用 e 节点 B、站点控制器、接入点 (AP)、无线路由器等等。虽然基站 114a、114b 各自被描述为单独的元件，但是应该理解的是基站 114a、114b 可以包括任何数量的互连基站和 / 或网络元件。

[0046] 基站 114a 可以是 RAN 104 的一部分，所述 RAN 104 还可包括其他基站和 / 或网络元件（未示出），例如基站控制器 (BSC)、无线电网络控制器 (RNC)、中继节点等等。基站 114a 和 / 或基站 114b 可被配置成在特定地理区域内传送和 / 或接收无线信号，所述特定地理区域可被称作小区（未示出）。所述小区可进一步划分为小区扇区。例如，与基站 114a 相关联的小区可被划分为三个扇区。因而，在一个实施方式中，基站 114a 可包括三个收发

信机，即小区的每个扇区使用一个收发信机。在另一个实施方式中，基站 114a 可使用多输入多输出 (MIMO) 技术，并且因此可针对小区的每个扇区使用多个收发信机。

[0047] 基站 114a、114b 可通过空中接口 116 与 WTRU 102a、102b、102c、102d 中的一者或多者进行通信，所述空中接口 116 可以是任何适当的无线通信链路 (例如，射频 (RF)，微波，红外 (IR)，紫外 (UV)，可见光等等)。空中接口 116 可使用任何适当的无线电接入技术 (RAT) 来建立。

[0048] 更具体地说，如上所述，通信系统 100 可以是多接入系统，并且可以使用一个或多个信道接入方案，例如 CDMA、TDMA、FDMA、OFDMA、SC-FDMA 等等。例如，RAN 104 中的基站 114a 和 WTRU 102a、102b、102c 可以实施例如通用移动电信系统 (UMTS) 陆地无线电接入 (UTRA) 的无线电技术，其可以使用宽带 CDMA(WCDMA) 来建立空中接口 116。WCDMA 可以包括通信协议，例如高速分组接入 (HSPA) 和 / 或演进型 HSPA(HSPA+)。HSPA 可以包括高速下行链路分组接入 (HSDPA) 和 / 或高速上行链路分组接入 (HSUPA)。

[0049] 在另一个实施方式中，基站 114a 和 WTRU 102a、102b、102c 可实施例如演进型 UMTS 陆地无线电接入 (E-UTRA) 的无线电技术，其可以使用长期演进 (LTE) 和 / 或高级 LTE(LTE-A) 来建立空中接口 116。

[0050] 在其他实施方式中，基站 114a 和 WTRU 102a、102b、102c 可实施例如 IEEE 802.16 (即，全球微波接入互操作性 (WiMAX))，CDMA2000，CDMA2000 1X，CDMA2000 EV-DO，临时标准 2000(IS-2000)，临时标准 95(IS-95)，临时标准 856(IS-856)，全球移动通信系统 (GSM)，用于 GSM 演进的增强型数据速率 (EDGE)，GSM EDGE(GERAN) 等等的无线电技术。

[0051] 图 1A 中的基站 114b 可以是无线路由器、家用节点 B、家用 e 节点 B 或接入点，例如，并且可以使用任何适当的 RAT 来促进局部区域中的无线连接，例如商业处所、住宅、车辆、校园等等。在一个实施方式中，基站 114b 和 WTRU 102c、102d 可以实施例如 IEEE 802.11 的无线电技术来建立无线局域网 (WLAN)。在另一个实施方式中，基站 114b 和 WTRU 102c、102d 可以实施例如 IEEE 802.15 的无线电技术来建立无线个域网 (WPAN)。仍然在另一个实施方式中，基站 114b 和 WTRU 102c、102d 可以使用基于蜂窝的 RAT(例如，WCDMA、CDMA2000、GSM、LTE、LTE-A 等) 来建立微微小区或毫微微小区。如图 1A 所示，基站 114b 可以具有到因特网 110 的直接连接。因此，基站 114b 可以不必须经由核心网 106 接入因特网 110。

[0052] RAN 104 可以与核心网 106 通信，所述核心网 106 可以是被配置为向 WTRU 102a、102b、102c、102d 中的一者或多者提供语音、数据、应用和 / 或网际协议上的语音 (VoIP) 服务的任何类型的网络。例如，核心网 106 可以提供呼叫控制、计费服务、基于移动位置的服务、预付费呼叫、因特网连接、视频分配等，和 / 或执行高级安全功能，例如用户认证。虽然图 1A 中未示出，应该理解的是 RAN 104 和 / 或核心网 106 可以与使用和 RAN 104 相同的 RAT 或不同 RAT 的其他 RAN 进行直接或间接的通信。例如，除了连接到正在使用 E-UTRA 无线电技术的 RAN 104 之外，核心网 106 还可以与使用 GSM 无线电技术的另一个 RAN(未示出) 通信。

[0053] 核心网 106 还可以充当 WTRU 102a、102b、102c、102d 接入 PSTN 108、因特网 110 和 / 或其他网络 112 的网关。PSTN 108 可以包括提供普通老式电话服务 (POTS) 的电路交换电话网络。因特网 110 可以包括使用公共通信协议的全球互联计算机网络和设备系统，所述公共通信协议例如 TCP/IP 因特网协议族中的传输控制协议 (TCP)、用户数据报协议 (UDP)

和网际协议 (IP)。网络 112 可以包括由其他服务提供商拥有和 / 或运营的有线或无线通信网络。例如，网络 112 可以包括连接到一个或多个 RAN 的另一个核心网，所述 RAN 可以使用和 RAN 104 相同的 RAT 或不同的 RAT。

[0054] 通信系统 100 中的 WTRU 102a、102b、102c、102d 的一些或所有可以包括多模式能力，即 WTRU 102a、102b、102c、102d 可以包括用于通过不同无线链路与不同无线网络进行通信的多个收发信机。例如，图 1A 中示出的 WTRU 102c 可被配置为与可以使用基于蜂窝的无线电技术的基站 114a 通信，以及与可以使用 IEEE 802 无线电技术的基站 114b 通信。

[0055] 图 1B 是示例 WTRU 102 的系统图。如图 1B 所示，WTRU 102 可以包括处理器 118、收发信机 120、发射 / 接收元件 122、扬声器 / 麦克风 124、键盘 126、显示器 / 触摸板 128、不可移除存储器 130、可移除存储器 132、电源 134、全球定位系统 (GPS) 芯片组 136 和其他外围设备 138。应该理解的是在保持与实施方式一致时，WTRU 102 可以包括前述元件的任何子组合。

[0056] 处理器 118 可以是通用处理器、专用处理器、常规处理器、数字信号处理器 (DSP)、多个微处理器、与 DSP 核心相关联的一个或多个微处理器、控制器、微控制器、专用集成电路 (ASIC)、现场可编程门阵列 (FPGA) 电路、任何其他类型的集成电路 (IC)、状态机等等。处理器 118 可执行信号编码、数据处理、功率控制、输入 / 输出处理和 / 或使 WTRU 102 能够在无线环境中进行操作的任何其他功能。处理器 118 可以耦合到收发信机 120，所述收发信机 120 可耦合到发射 / 接收元件 122。虽然图 1B 将处理器 118 和收发信机 120 描述成是单独的部件，但是应该理解的是处理器 118 和收发信机 120 可以被一起集成在电子封装或芯片中。

[0057] 发射 / 接收元件 122 可以被配置为通过空中接口 116 将信号传送到基站 (例如，基站 114a)，或从基站 (例如，基站 114a) 中接收信号。例如，在一个实施方式中，发射 / 接收元件 122 可以是被配置为传送和 / 或接收 RF 信号的天线。在另一个实施方式中，发射 / 接收元件 122 可以是被配置为传送和 / 或接收例如 IR、UV 或可见光信号的发射器 / 检测器。仍然在另一个实施方式中，发射 / 接收元件 122 可以被配置为传送和接收 RF 和光信号两者。应该理解的是发射 / 接收元件 122 可以被配置为传送和 / 或接收无线信号的任何组合。

[0058] 此外，虽然发射 / 接收元件 122 在图 1B 中被描述为单独的元件，但是 WTRU 102 可以包括任意数量的发射 / 接收元件 122。更具体地说，WTRU 102 可以使用 MIMO 技术。因此，在一个实施方式中，WTRU 102 可以包括用于通过空中接口 116 传送和接收无线信号的两个或更多个发射 / 接收元件 122(例如，多个天线)。

[0059] 收发信机 120 可以被配置为对要由发射 / 接收元件 122 传送的信号进行调制，以及对由发射 / 接收元件 122 接收的信号进行解调。如上所述，WTRU 102 可以具有多模式能力。因此，收发信机 120 可以包括使 WTRU 102 能够经由多个 RAT 通信的多个收发信机，所述多个 RAT 例如有 UTRA 和 IEEE 802.11。

[0060] WTRU 102 的处理器 118 可以耦合到下述设备，并且可以从下述设备中接收用户输入数据 :扬声器 / 麦克风 124、键盘 126 和 / 或显示器 / 触摸板 128(例如，液晶显示器 (LCD) 显示单元或有机发光二极管 (OLED) 显示单元)。处理器 118 还可以输出用户数据到扬声器 / 麦克风 124、键盘 126 和 / 或显示器 / 触摸板 128。此外，处理器 118 可以从任何类型的适

当的存储器中访问信息，并且可以存储数据到所述存储器中，所述存储器例如不可移除存储器 130 和 / 或可移除存储器 132。不可移除存储器 130 可以包括随机存取存储器 (RAM)、只读存储器 (ROM)、硬盘或任何其他类型的存储器存储设备。可移除存储器 132 可以包括用户标识模块 (SIM) 卡、记忆棒、安全数码 (SD) 存储卡等等。在其他实施方式中，处理器 118 可以从物理上没有位于 WTRU 102 上（例如位于服务器或家用计算机（未示出）上）的存储器中访问信息，并且可以将数据存储在所述存储器中。

[0061] 处理器 118 可以从电源 134 接收电力，并且可以被配置为分配和 / 或控制到 WTRU 102 中的其他部件的电力。电源 134 可以是给 WTRU 102 供电的任何适当的设备。例如，电源 134 可以包括一个或多个干电池（例如，镍镉 (NiCd)、镍锌 (NiZn)、镍金属氢化物 (NiMH)、锂离子 (Li-ion)，等等），太阳能电池，燃料电池等等。

[0062] 处理器 118 还可以耦合到 GPS 芯片组 136，所述 GPS 芯片组 136 可以被配置为提供关于 WTRU 102 的当前位置的位置信息（例如，经度和纬度）。除来自 GPS 芯片组 136 的信息或作为替代，WTRU 102 可以通过空中接口 116 从基站（例如，基站 114a、114b）中接收位置信息，和 / 或基于从两个或更多个邻近基站接收到的信号的定时来确定其位置。应该理解的是在保持实施方式的一致性的同时，WTRU 102 可以通过任何适当的位置确定方法获得位置信息。

[0063] 处理器 118 可进一步耦合到其他外围设备 138，所述外围设备 138 可以包括一个或多个提供附加特征、功能和 / 或有线或无线连接的软件和 / 或硬件模块。例如，外围设备 138 可以包括加速计、电子罗盘、卫星收发信机、数码相机（用于照片或视频）、通用串行总线 (USB) 端口、振动设备、电视收发信机、免持耳机、蓝牙®模块、调频 (FM) 无线电单元、数字音乐播放器、媒体播放器、视频游戏机单元、因特网浏览器等等。

[0064] 图 1C 是根据实施方式的 RAN 104 和核心网 106 的系统图。如上所述，RAN 104 可使用 E-UTRA 无线电技术以通过空中接口 116 与 WTRU 102a、102b、102c 通信。RAN 104 还可与核心网 106 通信。

[0065] RAN 104 可包括 e 节点 B 140a、140b、140c，但是应该理解的是在与实施方式保持一致的同时，RAN 104 可包括任意数量的 e 节点 B。e 节点 B 140a、140b、140c 每一个可包括用于通过空中接口 116 与 WTRU 102a、102b、102c 通信的一个或多个收发信机。在一个实施方式中，e 节点 B 140a、140b、140c 可实施 MIMO 技术。因而，e 节点 B 140a 例如可使用多个天线以将无线信号传送到 WTRU 102a，以及从 WTRU 102a 接收无线信号。

[0066] e 节点 B 140a、140b、140c 中的每个都可以与特定小区（未示出）关联，并且可被配置为处理无线电资源管理决策、切换决策、上行链路和 / 或下行链路中的用户调度等等。如图 1C 中所示，e 节点 B 140a、140b、140c 可通过 X2 接口彼此通信。

[0067] 图 1C 中示出的核心网 106 可包括移动性管理网关 (MME) 142，服务网关 144，和分组数据网络 (PDN) 网关 146。虽然前述的每个元件都被描述为核心网 106 的一部分，但是应该理解的是这些元件中的任何一个都可由除核心网运营商之外的实体拥有和 / 或运营。

[0068] MME 142 可经由 S1 接口连接到 RAN 104 中的 e 节点 B 140a、140b、140c 的每一个，并且可用作控制节点。例如，MME 142 可负责认证 WTRU 102a、102b、102c 的用户、承载激活 / 去激活、在 WTRU 102a、102b、102c 的初始附着期间选择特定服务网关，等等。MME 142 还可提供控制平面功能，以用于在 RAN 104 和使用其它无线电技术（例如 GSM 或 WCDMA）的其

它 RAN(未示出)之间进行切换。

[0069] 服务网关 144 可经由 S1 接口连接到 RAN 104 中的 e 节点 B 140a、140b、140c 中的每个。服务网关 144 通常可以路由和转发去往 / 来自 WTRU 102a、102b、102c 的用户数据分组。服务网关 144 还可以执行其它功能,例如在 e 节点 B 间切换期间锚定用户平面,在下行链路数据可用于 WTRU 102a、102b、102c 时触发寻呼,管理和存储 WTRU 102a、102b、102c 的上下文,等等。

[0070] 服务网关 144 还可连接到 PDN 网关 146,所述 PDN 网关 146 可向 WTRU 102a、102b、102c 提供到分组交换网络(例如因特网 110)的接入,以促进 WTRU 102a、102b、102c 与 IP 使能设备间的通信。

[0071] 核心网 106 可促进与其它网络的通信。例如,核心网 106 可向 WTRU 102a、102b、102c 提供到电路交换网络(例如 PSTN 108)的接入,以促进 WTRU 102a、102b、102c 与传统陆线通信设备间的通信。例如,核心网 106 可包括 IP 网关(例如,IP 多媒体子系统 (IMS) 服务器),或可之通信,所述 IP 网关作为核心网 106 与 PSTN 108 之间的接口。此外,核心网 106 还可向 WTRU 102a、102b、102c 提供到网络 112 的接入,所述网络 112 可包括由其它服务提供商拥有和 / 或运营的其它有线或无线网络。

[0072] 其他网络 112 还可以连接到基于 IEEE 802.11 的无线局域网 (WLAN)160。所述 WLAN 160 可以包括接入路由器 165。接入路由器可以包括网关功能。接入路由器 165 可以与多个接入点 (AP)170a、170b 通信。接入路由器 165 与 AP 170a、170b 之间的通信可经由有线以太网 (IEEE 802.3 标准),或任何类型的无线通信协议。AP 170a 通过空中接口与 WTRU 102d 进行无线通信。

[0073] 在下文中,术语“短帧”和“空数据分组”(NDP) 将交替使用。短帧(例如短 ACK、短块 ACK、短清除发送 (CTS)、短探测请求等)是不携带数据字段的物理层会聚协议 (PLCP) 协议数据单元 (PPDU)。在下文中,术语“STA”(例如,WTRU) 可包括非 AP 站或 AP 站。这里公开的实施方式可由非 AP STA 或 AP 站 (AP) 实施。下文中公开的实施方式可应用到任何 IEEE 802.11 系统和任何其他无线通信系统中。

[0074] 无线传输可能是错误的,即使保护机制(例如信道编码和交织)被用于保护所述传输。因此,在 WLAN 系统中已经引入了用于对正确分组接收进行确认的机制。成功接收到被定址为自己的数据帧的 STA/AP 发送肯定确认。如果传送帧的 STA/AP 在规定时间量内没有接收到 ACK,其可以假设所述数据帧没有被正确接收,并重新传送所述数据帧。不是所有的数据帧都能够用这种方式确认。当发起方显式地指示不期望来自数据帧的接收者的确认时,802.11 标准还支持“无 ACK”。

[0075] 802.11e 修正案中引入了块 ACK。块 ACK 通过允许多个帧的接收者传送单个块 ACK 以确认数据帧块来改善系统效率。块 ACK 可以是即时块 ACK 或延迟块 ACK。

[0076] 图 2 示出了常规 ACK 帧 200。常规 ACK 帧 200 具有 PLCP 前导码,其包括短训练字段 (STF)202 和长训练字段 (LTF)204,信号 (SIG) 字段 206 和 ACK 主体帧 208。ACK 主体帧 208 具有 2 字节帧控制字段 210,2 字节持续时间字段 212,6 字节接收方地址 (RA) 字段 214,和 4 字节帧检验序列 (FCS)216。由帧控制字段 210 携带的信息指示这是 ACK 帧。RA 字段 214 指示数据交换会话的发起方。

[0077] 短 ACK 帧可以用于确认来自发起方的数据帧(或任何其他帧)。图 3 示出了数据帧

和短 ACK 帧的示例消息交换序列。图 3 还示出了根据一个实施方式的短 ACK 帧的示例 PPDU 帧结构。发起方传送数据帧 310 至接收者，该接收者解码所述数据帧 310，并传送短 ACK 帧 320 至发起方，以指示数据帧的成功或不成功解码。在数据帧 310 中，发起方可指示期望的 ACK 传输将是短 ACK。发起方可在数据帧 310 中显式地或隐式地标识 ACK 序列 ID。然后接收者将对应的 ACK 序列包括在短 ACK 帧 320 的 ACK 序列字段 324 中。

[0078] 短 ACK 帧 320 包括 STF 322 和 ACK 序列字段 324。STF 322 可用于自动增益控制 (AGC) 和粗时频偏移估计。短 ACK 帧 320 可由 STF 322 从其他帧中识别出来。

[0079] 对应于由数据帧 310 指示的 ACK 序列 ID 的 ACK 序列指示相应的数据帧 310。ACK 序列可在频域或时域中被调制。例如，具有恒幅零自相关 (CAZAC) 性质的预定义的序列集可被用作 ACK 序列。例如，可使用通用线性调频 (GCL) 序列。Zadoff-Chu(ZC) 序列是 GCL 序列的特殊情况。每个序列具有一个序列 ID。发起方隐式地或显式地在传送的数据帧 310 中分配该序列 ID。接收者将相应的序列包括在短 ACK 帧 320 中。由于选择了正交序列，短 ACK 帧 320 可用于同步多用户接入。

[0080] 发起方通过在频域或时域中与分配的 ACK 序列相关，来对接收到的短 ACK 帧进行解调。一旦发起方正确解调短 ACK，发起方知道这是对之前传送的数据分组的确认。错误检测是可能的。然而，可通过增加 ACK 序列的数量来降低错误检测的可能性。

[0081] 当非计划中的 (unintended)STA 解调从发起方传送的数据分组 310 时，他们可设置其网络分配矢量 (NAV)。考虑到接下来的 ACK 将是短 ACK 的事实，可设置由数据分组 310 携带的持续时间字段。如果非计划中的 STA 解调数据分组 310 失败，但是检测到短 ACK STF 字段，则非计划中的 STA 确定这是短 ACK 帧，并且因此推迟接入媒介。

[0082] 在检测到帧但是没有正确接收到该帧的情况下，扩展帧间间隔 (EIFS) 可被用于延迟。在当前的 802.11 中，EIFS = aSIFSTime+ACKTxTime+DIFS。如果系统针对所有 ACK 传输使用短 ACK，或者如果 STA 知道正在使用短 ACK，则 STA 可使用重新定义的 EIFS 或新定义的 EIFS_SACK 来进行延迟。例如，EIFS_SACK = aSIFSTime+SACKTxTime+DIFS，其中 SACKTxTime 是以最低数据速率传送 S-ACK 帧所需要的时间。

[0083] 发起方可为数据分组中的短 ACK 帧分配 ACK 序列 ID。可隐式地指示所述 ACK 序列 ID。例如，ACK 序列 ID 可根据下列参数中的一者或任意（全部或部分）组合来被确定：扰码器种子 (6 比特)，FCS(4 字节)，SIG 字段中的 CRC(4 比特)，SIG 字段中的长度字段 (9-21 比特)，和 / 或基础服务集标识 (BSSID)(6 字节)。

[0084] 可替换地，可显式地指示 ACK 序列 ID。例如，可通过使用数据帧中的服务字段来指示 ACK 序列 ID。图 4 示出了示例 PPDU 数据帧格式。PPDU 400 包括前导码 410，SIG 字段 420，和数据字段 430。数据字段 430 包括服务字段 432，MPDU 434，和尾部和填充比特 436。服务字段 432 是 16 比特字段。服务字段 432 的前 7 个比特是扰码器初始化比特，其用于同步解扰码器，且通常被设置为零。服务字段 432 的剩余的 9 比特当前是预留的。服务字段 432 中预留的 9 比特可用于显式地分配 ACK 序列 ID。

[0085] 发起方可在其数据分组中指示期望响应于该数据分组的短 ACK 帧。该指示可通过使用 SIG 字段 420(例如，使用 SIG 字段 420 中的 1 比特来指示短 ACK 帧是期望的或可接受的）或服务字段 432(例如，使用服务字段 432 中的 1 比特（例如，比特 7）来指示短 ACK 帧是期望的或可接受的）来提供。

[0086] 在另一个实施方式中，接收者可用短 ACK 帧来响应数据帧，并且短 ACK 指示可被显式地或隐式地包括在短 ACK 帧中。AP 和 STA（计划中 (intended) 的和非计划中的）可基于短 ACK 指示识别作为短 ACK 帧的帧。由于短 ACK 帧的简单结构，接收 STA 可在开始 ACK 序列的相关检测之前确定它是短 ACK 帧。

[0087] 短 ACK 指示可被包括在 STF 字段中。STF 包括若干重复的序列。例如，大部分 802.11 系统包括 10 个重复的 STF 序列，而针对 1MHz 的 802.11ah STF 具有 20 次重复次数。在一个实施方式中，一个或多个重复的 STF 序列的符号可被倒装 (flip) 以指示帧是短 ACK 帧。图 5 示出了标准 PPDU 510 和具有短 ACK 指示的示例短 ACK 帧 520。在图 5 中，最后两个 STF 序列 522 的符号可被倒装以指示帧是短 ACK 帧。这将改变自相关行为，从而接收方可检测这是短 ACK 帧。

[0088] 在另一个实施方式中，扩展重复次数的 STF 序列可用于指示短 ACK 帧。图 6 示出了标准 PPDU 610 和具有扩展的 STF 622 的示例短 ACK 帧 620。一旦接收方检测到长于标准 STF 或自相关平台，其可以确定帧是短 ACK 帧。

[0089] 在传输之前，在物理层中调制和编码 ACK 帧。调制和编码方案 (MCS) 可以是 BSS 基础速率集 (BSSBasicRateSet) 参数中的最高速率，其小于或等于之前接收的数据帧的速率 (MCS)。这样，BSS 中的 STA 具有检测 ACK 帧的能力。

[0090] 为了降低来自 ACK 的开销，较高的 MCS 可能更有前景，因为它可以要求传送较少数量的 OFDM 符号。在一些 802.11 标准中，ACK 指示字段被定义在 SIG 字段中，并由发起方传送。ACK 指示用于指示有关随后的 ACK 帧的信息。例如，在 802.11ah 中，ACK 指示具有下述定义 (00 :ACK ;01 :BA ;10 :无 ACK ;11 :不是 ACK、BA 或 CTS 的帧）。由于 ACK 指示，非计划中的 STA 可断定随后的帧是否是 ACK 帧。因而，不需要 STA 必须理解 ACK 帧主体。在一个实施方式中，当在 SIG 字段中使用 ACK 指示时，可放松对于在 BSSBasicRateSet 中选择用于 ACK 帧的 MCS 的要求。在没有在来自发起方的 SIG 字段中传送的 ACK 指示的情况下，非计划中的 STA 必须解码 ACK 帧，以断定这是 ACK 帧。因而，ACK 帧应该使用所有 STA 都能理解的基础 MCS。它必须是 BSSBasicRateSet 中定义的 MCS。在具有来自发起方的 SIG 字段中的 ACK 指示的情况下，非计划中的 STA 可检测 SIG 字段，并注意到 ACK 帧即将到来，并延迟特定持续时间。这样，其他 STA 完全不需要解码 ACK 帧，因此 ACK 帧可使用除了在 BSSBasicRateSet 中定义的 MCS 之外的任何 MCS。

[0091] 在另一个实施方式中，发起方可为 ACK 帧分配 MCS 和 / 或带宽，以及接收者可用预分配的 MCS 和 / 或带宽来传送 ACK 帧。

[0092] 在 802.11ah 中，接收方应该支持 1MHz 和 2MHz 两者的接收，而 1MHz 则需要在发射方侧得到支持。因此，可能发生的是，AP 传送 2MHz 分组至 STA，并在数据分组中显式地或隐式地指示随后的 ACK 将用 1MHz 传送。可替换地，STA 可传送 1MHz 分组至 AP，而在 2MHz 信道上操作的 AP 可选择用 1MHz 或 2MHz ACK 来回复。用 2MHz 传送 ACK 可降低 ACK 开销。在上述示例中，STA 可指示 AP 使用的用于 ACK 传输的带宽。

[0093] 在另一个示例中，STA 可以有两个接收射频 (RF) 链，而有一个发射 RF 链。一旦 STA 传送一个数据流分组至 AP，按照当前的标准，AP 可向一个数据流传送 ACK。然而，如果信道条件非常好，允许 AP 向两个数据流传送 ACK 会更有效。在一个实施方式中，STA 可在其从 AP 接收到先前两个数据流分组时检测信道条件，并确定其是否适合 AP 向两个数据流传送

ACK。

[0094] 当发起方传送数据分组至接收者时，如果发起方具有对从接收者到该发起方的信道的一些了解，并知道非对称发射和接收能力，则发起方可确定用于 ACK 帧的特定 MCS 和 / 或带宽，并在数据帧中指示它。否则，发起方可选择等于或低于在先前数据分组中使用的 MCS 的 MCS，并根据发起方和接收者的能力选择带宽。

[0095] 选择的用于随后的 ACK 帧的 MCS 和带宽可在数据分组的 MAC 报头中被指示。图 7 示出了常规 MAC 帧格式。在当前的 802.11 标准中，在 MAC 报头的 QoS 控制字段 710 中定义了 ACK 策略子字段。ACK 策略子字段有 2 比特长，并标识了紧随 MPDU 传递之后的确认策略。在一个实施方式中，可为 MCS 和带宽指示扩展 ACK 策略子字段。MCS 和带宽信息需要的比特数量可取决于标准而变化。例如，对于 802.11ah，2 比特可用于指示带宽，如表 1 所示。

[0096] 表 1

[0097]

[B0,B1]	含义
00	1MHz
01	2MHz
10	与先前分组相同的带宽
11	预留

[0098] 可替换地，可在 SIG 字段中显式地指示用于 ACK 帧的 MCS 和带宽。例如，若干比特可被添加到 SIG 字段中，以表示用于 ACK 帧的 MCS 和带宽。

[0099] 可替换地，可通过在 MAC 报头中设置持续时间字段 720 来隐式地指示用于 ACK 帧的 MCS 和带宽。MAC 报头中的持续时间字段 720 可被设置为传送待处理的 (pending) 分组所需要的时间值加一个 ACK 或块 ACK 加短帧间间隔 (SIFS) 间隔。ACK 或块 ACK 的持续时间值可用预分配的 MCS 和带宽计算。

[0100] 当以预分配的 MCS 和带宽传送 ACK 帧时，NAV 设置可被相应地修改。发起方传送的 MAC 帧的持续时间字段 720 持有时间值，该时间值指示发起方希望媒介繁忙的持续时间。按照惯例，发起方不给随后的 ACK 帧分配 MCS。因而，发起方基于系统支持的最低 MCS 来估计随后的 ACK 传输的持续时间。利用根据这里公开的实施方式的预分配的 MCS，发起方可使用分配的 MCS 来估计随后的 ACK 传输，并在持续时间字段 720 中给出更精确的时间值。这样，非计划中的 STA 可更精确地设置 NAV。

[0101] 一旦接收者正确地解调数据分组，它相应地准备 ACK 分组。当使用显式指示时，接收者可以预分配的 MCS 和带宽传送 ACK 帧。当使用隐式指示时，接收者可以在规定的持续时间内完成 ACK 传输的 MCS 和带宽传送 ACK 帧。接收者使用的 MCS 和带宽可以不被要求与发起方选择的一样。然而，ACK PPDU 持续时间需要符合由发起方在 MAC 报头中设置的持续时间值。

[0102] 针对多个用户 (例如，STA) 的 ACK 或 BA 可经由单个 ACK 或 BA 传输来传送。针对多个用户的 ACK(或 BA) 可在空间域中被聚合，并使用多用户多输入多输出 (MU-MIMO) 来被

传送，或在时域中被聚合并使用聚合多用户 ACK 来被传送。

[0103] 在一个实施方式中，MU-MIMO PPDU 格式可被用于传送延迟多用户 ACK 或块 ACK。图 8 示出了用于 MU-MIMO 块 ACK 的 PPDU 帧结构的示例。PPDU 包括全方位 (omni) 部分 810 和 MU 部分 820。全方位部分 810 针对所有用户被传送，而 MU 部分 820 经由 MU-MIMO 传输的每个空间流来被传送。全方位部分 810 包括 STF、LTS 和 SIG 字段 (SIGA)。MU 部分 820 包括 STF、LTF 和 ACK 主体帧 822。图 8 中示出的 ACK 主体帧 822 是 BA 帧 830。可替换地，ACK 主体帧 822 可以是标准 ACK 帧。多用户块 ACK 可被应用到延迟多用户块 ACK。

[0104] 图 9 示出了用于延迟 MU-MIMO 块 ACK 的示例消息交换序列。STA1 获得信道，并以少量消息交换 910 来与 AP 协商，以用延迟块 ACK 策略与 AP 建立块 ACK 会话。发起方 (在该示例中为 STA1) 传送数据，所述数据后面跟随着块 ACK 请求 (BAR)914。BAR 帧 914 请求来自接收者 (在该示例中为 AP) 的 ACK 帧 916。图 10 示出了 BAR 帧格式。BAR 帧 914 包括 BAR 控制字段 1002。如果 BAR 控制字段 1002 中的 BAR ACK 策略字段被设置为 '1'，则接收者在接收到 BAR 帧 914 时立即返回 ACK。如果 BAR 控制字段 1002 中的 BAR ACK 策略字段被设置为 '0'，则接收者在接收到 BAR 帧 914 时不发送 ACK。在图 9 中示出的示例中，AP 发送响应于 BAR 帧 914 的 ACK 916。在每个 BA 会话期间，非计划中的 STA (除了发起方 (在该示例中为 STA2-STA4) 和接收者 (在该示例中为 AP) 之外的所有 STA) 可在 BA 会话期间设置其 NAV。AP 将为 STA1 保留 BA，并等待延迟的传输。

[0105] 之后，STA2 获得信道并交换消息 920，以与 AP 建立 BA 会话并向 AP 传送数据帧 922 和 BAR 帧 924，以及接收来自 AP 的 ACK 帧 926。之后，STA3 获得信道并交换消息 930，以与 AP 建立 BA 会话，并传送数据帧 932 和 BAR 帧 934 至 AP，以及从 AP 接收 ACK 帧 936。之后，STA4 获得信道并交换消息 940，以与 AP 建立 BA 会话，并传送数据帧 942 和 BAR 帧 944 至 AP，以及从 AP 接收 ACK 帧 946。

[0106] AP 可对若干块 ACK 进行分组 (在该示例中为 BA1-BA4)，并使用 MU-MIMO 传输来传送它们 (即，延迟 MU-MIMO BA)。AP 可根据一些分组准则 (例如，以相似的接入类别 (AC)，或好的空间信道相关性) 来对多个块 ACK 进行分组，以用于 MU-MIMO 块 ACK 传输。

[0107] AP 可用不同的 MU-MIMO 权重来调制 BA，并同时传送它们。在 MU-MIMO BA 帧内，BA 控制字段中的 BA ACK 策略字段指示 ACK 是否是响应于 BA 帧而被请求的。BA ACK 策略字段可针对所有的用户被设置为 '0' 或 '1'。如果 BA ACK 策略字段被设置为 '1'，则 BA 帧 950 将不会请求来自发起方 (在该示例中为 STA1-STA4) 的 ACK 响应。如果 BA ACK 策略字段被设置为 '0'，则 BA 帧 950 请求来自发起方 (在该示例中为 STA1-STA4) 的 ACK 响应，如图 9 所示。

[0108] 来自 STA 的响应于 MU-MIMO BA 950 的 ACK 响应 960 可由 STA 使用 MU-MIMO 来同时传送。可替换地，STA 可按顺序传送 ACK，例如根据在组 ID 中定义的用户位置数组。组 ID 可被包括在 SIG 字段中。

[0109] 在延迟 MU-MIMO ACK 序列中涉及到的所有 AP/STA 可宣布对于延迟块 ACK 和 MU-MIMO 的支持。

[0110] 在另一个实施方式中，不是以 MU-MIMO 向多个用户传送 ACK 或 BA，而是 ACK 或 BA 可在时域中被聚合并按顺序被传送 (即，聚合多用户 ACK(A-MU-ACK))。接收方 (STA 或 AP) 接收数据分组，并响应于接收的数据分组而生成确认分组，以及可以聚合确认分组，并在单

次传输中传送聚合的确认分组。

[0111] 图 11 示出了用于 A-MU-ACK 帧的示例 PPDU 结构。在图 11 中，ACK 在 MPDU 级被聚合。聚合的 ACK 可以是块 ACK 或标准 ACK。用于 A-ML-ACK 1100 的 PPDU 包括前导码 1110，SIG 字段 1120 和数据字段 1130。在数据字段 1130 内，A-MU-ACK 帧 1132 被包括在内。A-MU-ACK 帧 1132 包括用于由 ACK 分隔符 1144 分开的一个或多个用户（在该示例中为 ACK1，ACK2，ACK3）的 ACK（或 BA）MPDU 1142。ACK/BA MPDU 1142 在 MAC 级被聚合，且 A-MU-ACK 帧 1132 作为聚合的 MPDU 分组被传递到物理层，从而物理层可将 A-MU-ACK 帧 1132 作为整个分组进行编码和调制。最低 MCS 可被用于 A-ML-ACK。

[0112] ACK 分隔符 1144 可被插入到每个 ACK/BA MPDU 1142 的开始处。ACK 分隔符 1144 可以是 32 比特或 8 比特长。32 比特 ACK 分隔符可包括长度字段，CRC 和 8 比特签名字段。长度字段可用于指示随后的 ACK/BA MPDU 的长度。签名字段可用于在扫描分隔符时检测 ACK 分隔符。8 比特 ACK 分隔符可包括 8 比特签名字段，其用于在扫描分隔符时检测 ACK 分隔符。

[0113] 聚合的多用户 ACK 分组可以被广播或多播到多于一个的用户（例如，STA）。因为不同的用户由于路径损耗、信道条件、接收方灵敏度等而具有不同的无线电链路质量，所以在相同的聚合多用户 ACK 分组中针对所有用户使用相同的 MCS 可能是简单的，但是不是有效的。此外，如果选择了相对较低的 MCS，所有用户不能正确解码聚合的多用户 ACK 帧。

[0114] 被聚合到多用户 ACK 帧的 ACK 或 BA MPDU 可用单独的 MCS 编码，如图 12 和 13 所示。在图 12 和 13 所示的示例中，被包括在聚合多用户 ACK 帧中的三个 ACK/BA MPDU 可用三个 MCS（可以相同或不相同）来被单独编码。每个 MPDU 的长度和 MCS 可在 SIG 字段中被指示。在图 12 中，聚合的多用户 ACK 帧包括用于三个 ACK MPDU 1210a-1210c 的公共 SIG 字段 1220。在图 13 中，针对每个 ACK/BA MPDU 1310a-1310c，单独的 SIG 字段 1320a-1320c 被包括。

[0115] 多用户聚合可在星座映射之后和反向离散傅里叶变换（IDFT）之前被执行。这样，对于除了最后一个帧之外的所有编码的 ACK 帧，可添加一个填充和尾部比特字段。不需要插入更多的填充比特来进位到整数个 OFDM 符号。对于最后编码的 ACK 帧，如果必要，则插入尾部和填充比特。在这种方案的情况下，SIG 字段中的长度字段可显式地指示以字节为单位的每个 ACK 主体帧的长度。

[0116] 可替换地，多用户聚合可在 IDFT 之后被执行（即，聚合是以 OFDM 符号为单位的）。每个编码的 ACK 帧可占据整数个 OFDM 符号。因此，可为每个编码的 ACK 帧添加尾部比特和 OFDM 符号填充比特。SIG 字段中的长度字段可指示以字节或 OFDM 符号为单位的每个 ACK 主体帧的长度。

[0117] 图 12 示出了具有公共 SIG 字段 1220 的聚合多用户 ACK 的示例。图 13 示出了具有单独 SIG 字段 1320 的聚合多用户 ACK 的示例。在图 12 和 13 中，每个 ACK/BA MPDU 都可以用单独的 MCS 来编码。

[0118] 在图 12 和 13 示出的示例中，所有用户都可以使用公共前导码 1230、1330 来进行信道估计。因此，MIMO 方案的使用会受到限制。例如，如果使用了空时块编码（STBC）方案，则 STBC 可用于分组中的所有用户，并且不同的 MIMO 方案不可用于某些用户。

[0119] 在另一个实施方式中，各种 MIMO 方案可被用于聚合多用户 ACK 帧的传输，例如，使

用图 14 中示出的 PPDU 结构。图 14 示出了为实施用户的各种 MIMO 方案，对于每个用户的具有单独 LTF 的聚合多用户 ACK 的示例。在图 14 中，针对每个用户，包括专用 LTF 1402（在该示例中为 LTF1，LTF2，LTF3），以进行 AGC 调整和信道估计。每个用户的专用 LTF 的长度可依赖于传送的数据流的数量和是否需要 AGC。由于单独的 LTF，不同 MIMO 方案可用于不同用户（在该示例中，用于用户 1 和用户 3 的波束成形，和用于用户 2 的 STBC）。

[0120] 在另一个实施方式中，分级调制可用于针对位于相同 OFDM 符号的不同星座内的不同用户同时传送 ACK。分级调制能将多个数据流（例如，用于不同用户）复用成一个单个的符号流，其中基础层符号和增强层符号在传输之前被同时令人 (overplay)。

[0121] 确认可被搭载在数据分组中（即，搭载 ACK）。由于搭载 ACK，数据帧由于对先前接收的 MAC 协议数据单元 (MPDU) 的确认和 / 或对帧所定向的 STA 的轮询而超载。搭载的 ACK 被用于降低确认的反馈所需要的开销。

[0122] ACK 和搭载 ACK 的数据可被定向至单用户（即，单用户搭载 ACK）。图 15 示出了单用户搭载 ACK 的示例。发起方传送数据分组 1510 至接收者。如果数据不是时间敏感的，则可使用搭载 ACK。发起方可指示（例如，在数据分组中）允许搭载 ACK。如果接收者有被定向至发起方的数据有效负载 1530，则接收者可用数据分组 1530 来搭载 ACK 1520。搭载 ACK 可以是即时的或延迟的。如果接收者没有到发起方的数据有效负载，则接收者可延迟 ACK（即，以后再用数据来搭载 ACK）。

[0123] 单用户搭载 ACK 可在 MSDU 级中被执行。图 16 示出了在 MSDU 级中聚合的单用户搭载 ACK 的示例。ACK（或 BA）MSDU 1610 和数据 MSDU 1620 可被聚合，并且修改的 MAC 报头 1630 可被添加到聚合 ACK 和数据 MSDU 中。MAC 报头 1630 可指示帧的子类型是具有搭载 ACK 或 BA 的数据帧。一旦 MAC 报头中的帧控制字段中的子类型字段指示帧是具有搭载 ACK 或 BA 的数据帧，则 MAC 报头中的序列控制字段可被扩展以覆盖数据 MSDU 和 ACK 的序列号。如果使用了 BA，则 BA 控制字段可被包括在 MAC 报头中。

[0124] 单用户搭载 ACK 可在 MPDU 级中被执行。图 17 示出了 MPDU 级中的搭载 ACK 的示例。ACK MPDU 1710 和数据 MPDU 1720 可被聚合，并传递给物理层。公共 PLCP 报头和前导码可被添加到聚合分组以形成 PPDU 1700。在该方案中，ACK MPDU 1710 和数据 MPDU 1720 可用相同的 MCS 来被编码和调制。ACK 和数据可被包括到具有单独的 MAC 报头的单独的 MPDU 中，并且 MPDU 由 MPDU 分隔符来分离。

[0125] 单用户搭载 ACK 可在 PPDU 级中被执行。图 18 示出了 PPDU 级中的搭载 ACK 的示例。ACK 和数据被包括在单独的 MPDU 中，以及 MPDU 可独立地被调制和编码。单独的 MCS 可用于 MPDU。如图 18 所示，可使用在其中定义用于 ACK 和数据的 MCS 的公共 SIG 字段。可替换地，可包括单独的 SIG 字段。

[0126] 单用户搭载分组可包括多于一个的数据分组和 / 或多于一个的 ACK/BA 分组。

[0127] ACK 和数据可被定向至不同用户（即多用户搭载 ACK）。搭载 ACK 可以是即时的或延迟的。图 19 示出了多用户搭载 ACK 的示例。发起方传送数据分组 1910 至接收者。如果数据不是时间敏感的，则发起方可允许搭载 ACK。在这种情况中，发起方可指示（例如，在数据分组中）允许搭载 ACK。接收者可选择用被定向至第三 STA 的数据分组 1930 来搭载 ACK 1920。

[0128] 多用户搭载 ACK 可在 MPDU 级中被执行。在这种情况中，ACK 和数据 MPDU 被聚合，

并传递到物理层。每个 MPDU 分组的 MAC 报头具有其自己的接收方地址 (RA) 信息。公共 PLCP 报头和前导码被添加到聚合分组以形成 PPDU。在该方案中，可用相同的 MCS 来编码和调制 ACK 和数据 MPDU。与单用户搭载 ACK 类似，MPDU 域中的多用户搭载可使用图 17 中所示的帧格式。

[0129] 多用户搭载 ACK 可在 PPDU 域中被执行。在这种情况中，ACK 和数据位于单独的 MPDU 中，并可以被独立调制和编码。可使用在其中定义用于 ACK 和数据的 MCS 的公共 SIG。可替换地，可使用单独的 SIG。

[0130] 多用户搭载 ACK 分组可包括多于一个的数据分组和 / 或多于一个的 ACK 或 BA 分组。

[0131] 在下文中阐述了用于延迟的多用户 ACK(DMA) 建立的实施方式。DMA 可以是高效的 ACK 机制，该机制能够通过同时对来自多个用户的分组进行确认，来有效降低数据分组的开销。

[0132] STA 可在关联期间或任何其他时间向 AP 指示所述 STA 能够接收延迟的多用户 ACK。为了促进延迟的多用户 ACK，可定义三种新的动作帧：添加延迟的多用户 ACK 请求动作帧 (ADDDMA 请求)，添加延迟的多用户 ACK 响应动作帧 (ADDDMA 响应)，和删除延迟的多用户 ACK 帧 (DELDMA)。

[0133] ADDDMA 帧可用于建立或修改用于特定业务类别 (TC) 或业务流 (TS) 的延迟的多用户 ACK。响应于 ADDDMA 请求帧，发送 ADDDMA 响应帧。DELDMA 帧可由发起方或接收者发送，以终止延迟的多用户 ACK 参与。

[0134] 三种新的动作帧可例如使用常规块 ACK 动作帧来实施。表 2 示出了 ADDDMA 请求、ADDDMA 响应和 DELDMA 帧的示例块 ACK 动作字段值。

[0135] 表 2

[0136]

块 ACK 动作字段值	含义
3	ADDDMA 请求
4	ADDDMA 响应
5	DELDMA
6	DMA 请求
7	DMA
8-255	预留

[0137]

[0138] ADDBA 请求帧可用作 ADDDMA 请求帧的格式。图 20 示出了常规 ADDBA 请求帧动作字段格式。块 ACK 动作字段 2002 可被设置为 '3'，以指示这是 ADDDMA 请求帧。块 ACK 参数集 2004 中的块 ACK 策略比特可被解释为：如果被设置为"0"，则是用于 STA 的常规延迟多用户 ACK，不是用于特定业务类别 (TC) 或业务流 (TS) 的，而如果被设置为"1"，则是用于

由块 ACK 参数集 2004 中的业务标识符 (TID) 字段规定的特定 TC 或 TS 的 STA 的延迟多用户 ACK。块 ACK 超时值字段 2006 或其他字段中的若干比特可用于指示延迟的多用户 ACK 选项：调度的延迟多用户 ACK，未经请求的延迟多用户 ACK，或请求的延迟多用户 ACK。

[0139] ADDBA 响应帧可用作 ADDDMA 响应帧的格式。图 21 示出了常规 ADDBA 响应帧动作字段格式。块 ACK 动作字段 2102 可被设置为‘4’，以指示这是 ADDDMA 响应帧。块 ACK 参数集 2104 中的块 ACK 策略比特可解释为：如果被设置为“0”，则是用于 STA 的常规延迟多用户 ACK，不是用于特定 TC 或 TS，而如果被设置为“1”，则是用于由块 ACK 参数集 2104 中的 TID 字段规定的特定 TC 或 TS 的 STA 的延迟多用户 ACK。块 ACK 超时值字段 2106 或其他字段中的若干比特可用于指示延迟的多用户 ACK 选项：调度的延迟多用户 ACK，未经请求的延迟多用户 ACK，或请求的延迟多用户 ACK。

[0140] DELBA 帧可用作 DELDMA 帧的格式。图 22 示出了常规 DELBA 帧。块 ACK 动作字段 2202 可被设置为‘5’，以指示这是 DELDMA 帧。DELBA 参数集字段 2204 的预留比特的其中之一（比特 0-10）可被解释为：如果被设置为“0”，则删除用于 STA 而不是用于特定 TC 或 TS 的延迟多用户 ACK，而如果被设置为“1”，则删除用于由 DELBA 参数集 2204 中的 TID 字段规定的特定 TC 或 TS 的 STA 的延迟多用户 ACK。

[0141] STA 可通过发送 ADDDMA 请求帧至接收 STA/AP 来指示接收 STA 或 AP 其能够并且愿意使用延迟的多用户 ACK 机制。STA 可通过发送 ADDDMA 请求帧来指示接收 STA/AP 其正在发起针对从它自己发起的仅一个 TS 或 TC 的延迟多用户 ACK，并将块 ACK 策略比特设置为“1”，以及将 TID 字段设置为 TS 或 TC 的 TID。

[0142] 接收 STA/AP 可通过发送 ADDDMA 响应帧来进行响应。接收 STA/AP 在从 STA 和已经与其建立了延迟多用户 ACK 的其他 STA 中接收到分组之后可记录接收到的分组。在调度的延迟多用户 ACK 或未经请求的延迟多用户 ACK 的情况下在预置时间，或者在经请求的延迟多用户 ACK 的情况下应多个 STA 中的一个 STA 的请求，接收 STA/AP 可稍后发送延迟多用户 ACK 帧。

[0143] 发射和接收 STA 或 AP 可通过传送 DELDMA 帧来删除延迟的多用户 ACK 安排 (arrangement)，这可由对方在延迟的多用户 ACK 中立即确认。

[0144] 在 STA 传送其分组之后，该分组可能不能由接收 STA/AP 立即确认，因为接收 STA/AP 可积累来自更多 STA 的分组，然后使用延迟的多用户 ACK 帧来同时确认它们。

[0145] 由于 STA 是电池供电的，期望的是 STA 传送其分组，进入打盹 (doze) 状态，并在预定时间唤醒以从接收者（例如，AP）接收延迟的多用户 ACK 帧。在调度的延迟多用户 ACK 的情况下，已经与接收者建立 DMA 安排的发起方（例如，STA）可在其自身的传输之后立即进入打盹状态，并在其自身的传输之后的延迟多用户 ACK 传输间隔唤醒，以从接收者接收延迟的多用户 ACK 帧。接收者可在信标中、或短信标或其他类型的管理、控制或动作帧中指示延迟的多用户 ACK 传输间隔。

[0146] 如果通过评估延迟的多用户 ACK 帧，发起方发现其分组没有被接收者成功接收，则发起方可立即重新传送没有被肯定确认的分组，或可在后来的时间点上重新传送。

[0147] 在未经请求的延迟多用户 ACK 的情况下，接收者（例如，AP）可决定它已经从已经与接收者建立 DMA 安排的发起方（例如，STA）中接收到足够数量的分组，并可传送延迟的多用户 ACK 帧来确认所有接收到的分组。

[0148] 在请求的延迟多用户 ACK 的情况下，已经与接收者建立 DMA 安排的发起方（例如，发射 STA）可以一些预定的或随机的间隔向接收者传送 DMA 请求帧。然后接收者可在接收到请求延迟多用户 ACK 帧的一个或多个 DMA 请求帧之后，传送延迟多用户 ACK 帧以确认所有接收到的分组。

[0149] 可例如通过使用块 ACK 动作帧或任何其他的管理或控制帧来实施 DMA 请求帧。如果被实施为块 ACK 动作帧，块 ACK 动作字段值可被设置为‘6’，以指示这是 DMA 请求帧。DMA 请求帧可包括用于指示 DMA 请求是用于整个组的还是用于个别的 STA 的 DMA 请求选项字段，和 / 或用于指示 DMA 请求是用于仅常规 ACK 的还是用于块 ACK 的 DMA 选项字段。

[0150] STA 可被自动地预安排成组，或由 AP 预安排成组。例如，AP 可使用组 ID 管理帧或任何其他管理或控制帧来宣布 STA 组成员。用于 STA 组的延迟多用户 ACK 帧的 MAC 报头中的接收方地址可以是 STA 和 AP 互相约定的广播或多播 MAC 地址。

[0151] 可使用块 ACK 动作帧或任何管理或控制帧来实施用于预安排的 STA 组的延迟多用户 ACK 帧。如果被实施为块 ACK 动作帧，块 ACK 动作字段值可被设置为‘7’，以指示这是用于预安排的 STA 组的延迟多用户 ACK 帧。

[0152] 用于预安排的 STA 组的延迟多用户 ACK 帧可包括 ACK 选项字段，以指示 DMA 是用于预安排的 STA 组的，以及指示 ACK 是标准 ACK 还是块 ACK。用于预安排的 STA 组的延迟多用户 ACK 帧还可包括块 ACK 选项字段，以指示用于预安排的组的每个成员的块 ACK 是否是多 TID（多个 TID），用于预安排的组的每个成员的块 ACK 是否是多 TID 以及经确认的每个 STA 的 TID 的数量 K（每个 STA 的 TID 的数量），和 / 或针对预安排的组的每个成员每个 TID 而被确认的帧的数量 N（每个 TID 的经确认的帧的数量）。

[0153] 用于预安排的 STA 组的延迟多用户 ACK 帧可包括指示 ACK 字段数量的字段。用于预安排的 STA 组的延迟多用户 ACK 帧包括 ACK 字段。图 23 示出了用于预安排的 STA 组的延迟多用户 ACK 帧中的 ACK 字段的示例。ACK 字段可按照与预安排的组中的 STA 的顺序相同的顺序来被安排。每个 ACK 字段可包括 K(TID+TID ACK) 个字段。数量 K 由块 ACK 选项字段中的每个 STA 的 TID 的数量来规定。TID ACK 字段可包括开始序列号和 N 个比特的位图，每个比特指示针对关联的 TID 的帧的 ACK。

[0154] 用于 ad-hoc STA 组的延迟多用户 ACK 帧可使用块 ACK 帧或任何管理或控制帧来实施。用于 ad-hoc STA 组的延迟多用户 ACK 帧可包括标识，其是指示这是 DMA 帧的字段。如果被实施为块 ACK 动作帧，块 ACK 动作字段值可被设置为 7。

[0155] 用于 ad-hoc STA 组的延迟多用户 ACK 帧可以包括 DA 字段。DMA 中的 MAC 报头中的目的地址可以是 STA 和 AP 互相约定的多播或广播地址。用于 ad-hoc STA 组的延迟多用户 ACK 帧可包括 ACK 选项字段。ACK 选项字段可指示 DMA 是用于 ad hoc 组的，并且可以指示 ACK 是标准 ACK 还是块 ACK。

[0156] 用于 ad-hoc STA 组的延迟多用户 ACK 帧可包括块 ACK 选项，以指示用于 ad hoc 组的每个成员的块 ACK 是否是多 TID（多个 TID），用于 ad hoc 组的每个成员的块 ACK 是否是多 TID 以及经确认的每个 STA 的 TID 的数量 K（每个 STA 的 TID 的数量），以及针对 ad hoc 组的每个成员每个 TID 而被确认的帧的数量 N（每个 TID 的经确认的帧的数量）。

[0157] 用于 ad-hoc STA 组的延迟多用户 ACK 帧可包括用于指示被包括在当前 DMA 帧中的 ACK 字段的数量的字段（ACK 字段数）。用于 ad-hoc STA 组的延迟多用户 ACK 帧包括 ACK 字

段。图 24 示出了用于 ad hoc STA 组的延迟多用户 ACK 帧中的 ACK 字段的示例。每个 ACK 字段是针对 ad hoc 组的每个成员的。每个 ACK 字段以 ID 字段开始，所述 ID 字段包括 ad hoc 组的成员的 ID。所述 ID 可以是 MAC 地址，关联 ID(AID) 或 STA 和 AP 约定的其他形式的 ID。每个 ACK 字段包括 K(TID+TID ACK) 个字段。数量 K 可由块 ACK 选项字段中的每个 STA 的 TID 的数量规定。TID ACK 字段可包括开始序列号和 N 个比特的位图，每个比特指示针对关联的 TID 的帧的 ACK。

[0158] 短 ACK 帧是缩短版本的 ACK 帧，它没有 MAC 层字段。短 BA 帧是缩短版本的 BA 帧，它没有 MAC 层字段。图 25 示出了常规短 ACK 帧格式。常规短 ACK 帧包括 STF 字段 2502，LTF 字段 2504，和 SIG 字段 2506。短 ACK 帧的 SIG 字段 2506 具有表明帧是短 ACK 帧的指示，以及用于指示短 ACK 的预期的接收方、更多数据字段和用于 NAV 设置的持续时间字段的其他指示和信令（例如 ACK ID）。短 BA 帧具有和短 ACK 帧同样的结构。短 BA 帧包括 STF 字段，LTF 字段，和 SIG 字段。短 BA 帧的 SIG 字段具有表明帧是短 BA 帧的指示，以及短 BA 帧需要的用于指示 BA 的预期的接收方、开始序列控制和块位图的其他指示和信令（例如块 ACK ID）。

[0159] 802.11ah 标准提供了用于早期的 ACK 指示的机制。SIG 字段包括 ACK 指示比特 (2 比特)，以指示期望作为待确认的帧的响应的确认的类型。针对 ACK，ACK 指示比特可被设置为“00”，针对 BA，可被设置为“01”，以及针对无 ACK，可被设置为“10”，并且“11”当前是预留的。

[0160] 如果 STA 跳过解码 PHY 前导码之后的分组以节省功率，或者其不能正确解码剩余分组，则 STA 不能从 MAC 报头获得持续时间值来出于媒介接入目的而更新其 NAV。在这种情况下，STA 可在检测到媒介是空闲的之后，推迟媒介接入于 EIFS 或 EIFS-DIFS+AIFS[AC] 的持续时间。DIFS 是 DCF 帧间间隔，而 AIFS 是仲裁帧间间隔（由 QoS 设备针对给定的接入类别使用的）。EIFS 被定义为 EIFS = SIFS+DIFS+ACK 时间，其中 ACK 时间是以最低物理层支持速率传送 ACK 帧所需的时间。

[0161] 在一个实施方式中，发起方 (STA 或 AP) 可请求或指示出接收者 (AP 或 STA) 发送响应于帧的短 ACK 或短 BA（常规格式或根据上述一个实施方式的在图 2 中示出的格式），而不是常规 ACK 或 BA。当分别使用短 ACK 或短 BA，而不是常规 ACK 或常规 BA 时，MAC 协议可被增强以提供更高效率。图 26 示出了短 ACK 响应的示例。发起方将数据帧 2602 与该数据帧 2602 中的短 ACK 指示一起发送至接收者，而该接收者发送短 ACK 2604 作为响应。短 ACK 指示可被扩展为短 BA 指示。发起方可与短 BA 指示一起发送块 ACK 请求 (BAR) 或具有即时 BAR 的聚合 MPDU(AMPDU)，而接收者发送短 BA 作为响应。

[0162] 发起方可通过使用 SIG 字段中的 ACK 指示比特的“10”值来传达短 ACK 指示或短 BA 指示（下文中统称为“短 ACK 指示”）。ACK 指示值“10”也用于传达“无 ACK”响应。这两种指示可如下结合在 ACK 指示的“10”值中。可为两种情况规定“短 EIFS”，而不是 EIFS。对于这两种情况，没有来自 MAC 报头的用以更新其 NAV 的持续时间值的非计划中的 STA 可在检测到媒介是空闲的之后推迟媒介接入于短 EIFS 的持续时间。短 EIFS 可被定义为短 EIFS = SIFS+DIFS+ 短 ACK 时间，其中短 ACK 时间是传送短 ACK 帧所需要的时间。短 ACK 时间可被定义为其字段的时间长度的相加（例如，STF、LTF 和 SIG 字段的时间长度被加在一起，以用于 1MHz 或 2MHz 以及更高带宽模式，这视情况而定）。可替换地，短 ACK 时间可按照

以最低 PHY 支持速率传送短 ACK 帧内容所需的时间来计算。短 EIFS 还可被定义为短 EIFS = SIFS+DIFS+ 短 BA 时间，其中短 BA 时间是传送短 BA 帧所需的时间。

[0163] 可替换地，帧的发起方可在帧的物理层部分的任何部分中传达短 ACK 指示（例如，在使用 SIG 字段中的一个或多个比特或子字段的前导码中）。

[0164] 可替换地，发起方可在帧的 MAC 部分中传达短 ACK 指示（例如，在 MAC 报头中）。例如，短 ACK 指示可在 MAC 报头的控制字段中被指示，或通过重用 MAC 报头中的任何现有字段或比特来指示。

[0165] 接收到被定址到它的帧（具有表明短 ACK 或短 BA 需要被发送作为响应的指示）的设备 (STA 或 AP) 可分别用短 ACK 帧或短 BA 帧进行响应。短 ACK 帧或短 BA 帧可在接收具有短 ACK 或短 BA 指示的帧的 SIFS 之后被发送。

[0166] STA 和 AP 可例如在关联过程期间使用关联请求和关联响应帧中的现有或新 IE、字段、子字段来指示其使用短 ACK 或短 BA 来确认分组的能力和偏好。

[0167] 可替换地，短 ACK 或短 BA 可以是允许的确认响应（即，可使用短 ACK 或短 BA，而不是标准 ACK 或标准 BA 帧）。

[0168] 当使用标准 ACK 或标准 BA 时，帧的持续时间字段中的值通常由发射方使用系统支持的最低 MCS 来估计。这易于高估持续时间，并因此导致媒介使用无效，因为持续时间字段由系统中的非计划中的 STA 使用来设置 NAV 以进行媒介接入。当要使用短 ACK 或短 BA 时，发射方 (STA 或 AP) 可通过使用传送短 ACK 帧或短 BA 帧所需的时间来更精确地设置 MAC 报头的持续时间字段中的持续时间值。这将导致更精确的持续时间值，并因此导致媒介使用有效，因为持续时间字段由系统中的非计划中的 STA 接收方使用来设置其 NAV 以进行媒介接入。

[0169] 短 ACK 或短 BA 机制可被应用到聚合的传输。AMPDU 是聚合的 MACPDU。常规 ACK 帧或常规 BA 帧可在 AMPDU 中被传送。短 ACK 或短 BA 不能作为 AMPDU 的一部分由 STA 或 AP 传送。短 ACK 或短 BA 可作为聚合的 PPDU 的一部分由 STA 或 AP 传送，其中若干物理层分组被聚合以增加精简帧间间隔 (RIFS) 突发中的媒介使用效率，其中多于一个的分组以分组之间的 RIFS 间隔被连续地传送。RIFS 小于 SIFS。

[0170] 短 CTS 帧是缩短版本的 CTS 帧，其没有 MAC 层字段。短 CTS 帧包括 STF 字段，LTS 字段，和 SIG 字段。短 CTS 帧的 SIG 字段包括表明帧是短 CTS 帧的指示，和用于指示 CTS 帧的预期接收机，带宽，和用于 NAV 设置的持续时间的其他指示和信令（例如 CTS ID）。

[0171] 请求发送 (RTS) 帧的发射方 (STA 或 AP)（即，启动方）可请求或指示短 CTS 帧应该由 RTS 帧的预期接收方 (AP 或 STA)（即，响应方）响应于 RTS 帧来被发送。

[0172] 在一个实施方式中，可通过重用 SIG 字段中的 ACK 指示比特的“10”值来在 RTS 帧内传达这种短 CTS 指示。ACK 指示比特“10”也用于传达“无 ACK”响应。这两种指示或情况可如下被结合到 ACK 指示比特的“10”值中。可为这两种情况规定“短 EIFS”，而不是 EIFS。对于这两种情况，没有来自 MAC 报头的用于更新其 NAV 的持续时间值的非计划中的 STA 可在检测到媒介是空闲的之后推迟媒介接入于短 EIFS 的持续时间。短 EIFS 被定义为短 EIFS = SIFS+DIFS+ 短 CTS 时间。短 CTS 时间可被定义为其字段的时间长度的相加（即，STF、LTF 和 SIG 字段的时间长度被加在一起，以用于 1MHz 和 2MHz 以及更高带宽模式）。可替换地，短 CTS 时间可按照以最低物理层支持速率传送短 CTS 帧内容所需的时间来计算。短 ACK

时间可与短 CTS 时间相同，并且短 ACK 时间可用于代替短 CTS 时间，因为短 ACK 帧和短 CTS 帧具有相同的格式和长度，即使它们携带的某些内容不同。

[0173] 可替换地，帧的 RTS 帧的发射方（即，发起方）可在帧的物理层部分的任意部分中传达短 CTS 指示（例如，在使用 SIG 字段中的一个或多个比特或子字段的前导码中）。

[0174] 可替换地，RTS 帧的发射方（即，发起方）可在帧的 MAC 部分中（例如，在 MAC 报头中）传达短 CTS 指示。例如，短 CTS 指示可以在 MAC 报头的控制字段中被指示，或者通过重用 MAC 报头中的任意现有的字段或比特来指示。

[0175] 接收被定向至它的 RTS 帧（具有表明短 CTS 需要被发送作为响应的指示）的设备 (STA 或 AP) 可用短 CTS 帧进行响应。短 CTS 帧可在接收具有短 CTS 指示的 RTS 帧的 SIFS 之后被发送。

[0176] STA 和 AP 可例如在关联过程期间使用关联请求和关联响应帧中的任意现有的或新的 IE、字段、子字段来指示其使用短 CTS 帧来响应 RTS 帧的能力和偏好。

[0177] 可替换地，短 CTS 可以是允许用于 RTS 帧的响应（即，可使用短 CTS，而不是常规 CTS 帧）。

[0178] 当由设备 (AP 或 STA) 发送 RTS 帧时，所述设备可为在其邻居中的设备设置 NAV。然而，响应 CTS 不能由邻近设备接收。例如，RTS 帧的预期接收方 (STA/AP) 可能不能用 CTS 帧响应，或 CTS 帧的接收可能失败。根据 802.11 标准，基于 RTS 帧的接收来进行其最后 NAV 更新的 STA 可在从 RTS 帧的接收末尾开始的 CTS 超时间隔之后重置其 NAV，如果在 CTS 超时间隔期间没有检测到接收。所述 CTS 超时间隔按照 (2×SIFS)+(CTS 时间)+ 接收方开始延迟 +(2× 时隙时间）来计算，其中 SIFS 和时隙时间是系统参数。CTS 时间是使用 CTS 帧的长度和接收 RTS 帧的数据速率计算的。

[0179] 在一个实施方式中，当传输 RTS 帧的设备 (STA 或 AP) 指示它的响应帧是短 CTS 帧或如果短 CTS 帧是允许用于 RTS 帧的响应，则可使用短 CTS 超时间隔，而不是 CTS 超时间隔。例如，短 CTS 超时间隔可按照 (2×SIFS)+(短 CTS 时间)+ 接收方开始延迟 +(2× 时隙时间）来获得，其中 SIFS 和时隙时间是系统参数。短 CTS 时间可被定义为其字段的时间长度的相加（例如，STF、LTF 和 SIG 字段的时间长度被加在一起）。可替换地，短 CTS 时间可按照以最低物理层支持速率传送短 CTS 帧内容所需的时间来计算。

[0180] 当传送 RTS 帧的设备 (STA 或 AP) 指示其响应帧应该是短 CTS 帧或如果短 CTS 帧是允许用于 RTS 帧的响应，则上述短 CTS 时间可用于估计要在 RTS 帧的持续时间 /ID 字段中设置的时间。

[0181] 802.11ah 标准已经引入了速度帧交换协议，其通过使用更多数据字段和响应帧字段来被使能。更多数据字段是 1 比特字段，其指示是否有更多的数据要发送。更多数据字段允许响应 STA 适当地设置响应帧字段。响应帧字段（或 ACK 指示比特）是 2 比特字段，其指示随后的帧的类型。对于 ACK，响应帧字段可被设置为“00”，对于 BA，可被设置为“01”，对于无 ACK，可被设置为“10”，以及对于不是 ACK、CTS 或 BA 的帧，可被设置为“11”（即，其指示响应帧是数据帧）。

[0182] 图 27 和 28 分别示出了用于下行链路和上行链路数据的速度帧交换的示例过程。在图 27 中，STA 发送 PS 轮询帧 2702 至 AP 以取得数据。AP 用具有被设置为‘1’的更多数据字段和被设置为“11”的响应帧字段的 ACK 2704 进行响应。然后，AP 发送具有被设置为

‘0’的更多数据字段和被设置为“00”的响应帧的数据帧 2706。STA 接收数据帧 2706，并发送具有被设置为‘0’的更多数据字段和被设置为“10”的响应帧字段的 ACK 帧 2708。

[0183] 在图 28 中，STA 发送具有被设置为‘1’的更多数据字段和被设置为“00”的响应帧字段的数据帧 2802 至 AP。然后，AP 发送具有被设置为‘0’的更多数据字段和被设置为“11”的响应帧字段的 ACK 帧 2804。然后 STA 发送具有被设置为‘0’的更多数据字段和被设置为“00”的响应帧字段的另一个数据帧 2806。然后，AP 发送具有被设置为‘0’的更多数据字段和被设置为“10”的响应帧字段的 ACK 帧 2808。

[0184] 在一个实施方式中，短 ACK 帧和短 BA 帧可用在速度帧交换中。短 ACK 可用于响应 PS 轮询帧或数据帧。短 BA 帧可用于响应 AMPDU。短 ACK 帧和短 BA 帧的 SIG 字段可包括响应帧字段（或 ACK 指示字段）和 / 或更多数据字段。响应帧字段（或 ACK 指示字段）可用于结合短 ACK 帧或短 BA 帧的更多数据字段来进行速度帧交换。

[0185] 图 29 示出了针对下行链路数据使用短 ACK 帧（或短 BA 帧）进行速度帧交换的示例。STA 发送 PS 轮询帧 2902 以从 AP 取得数据。AP 用具有被设置为‘1’的更多数据字段和被设置为“11”的响应帧字段的短 ACK 帧 2904 进行响应。AP 发送具有被设置为‘0’的更多数据字段和针对非聚合数据帧被设置为“短 ACK”或针对聚合数据帧被设置为“短 BA”的响应帧字段的数据帧 2906（或 AMPDU）。然后，STA 依赖于接收到的数据类型用具有被设置为‘0’的更多数据字段和被设置为“10”的响应帧字段的短 ACK（或短 BA）2908 进行响应。

[0186] 图 30 示出了针对上行链路数据使用短 ACK（或短 BA）帧进行速度帧交换的示例。STA 发送具有被设置为‘1’的更多数据字段和依赖于数据类型被设置为“短 ACK”或“短 BA”的响应帧字段的数据帧 3002（或 AMPDU）。然后，AP 发送具有被设置为‘0’的更多数据字段和被设置为“11”的响应帧字段的短 ACK 帧 3004（或短 BA）。然后，STA 发送具有被设置为‘0’的更多数据字段和被设置为“短 ACK”或“短 BA”的响应帧字段的另一个数据帧 3006（或 AMPDU）。然后，AP 发送具有被设置为‘0’的更多数据字段和被设置为“10”的响应帧字段的短 ACK 帧 3008（或短 BA）。

[0187] 作为示例，响应帧字段（或 ACK 指示字段）值可被设置为“00”以指示短 ACK，以及被设置为“01”以指示短 BA，或可替换地，被设置为“10”以指示短 ACK 和短 BA。

[0188] 在另一个实施方式中，短 PS 轮询帧可用于速度帧交换中。短 PS 轮询帧的 SIG 字段可包括响应帧字段（或 ACK 指示字段）或更多数据字段中的一者或两者。来自 STA 的短 PS 轮询指示响应是短 ACK 帧，并且还指示有更多数据要被传送。

[0189] 图 31 示出了使用短 PS 轮询帧和短 ACK（或短 BA）帧进行速度帧交换的示例。STA 发送具有被设置为‘1’的更多数据字段和被设置为“短 ACK”的响应帧字段的短 PS 轮询帧 3102，以从 AP 取得数据。AP 用具有被设置为‘0’的更多数据字段和被设置为“11”的响应帧字段的短 ACK 帧 3104 进行响应。STA 发送具有被设置为‘0’的更多数据字段、和针对非聚合数据帧被设置为“短 ACK”或针对聚合数据帧被设置为“短 BA”的响应帧字段的数据帧 3106（或 AMPDU）。然后，AP 依赖于接收到的数据类型用具有被设置为‘0’的更多数据字段和被设置为“10”的响应帧字段的短 ACK 3108（或短 BA）进行响应。

[0190] 可基于 STA 是否具有上行链路数据来设置更多数据字段。如果短 PS 轮询帧是在未调度唤醒事件中由 STA 发送的，那么响应帧字段可被设置为指示短 ACK，因为 AP 将最可能发送确认，而不是数据。

[0191] 在常规的 MAC 帧中，MAC 报头中的持续时间字段被用于为帧的非计划中的接收方设置 NAV。然而短帧（例如，短 ACK，短 BA，短 CTS）可能没有持续时间字段，也可能不携带持续时间信息。

[0192] 在 STA 从睡眠状态中唤醒，并监控媒介以接收帧序列来设置其 NAV 的情况下，该 STA 可持续执行空闲信道评估 (CCA)，直到检测到具有持续时间字段的常规帧（不是短帧），检测到具有持续时间信息的短帧，或等于被规定为系统参数的探测延迟的时间周期的流逝。如果接收到短帧，以及如果它在 SIG 字段中包含持续时间字段或信息，STA 可使用它来设置其 NAV。如果接收到短帧，并且如果它不包含持续时间字段或信息，则 STA 可为 NAV 设置目的而忽略该帧。

[0193] 在非计划中的 STA 接收到短帧并且该短帧不包括持续时间字段或信息的情况下，该非计划中的 STA 可以不更新其 NAV，而保持其现有的 NAV 设置。现有的 NAV 设置可能已经由帧交换序列（例如，在短波束成形报告 (BR) 轮询的情况下的探测帧序列，在短 BA 的情况下的数据和 ACK 帧序列）的较早帧中的持续时间设置触发了。

[0194] 如果短帧具有持续时间字段或信息，如果新的 NAV 值比当前 / 现有的 NAV 值大，则非计划中的 STA 可基于持续时间字段或信息更新其 NAV。

[0195] 在非计划中的 STA 接收到短 PS 轮询帧的情况下，如果新的 NAV 值比当前的 NAV 值大，则非计划中的 STA 可使用传送响应帧（例如，数据，ACK，短 ACK）所需的持续时间加一个 SIFS 间隔来更新其 NAV 设置。可替换地，如果短 PS 轮询帧中没有指示响应帧，则非计划中的 STA 可使用默认响应帧或系统中规定的响应帧持续时间来更新其 NAV 设置。可替换地，如果新的 NAV 值大于当前的 NAV 值，非计划中的 STA 可使用传送在短 PS 轮询帧中指示的响应帧（例如，数据，ACK，短 ACK）所需的持续时间加一个 SIFS 间隔来更新其 NAV 设置。非计划中的 STA 可在持续时间计算中将任何需要的开销帧或额外的响应帧（例如，ACK 帧）包括到短 PS 轮询帧和关联 SIFS 间隔中指示的响应帧。

[0196] 在一个实施方式中，短帧（例如，短 BA，短 BR 轮询和短探测请求）可将持续时间字段或信息包括在 SIG 字段中，以用于 NAV 设置。SIG 字段的大小可例如通过使用较高的 MCS 来增加。

[0197] 当 STA 使用发起或触发帧（例如，PS 轮询帧或数据帧）来发起与 AP 的通信时，STA 可通过设置其帧的持续时间字段以及从而设置非计划中的接收方 /STA 的 NAV 来建立其传输时机 (TXOP) 持续时间。在存在由 AP 传送的下行链路数据以及 STA 是 TXOP 持有者或 TXOP 发起者时的速度帧交换中，STA 可最初估计用于整个 TXOP（多个帧的整个序列）的持续时间，并使用该持续时间来设置其传送的用于设置 NAV 的帧中的持续时间字段。例如，估计可基于以下中的一者或多者：要传送的任意数据，要接收的期望数据，要使用的期望 MCS 和帧间间隔（例如，SIFS）。STA 可使用 CF 结束帧来截断任何剩余未使用的 TXOP 持续时间。

[0198] 可替换地，STA 可估计用于其发起或触发帧、任何需要的响应帧、并销帧和帧间间隔（例如，SIFS）的持续时间，并基于所述估计设置其发起 / 触发帧中的持续时间字段。然后，每当 AP 指示有更多数据（更多数据字段 = 1）时，STA 可扩展 TXOP 持续时间。STA 可以不扩展超过针对给定 QoS 传输的规定 TXOP 持续时间限制（例如，根据 EDCA 规则规定的）的 TXOP 持续时间。

[0199] STA 可在没有数据要发送或接收时使用 CF 结束帧来截断用于速度帧交换的媒介

预留或 TXOP 持续时间。

[0200] AP 基于其从 STA 中接收到的帧中的持续时间值来设置其传送的帧中的持续时间值。

[0201] 在非计划中的 STA 接收到 PS 轮询帧的情况下，如果新的 NAV 值大于当前的 NAV 值，则非计划中的 STA 可使用传送响应帧（例如，数据，ACK，短 ACK）所需的持续时间加一个 SIFS 间隔来更新其 NAV。可替换地，如果在 PS 轮询帧中没有指示响应帧，非计划中的 STA 可使用默认响应帧或系统中规定的响应帧持续时间来设置其 NAV 设置。可替换地，如果新的 NAV 值大于当前的 NAV 值，则非计划中的 STA 可使用传送在 PS 轮询帧中指示的响应帧（例如，数据，ACK，短 ACK）所需的持续时间加一个 SIFS 间隔来设置其 NAV 设置。非计划中的 STA 可在持续时间计算中将任何需要的开销帧或额外的响应帧（例如，ACK 帧）包括到 PS 轮询帧和关联的 SIFS 间隔中指示的响应帧。

[0202] 当站需要从另一个站获得信息时，该站发送探测请求帧。代替常规的探测请求帧，可使用短探测请求帧。所述短探测请求帧包括 STF 字段，LTF 字段和 SIG 字段。短探测请求帧的 SIG 字段包括在需要的其他指示和信令（例如，接入网选项，部分 SSID）之中表明帧是短探测请求帧的指示，以及表明探测响应或短信标是否是期望的作为对短探测请求帧的响应的指示。

[0203] 当 STA 接收到具有不同于 STA 的存储的变化序列的变化序列的短信标时，该 STA 需要更新其系统信息。所述系统信息更新可使用探测请求帧来完成，所述探测请求帧携带变化序列，以触发 AP 发送最优探测响应帧，所述探测响应帧包括需要由 STA 更新的系统信息元素和变化序列。

[0204] 由于尺寸较小，使用 NDP 探测请求帧比使用将占用更多媒介时间的常规探测请求帧更有效，尤其当有大量 STA 希望更新系统信息时。通过使用 NDP 探测请求帧也会降低 STA 处的功耗。当不频繁传送全信标或在 BSS 中使用短信标时，这尤其有用。

[0205] 在一个实施方式中，NDP 探测请求帧可包括存储在 STA 中的变化序列。这可以例如通过使用小尺寸变化序列（例如，4 比特序列，而不是 8 比特序列）来完成，所述小尺寸变化序列可在 SIG 字段中可用的受限比特内被容纳。

[0206] NDP 探测请求帧可指示 STA 需要什么系统信息元素（例如，表示系统信息元素子集的位图）。NDP 探测请求帧可指示最后接收到的短信标中的变化序列不同于 STA 中存储的变化序列。

[0207] NDP 探测请求帧可指示 STA 需要哪个预定义的系统信息元素集合。预定义的系统信息元素的集合可被索引，并且表示系统信息集合的索引可在 NDP 探测请求帧中被用信号发送。例如，系统信息元素的预定义集合可以是包含强制信息的系统信息元素或字段的集合，所述强制信息例如时间戳、信标间隔和能力；包含其他信息的系统信息元素或字段的集合，所述其他信息例如 EDCA 参数、静态元素、BBS 负载、信道切换宣告、HT 操作元素、VHT 操作元素；或包含强制信息和其他信息的任何组合的系统信息元素或字段的集合。例如，上述信令可使用 NDP 探测请求帧的 SIG 字段中的预留比特中的一个或多个比特来实现。

[0208] 当 STA 发送包括存储在 STA 中的变化序列的 NDP 探测请求帧时，AP 可发送包括需要由 STA 和变化序列更新的系统信息元素的最优探测响应帧。AP 能够通过存储先前的变化序列和相应变化的系统信息元素的 ID 来实现这一点。AP 通过比较从 STA 中接收的变化序

列与其存储的先前的变化序列，来发现要发送的更新信息。

[0209] 当 STA 发送指示需要什么系统信息元素的 NDP 探测请求帧时，AP 可发送包括需要由 STA 和变化序列更新的系统信息元素的最优探测响应帧。

[0210] 当 STA 发送指示需要哪个预定义的系统信息元素集合的 NDP 探测请求帧时，AP 可发送包括指示的预定义的系统信息元素和变化序列集合的最优探测响应帧。

[0211] 当 STA 发送指示最后接收的短信标中的变化序列不同于 STA 中存储的变化序列的 NDP 探测请求帧时，AP 可发送包括需要由 STA 和变化序列更新的预定义的或基础的系统信息元素集合的最优探测响应帧。

[0212] 在上述任何实施方式中，对于 NDP 探测请求帧的响应可以是短探测响应帧，其包括在 NDP 探测请求帧中请求或指示的信息。

[0213] NDP PS 轮询帧可被用于主动 (active) 轮询。NDP PS 轮询帧包括 STF 字段、LTF 字段和 SIG 字段。短 PS 轮询帧的 SIG 字段具有表明帧是短 PS 轮询帧的指示，和短 PS 轮询帧需要的其他指示或信令，例如发射 STA 的 AID 或部分 AID，STA 在其中关联的 BSS 的 BSSID 或部分 BSSID，和用于从 AP 中接收数据的 STA 的优选 MCS。

[0214] NDP PS 轮询帧可包括用于请求 BSS 变化序列和 / 或当前时间戳的信令。所述信令可被包括在 NDP PS 轮询帧的 SIG 字段中。SIG 字段的一个或多个比特可用于指示来自 AP 的变化序列请求和 / 或当前时间戳请求。SIG 字段的一个或多个比特可用于指示是否包括下述字段中的一者或多者 :优选的 MCS，变化序列请求和当前时间戳请求。

[0215] 当 STA 发送包含对 BSS 变化序列的请求的 NDP PS 轮询帧时，AP 可在响应帧中立即发送 BSS 变化序列，或在响应帧中指示 STA 它应该校验信标。当 STA 发送包含对当前时间戳的请求的 NDP PS 轮询帧时，AP 可在响应帧中立即发送当前时间戳，或在响应帧中指示 STA 它应该校验信标。

[0216] 响应于 PS 轮询帧而被传送的来自 AP 的任何帧（例如 ACK 或数据）可携带来自 AP 的请求信息。可替换地，来自 AP 的新响应帧可针对 PS 轮询帧而被定义，以携带来自 AP 的请求信息。该帧可以属于任何类型，例如管理、控制或数据。

[0217] 虽然这里参考 IEEE 802.11 协议描述了实施方式，但是应该理解的是，这些实施方式适用于任何无线通信系统。虽然 SIFS 在各种实施方式中被用作帧间间隔，但是所有其他帧间间隔（例如 RIFS 或其他达成一致的时间间隔）也可以被使用。

[0218] 实施例

[0219] 1. 一种在站中使用的用于在无线通信中传送响应于数据分组的确认的方法。

[0220] 2. 根据实施例 1 所述的方法，该方法包括从多个站中接收数据分组。

[0221] 3. 根据实施例 2 所述的方法，该方法包括生成对数据分组的确认。

[0222] 4. 根据实施例 3 所述的方法，该方法包括获得传输时机。

[0223] 5. 根据实施例 4 所述的方法，该方法包括在单次传输中向多个站传送对数据分组的确认。

[0224] 6. 根据实施例 5 所述的方法，其中所述确认是使用 MU-MIMO 传送的。

[0225] 7. 根据实施例 5-6 中任意一者所述的方法，其中所述确认是在从接收到数据分组起的预定时间之后被传送的。

[0226] 8. 根据实施例 5-7 中任意一者所述的方法，其中所述确认是基于约定的调度、或

基于所述站中的一者的请求、或者在接收到预定数量的数据分组的情况下而被传送的。

[0227] 9. 根据实施例 4 所述的方法，其中生成对数据分组的确认包括生成对数据分组的确认分组，以及聚合确认分组。

[0228] 10. 根据实施例 9 所述的方法，其中传送确认包括在单次传输中传送聚合的确认分组。

[0229] 11. 根据实施例 10 所述的方法，其中确认分组是在 MAC 服务数据单元中、在 MAC 协议数据单元中，或在 PPDU 中被聚合的。

[0230] 12. 一种在站中使用的用于在无线通信中传送确认的方法。

[0231] 13. 根据实施例 12 所述的方法，该方法包括接收指示序列 ID 的帧。

[0232] 14. 根据实施例 13 所述的方法，该方法包括响应于接收到的帧而传送短 ACK 帧，其中所述短 ACK 帧包括对应于序列 ID 的 ACK 序列。

[0233] 15. 根据实施例 14 所述的方法，其中短 ACK 帧包括 STF 和 ACK 序列。

[0234] 16. 根据实施例 14-15 中任意一者所述的方法，其中短 ACK 帧是随短 ACK 指示传送的。

[0235] 17. 根据实施例 14-16 中任意一者所述的方法，其中短 ACK 帧是响应于被包括在帧中的指示而被传送的。

[0236] 18. 一种用于在无线通信中传送响应于数据分组的确认的 WTRU。

[0237] 19. 根据实施例 18 所述的 WTRU，该 WTRU 包括处理器，该处理器被配置成从多个站中接收数据分组。

[0238] 20. 根据实施例 19 所述的 WTRU，其中所述处理器被配置成生成对数据分组的确认。

[0239] 21. 根据实施例 19 所述的 WTRU，其中所述处理器被配置成在单次传输中向站传送对数据分组的确认。

[0240] 22. 根据实施例 21 所述的 WTRU，其中所述处理器被配置成使用 MU-MIMO 传送确认。

[0241] 23. 根据实施例 21-22 中任意一者所述的 WTRU，其中所述处理器被配置成在从接收到数据分组起的预定时间之后传送确认。

[0242] 24. 根据实施例 21-23 中任意一者所述的 WTRU，其中所述处理器被配置成基于约定的调度、或基于多个站中的一个站的请求、或在接收到预定数量的数据分组的情况下，传送确认。

[0243] 25. 根据实施例 21 所述的 WTRU，其中所述处理器被配置成生成对数据分组的确认分组，并聚合所述确认分组，其中所聚合的确认分组是在单次传输中被传送的。

[0244] 26. 根据实施例 25 所述的 WTRU，其中所述处理器被配置成在 MAC 服务数据单元中、在 MAC 协议数据单元中或在 PPDU 中聚合确认分组。

[0245] 27. 一种用于在无线通信中传送确认的 WTRU。

[0246] 28. 根据实施例 27 所述的 WTRU，该 WTRU 包括处理器，该处理器被配置成接收帧。

[0247] 29. 根据实施例 28 所述的 WTRU，其中所述处理器被配置成响应于接收到的帧而传送短 ACK 帧。

[0248] 30. 根据实施例 29 所述的 WTRU，其中接收到的帧包括序列 ID，以及短 ACK 帧包括

对应于序列 ID 的 ACK 序列。

[0249] 31. 根据实施例 29-30 中任意一者所述的 WTRU，其中短 ACK 帧包括 STF 和 ACK 序列。

[0250] 32. 根据实施例 29-31 中任意一者所述的 WTRU，其中短 ACK 帧是随短 ACK 指示被传送的。

[0251] 33. 根据实施例 29-32 中任意一者所述的 WTRU，其中短 ACK 帧是响应于被包括在帧中的指示被传送的。

[0252] 虽然上面以特定的组合描述了特征和元素，但是本领域的普通技术人员可以理解，每个特征或元素可以单独的使用或与其他的特征和元素进行组合使用。此外，这里描述的方法可以在引入到计算机可读介质中并供计算机或处理器运行的计算机程序、软件或固件中实施。计算机可读介质的示例包括电信号（通过有线或无线连接传送）和计算机可读存储介质。计算机可读存储介质的示例包括但不限制为：只读存储器 (ROM)、随机存取存储器 (RAM)、寄存器、缓冲存储器、半导体存储器设备、例如内部硬盘和可移动磁盘之类的磁性介质，磁光介质和例如 CD-ROM 盘和数字通用盘 (DVD) 之类的光介质。与软件关联的处理器可被用于实施在 WTRU、UE、终端、基站、RNC 或任何主计算机中使用的射频收发信机。

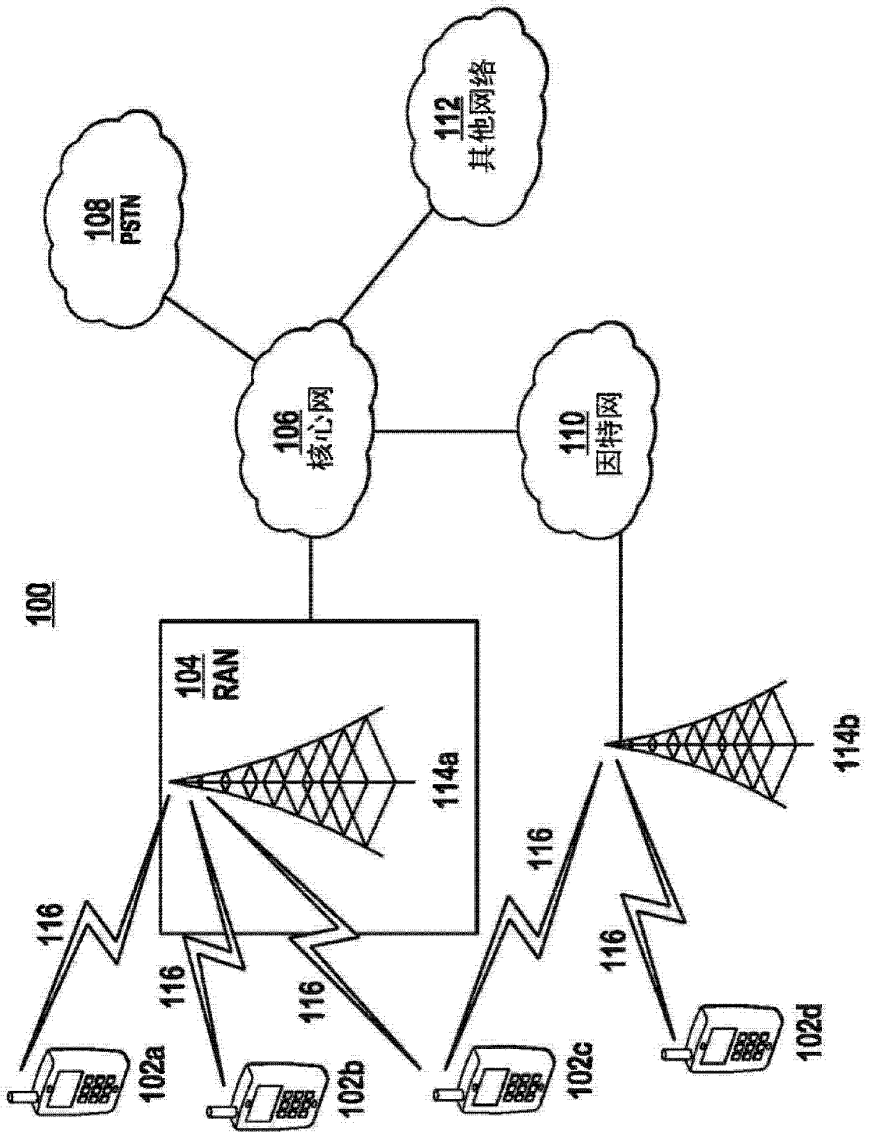

112
其他网络
108
PSTN
106
核心网
110
因特网
100
104
RAN
114a
114b
116
116
116
116
116
102a
102b
102c
102d

图 1A

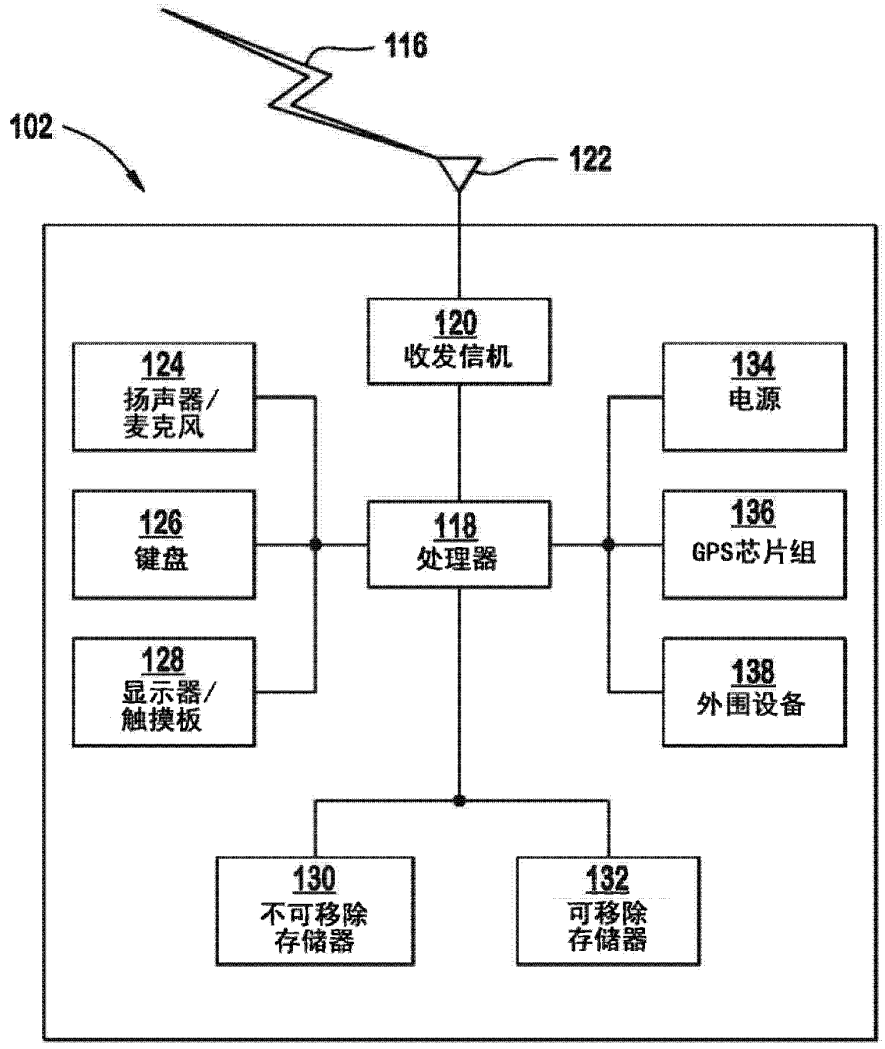

116
102
122
120
收发信机
124
扬声器/
麦克风
134
电源
126
键盘
118
处理器
136
GPS芯片组
128
显示器/
触摸板
138
外围设备
130
不可移除
存储器
132
可移除
存储器

图 1B

30

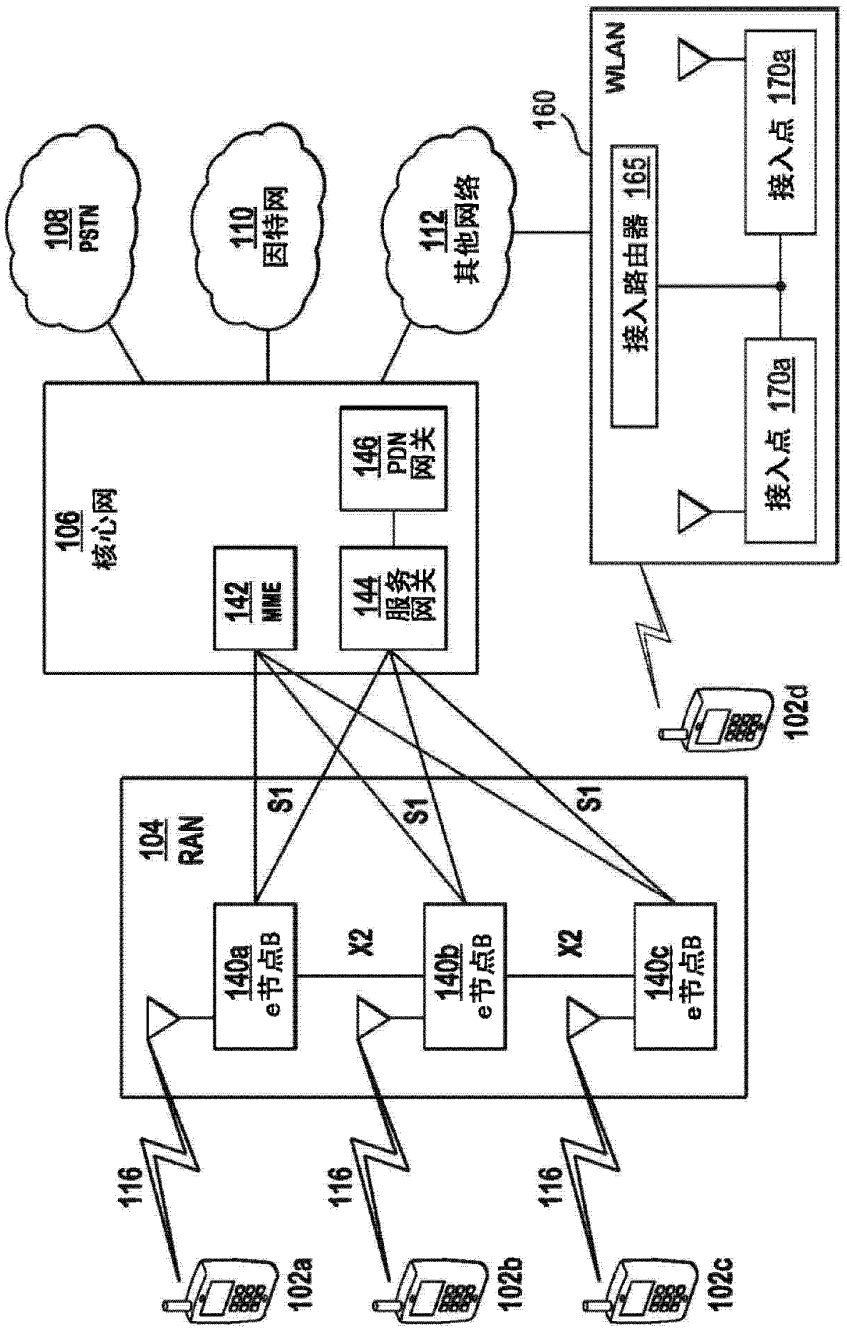

108
PSTN
110
因特网
112
其他网络
160
WLAN
接入路由器 165
接入点 170a
接入点 170a
106
核心网
146
PDN
网关
142
MME
144
服务
网关
102d
104
RAN
S1
S1
S1
140a
e节点B
X2
140b
e节点B
X2
140c
e节点B
116
116
116
102a
102b
102c

图 1C

31

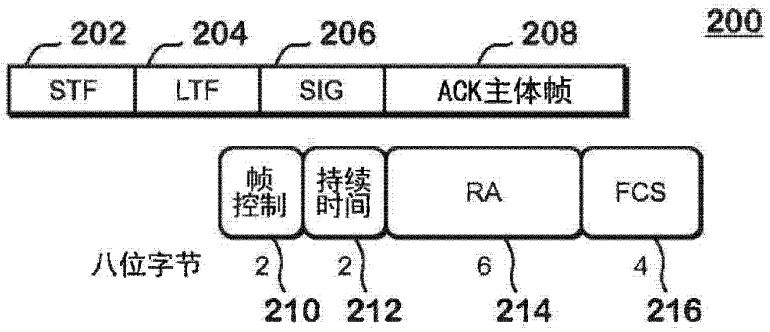

200
202
204
206
208
STF
LTF
SIG
ACK主体帧
帧控制
持续时间
RA
FCS
八位字节
2
2
6
4
210
212
214
216

图 2

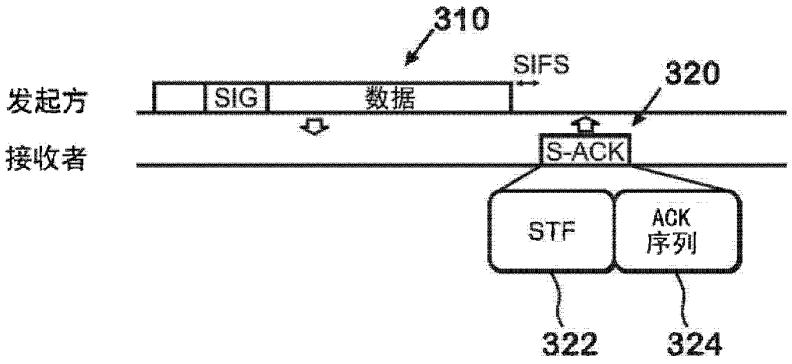

310
SIFS
320
发起方
SIG
数据
接收者
S-ACK
STF
ACK序列
322
324

图 3

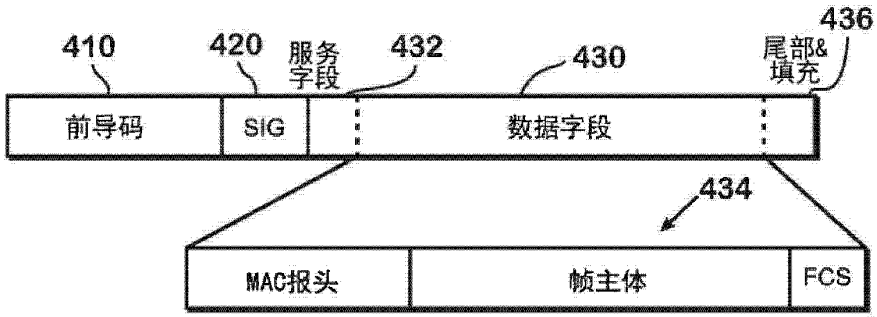

436
410
420
服务字段
432
430
尾部&填充
前导码
SIG
数据字段
434
MAC报头
帧主体
FCS

图 4

32

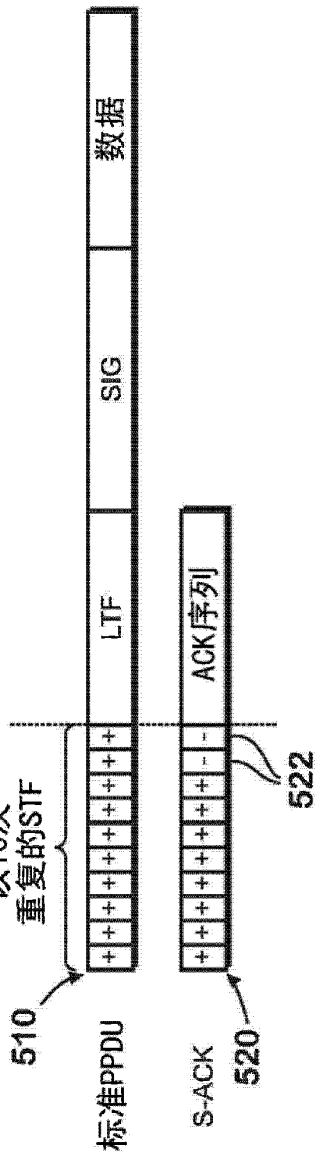

以10次
重复的STF
LTF
SIG
数据
510
标准PPDU
ACK序列
522
S-ACK
520

图 5

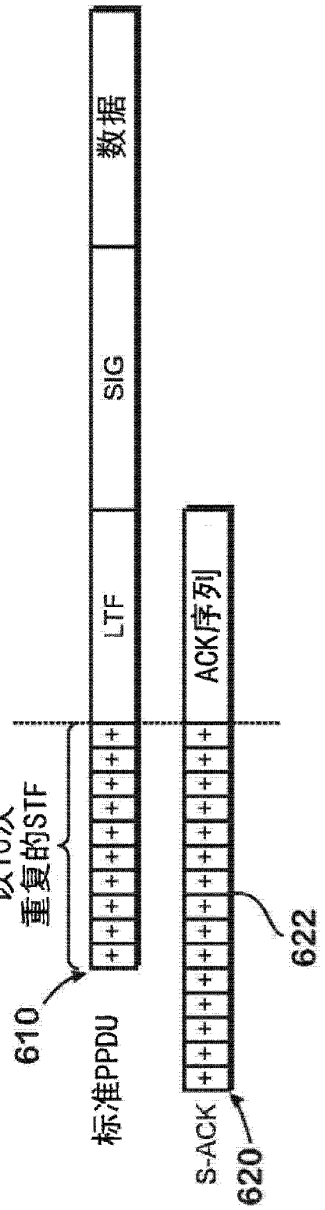

以10次
重复的STF
LTF
SIG
数据
610
标准PPDU
ACK序列
622
S-ACK
620

图 6

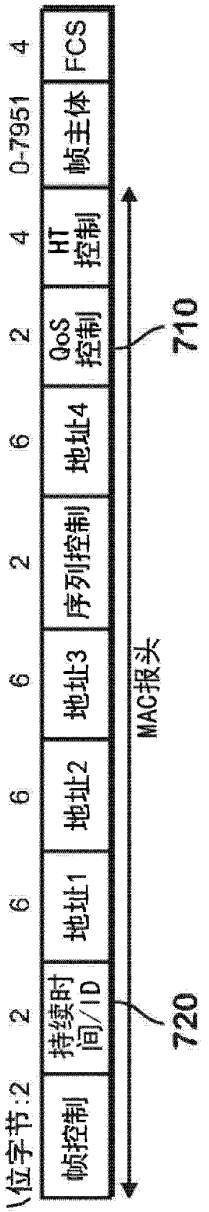

八位字节:2 2 6 6 6 2 6 2 4 0-7951 4
帧控制
持续时间/ID
地址1
地址2
地址3
序列控制
地址4
QoS控制
HT控制
帧主体
FCS
MAC报头
720
710

图 7

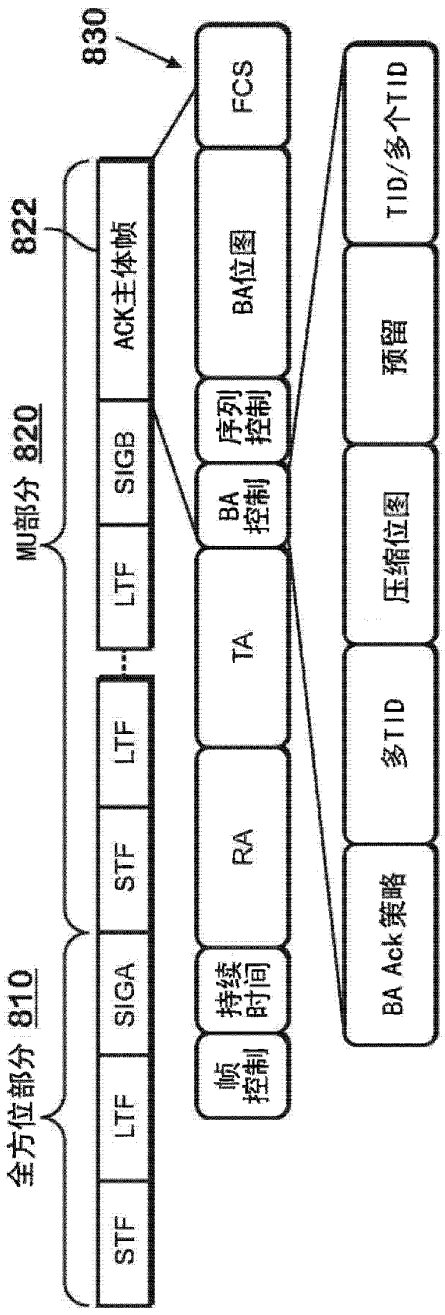

全方位部分 810
MU部分 820
822
830
STF
LTF
SIGA
STF
LTF
LTF
SIGB
ACK主体帧
帧控制
持续时间
RA
TA
BA控制
序列控制
BA位图
FCS
BA Ack策略
多TID
压缩位图
预留
TID/多个TID

图 8

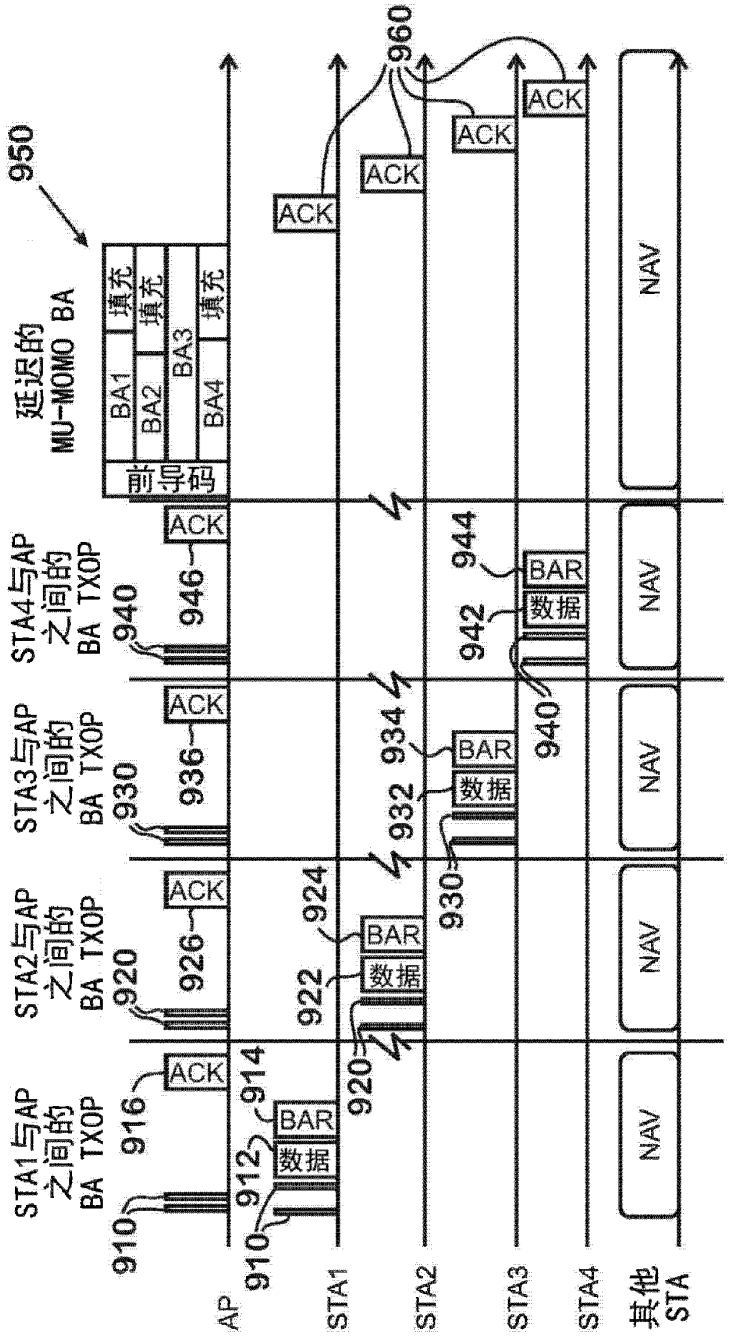

950
延迟的
MU-MOMO BA
前导码
BA1
填充
BA2
填充
BA3
BA4
填充
960
ACK
ACK
ACK
ACK
STA4与AP
之间的
BA TXOP
940
946
944
BAR
数据
942
940
STA3与AP
之间的
BA TXOP
930
936
934
BAR
数据
932
930
STA2与AP
之间的
BA TXOP
920
926
924
BAR
数据
922
920
STA1与AP
之间的
BA TXOP
910
916
914
BAR
数据
912
910
NAV
AP
STA1
STA2
STA3
STA4
其他
STA

图 9

35

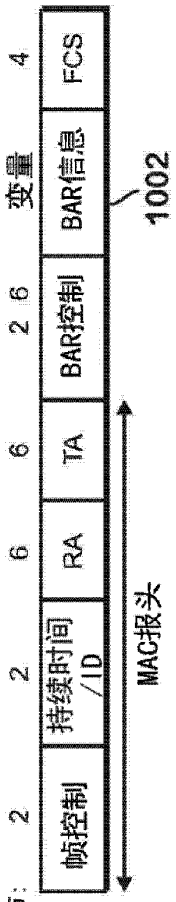

八位字节：
2
2
6
6
6
2 6
变量
4
帧控制
持续时间/ID
RA
TA
BAR控制
BAR信息
FCS
MAC报头
1002

图 10

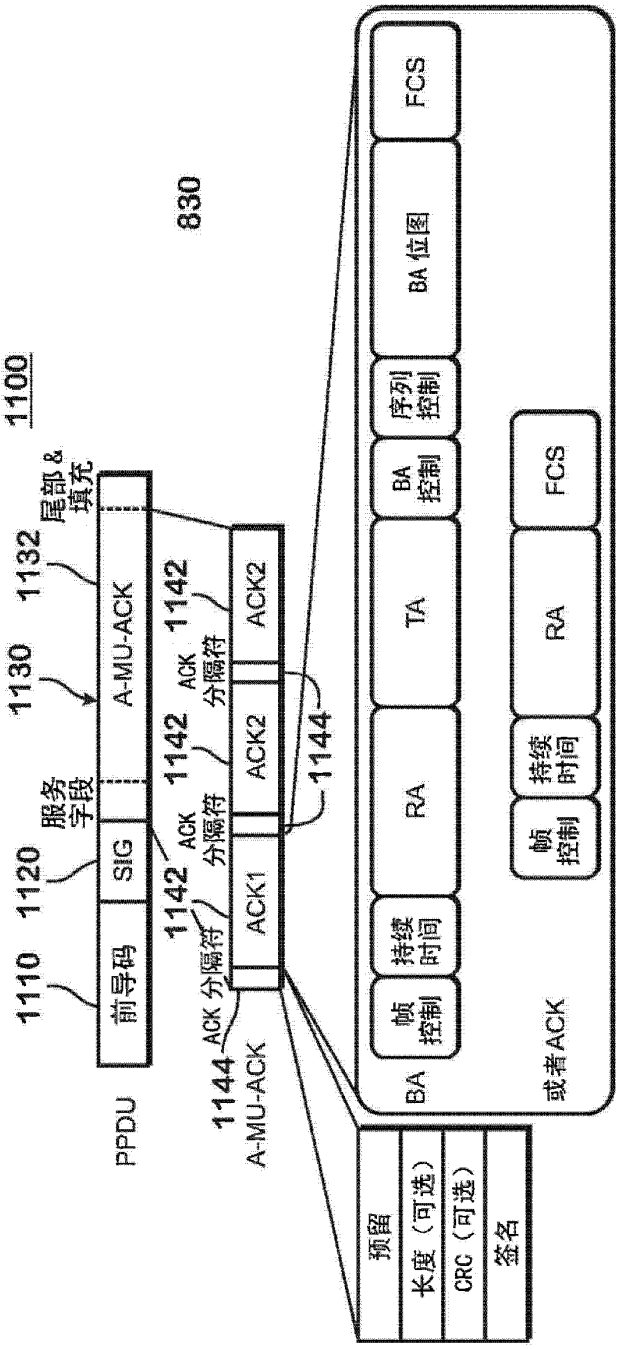

1100
1110
1120
1130
1132
1142
1144
830
PPDU
前导码
SIG
服务字段
A-MU-ACK
尾部&填充
ACK分隔符
ACK1
ACK2
A-MU-ACK
BA
或者ACK
帧控制
持续时间
RA
TA
BA控制
序列控制
BA位图
FCS
持续时间
预留
长度（可选）
CRC（可选）
签名

图 11

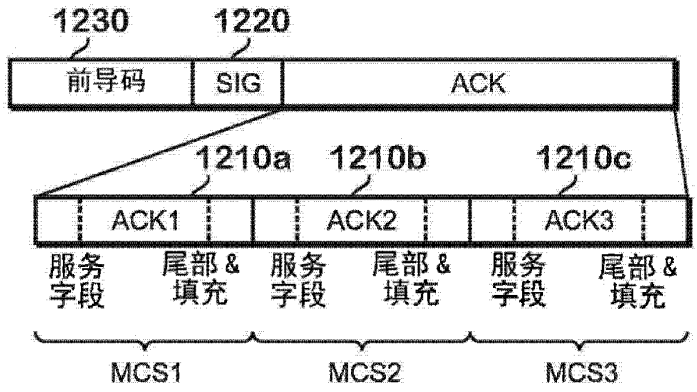

1230
1220
前导码
SIG
ACK
1210a
1210b
1210c
ACK1
ACK2
ACK3
服务字段
尾部 & 填充
服务字段
尾部 & 填充
服务字段
尾部 & 填充
MCS1
MCS2
MCS3

图 12

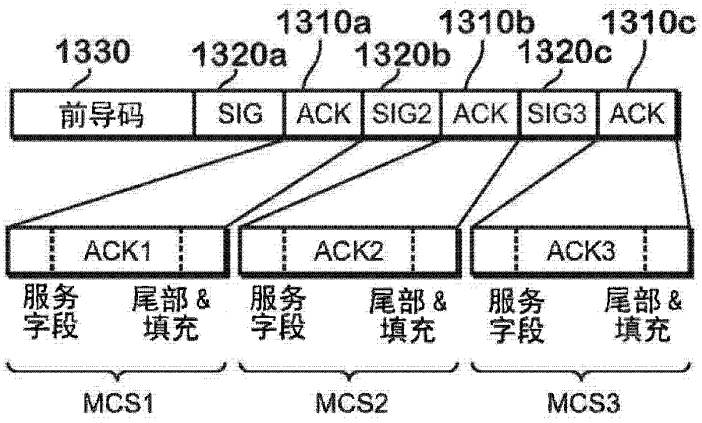

1330
1320a
1310a
1320b
1310b
1320c
1310c
前导码
SIG
ACK
SIG2
ACK
SIG3
ACK
ACK1
ACK2
ACK3
服务字段
尾部 & 填充
服务字段
尾部 & 填充
服务字段
尾部 & 填充
MCS1
MCS2
MCS3

图 13

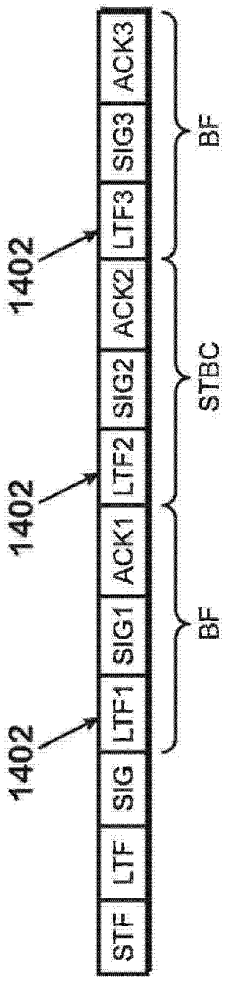

STF
LTF
SIG
LTF1
SIG1
ACK1
LTF2
SIG2
ACK2
LTF3
SIG3
ACK3
1402
1402
1402
BF
STBC
BF

图 14

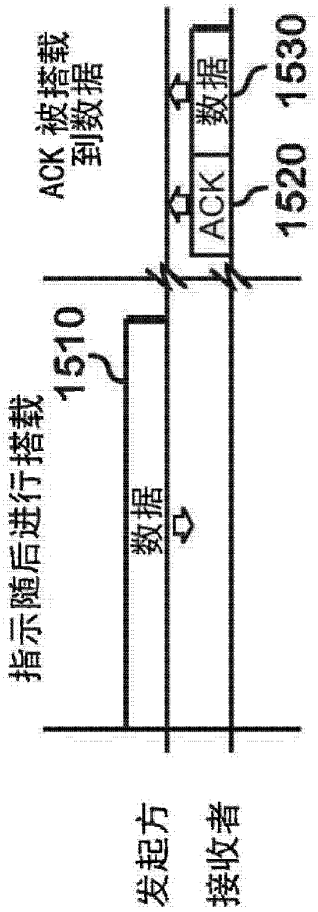

指示随后进行搭载
1510
数据
ACK 被搭载
到数据
ACK
数据
1520
1530
发起方
接收者

图 15

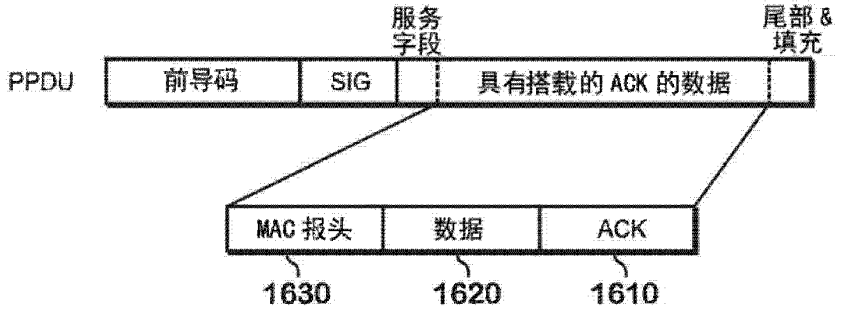

服务
字段
尾部 &
填充
PPDU
前导码
SIG
具有搭载的 ACK 的数据
MAC 报头
数据
ACK
1630
1620
1610

图 16

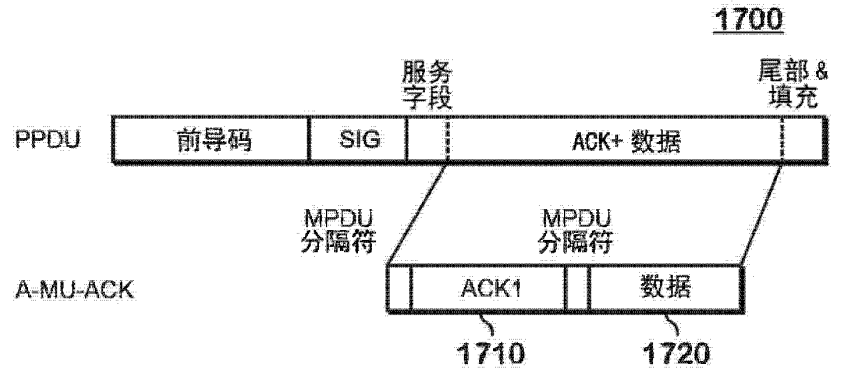

1700
服务
字段
尾部 &
填充
PPDU
前导码
SIG
ACK+ 数据
MPDU
分隔符
MPDU
分隔符
A-MU-ACK
ACK1
数据
1710
1720

图 17

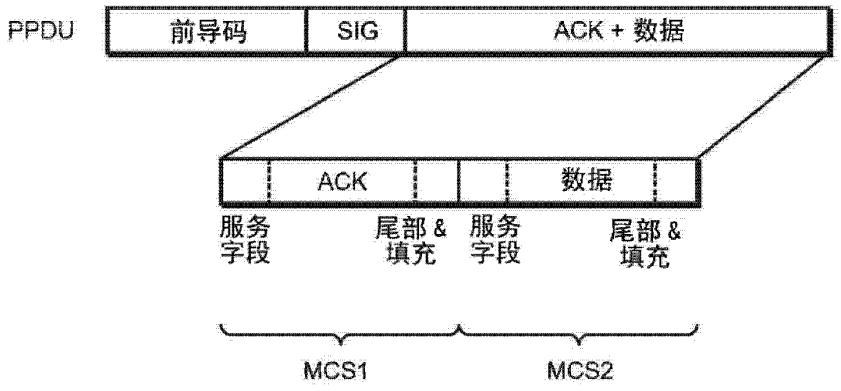

PPDU
前导码
SIG
ACK + 数据
ACK
数据
服务
字段
尾部 &
填充
服务
字段
尾部 &
填充
MCS1
MCS2

图 18

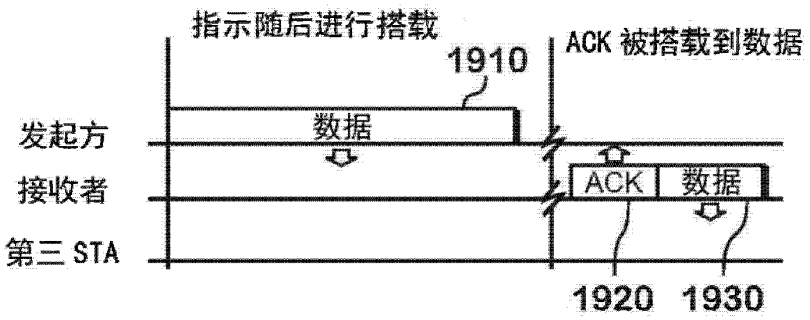


图 19

顺序	信息	
1	类别	
2	块 Ack 动作	2002
3	对话令牌	
4	块 Ack 参数集	2004
5	块 Ack 超时值	2006
6	块 Ack 开始序列控制	

图 20

顺序	信息	
1	类别	
2	块 Ack 动作	2102
3	对话令牌	
4	状态码	
5	块 Ack 参数集	2104
6	块 Ack 超时值	2106

图 21

40

顺序	信息
1	类别
2	块 Ack 动作
3	DELBA 参数集
4	原因码

2202

2204

图 22

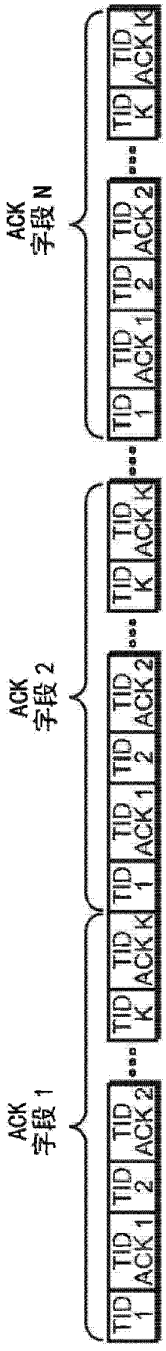

ACK 字段 1
TID 1
TID ACK 1
TID 2
TID ACK 2
TID K
TID ACK K
ACK 字段 2
TID 1
TID ACK 1
TID 2
TID ACK 2
TID K
TID ACK K
ACK 字段 N
TID 1
TID ACK 1
TID 2
TID ACK 2
TID K
TID ACK K

图 23

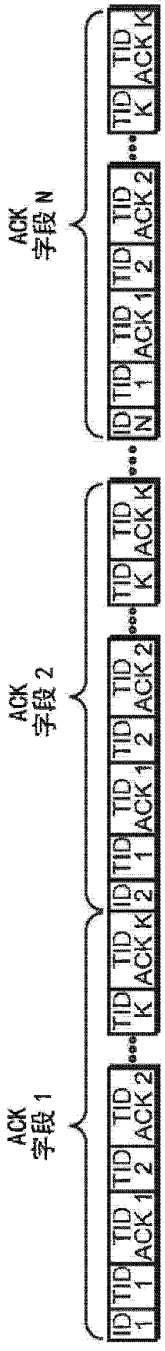

ACK 字段 1
ID 1
TID 1
TID ACK 1
TID 2
TID ACK 2
TID K
TID ACK K
ACK 字段 2
ID 2
TID 1
TID ACK 1
TID 2
TID ACK 2
TID K
TID ACK K
ACK 字段 N
ID N
TID 1
TID ACK 1
TID 2
TID ACK 2
TID K
TID ACK K

图 24

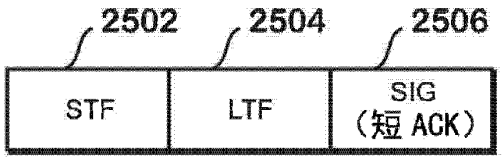


图 25（现有技术）

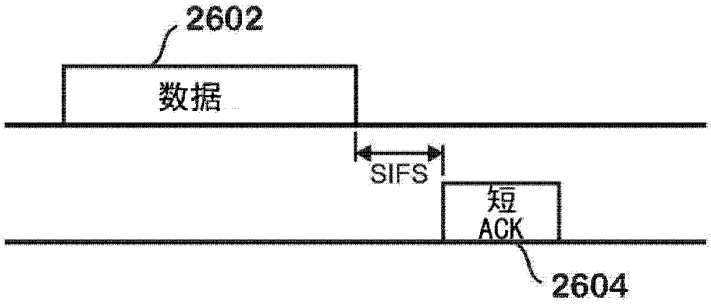


图 26

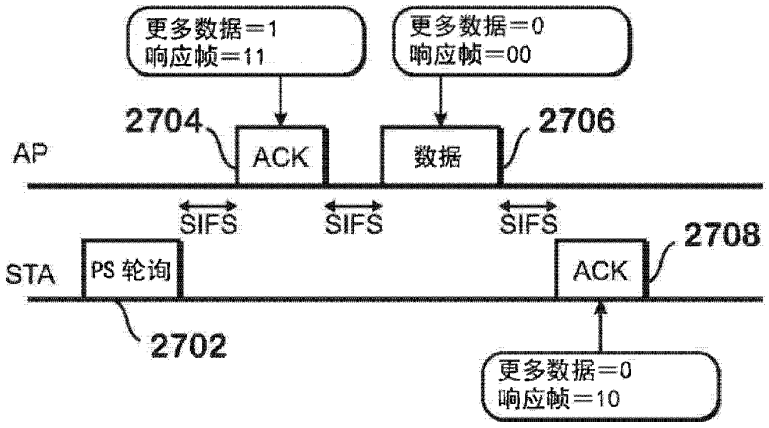


图 27

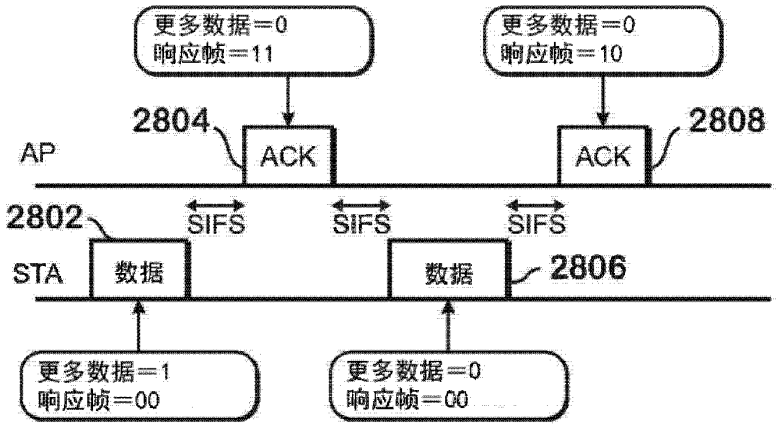

更多数据=0
响应帧=11
更多数据=0
响应帧=10
2804
2808
AP
ACK
ACK
2802
SIFS
SIFS
SIFS
STA
数据
数据
2806
更多数据=1
响应帧=00
更多数据=0
响应帧=00

图 28

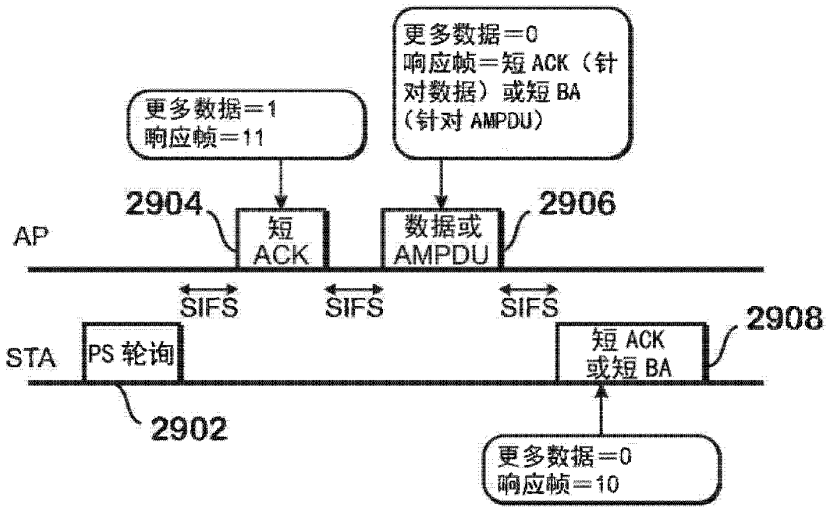

更多数据=0
响应帧=短 ACK（针对数据）或短 BA（针对 AMPDU）
更多数据=1
响应帧=11
2904
2906
AP
短 ACK
数据或 AMPDU
SIFS
SIFS
SIFS
2908
STA
PS 轮询
短 ACK 或短 BA
2902
更多数据=0
响应帧=10

图 29

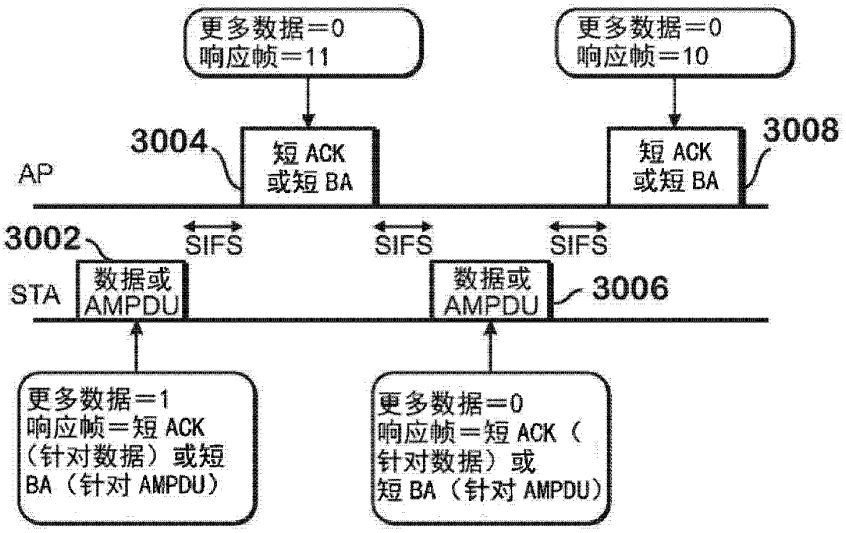

更多数据＝0
响应帧＝11
更多数据＝0
响应帧＝10
3004
短 ACK
或短 BA
3008
短 ACK
或短 BA
AP
3002
SIFS
SIFS
SIFS
STA
数据或
AMPDU
数据或
AMPDU
3006
更多数据＝1
响应帧＝短 ACK
（针对数据）或短
BA（针对 AMPDU）
更多数据＝0
响应帧＝短 ACK（
针对数据）或
短 BA（针对 AMPDU）

图 30

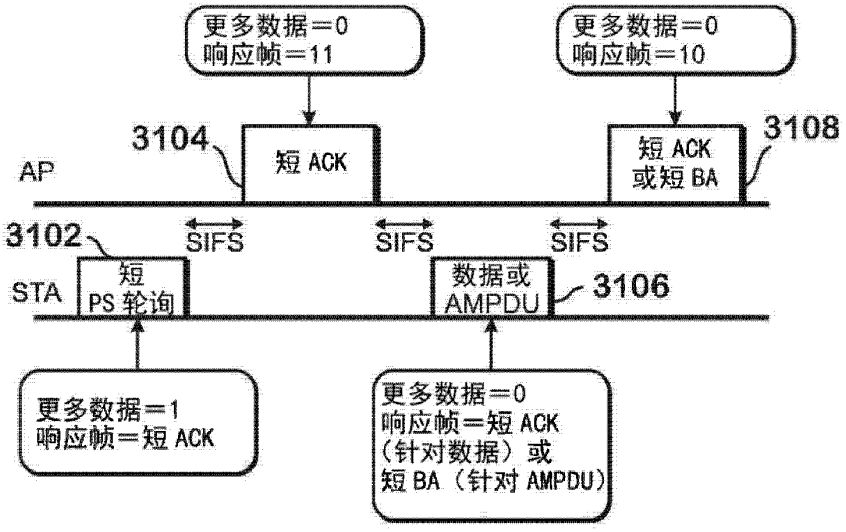

更多数据＝0
响应帧＝11
更多数据＝0
响应帧＝10
3104
短 ACK
3108
短 ACK
或短 BA
AP
3102
SIFS
SIFS
SIFS
STA
短
PS 轮询
数据或
AMPDU
3106
更多数据＝1
响应帧＝短 ACK
更多数据＝0
响应帧＝短 ACK
（针对数据）或
短 BA（针对 AMPDU）

图 31

Espacenet

Bibliographic data: CN103563457 (A) — 2014-02-05

Method for transmitting and receiving physical layer convergence procedure protocol data unit in wireless local area network system supporting power save mode operation and apparatus for the same

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Applicant(s): LG ELECTRONICS INC ± (LG ELECTRONICS INC, ; LG电子株式会社)

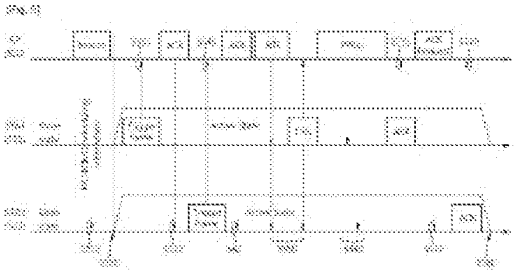
Classification: **- international:** ***H04B7/04; H04W52/02; H04W80/00***
- cooperative: **H04B7/0452 (EP, US); H04W52/02 (KR); H04W52/0216 (EP, US); H04W52/0219 (EP, US); H04W52/0225 (EP, US); H04W72/12 (KR); H04W72/1263 (US);** Y02D30/70 (EP, US)

Application number: CN20118071381 20111123 Global Dossier

Priority number(s): WO2011KR08970 20111123 ; US201161491871P 20110531

Also published as: CN103563457 (B) EP2716112 (A1) EP2716112 (A4) EP2716112 (B1) EP2852228 (A1) more

Abstract of CN103563457 (A)



A method of transmitting a data frame in a wireless local area network (WLAN) is provided. The method includes transmitting, by an access point (AP), a scheduling information element including information on a time period for data frame transmission to a first station (STA) and a second STA, wherein the scheduling information element includes an offset field indicating a start time point of the time period and transmitting, by the AP, the data frame to the first STA and the second STA by using a multi user-multiple input multiple output (MU-MIMO) transmission scheme after the start time point indicated by

the offset field.

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CLAIMS CN103563457A

1.

A method of sending data frames in a wireless local area network (WLAN), the method comprising:

A scheduling information element including information about a time period for data frame transmission is sent by an access point (AP) to the first station (STA) and the second STA, wherein the scheduling information element includes a value indicating the time period. the offset field for the start time point; and

After the start time point indicated by the offset field, the data frame is transmitted by the AP to the first STA and the first STA by using a multi-user multiple-input multiple-output (MU-MIMO) transmission scheme The second STA.

2.

The method of claim 1, further comprising operating by the first STA and the second STA by transitioning to an awake state at the starting time point indicated by the offset field.

3.

The method according to claim 2,

wherein, the scheduling information element includes a group identifier indicating the target STA group for the data frame transmission, and

Wherein, the target STA group includes the first STA and the second STA.

4.

The method of claim 3, wherein the operation by transitioning to the awake state comprises:

determining by each STA of the first STA1 and the second STA2 whether the each STA is a member STA of the target STA group based on the group identifier field of the scheduling information element; and

It is operated by each STA by transitioning to the awake state if the STA is the member STA.

5.

The method of claim 4,

wherein the scheduling information element further includes a duration field indicating the duration of the time period, and

wherein the transmission of the data frame is performed within the duration indicated by the duration field.

6.

The method of claim 5, further comprising operating by the first STA and the second STA by transitioning to a sleep state when the time period has elapsed from the start time point.

7.

The method of claim 6, wherein the scheduling information element further comprises an interval subfield indicating an interval at which the time period periodically restarts, and

Further comprising operating by the first STA and the second STA by transitioning to the awake state in each interval relative to the starting point in time.

8.

The method of claim 4,

wherein the data frame includes signal fields and data units containing information for interpreting the data frame, and

Wherein, the signal field includes the group identifier and an indicator indicating the number of spatial streams allocated to the first STA and the second STA, respectively.

9.

The method of claim 8, further comprising operating by the first STA and the second STA by transitioning to a sleep state when the indicator indicates that the number of allocated spatial streams is 0.

10.

The method of claim 1, further comprising:

receiving, by the AP, a first trigger frame from the first STA to notify that the first STA is ready to receive the data frame after the start time point; and

A second trigger frame is received by the AP from the second STA to inform that the second STA is ready to receive the data frame after the start time point.

11.

The method of claim 10, wherein the data frame is transmitted after the first trigger frame and the second trigger frame are received.

12.

A wireless device comprising:

a transceiver for transmitting and receiving radio signals; and

a processor functionally coupled to the transceiver,

wherein the processor is configured to:

sending a scheduling information element including information about a time period for data frame transmission to the first STA and the second STA, wherein the scheduling information element includes an offset field indicating a start point in time of the time period; and

After the start time point indicated by the offset field, the data frame is transmitted to the first STA and the second STA by using a MU-MIMO transmission scheme.

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DESCRIPTION CN103563457A

Method and apparatus for transmitting and receiving physical layer convergence procedure protocol data units in a wireless local area network system supporting power saving mode operation

[0001]

technical field

[0002]

The present invention relates to wireless local area network (WLAN) systems, and more particularly, to a method of transmitting and receiving Physical Layer Convergence Procedure (PLCP) Protocol Data Units (PPDUs) by a station (STA) in a WLAN system supporting power save mode operation.

[0003]

Background technique

[0004]

With the advancement of information communication technologies, various wireless communication technologies have recently been developed.

Among wireless communication technologies, a wireless local area network (WLAN) is a technology by which portable terminals such as personal digital assistants (PDAs), laptop Computers, Portable Multimedia Players (PMPs), etc., with wireless Internet access.

[0005]

IEEE 802.11n is a recently introduced technical standard to overcome the limited data rate considered a disadvantage in WLAN.

IEEE802.11n is designed to increase network speed and reliability, and to extend the operating distance of wireless networks.

More specifically, IEEE802.11n supports high throughput (HT), ie, data processing rates above 540Mbps at most, and is based on the use of multiple antennas in both the transmitter and receiver to minimize and optimize transmission errors Multiple-input and multiple-output (MIMO) technology for data rates.

[0006]

The WLAN system supports active mode and power saving mode as operation modes of a station (STA).

The active mode refers to an operation mode in which the STA operates in an awake state capable of transmitting and receiving frames.

On the other hand, the power saving mode supports power saving for STAs that need to be in an active state to receive frames. A STA supporting a power save mode (PSM) can avoid unnecessary power consumption by operating in a sleep mode when it is not a time period during which the STA can access the radio medium. That is, the STA operates in an awake state only for a period in which a frame can be transmitted to the STA, or a period in which the STA can transmit a frame. With the wide application of WLAN and the diversification of applications using WLAN, there is recently a need for a new WLAN system supporting a higher throughput than the data processing rate supported by IEEE 802.11n. The next-generation WLAN system supporting very high throughput (VHT) is the next version of the IEEE802.11n WLAN system, and is IEEE802 that has recently been proposed to support data processing rates above 1 Gbps in the MAC Service Access Point (SAP). A kind of 11WLAN system.

[0007]

To efficiently utilize radio channels, next-generation WLAN systems support multi-user multiple-input multiple-output (MU-MIMO) transmission in which multiple non-access point (AP) stations (STAs) access the channel simultaneously.

In accordance with MU-MIMO transmission, an AP can simultaneously transmit Physical Layer Convergence Procedure (PLCP) Protocol Data Units (PPDUs) to one or more MIMO paired STAs.

[0008]

However, since the STAs operating in the power saving mode operate by transitioning between the sleep state and the awake state, the MU-MIMO transmission of the AP depends on the operation state of the MU-MIMO paired STAs.

Therefore, the AP needs to provide information about the time period for MU-MIMO transmission to the MU-MIMO paired STAs. Therefore, there exists a need for a method of transmitting and receiving PPDUs by using a MU-MIMO transmission scheme in a WLAN system that supports power saving mode operation.

[0009]

SUMMARY OF THE INVENTION

[0010]

technical problem

[0011]

The present invention provides a method of transmitting and receiving Physical Layer Convergence Procedure (PLCP) Protocol Data Units (PPDUs) by a station (STA) in a wireless local area network (WLAN) system supporting power saving mode operation.

[0012]

solution to the problem

[0013]

In one aspect, a method of transmitting data frames in a wireless local area network (WLAN) is provided.

The method includes transmitting, by an access point (AP) to a first station (STA) and a second STA, a scheduling information element including information about a time period for data frame transmission, wherein the scheduling information element includes a time period indicating a time period The offset field of the start time point, and after the start time point indicated by

the offset field, the data frame is sent by the AP to the first STA and the second STA by using a multi-user multiple-input multiple-output (MU-MIMO) transmission scheme .

[0014]

The method may further include operating, by the first STA and the second STA, by transitioning to an awake state at a start time point indicated by the offset field.

[0015]

The scheduling information element may include a group identifier indicating a target group of STAs for data frame transmission, and wherein the target STA group includes the first STA and the second STA.

[0016]

The operation by transitioning to the awake state may include determining, by each STA of the first STA1 and the second STA2 based on the group identifier field of the scheduling information element, whether each STA is a member STA of the target STA group, and if each STA is a member STA of the target STA group Member STAs are operated by each STA by transitioning to the awake state.

[0017]

The scheduling information element may further include a duration field indicating the duration of the time period, and the transmission of the data frame may be performed within the duration indicated by the duration field.

[0018]

The method may further include operating by the first STA and the second STA by transitioning to a sleep state when a time period has elapsed from the start time point.

[0019]

The scheduling information element may further include an interval subfield indicating an interval at which the time period periodically restarts, and the method may further include: by the first STA and the second STA in each interval relative to the start time point by transitioning to Wake up state to operate.

[0020]

The data frame may include a signal field and a data unit containing information for interpreting the data frame, and the signal field may include a group identifier and an indicator indicating the number of spatial streams allocated to the first STA and the second STA, respectively.

[0021]

The method may further include operating by the first STA and the second STA by transitioning to a sleep state when the indicator indicates that the number of allocated spatial streams is 0.

[0022]

The method may further include: receiving, by the AP, a first trigger frame from the first STA to notify that the first STA is ready to receive the data frame after the start time point; and receiving, by the AP, a second trigger frame from the second STA to notify that at the start time point Then the second STA prepares to receive the data frame.

[0023]

The data frame may be sent after the first trigger frame and the second trigger frame are received.

[0024]

In another aspect, a wireless device is provided.

The apparatus includes a transceiver for transmitting and receiving radio signals, and a processor functionally coupled to the transceiver, wherein the processor is configured to include information about a time period for data frame transmission The scheduling information element of the information is transmitted to the first STA and the second STA, and the data frame is transmitted to the first STA and the second STA by using the MU-MIMO transmission scheme after the start time point indicated by the offset field.

The scheduling information element includes an offset field indicating the start point in time of the time period.

[0025]

The beneficial effects of the present invention

[0026]

The access point (AP) provides information about the wake-up period for multi-user multiple-input multiple-output (MU-MIMO) transmission to the MU-MIMO paired station (STA).

Therefore, the STA can recognize the time point when the AP transmits the Physical Layer Convergence Procedure (PLCP) Protocol Data Unit (PPDU), and can wait to receive the PPDU by transitioning to the awake state according to the recognized time point.

Since the STA remains awake according to the time period in which the PPDU is transmitted, unnecessary power consumption can be avoided.

[0027]

The AP is configured such that the PPDU is sent after receiving the trigger frame sent by the STA, or that the wake-up period restarts in each Transport Traffic Indication Mapping (DTIM) transmission period.

Therefore, it can be guaranteed that the STA is in a reception waiting state before PPDU transmission.

Therefore, very reliable PPDU transmission can be guaranteed, and the overall throughput of a wireless local area network (WLAN) system can be improved by avoiding repeated transmission of the same traffic.

[0028]

Description of drawings

[0029]

FIG. 1 is a schematic diagram showing a configuration of a WLAN system to which an embodiment of the present invention can be applied.

[0030]

FIG. 2 shows an example of a power management operation.

[0031]

Figure 3 shows an example of a PPDU format according to one embodiment of the present invention.

[0032]

Figure 4 shows the format of a group ID management frame according to one embodiment of the present invention.

[0033]

FIG. 5 illustrates a PPDU transmission method according to an embodiment of the present invention.

[0034]

Figure 6 shows the format of a MU-MIMO scheduling information element according to one embodiment of the present invention.

[0035]

Figure 7 shows another example of a group ID management frame format according to one embodiment of the present invention.

[0036]

8 is a block diagram illustrating a wireless device according to one embodiment of the present invention.

[0037]

detailed description

[0038]

FIG. 1 is a schematic diagram showing a configuration of a WLAN system to which an embodiment of the present invention can be applied.

[0039]

Referring to FIG. 1, a WLAN system includes one or more Basic Service Sets (BSS).

A BSS is a collection of stations (STAs) capable of communicating with each other via successful synchronization.

BSS is not a concept that represents a specific area.

[0040]

The infrastructure BSS includes one or more non-AP STAs STA1, STA2, STA3, STA4, and STA5, APs (Access Points) providing distributed services, and a Distribution System (DS) connecting multiple APs.

In the infrastructure BSS, the AP manages the non-AP STAs of the BSS.

[0041]

On the other hand, an individual BSS (IBSS) operates in an ad-hoc (Ad-Hoc) mode.

The IBSS does not have a centralized management entity for performing management functions as it does not include APs.

That is, in IBSS, non-AP STAs are managed in a distributed manner.

In IBSS, all STAs may consist of mobile STAs.

All STAs form a self-contained network because they are not allowed to access the DS.

[0042]

STA is a functional medium, including Media Access Control (MAC), and a wireless medium physical layer interface that complies with the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard.

In the following, STA refers to both AP and non-AP STAs.

[0043]

A non-AP STA is a STA that is not an AP.

A non-AP STA may also be referred to as a mobile terminal, wireless device, wireless transmit/receive unit (WTRU), user equipment (UE), mobile station (MS), mobile subscriber unit, or simply a user.

For convenience of explanation, the non-AP STA will hereinafter be referred to as a STA.

[0044]

An AP is a functional entity for providing a connection to a DS through a wireless medium for STAs associated with the AP.

Although the communication between the STAs in the infrastructure BSS including the AP is performed via the AP in principle, when the direct link is established, the STA can perform the direct communication.

An AP may also be referred to as a central controller, base station (BS), node B, base transceiver system (BTS), site controller, and so on.

[0045]

A plurality of infrastructure BSSs including the BSS shown in FIG. 1 can be connected to each other by using DSs.

An Extended Service Set (ESS) is a multiple BSS connected by using a DS.

APs and/or STAs included in the ESS can communicate with each other.

In the same ESS, STAs can move from one BSS to another while performing seamless communication.

[0046]

In the WLAN system based on IEEE802.11, the basic access mechanism of medium access control (MAC) is the carrier sense multiple access (CSMA/CA) mechanism to avoid collision.

The CSMA/CA mechanism is also called the Distributed Coordination Function (DCF) of the IEEE802.11 MAC, and basically adopts a "listen before talk" access mechanism.

In this type of access mechanism, the AP and/or STA listen to the wireless channel or medium before starting to transmit.

As a result of the snooping, if it is determined that the medium is in an idle state, frame transmission is started by using the medium.

Otherwise, if the medium is sensed to be occupied, the AP and/or STA do not start their transmissions, but instead set and wait for a delay duration for medium access.

[0047]

In addition to physical carrier sensing where the AP and/or STA directly sense the medium, the CSMA/CA mechanism also includes virtual carrier sensing.

The virtual carrier sense is designed to compensate for problems that may arise in medium access, such as hidden node problems.

For virtual carrier transmission, the MAC of the WLAN system uses the Network Allocation Vector (NAV).

NAV is a value sent by an AP and/or STA that is currently using a medium or has the right to use the medium to another AP or

another STA to indicate the time remaining until the medium returns to a usable state.

Therefore, the value set to NAV corresponds to the period reserved for the use of the medium by the AP and/or STA sending the corresponding frame.

[0048]

The AP and/or STA may perform a process of exchanging request-to-send (RTS) frames and clear-to-send (CTS) frames to notify their intention to access the medium.

RTS frames and CTS frames include information indicating the duration of radio medium access required to transmit and receive ACK frames while supporting actual data frame transmission and acknowledgement of receipt (ACK).

Upon receipt of an RTS frame sent from an AP and/or STA that intends to send the frame, or upon receipt of a CTS frame sent from a frame transmission target STA, another STA can be configured with the information included in the RTS/CTS frame No access to the medium for the duration indicated.

This can be achieved by configuring the NAV with respect to the duration.

[0049]

Meanwhile, if channel sensing is always performed for frame transmission and reception, persistent power consumption of the STA is caused.

Since the power consumption in the reception state is very different from that in the transmission state, if the reception state needs to be maintained continuously, a relatively large power consumption is generated in the STA that is operated by using the battery.

Therefore, when a STA in a WLAN system listens to a channel by persistently maintaining a receive standby state, in terms of WLAN throughput, without a specific synergistic effect, inefficient power consumption may result, and thus in terms of power management may be inappropriate.

[0050]

To compensate for the above-mentioned problems, the WLAN system supports a power management (PM) mode of the STA.

In a WLAN system, a power management (PM) mode of a STA is divided into an active mode and a power saving (PS) mode.

Basically, the STA operates in active mode.

When operating in active mode, the STA can operate in an awake state so that it can always receive frames.

[0051]

When operating in PS mode, the STA operates by transitioning between a sleep state and an awake state.

When operating in the sleep state, the STA operates with minimum power and does not receive radio signals including data frames transmitted from the AP.

Also, STAs operating in the sleep state do not perform channel listening.

[0052]

The longer the STA operates in the sleep state, the less power is consumed, and thus, the longer the STA operates.

However, since frames cannot be transmitted and received in the sleep state, the STA cannot operate unconditionally for a long time.

If the STA operating in the sleep state has a frame to transmit to the AP, the STA can transition to the awake state to transmit the frame.

However, if the AP has a frame to send to a STA operating in a sleep state, the STA cannot receive the frame and has no way of

knowing that there is a frame to receive.

Therefore, the STA may need to know whether there is a frame to be sent to the STA, and if there is such a frame, may need to transition to the awake state according to a certain period of time. Following this operation, the AP can transmit the frame to the STA. This will be described with reference to FIG. 2 .

[0053]

FIG. 2 shows an example of a power management operation.

[0054]

Referring to FIG. 2 , the AP 210 transmits a beacon frame to the STA in the BSS according to a specific period (step S210).

The beacon frame includes a Traffic Indication Map (TIM) information element.

The TIM element includes information to report that the AP 210 has buffered the traffic associated with the STA and that the frame is about to be sent. Examples of TIM elements include TIM for reporting unicast frames and Transport Traffic Indication Map (DTIM) for reporting multicast or broadcast frames.

[0055]

The AP 210 sends the DTIM once every time the beacon frame is sent three times.

[0056]

STA1 221 and STA2 222 are STAs operating in PS mode.

STA1 221 and STA2 222 can be configured such that they can transition from the sleep state to the awake state in each awake interval of a certain period to receive the TIM element sent by the AP 210.

[0057]

A specific wake-up interval can be configured such that the STA1 221 transitions to the wake-up state in each beacon interval to receive TIM elements.

Therefore, when the AP 210 transmits the first beacon frame (step S211), the STA1 221 transitions to the awake state (step S221).

STA1 221 receives the beacon frame and acquires the TIM element. If the acquired TIM element indicates that there is a frame to be sent to the STA1221, then the STA1221 sends a PS-poll frame requesting the AP210 to send the frame to the AP210 (step S221a). The AP 210 transmits the frame to the STA1 221 in response to the PS-Poll frame (step S231). Once frame reception is completed, the STA1 221 operates by transitioning back to the sleep state.

[0058]

When the AP 210 sends the second beacon frame, the medium is busy, that is, another device is accessing the medium, for example.

Therefore, the AP 210 cannot transmit the beacon frame at the correct beacon interval, but can transmit the beacon frame at a delayed time point (step S212). In this case, the STA1221 switches its mode to the awake state at the beacon interval, but cannot receive the beacon frame transmitted with a delay, and therefore, transitions back to the sleep state (step S222).

[0059]

When the AP 210 sends the third beacon frame, the beacon frame may include a TIM element configured as a DTIM.

However, since the medium is busy, the AP 210 sends the beacon frame with a delay (step S213). The STA1221 operates by transitioning to the awake state at the beacon interval, and can acquire DTIM by using the beacon frame transmitted by the

AP210. The DTIM acquired by STA1 221 indicates that there are no frames to send to STA1 221 and that there is a frame for another STA. Therefore, the STA1221 operates by transitioning back to the sleep state. After sending the beacon frame, the AP 210 sends the frame to the corresponding STA (step S232).

[0060]

The AP 210 transmits the fourth beacon frame (step S214).

However, since STA1221 cannot obtain information indicating that there is a buffered service for STA1221 by receiving the TIM element twice, STA1221 can adjust the wakeup interval for receiving the TIM element. Alternatively, if signaling information for adjusting the wake-up interval value of STA1221 is included in the beacon frame sent by AP210, the wake-up interval value of STA1221 may be adjusted. Instead of transitioning the operational state for every beacon interval to receive the TIM element, the STA1 221 can in this embodiment be configured such that the operational state is transitioned once for every three beacon intervals. Therefore, the STA1221 cannot acquire the corresponding TIM element because the AP210 transmits the fourth beacon frame (step S214), and maintains the sleep state (step S215) while transmitting the fifth beacon frame.

[0061]

When the AP 210 transmits the sixth beacon frame (step S216), the STA1 221 operates by transitioning to the awake state, and acquires the TIM element included in the beacon frame (step S224).

The TIM element is the DTIM indicating the existence of the broadcast frame, and therefore, the STA1 221 receives the broadcast frame transmitted by the AP 210 (step S234), instead of transmitting the PS-Poll frame to the AP 210.

[0062]

Meanwhile, the wake-up interval allocated to STA2 222 may have a longer period than that of STA1 221.

Therefore, when the fifth beacon frame is transmitted (step S215), the STA2 222 can receive the TIM element by transitioning to the awake state (step S225). The STA2 222 knows that there is a frame to be transmitted to the STA2 222 by using the TIM element, and transmits the PS-Poll frame to the AP 210 to request transmission (step S225a). The AP 210 transmits the frame to the STA 2222 in response to the PS-Poll frame (step S233).

[0063]

In order to operate the PS mode of FIG. 2, the TIM element includes a TIM indicating whether there is a frame to be sent to the STA, or a DTIM indicating whether there is a broadcast/multicast frame.

DTIM can be implemented by configuring the fields of the TIM element.

[0064]

Unlike conventional WLAN systems, next-generation WLAN systems require higher throughput.

This is called very high throughput (VHT). In this regard, next-generation WLAN systems are intended to support 80 MHz, contiguous 160 MHz, non-contiguous 160 MHz bandwidth transmissions, and/or higher bandwidth transmissions. In addition, a multi-user multiple-input multiple-output (MU-MIMO) transmission scheme is provided for higher throughput. In next-generation WLAN systems, an AP can simultaneously transmit data frames to at least one or more MIMO paired STAs. In the WLAN system of FIG. 1, the AP 10 can simultaneously transmit data to a STA group including at least one or more STAs among the plurality of STAs 21, 22, 23, 24 and 25 associated with the AP 10. In this case, the data sent to each STA can be sent via different spatial streams. The data frames sent by the AP 10 can be referred to as Physical Layer Convergence Procedure (PLCP) Protocol Data Units (PPDUs) generated and sent in the Physical Layer (PHY) of the WLAN system. In the embodiment of the present invention, it is assumed that the group of transmission target STAs paired with AP10MU-MIMO are STA121, STA222, STA323, and STA424. In this case, the spatial stream cannot be assigned to a specific STA in the transmission target STA group, and thus data cannot be transmitted. Meanwhile, it is assumed that the STA 525 is an STA associated with the AP but not included in the transmission target STA group.

[0065]

Figure 3 shows an example of a PPDU format according to one embodiment of the present invention.

[0066]

3, PPDU 300 includes L-STF field 310, L-LTF field 320, L-SIG field 330, VHT-SIGA field 340, VHT-STF field 350, VHT-LTF field 360, VHT-SIGB field 370, and data Field 380.

[0067]

The PLCP sublayer constituting the PHY transforms the PLCP Service Data Unit (PSDU) transmitted from the MAC layer into the data field 380 by appending the necessary information to the PSDU, by appending several fields such as the L-STF field 310, the L-LTF field 320, L-SIG field 330, VHT-SIGA field 340, VHT-STF field 350, VHT-LTF field 360, VHT-SIGB field 370, etc. to generate PPDU 300, and via the Physical Medium Dependent (PMD) sublayer constituting the PHY PPDU 300 is transmitted to one or more STAs.

[0068]

The L-STF field 310 is used for frame timing acquisition, automatic gain control (AGC) convergence, coarse frequency acquisition, and the like.

[0069]

L-LTF field 320 is used for channel estimation for L-SIG field 330 and VHT-SIGA field 340 demodulation.

[0070]

The L-SIG field 330 is used when the L-STA receives the PPDU to acquire data.

[0071]

The VHT-SIGA field 340 includes control information for interpreting the received PPDU 300 as common control information required by VHT-STAs paired with AP MIMO.

The VHT-SIGA field 340 includes information on a spatial stream for each of a plurality of MIMO paired STAs, bandwidth information, identification information on whether to use space-time block coding (STBC), a group identification for a transmission target STA group symbol, information on spatial streams allocated to STAs included in the transmission target group STA indicated by the group identifier, information on the short guard interval (GI) of the transmission target STA, coding information, modulation and coding scheme (MCS) information, information indicating whether beamforming is performed, and CRC-related information.

Here, the group identifier may include whether the currently used MIMO transmission method is MU-MIMO or SU-MIMO.

The VHT-SIGA field 340 may be transmitted by using two OFDM symbols.

In this case, the field associated with the first arriving symbol can be referred to as VHT-SIGA1, and the field associated with subsequent symbols can be referred to as VHT-SIGA2 field.

[0072]

The VHT-STF field 350 is used to improve the performance of AGC estimation in MIMO transmission.

[0073]

The VHT-LTF field 360 is used when the STA estimates the MIMO channel.

Since the next generation WLAN system supports MU-MIMO, the VHT-LTF field 360 can be configured by the number of spatial

streams on which the PPDU 300 is sent.

Furthermore, the number of VHT-LTFs can be increased when all-channel sounding is supported and performed.

[0074]

The VHT-SIGB field 370 includes dedicated control information required when multiple MIMO paired STAs receive the PPDU 300 to acquire data.

Therefore, the STA may be designed such that the VHT-SIGB field 370 is decoded only when the common control information included in the VHT-SIGB field 370 indicates that the currently received PPDU 300 was sent using MU-MIMO transmission.

Conversely, the STA may be designed such that the VHT-SIGB field 370 is not decoded when the common control information indicates that the currently received PPDU 300 is for a single STA (including SU-MIMO).

[0075]

The VHT-SIGB field 370 includes length information of the PSDU included in the data field transmitted to each STA, MSC information, and trailer related information included in the data field.

Additionally, the VHT-SIGB field 370 includes information on coding and rate matching.

The size of the VHT-SIGB field 370 may vary according to the MIMO transmission method (MU-MIMO or SU-MIMO) and the channel bandwidth used for PPDU transmission.

[0076]

Data field 380 includes data intended to be sent to the STA.

The data field 380 includes the service fields used to initialize the scrambler and the PLCP service data unit (PSDU) to which the MAC protocol data unit (MPDU) of the MAC layer is transferred, including the required data to reset the convolutional encoder to the zero state. The tail field of the bit sequence, and the padding bits used to normalize the length of the data field.

[0077]

In the WLAN system of FIG. 1 , if AP10 intends to send data to STA121 , STA222 and STA323 , the PPDU may be sent to the STA group including STA121 , STA2 22 , STA323 and STA424 .

In this case, as shown in FIG. 2, the spatial stream cannot be allocated to STA424, and a certain number of spatial streams can be allocated to each of STA1 21, STA222, and STA323, and then data can be transmitted accordingly.

In the example of Figure 2, one spatial stream is assigned to STA121, three spatial streams are assigned to STA222, and two spatial streams are assigned to STA323.

[0078]

In order to transmit data to a receiving STA group via the MU-MIMO transmission scheme by using the PPDU format of FIG. 3, information on the STA group needs to be provided to each STA.

That is, each STA can know that it is the target STA of the transmitted PPDU only when the information about the group ID to be allocated to it is received in advance.

[0079]

The AP can send a group ID management message to each STA before sending the PPDU via the MU-MIMO transmission scheme.

The group ID management message includes a group ID assigned to the STA and spatial stream information related to the group ID. The group ID management message can be sent to the STA via the transmission of a group ID management frame including a group ID management information element. However, the group ID management information element can be

transmitted by being included in another management frame.

[0080]

Figure 4 shows the format of a group ID management frame according to one embodiment of the present invention.

[0081]

Referring to FIG. 4 , the group ID management frame 400 includes a category field 410 , an action field 420 , and a group ID management information element field 430 .

[0082]

The class field 410 and the action field 420 are configured to indicate that the corresponding frame is a group ID management frame.

[0083]

The group ID management information meta field 430 includes a meta ID field 431, a length field 432, and at least one spatial stream position field 433.

[0084]

The element ID field 431 is configured to indicate that the corresponding information element is a group ID management information element.

The length field 432 is configured to indicate the length of the group ID management information element.

[0085]

The spatial stream position field 433 includes information indicating, for each group ID, whether the spatial stream belongs to a specific group, and if it belongs to a specific group, the specific position where the spatial stream is located.

[0086]

For example, assume that the bits of the spatial stream location field 433 are set to the values 0, 1, 2, 4, 0, 0, 0, . . . , 0, 0, 0, respectively.

It can be seen that the STA receiving the group ID management frame 400 is included in the group of STAs based on group ID2, group ID3, and group ID4.

Under such conditions, the STA can know that its spatial stream is the first spatial stream in the group with group ID2, the second spatial stream in the group with group ID3, and the fourth spatial stream in the group with group ID4 spatial flow.

[0087]

The position of the spatial stream means that when the STA receives a PPDU to be transmitted to the STA group for a specific group ID, it must receive the spatial stream at the position corresponding to the spatial stream position value.

Also, which spatial stream is used for the STA can be determined by using information on the spatial stream allocated to the STA and included in the VHT-SIGA field 340 having the PPDU format of FIG. 3 .

[0088]

The information on the spatial stream of the VHT-SIGA field 340 can indicate the number of spatial streams allocated to the spatial stream location.

For example, as shown in Fig. 3, it is assumed that the VHT-SIGA field includes spatial stream information.

The spatial stream information indicates that the number of spatial streams for the first spatial stream position is 1, the number of spatial streams for the second spatial stream position is 3, the number of spatial streams for the third spatial stream position is 2, And the number of spatial streams for the fourth spatial stream position is zero.

If the information indicating the group ID2 is included in the VHT-SIGA field of the transmitted PPDU, the receiving STA can receive data via one spatial stream allocated to the first location.

If the information indicating the group ID3 is included in the VHT-SIGA field, the receiving STA can receive data via the three spatial streams allocated to the second location.

If the information indicating the group ID4 is included in the VHT-SIGA field, the receiving STA can determine that there is no spatial stream allocated to the fourth position, that is, there is no data to be transmitted to the STA.

[0089]

Meanwhile, if the STA belonging to the STA group based on the specific group ID operates in the power saving mode, the STA must remain in the awake state when the AP transmits the PPDU to the STA via the MU-MIMO transmission scheme.

However, since the STA operating in the sleep state cannot know the specific time point at which the AP starts to transmit the PPDU, it is difficult to determine the time to transition to the awake state. If the time at which the STA transitions to the awake state is faster than the time at which the AP performs MU-MIMO transmission, unnecessary power consumption occurs after the operation mode transition time and before the MU-MIMO transmission time point. To prevent this, a method is required in which STAs of a STA group based on a specific group ID can operate by simultaneously transitioning to an awake state at the MU-MIMO transmission time. To this end, it is recommended that the AP transmit MU-MIMO scheduling information to the STA.

[0090]

FIG. 5 illustrates a PPDU transmission method according to an embodiment of the present invention.

STA1521 and STA2522 are paired with AP510MU-MIMO. STA1 521 and STA2 522 are grouped by at least one group ID and are STAs operating in power saving mode.

[0091]

Referring to FIG. 5, the AP 510 sends the MU-MIMO scheduling information to the STA1 521 and the STA2 522 (step S510).

The MU-MIMO scheduling information includes information related to the time at which the PPDU is transmitted to a specific STA group by using the MU-MIMO transmission scheme. The MU-MIMO scheduling information can be transmitted when the MU-MIMO scheduling information element is transmitted by being included in the beacon frame. The beacon frame may further include a TIM element indicating that there is buffered traffic for the STA.

[0092]

Figure 6 shows the format of a MU-MIMO scheduling information element according to one embodiment of the present invention.

[0093]

Referring to FIG. 6 , the MU-MIMO scheduling information element 600 includes an element ID field 610, a length field 620, a group ID field 630, and a wake-up scheduling field 640.

[0094]

The element ID field 610 is set to a value indicating that the particular element is a MU-MIMO scheduling information element.

The length field 620 is set to a value indicating the length of the MU-MIMO scheduling information element 600.

[0095]

The group ID field 630 is set to a group ID value indicating the group of transmission target STAs of the PPDU transmitted by the AP.

STAs can determine whether the MU-MIMO scheduling information element 600 is the information element for them by using the group ID value of the group ID field 630.

If the group ID field 630 is different from the receiving STA's group ID value, the receiving STA discards the information element and operates according to typical power save mode operation methods.

If the wake-up schedule field 640 is equal to the group ID value assigned to the receiving STA, then the receiving STA operates in a power save mode based on the information included in the wake-up schedule field 640.

[0096]

Wakeup schedule field 640 includes wakeup offset subfield 641, wakeup duration subfield 642, and wakeup interval subfield 643.

[0097]

The wake-up offset subfield 641 indicates the time interval relative to the wake-up timing, which is the first operational state transition time from the point in time when the MU-MIMO scheduling information element is received.

[0098]

The wake-up duration subfield 642 indicates the length of time for the wake-up period, which is the period of time the state remains after transitioning to the wake-up state.

[0099]

The wakeup interval subfield 643 indicates the time interval between consecutive wakeup periods.

[0100]

Referring back to Figure 5, STA1 521 and STA2 522 operating in the power saving mode can know that there is traffic for their buffering by using the transmitted TIM element.

Also, information on the point in time at which MU-MIMO transmission starts for the STA group based on the group ID assigned thereto can be obtained by using the MU-MIMO scheduling information element.

[0101]

STA1 521 and STA2 522 transition to the awake state at the wake-up timing, which is the time point indicated by the wake-up offset subfield 641 of the MU-MIMO scheduling information element, and wait for MU-MIMO transmission performed by the AP 510 (step S520).

[0102]

After transitioning to the awake state, the STA1 521 transmits a trigger frame to the AP 510, and thereby starts the service period (step S531).

After transitioning to the awake state, the STA2 522 also transmits a trigger frame to the AP 510, and thereby starts the service period (step S542).

This is to report to the AP 510 that STAs belonging to the transmission target STA group transition to an awake state and wait for transmission before sending PPDUs via the MU-MIMO transmission scheme.

This is because it cannot be assumed that STAs transmitting packets for MU-MIMO receive the same beacon frame and simultaneously transition to the awake state, because the listening interval, i.e., the interval for receiving the beacon frame, may differ among STAs.

[0103]

In response to the trigger frames sent by STA1 521 and STA2 522, AP 510 sends corresponding acknowledgement (ACK) frames (steps S532 and S542).

[0104]

If the STA operating in the power saving mode receives the beacon frame at a certain interval, and the wake-up schedule is determined at this interval, it can be assumed that the STA transitions to the wake-up state at the same time.

In this case, the process of STA1 521 and STA2 522 sending a trigger frame to AP 510 to start a service period can be omitted.

[0105]

The AP 510 configures the NAV by exchanging RTS/CTS frames (step S550), and starts to transmit PPDUs via the MU-MIMO transmission scheme with respect to the STA starting the service period (step S560).

[0106]

The STA1521 transmits an ACK to the AP510 in response to the received PPDU (step S571).

After receiving the ACK from STA1 521, the AP 510 transmits an ACK request frame to STA2 522 to request ACK transmission (step S572).

The STA2 522 transmits the ACK frame to the AP 510 in response to the ACK request frame (step S573).

In this case, if the data unit included in the PPDU is composed of the A-MPDU format, the ACK sent by the STA1 521 and the STA2 522 may be a block ACK.

[0107]

If the PPDU sent by AP 510 does not include data for STA1 521 and/or STA2 522, then STA1 521 and/or STA2 522 can operate by transitioning to a sleep state before the time period indicated by wake-up duration subfield 642 has elapsed.

Whether the PPDU includes data for STA1 521 and/or STA2 522 can be determined based on the information about the spatial stream included in the VHT-SIGA field of the PPDU.

If the number of allocated spatial streams is '0', STA1 521 and/or STA2 522 determine that there is no data intended for STA1 521 and/or STA2 522 and can operate by transitioning to a sleep state.

[0108]

Among the STAs in which the STA operates in the power saving mode, if there is a STA that does not transmit a trigger frame to the AP and does not start a service period, it is considered that the STA does not receive the MU-MIMO scheduling information element, and therefore, MU-MIMO is not performed on the STA MIMO transmission.

[0109]

STA1 521 and STA2 522 complete receiving the PPDU from the AP 510, and operate by transitioning to the sleep state when the time period indicated by the wake-up duration subfield 642 has elapsed (step S580).

[0110]

The wake-up period of STA1 521 and STA2 522 may repeat periodically.

This can be achieved by including the wakeup interval subfield 643 into the scheduling information element 600.

The wake-up interval subfield 643 indicates the interval at which the wake-up period repeats as described above.

In this case, the interval must be greater than the value of the wakeup interval subfield 643.

Therefore, STA1 521 and STA2 522 can operate by transitioning to the awake state in each interval indicated by the awake interval subfield 643 relative to the awake period start time point specified by the awake offset subfield 641.

AP 510, STA1 521 and STA2 522 can repeatedly perform the power saving mode operation method defined in the aforementioned wake-up period.

[0111]

Meanwhile, if the MU-MIMO scheduling information element having the format of Fig. 6 is broadcast by being included in the beacon frame in each beacon interval, the overhead generated by the transmission of the beacon frame can be further improved.

Therefore, the MU-MIMO scheduling information element can be transmitted by being included in a unicast frame. This can be accomplished via the transmission of a separate action/management frame including the MU-MIMO scheduling information element, or the information element can be sent by being additionally included in the packet ID management frame of Figure 4 .

[0112]

Figure 7 shows another example of a group ID management frame format according to one embodiment of the present invention.

[0113]

Referring to FIG. 7 , the group ID management frame 700 includes a category field 710 , an action field 720 , a group ID management information element field 730 , and a MU-MIMO scheduling information element field 740 .

[0114]

The category field 710 and the action field 720 are set to values indicating that the particular frame is a group ID management frame 700.

However, in order to determine whether the group ID management frame is configured in the format of FIG. 4, or in a format that further includes the MU-MIMO scheduling information element field 740, the category field 710 and the action field 720 can be set to be compatible with the category field 410 of FIG. 4. A value that is distinguished from the value of the action field 420.

If the category field 710 and the action field 720 are set to the same field values of FIG. 4 , the group ID management frame 700 may further include a bit field indicating that the MU-MIMO scheduling information element field 740 is further included.

[0115]

The group ID management information element field 730 includes the same fields as the group ID management information element field 430 of FIG. 4 .

Therefore, STAs operate based on the same protocol.

[0116]

The MU-MIMO scheduling information element field 740 includes the same fields as the MU-MIMO scheduling information element 600 of FIG. 6 .

Therefore, the STA operates based on the same protocol, and after receiving the beacon frame of Fig. 5, the operation procedures of the AP and the STA can be incorporated herein by reference.

[0117]

8 is a block diagram illustrating a wireless device according to one embodiment of the present invention.

[0118]

8, a wireless device 800 includes a processor 810, a memory 820, and a transceiver 830.

The transceiver 830 transmits and/or receives radio signals and implements the IEEE 802.11 physical (PHY) layer.

The processor 810, functionally coupled to the transceiver 830, is capable of supporting a power saving mode of operation, which operates by transitioning between an awake state and a sleep state.

The processor 810 can be configured to transmit and receive MU-MIMO scheduling information elements, and to receive and transmit PPDUs based on the MU-MIMO scheduling information elements. The processor 810 is configured to implement the MAC layer and/or the PHY layer for implementing the embodiments of the present invention shown in FIGS. 2-7 .

[0119]

Processor 810 and/or transceiver 830 may include application specific integrated circuits (ASICs), separate chipsets, logic circuits, and/or data processing units.

When embodiments of the present invention are implemented in software, the aforementioned methods can be implemented in modules (i.e., processes, functions, etc.) for performing the aforementioned functions. Modules may be stored in memory 820 and executed by processor 810. Memory 820 may be internal or external to processor 810, and may be coupled to processor 810 using a variety of well-known means.

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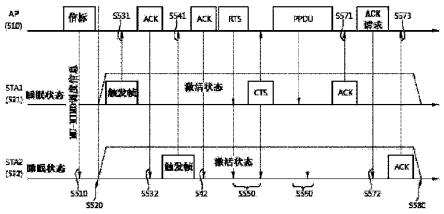
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(54)发明名称

在支持功率节省模式操作的无线局域网系统中发送和接收物理层会聚过程协议数据单元的方法及其装置

(57)摘要

提供了一种在无线局域网(WLAN)中发送数据帧的方法。该方法包括由接入点(AP)将包括有关用于数据帧传输的时间段的信息的调度信息元发送给第一站(STA)和第二STA,其中调度信息元包括指示时间段的开始时间点的偏移字段,并且在由偏移字段指示的开始时间点之后,由AP通过使用多用户多输入多输出(MU-MIMO)传输方案将数据帧发送给第一STA和第二STA。



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1. 一种在无线局域网(WLAN)中发送数据帧的方法,所述方法包括:

由接入点(AP)将包括有关用于数据帧传输的时间段的信息的调度信息元发送给第一站(STA)和第二 STA,其中所述调度信息元包括指示所述时间段的开始时间点的偏移字段;和

在由所述偏移字段指示的所述开始时间点之后,由所述 AP 通过使用多用户多输入多输出(MU-MIMO)传输方案将所述数据帧发送给所述第一 STA 和所述第二 STA。

2. 根据权利要求 1 所述的方法,进一步包括:由所述第一 STA 和所述第二 STA 在由所述偏移字段指示的所述开始时间点通过转变为唤醒状态来操作。

3. 根据权利要求 2 所述的方法,

其中,所述调度信息元包括指示所述数据帧传输的目标 STA 组的组标识符,并

其中,所述目标 STA 组包括所述第一 STA 和所述第二 STA。

4. 根据权利要求 3 所述的方法,其中,通过转变为所述唤醒状态的操作包括:

基于所述调度信息元的所述组标识符字段由所述第一 STA1 和所述第二 STA2 的每个 STA 确定所述每个 STA 是否是所述目标 STA 组的成员 STA;以及

如果所述每个 STA 是所述成员 STA,则由所述每个 STA 通过转变为所述唤醒状态来操作。

5. 根据权利要求 4 所述的方法,

其中,所述调度信息元进一步包括指示所述时间段的持续时间的持续时间字段,并且

其中所述数据帧的发送是在由所述持续时间字段指示的持续时间内执行的。

6. 根据权利要求 5 所述的方法,进一步包括:当从所述开始时间点经过了所述时间段的时候,由所述第一 STA 和所述第二 STA 通过转变为睡眠状态来操作。

7. 根据权利要求 6 所述的方法,其中,所述调度信息元进一步包括指示所述时间段周期性重新开始的间隔的间隔子字段,并且

进一步包括由所述第一 STA 和所述第二 STA 在相对于所述开始时间点的每个间隔中通过转变为所述唤醒状态来操作。

8. 根据权利要求 4 所述的方法,

其中,所述数据帧包括含有用于解释所述数据帧的信息的信号字段和数据单元,并且

其中,所述信号字段包括所述组标识符和指示分别分配给所述第一 STA 和所述第二 STA 的空间流的数目的指示符。

9. 根据权利要求 8 所述的方法,进一步包括:当所述指示符指示分配的空间流的数目是 0 的时候,由所述第一 STA 和所述第二 STA 通过转变为睡眠状态来操作。

10. 根据权利要求 1 所述的方法,进一步包括:

由所述 AP 从所述第一 STA 接收第一触发帧以通知在所述开始时间点之后所述第一 STA 准备接收所述数据帧;和

由所述 AP 从所述第二 STA 接收第二触发帧以通知在所述开始时间点之后所述第二 STA 准备接收所述数据帧。

11. 根据权利要求 10 所述的方法,其中,在接收到所述第一触发帧和所述第二触发帧之后发送所述数据帧。

12. 一种无线装置,包括:

收发机，所述收发机用于发送和接收无线电信号；和

处理器，所述处理器功能地耦合到所述收发机，

其中，所述处理器被配置用于：

将包括有关用于数据帧传输的时间段的信息的调度信息元发送给第一 STA 和第二 STA，其中所述调度信息元包括指示所述时间段的开始时间点的偏移字段；以及

在由所述偏移字段指示的所述开始时间点之后，通过使用 MU-MIMO 传输方案将所述数据帧发送给所述第一 STA 和所述第二 STA。

在支持功率节省模式操作的无线局域网系统中发送和接收物理层会聚过程协议数据单元的方法及其装置

技术领域

[0001] 本发明涉及无线局域网(WLAN)系统，尤其是，涉及在支持功率节省模式操作的WLAN系统中由站(STA)发送和接收物理层会聚过程(PLCP)协议数据单元(PPDU)的方法。

背景技术

[0002] 随着信息通信技术的提升，近来已经开发了各种无线通信技术。在无线通信技术之中，无线局域网(WLAN)是一种技术，通过该技术在家庭或者商务中、或者在提供特定服务的区域中，通过使用便携式终端，诸如个人数字助理(PDA)、膝上电脑、便携式多媒体播放器(PMP)等等，能够以无线方式进行互联网接入。

[0003] IEEE802.11n是最近引入的技术标准，以克服在WLAN中被认为是缺点的受限的数据速率。IEEE802.11n被设计为提高网络速度和可靠性，并且扩展无线网络的操作距离。更具体地说，IEEE802.11n支持高吞吐量(HT)，即，最多540Mbps以上的数据处理速率，并且基于在发射机和接收机两者中使用多个天线以将传输误差减到最小和优化数据速率的多输入和多输出(MIMO)技术。

[0004] WLAN系统支持激活模式和功率节省模式作为站(STA)的操作模式。激活模式指的是STA以能够发送和接收帧的唤醒状态操作的操作模式。另一方面，功率节省模式支持需要处于激活状态来接收帧的STA的功率节省。当不是STA能够接入无线电介质的时间段的时候，支持功率节省模式(PSM)的STA能够通过以睡眠模式操作来避免不必要的功率消耗。也就是说，STA仅仅对于帧能够被发送给STA的时间段，或者STA能够发送帧的时间段以唤醒状态操作。随着WLAN的广泛应用和使用WLAN的应用的多样化，近来存在对于支持比由IEEE802.11n支持的数据处理速率更高的吞吐量的新WLAN系统的需要。支持非常高吞吐量(VHT)的下一代WLAN系统是IEEE802.11n WLAN系统的下一个版本，并且是近来已经提出以在MAC服务接入点(SAP)中支持1Gbps以上的数据处理速率的IEEE802.11WLAN系统的一种。

[0005] 为了有效地利用无线电信道，下一代WLAN系统支持多个非接入点(AP)站(STA)同时接入信道的多用户多输入多输出(MU-MIMO)传输。按照MU-MIMO传输，AP能够将物理层会聚过程(PLCP)协议数据单元(PPDU)同时发送给一个或多个MIMO配对的STA。

[0006] 但是，由于以功率节省模式操作的STA通过在睡眠状态和唤醒状态之间转变来操作，所以AP的MU-MIMO传输取决于MU-MIMO配对的STA的操作状态。因此，AP需要将有关用于MU-MIMO传输的时间段的信息提供给MU-MIMO配对的STA。因此，存在对于在支持功率节省模式操作的WLAN系统中通过使用MU-MIMO传输方案发送和接收PPDU的方法的需要。

发明内容

[0007] 技术问题

[0008] 本发明提供了一种在支持功率节省模式操作的无线局域网(WLAN)系统中由站

(STA)发送和接收物理层会聚过程(PLCP)协议数据单元(PPDU)的方法。

[0009] 问题的解决方案

[0010] 在一个方面中,提供了一种在无线局域网(WLAN)中发送数据帧的方法。该方法包括:由接入点(AP)将包括有关用于数据帧传输的时间段的信息的调度信息元发送给第一站(STA)和第二 STA,其中调度信息元包括指示时间段的开始时间点的偏移字段,并且在由偏移字段指示的开始时间点之后,由 AP 通过使用多用户多输入多输出(MU-MIMO)传输方案将数据帧发送给第一 STA 和第二 STA。

[0011] 该方法可以进一步包括:由第一 STA 和第二 STA 通过在由偏移字段指示的开始时间点转变为唤醒状态来操作。

[0012] 该调度信息元可以包括指示数据帧传输的目标 STA 组的组标识符,并且其中目标 STA 组包括第一 STA 和第二 STA。

[0013] 通过转变到唤醒状态的操作可以包括:基于调度信息元的组标识符字段由第一 STA1 和第二 STA2 的每个 STA 确定每个 STA 是否是目标 STA 组的成员 STA,并且如果每个 STA 是成员 STA,则由每个 STA 通过转变为唤醒状态来操作。

[0014] 该调度信息元可以进一步包括指示时间段的持续时间的持续时间字段,并且数据帧的发送可以在由持续时间字段指示的持续时间内执行。

[0015] 该方法可以进一步包括:当从开始时间点经过了时间段的时候,由第一 STA 和第二 STA 通过转变为睡眠状态来操作。

[0016] 该调度信息元可以进一步包括指示时间段周期性重新开始的间隔的间隔子字段,并且该方法可以进一步包括:由第一 STA 和第二 STA 在相对于开始时间点的每个间隔中通过转变为唤醒状态来操作。

[0017] 数据帧可以包括含有用于解释数据帧的信息的信号字段和数据单元,并且信号字段可以包括组标识符和指示分别分配给第一 STA 和第二 STA 的空间流的数目的指示符。

[0018] 该方法可以进一步包括:当指示符指示分配的空间流的数目是 0 的时候,由第一 STA 和第二 STA 通过转变为睡眠状态来操作。

[0019] 该方法可以进一步包括:由 AP 从第一 STA 接收第一触发帧以通知在开始时间点之后第一 STA 准备接收数据帧;以及由 AP 从第二 STA 接收第二触发帧以通知在开始时间点之后第二 STA 准备接收数据帧。

[0020] 可以在接收到第一触发帧和第二触发帧之后发送数据帧。

[0021] 在另一个方面中,提供了一种无线装置。该装置包括:收发机,该收发机用于发送和接收无线电信号,和处理器,该处理器功能地耦合到收发机,其中处理器被配置用于将包括有关用于数据帧传输的时间段的信息的调度信息元发送给第一 STA 和第二 STA,并且在由偏移字段指示的开始时间点之后,通过使用 MU-MIMO 传输方案将数据帧发送给第一 STA 和第二 STA。调度信息元包括指示时间段的开始时间点的偏移字段。

[0022] 本发明的有益效果

[0023] 接入点(AP)将有关用于多用户多输入多输出(MU-MIMO)传输的唤醒时段的信息提供给 MU-MIMO 配对的站(STA)。因此,STA 能够识别 AP 发送物理层会聚过程(PLCP)协议数据单元(PPDU)的时间点,并且能够按照识别的时间点通过转变为唤醒状态等待接收 PPDU。由于 STA 按照在其中发送 PPDU 的时间段保持唤醒状态,所以能够避免不必要的功率消耗。

[0024] AP 被配置为使得在接收到由 STA 发送的触发帧之后发送 PPDU，或者使得唤醒时段在每个传送业务指示映射（DTIM）传输时段中重新开始。因此，能够保证在 PPDU 传输之前 STA 处于接收等待状态之中。因此，能够保证非常可靠的 PPDU 传输，并且通过避免相同的业务的重复传输能够改善无线局域网（WLAN）系统的整体吞吐量。

附图说明

[0025] 图 1 是示出本发明的实施例可应用到的 WLAN 系统的配置的示意图。

[0026] 图 2 示出功率管理操作的示例。

[0027] 图 3 示出按照本发明的一个实施例的 PPDU 格式的示例。

[0028] 图 4 示出按照本发明的一个实施例的组 ID 管理帧的格式。

[0029] 图 5 示出按照本发明的一个实施例的 PPDU 传输方法。

[0030] 图 6 示出按照本发明的一个实施例的 MU-MIMO 调度信息元的格式。

[0031] 图 7 示出按照本发明的一个实施例的组 ID 管理帧格式的另一个示例。

[0032] 图 8 是示出按照本发明的一个实施例的无线装置的方框图。

具体实施方式

[0033] 图 1 是示出本发明的实施例可应用到的 WLAN 系统配置的示意图。

[0034] 参考图 1，WLAN 系统包括一个或多个基本服务集（BSS）。BSS 是能够经由成功的同步而互相通信的站（STA）的集合。BSS 不是表示特定区域的概念。

[0035] 基础结构 BSS 包括一个或多个非 AP STA STA1、STA2、STA3、STA4 和 STA5，提供分布服务的 AP（接入点），和连接多个 AP 的分布系统（DS）。在基础结构 BSS 中，AP 管理 BSS 的非 AP STA。

[0036] 另一方面，单独的 BSS（IBSS）以自组织（Ad-Hoc）模式操作。IBSS 不具有用于执行管理功能的集中管理实体，因为其不包括 AP。也就是说，在 IBSS 中，非 AP STA 被以分布方式管理。在 IBSS 中，所有 STA 可以由移动 STA 组成。所有 STA 形成自包含的网络，因为它们不被允许接入 DS。

[0037] STA 是某个功能介质，包括媒体访问控制（MAC），和满足电气与电子工程师协会（IEEE）802.11 标准的无线介质物理层接口。在下文中，STA 指的是 AP 和非 AP STA 两者。

[0038] 非 AP STA 为不是 AP 的 STA。非 AP STA 也可以称为移动终端、无线设备、无线发送/接收单元（WTRU）、用户设备（UE）、移动站（MS）、移动订户单元，或者简单地用户。为了解释方便起见，非 APSTA 在下文中将称为 STA。

[0039] AP 是用于提供通过用于与 AP 相关联的 STA 的无线介质到 DS 的连接的功能实体。虽然在包括 AP 的基础结构 BSS 中在 STA 之间的通信原则上经由 AP 执行，但是当建立直接链接的时候，STA 能够执行直接通信。AP 也可以称为中央控制器、基站（BS）、节点 B、基站收发机系统（BTS）、站点控制器等等。

[0040] 包括在图 1 中示出的 BSS 的多个基础结构 BSS 能够通过利用 DS 相互连接。扩展的服务集（ESS）是通过使用 DS 连接的多个 BSS。包括在 ESS 中的 AP 和/或 STA 能够彼此通信。在同一 ESS 中，STA 能够从一个 BSS 移动到另一个 BSS，同时执行无缝通信。

[0041] 在基于 IEEE802.11 的 WLAN 系统中，媒体访问控制（MAC）的基本接入机制是避免

冲突的载波侦听多路访问(CSMA/CA)机制。CSMA/CA 机制也称为 IEEE802.11MAC 的分布式协调功能(DCF),并且基本上采用“先听后讲”接入机制。在这种类型的接入机制中,AP 和/或 STA 在开始传输之前侦听无线信道或者介质。作为侦听的结果,如果确定介质处于空闲状态,则通过使用该介质开始帧传输。否则,如果侦听到介质处于占据状态,则 AP 和/或 STA 不开始其传输,而是设置并等待用于介质接入的延迟持续时间。

[0042] 除了 AP 和/或 STA 直接侦听介质的物理载波侦听之外,CSMA/CA 机制还包括虚拟载波侦听。该虚拟载波侦听被设计成补偿在介质接入中可能出现的问题,诸如隐藏节点问题。对于虚拟载波发送,WLAN 系统的 MAC 使用网络分配矢量(NAV)。NAV 是由当前使用介质或者具有使用介质的权利的 AP 和/或 STA 发送给另一个 AP 或者另一个 STA,以指示在该介质返回到可用状态之前的剩余时间的值。因此,设置为 NAV 的值对应于为了由发送对应帧的 AP 和/或 STA 使用介质而预留的时段。

[0043] AP 和/或 STA 可以执行交换请求发送(RTS)帧和准许发送(CTS)帧以通知其意图接入介质的过程。RTS 帧和 CTS 帧包括指示当支持实际的数据帧传输和接收确认(ACK)的时候,为了发送与接收 ACK 帧所需要的无线电介质接入而预留的持续时间的信息。一旦接收到从意图发送帧的 AP 和/或 STA 发送的 RTS 帧,或者一旦接收到从帧传输目标 STA 发送的 CTS 帧,另一个 STA 就能够被配置为在由 RTS/CTS 帧中包括的信息所指示的持续时间不接入介质。这能够通过关于持续时间配置 NAV 来实现。

[0044] 同时,如果对于帧传输和接收始终执行信道侦听,则导致 STA 持久的功率消耗。由于在接收状态下的功率消耗非常不同于在传输状态下的功率消耗,所以如果需要持续保持接收状态,则在通过使用电池操作的 STA 中产生相对大的功率消耗。因此,当在 WLAN 系统中 STA 通过持久保持接收待机状态来侦听信道的时候,就 WLAN 吞吐量而言,在没有特定协同效果的情况下,可能导致低效的功率消耗,并且因此就功率管理而言,可能是不适当的。

[0045] 为了补偿上述的问题,WLAN 系统支持 STA 的功率管理(PM)模式。在 WLAN 系统中,STA 的功率管理(PM)模式被划分为激活模式和功率节省(PS)模式。基本上,STA 以激活模式操作。当以激活模式操作的时候,STA 能够以唤醒状态操作,以便能够始终接收帧。

[0046] 当以 PS 模式操作的时候,STA 通过在睡眠状态和唤醒状态之间转变来操作。当以睡眠状态操作的时候,STA 以最小功率操作,并且不接收从 AP 发送的包括数据帧的无线电信号。此外,以睡眠状态操作的 STA 不执行信道侦听。

[0047] STA 以睡眠状态操作越长,功率消耗越少,并且因此,STA 操作得越长。但是,由于在睡眠状态下不能发送和接收帧,所以 STA 不能无条件地长时间操作。如果以睡眠状态操作的 STA 具有要发送给 AP 的帧,则 STA 能够转变为唤醒状态以发送该帧。但是,如果 AP 具有要发送给以睡眠状态操作的 STA 的帧,则 STA 不能接收该帧,并且无法知道存在要接收的帧。因此,STA 可能需要知道是否存在要发送给 STA 的帧,并且如果存在该帧,则可能需要按照特定时段转变为唤醒状态的操作。按照这种操作,AP 能够将帧发送给 STA。这将参考图 2 描述。

[0048] 图 2 示出功率管理操作的示例。

[0049] 参考图 2,AP210 按照特定时段将信标帧发送给在 BSS 中的 STA(步骤 S210)。该信标帧包括业务指示映射(TIM)信息元。TIM 元包括用于报告 AP210 已经缓存了与 STA 相关联的业务并且帧将要被发送的信息。TIM 元的示例包括用于报告单播帧的 TIM 和用于报

告多播或者广播帧的传送业务指示映射(DTIM)。

[0050] 每当信标帧被发送三次时,AP210 发送 DTIM 一次。

[0051] STA1221 和 STA2222 是以 PS 模式操作的 STA。STA1221 和 STA2222 能够被配置为使得它们能够在特定时段的每个唤醒间隔中从睡眠状态转变为唤醒状态,以接收由 AP210 发送的 TIM 元。

[0052] 特定的唤醒间隔能够被配置为使得 STA1221 在每个信标间隔中转变为唤醒状态以接收 TIM 元。因此,当 AP210 发送第一信标帧(步骤 S211)的时候,STA1221 转变为唤醒状态(步骤 S221)。STA1221 接收信标帧,并且获取 TIM 元。如果获取的 TIM 元指示存在要发送给 STA1221 的帧,那么,STA1221 将请求 AP210 去发送帧的 PS 轮询帧发送给 AP210(步骤 S221a)。AP210 响应于 PS 轮询帧将帧发送给 STA1221(步骤 S231)。一旦完成帧接收,STA1221 通过转变回睡眠状态来操作。

[0053] 当 AP210 发送第二信标帧的时候,介质忙,也就是说,例如另一个设备访问该介质。因此,AP210 不能按照正确的信标间隔发送信标帧,但是,可以在延迟的时间点发送信标帧(步骤 S212)。在这种情况下,STA1221 按照该信标间隔将其模式切换到唤醒状态,但是,不能接收以延迟发送的信标帧,并且因此,转变回到睡眠状态(步骤 S222)。

[0054] 当 AP210 发送第三信标帧的时候,该信标帧可以包括被配置为 DTIM 的 TIM 元。但是,由于介质忙,AP210 以延迟发送信标帧(步骤 S213)。STA1221 通过按照信标间隔转变为唤醒状态来操作,并且能够通过使用由 AP210 发送的信标帧获取 DTIM。通过 STA1221 获取的 DTIM 指示没有要发送给 STA1221 的帧,并且存在用于另一个 STA 的帧。因此,STA1221 通过转变回到睡眠状态来操作。在发送该信标帧之后,AP210 将帧发送给对应的 STA(步骤 S232)。

[0055] AP210 发送第四信标帧(步骤 S214)。但是,由于 STA1221 不能通过接收 TIM 元两次来获取指示存在用于 STA1221 的缓存的业务的信息,STA1221 可以调节用于接收 TIM 元的唤醒间隔。或者,如果用于调节 STA1221 的唤醒间隔值的信令信息包括在由 AP210 发送的信标帧中,则 STA1221 的唤醒间隔值可以被调节。代替对于每个信标间隔转变操作状态来接收 TIM 元,STA1221 能够在本实施例中被配置为使得对于每三个信标间隔操作状态被转变一次。因此,STA1221 不能获取对应的 TIM 元,因为 AP210 发送第四信标帧(步骤 S214),并且当发送第五信标帧的时候维持睡眠状态(步骤 S215)。

[0056] 当 AP210 发送第六信标帧(步骤 S216)的时候,STA1221 通过转变为唤醒状态来操作,并且获取包括在该信标帧中的 TIM 元(步骤 S224)。TIM 元是指示广播帧存在的 DTIM,并且因此,STA1221 接收由 AP210 发送的广播帧(步骤 S234),代替将 PS 轮询帧发送给 AP210。

[0057] 同时,分配给 STA2222 的唤醒间隔可以具有比 STA1221 更长的时段。因此,当发送第五信标帧(步骤 S215)的时候,STA2222 能够通过转变为唤醒状态接收 TIM 元(步骤 S225)。STA2222 通过使用 TIM 元知道存在要发送给 STA2222 的帧,并且将 PS 轮询帧发送给 AP210 以请求传输(步骤 S225a)。AP210 响应于 PS 轮询帧将帧发送给 STA2222(步骤 S233)。

[0058] 为了操作图 2 的 PS 模式,TIM 元包括指示是否存在要发送给 STA 的帧的 TIM,或者指示是否存在广播 / 多播帧的 DTIM。可以通过配置 TIM 元的字段实现 DTIM。

[0059] 与常规的 WLAN 系统不同,下一代 WLAN 系统需要更高的吞吐量。这称作非常高吞吐量(VHT)。对此,下一代 WLAN 系统意图支持 80MHz、连续的 160MHz、非连续的 160MHz 带宽

传输和/或更高的带宽传输。此外，为了更高的吞吐量提供多用户多输入多输出(MU-MIMO)传输方案。在下一代 WLAN 系统中，AP 能够将数据帧同时地发送给至少一个或多个 MIMO 配对的 STA。在图 1 的 WLAN 系统中，AP10 能够同时地将数据发送给包括与 AP10 相关联的多个 STA21、22、23、24 和 25 之中的至少一个或多个 STA 的 STA 组。在这种情况下，发送给每个 STA 的数据能够经由不同的空间流发送。由 AP10 发送的数据帧能够称为在 WLAN 系统的物理层(PHY)中产生和发送的物理层会聚过程(PLCP)协议数据单元(PPDU)。在本发明的实施例中假设与 AP10MU-MIMO 配对的传输目标 STA 组是 STA121、STA222、STA323 和 STA424。在这种情况下，空间流不能分配给在传输目标 STA 组中的特定 STA，并且因此数据不能被发送。同时，假设 STA525 是与 AP 相关联，但是不包括在传输目标 STA 组中的 STA。

[0060] 图 3 示出按照本发明的一个实施例的 PPDU 格式的示例。

[0061] 参考图 3，PPDU300 包括 L-STF 字段 310、L-LTF 字段 320、L-SIG 字段 330、VHT-SIGA 字段 340、VHT-STF 字段 350、VHT-LTF 字段 360、VHT-SIGB 字段 370，和数据字段 380。

[0062] 构成 PHY 的 PLCP 子层通过将必要的信息附加给 PSDU 来将从 MAC 层传送的 PLCP 服务数据单元(PSDU)变换为数据字段 380，通过附加若干字段，诸如 L-STF 字段 310、L-LTF 字段 320、L-SIG 字段 330、VHT-SIGA 字段 340、VHT-STF 字段 350、VHT-LTF 字段 360、VHT-SIGB 字段 370 等来产生 PPDU300，并且经由构成 PHY 的物理介质依赖(PMD)子层将 PPDU300 传送给一个或多个 STA。

[0063] L-STF 字段 310 用于帧定时获取、自动增益控制(AGC)会聚、粗略的频率获取等等。

[0064] L-LTF 字段 320 用于对于 L-SIG 字段 330 和 VHT-SIGA 字段 340 解调的信道估计。

[0065] 当 L-STA 接收 PPDU 来获取数据的时候使用 L-SIG 字段 330。

[0066] VHT-SIGA 字段 340 包括用于解释接收的 PPDU300 的控制信息，作为与 AP MIMO 配对的 VHT-STA 所需的公共控制信息。VHT-SIGA 字段 340 包括有关用于多个 MIMO 配对的 STA 的每一个的空间流的信息、带宽信息、关于是否使用空时块编译(STBC)的识别信息、用于传输目标 STA 组的组标识符、关于分配给在由组标识符指示的传输目标组 STA 中包括的 STA 的空间流的信息、关于传输目标 STA 的短保护间隔(GI)的信息、编译信息、调制和编译方案(MCS)信息、指示是否执行波束形成的信息，和 CRC 相关的信息。在此处，组标识符可以包括当前使用的 MIMO 传输方法是 MU-MIMO 还是 SU-MIMO。可以通过使用两个 OFDM 符号发送 VHT-SIGA 字段 340。在这种情况下，与首先到达的符号相关的字段能够被称为 VHT-SIGA1，并且与后续的符号相关的字段能够被称为 VHT-SIGA2 字段。

[0067] VHT-STF 字段 350 用于改善在 MIMO 传输中 AGC 估计的性能。

[0068] 当 STA 估计 MIMO 信道的时候使用 VHT-LTF 字段 360。由于下一代 WLAN 系统支持 MU-MIMO，所以 VHT-LTF 字段 360 能够通过在其上发送 PPDU300 的空间流的数目来配置。此外，当支持和执行全信道探测的时候，VHT-LTF 的数目可以增加。

[0069] VHT-SIGB 字段 370 包括当多个 MIMO 配对的 STA 接收 PPDU300 来获取数据的时候需要的专用控制信息。因此，STA 可以被设计为使得只有当在 VHT-SIGB 字段 370 中包括的公共控制信息指示当前接收的 PPDU300 是使用 MU-MIMO 传输发送的时，解码 VHT-SIGB 字段 370。相反地，STA 可以被设计为使得当公共控制信息指示当前接收的 PPDU300 用于单个 STA(包括 SU-MIMO)的时候，不解码 VHT-SIGB 字段 370。

[0070] VHT-SIGB 字段 370 包括在发送给每个 STA 的数据字段中包括的 PSDU 的长度信

息、MSC 信息，和在数据字段中包括的尾部相关信息。此外，VHT-SIGB 字段 370 包括有关编码和速率匹配的信息。VHT-SIGB 字段 370 的大小可以按照 MIMO 传输方法（MU-MIMO 或者 SU-MIMO）和用于 PPDU 传输的信道带宽而不同。

[0071] 数据字段 380 包括意图发送给 STA 的数据。数据字段 380 包括用于初始化加扰器和 MAC 层的 MAC 协议数据单元（MPDU）被传送到的 PLCP 服务数据单元（PSDU）的服务字段、包括将卷积编码器重置为零状态所需的位序列的尾部字段，和用于标准化数据字段长度的填充位。

[0072] 在图 1 的 WLAN 系统中，如果 AP10 意图发送数据给 STA121、STA222 和 STA323，那么，PPDU 可以被发送给包括 STA121、STA222、STA323 和 STA424 的 STA 组。在这种情况下，如图 2 所示，空间流不可以分配给 STA424，并且特定数目的空间流可以分配给 STA121、STA222 和 STA323 的每个，然后数据能够据此发送。在图 2 的示例中，一个空间流被分配给 STA121，三个空间流被分配给 STA222，并且两个空间流被分配给 STA323。

[0073] 为了通过使用图 3 的 PPDU 格式经由 MU-MIMO 传输方案发送数据给接收 STA 组，有关 STA 组的信息需要提供给每个 STA。也就是说，只有当预先接收到与要向其分配的组 ID 相关的信息时，每个 STA 能够知道其是发送的 PPDU 的目标 STA。

[0074] AP 能够在经由 MU-MIMO 传输方案发送 PPDU 之前将组 ID 管理消息发送给每个 STA。组 ID 管理消息包括分配给 STA 的组 ID 和与组 ID 相关的空间流信息。组 ID 管理消息能够经由包括组 ID 管理信息元的组 ID 管理帧的传输而发送给 STA。但是，组 ID 管理信息元能够通过被包括在另一个管理帧中来发送。

[0075] 图 4 示出按照本发明的一个实施例的组 ID 管理帧的格式。

[0076] 参考图 4，组 ID 管理帧 400 包括类别字段 410、动作字段 420，和组 ID 管理信息元字段 430。

[0077] 类别字段 410 和动作字段 420 被配置为指示对应的帧是组 ID 管理帧。

[0078] 组 ID 管理信息元字段 430 包括元 ID 字段 431、长度字段 432，和至少一个空间流位置字段 433。

[0079] 元 ID 字段 431 被配置为指示对应的信息元是组 ID 管理信息元。长度字段 432 被配置为指示组 ID 管理信息元的长度。

[0080] 空间流位置字段 433 包括对于每个组 ID 指示是否空间流属于特定的组，并且如果其属于特定的组，则空间流所位于的特定位置的信息。

[0081] 例如，假设空间流位置字段 433 的位被分别地设置为值 0、1、2、4、0、0、0、…、0、0、0。能够看出，接收组 ID 管理帧 400 的 STA 包括在基于组 ID2、组 ID3，和组 ID4 的 STA 组中。在这样的条件下，STA 能够知道其空间流是在具有组 ID2 的组中的第一空间流，在具有组 ID3 的组中的第二空间流，和在具有组 ID4 的组中的第四空间流。

[0082] 空间流的位置指的是当 STA 接收要发送给对于特定组 ID 的 STA 组的 PPDU 的时候，必须接收位于对应于空间流位置值的位置的空间流。此外，能够通过使用关于分配给 STA 并且包括在具有图 3 的 PPDU 格式的 VHT-SIGA 字段 340 中的空间流的信息确定哪个空间流用于 STA。

[0083] VHT-SIGA 字段 340 的关于空间流的信息能够指示分配给空间流位置的空间流的数目。例如，如图 3 所示，假设 VHT-SIGA 字段包括空间流信息。该空间流信息指示用于第

一空间流位置的空间流的数目是 1，用于第二空间流位置的空间流的数目是 3，用于第三空间流位置的空间流的数目是 2，并且用于第四空间流位置的空间流的数目是 0。如果指示组 ID2 的信息包括在发送的 PPDU 的 VHT-SIGA 字段中，则接收 STA 能够经由分配给第一位置的一个空间流来接收数据。如果指示组 ID3 的信息包括在 VHT-SIGA 字段中，则接收 STA 能够经由分配给第二位置的三个空间流来接收数据。如果指示组 ID4 的信息包括在 VHT-SIGA 字段中，则接收 STA 能够确定没有分配给第四位置的空间流，也就是说，没有要发送给 STA 的数据。

[0084] 同时，如果属于基于特定组 ID 的 STA 组的 STA 以功率节省模式操作，则当 AP 经由 MU-MIMO 传输方案发送 PPDU 给 STA 的时候，STA 必须保持在唤醒状态中。但是，由于操作在睡眠状态的 STA 无法知道在 AP 开始发送 PPDU 的特定时间点，所以其很难确定转变为唤醒状态的时间。如果 STA 转变为唤醒状态的时间比 AP 执行 MU-MIMO 传输的时间更快，则在操作模式转变时间之后且在 MU-MIMO 传输时间点之前出现不必要的功率消耗。为了防止这些，需要基于特定组 ID 的 STA 组的 STA 能够通过在 MU-MIMO 传输时间同时转变为唤醒状态来操作的方法。为此，建议 AP 将 MU-MIMO 调度信息传送给 STA。

[0085] 图 5 示出按照本发明的一个实施例的 PPDU 传输方法。STA1521 和 STA2522 与 AP510MU-MIMO 配对。STA1521 和 STA2522 通过至少一个组 ID 分组，并且是以功率节省模式操作的 STA。

[0086] 参考图 5，AP510 将 MU-MIMO 调度信息发送给 STA1521 和 STA2522（步骤 S510）。MU-MIMO 调度信息包括与通过使用 MU-MIMO 传输方案将 PPDU 发送给特定的 STA 组的时间相关的信息。当 MU-MIMO 调度信息元通过被包括在信标帧中来发送的时候，MU-MIMO 调度信息能够被传送。该信标帧可以进一步包括指示存在用于 STA 的缓存的业务的 TIM 元。

[0087] 图 6 示出按照本发明的一个实施例的 MU-MIMO 调度信息元的格式。

[0088] 参考图 6，MU-MIMO 调度信息元 600 包括元 ID 字段 610、长度字段 620、组 ID 字段 630，和唤醒调度字段 640。

[0089] 元 ID 字段 610 被设置为指示特定的元是 MU-MIMO 调度信息元的值。长度字段 620 被设置为指示 MU-MIMO 调度信息元 600 长度的值。

[0090] 组 ID 字段 630 被设置为指示由 AP 发送的 PPDU 的传输目标 STA 组的组 ID 值。STA 能够通过使用组 ID 字段 630 的组 ID 值确定 MU-MIMO 调度信息元 600 是否是用于它们的信息元。如果组 ID 字段 630 不同于接收 STA 的组 ID 值，则接收 STA 丢弃信息元，并且按照典型的功率节省模式操作方法操作。如果唤醒调度字段 640 等于分配给接收 STA 的组 ID 值，则接收 STA 基于在唤醒调度字段 640 中包括的信息以功率节省模式操作。

[0091] 唤醒调度字段 640 包括唤醒偏移子字段 641、唤醒持续时间子字段 642，和唤醒间隔子字段 643。

[0092] 唤醒偏移子字段 641 指示相对于唤醒定时的时间间隔，唤醒定时是从接收 MU-MIMO 调度信息元的时间点开始的第一操作状态转变时间。

[0093] 唤醒持续时间子字段 642 指示唤醒时段的时间长度，唤醒时段是在转变为唤醒状态之后状态保持的时间段。

[0094] 唤醒间隔子字段 643 指示在连续的唤醒时段之间的时间间隔。

[0095] 回到参考图 5，以功率节省模式操作的 STA1521 和 STA2522 能够通过使用发送的

TIM 元知道存在用于它们的缓存的业务。此外，有关对于基于向其分配的组 ID 的 STA 组的 MU-MIMO 传输开始的时间点的信息能够通过使用 MU-MIMO 调度信息元来获得。

[0096] STA1521 和 STA2522 在唤醒定时转变为唤醒状态，并且等待由 AP510 执行的 MU-MIMO 传输（步骤 S520），唤醒定时是由 MU-MIMO 调度信息元的唤醒偏移子字段 641 指示的时间点。

[0097] 在转变为唤醒状态之后，STA1521 将触发帧发送给 AP510，并且由此开始服务时段（步骤 S531）。在转变为唤醒状态之后，STA2522 也将触发帧发送给 AP510，并且由此开始服务时段（步骤 S542）。这是向 AP510 报告属于传输目标 STA 组的 STA 转变为唤醒状态，并且在经由 MU-MIMO 传输方案发送 PPDU 之前等待传输。这是因为不能假设对于 MU-MIMO 传输分组的 STA 接收相同的信标帧，并且同时转变为唤醒状态，因为监听间隔，即，用于接收信标帧的间隔，可以在 STA 之间不同。

[0098] 响应于由 STA1521 和 STA2522 发送的触发帧，AP510 发送相应的确认（ACK）帧（步骤 S532 和 S542）。

[0099] 如果以功率节省模式操作的 STA 按照特定间隔接收信标帧，并且唤醒调度按照这个间隔确定，则能够假设 STA 同时转变为唤醒状态。在这种情况下，STA1521 和 STA2522 将触发帧发送给 AP510 以开始服务时段的过程能够被省略。

[0100] AP510 通过交换 RTS/CTS 帧来配置 NAV（步骤 S550），并且相对于开始服务时段的 STA 经由 MU-MIMO 传输方案开始发送 PPDU（步骤 S560）。

[0101] STA1521 响应于接收的 PPDU 将 ACK 发送给 AP510（步骤 S571）。在从 STA1521 接收到 ACK 之后，AP510 将 ACK 请求帧发送给 STA2522 以请求 ACK 传输（步骤 S572）。STA2522 响应于 ACK 请求帧将 ACK 帧发送给 AP510（步骤 S573）。在这种情况下，如果包括在 PPDU 中的数据单元由 A-MPDU 格式组成，则由 STA1521 和 STA2522 发送的 ACK 可以是块 ACK。

[0102] 如果由 AP510 发送的 PPDU 不包括用于 STA1521 和 / 或 STA2522 的数据，则 STA1521 和 / 或 STA2522 能够在由唤醒持续时间子字段 642 指示的时间段经过之前通过转变为睡眠状态来操作。PPDU 是否包括用于 STA1521 和 / 或 STA2522 的数据能够基于在 PPDU 的 VHT-SIGA 字段中包括的有关空间流的信息来确定。如果分配的空间流的数目是“0”，则 STA1521 和 / 或 STA2522 确定没有意图发送给 STA1521 和 / 或 STA2522 的数据，并且能够通过转变为睡眠状态来操作。

[0103] 在 STA 以功率节省模式操作的 STA 之中，如果存在不发送触发帧给 AP，并且不开始服务时段的 STA，则认为 STA 不接收 MU-MIMO 调度信息元，并且因此，不在 STA 上执行 MU-MIMO 传输。

[0104] STA1521 和 STA2522 完成从 AP510 接收 PPDU，并且在经过了由唤醒持续时间子字段 642 指示的时间段时，通过转变为睡眠状态来操作（步骤 S580）。

[0105] STA1521 和 STA2522 的唤醒时段可以周期重复。这能够通过将唤醒间隔子字段 643 包括进调度信息元 600 中实现。唤醒间隔子字段 643 指示唤醒时段如上所述重复的间隔。在这种情况下，该间隔必须比唤醒间隔子字段 643 的值更大。因此，STA1521 和 STA2522 能够相对于由唤醒偏移子字段 641 指定的唤醒时段开始时间点，在由唤醒间隔子字段 643 指示的每个间隔中通过转变为唤醒状态来操作。AP510、STA1521 和 STA2522 能够重复地执行在前面提到的唤醒时段中定义的功率节省模式操作方法。

[0106] 同时，如果具有图 6 格式的 MU-MIMO 调度信息元在每个信标间隔中通过包括在信标帧中广播，则可以进一步提高由信标帧的传输产生的开销。因此，MU-MIMO 调度信息元能够通过包括在单播帧中来发送。这能够经由包括 MU-MIMO 调度信息元的单独的动作 / 管理帧的传输来实现，或者信息元能够通过另外包括在图 4 的分组 ID 管理帧中被发送。

[0107] 图 7 示出按照本发明的一个实施例的组 ID 管理帧格式的另一个示例。

[0108] 参考图 7，组 ID 管理帧 700 包括类别字段 710、动作字段 720、组 ID 管理信息元字段 730，和 MU-MIMO 调度信息元字段 740。

[0109] 类别字段 710 和动作字段 720 被设置为指示特定的帧是组 ID 管理帧 700 的值。但是，为了确定组 ID 管理帧是否以图 4 的格式，或者以进一步包括 MU-MIMO 调度信息元字段 740 的格式配置，类别字段 710 和动作字段 720 能够被设置为能够与图 4 的类别字段 410 和动作字段 420 的值相区分的值。如果类别字段 710 和动作字段 720 被设置为图 4 的相同的字段值，则组 ID 管理帧 700 可以进一步包括指示进一步包括 MU-MIMO 调度信息元字段 740 的位字段。

[0110] 组 ID 管理信息元字段 730 包括与图 4 的组 ID 管理信息元字段 430 相同的字段。因此，STA 基于相同的协议操作。

[0111] MU-MIMO 调度信息元字段 740 包括与图 6 的 MU-MIMO 调度信息元 600 相同的字段。因此，STA 基于相同的协议操作，并且在接收到图 5 的信标帧之后，AP 和 STA 的操作过程能够通过引用被结合在此处。

[0112] 图 8 是示出按照本发明的一个实施例的无线装置的方框图。

[0113] 参考图 8，无线装置 800 包括处理器 810、存储器 820 和收发机 830。收发机 830 发送和 / 或接收无线电信号，并且实现 IEEE802.11 物理 (PHY) 层。功能地耦合到收发机 830 的处理器 810 能够支持功率节省模式操作，其通过在唤醒状态和睡眠状态之间转变来操作。处理器 810 能够被配置为发送与接收 MU-MIMO 调度信息元，并且基于 MU-MIMO 调度信息元接收和发送 PPDU。处理器 810 被配置为实现 MAC 层和 / 或 PHY 层用来实现在图 2 至图 7 中示出的本发明实施例。

[0114] 处理器 810 和 / 或收发机 830 可以包括专用集成电路 (ASIC)、单独的芯片组、逻辑电路，和 / 或数据处理单元。当本发明的实施例以软件实现的时候，前面提到的方法能够以用于执行前面提到的功能的模块 (即，处理、功能等等) 实现。模块可以存储在存储器 820 中，并且可以由处理器 810 执行。存储器 820 可以位于处理器 810 的内部或者外部，并且可以通过使用各种各样公知的手段耦合到处理器 810。

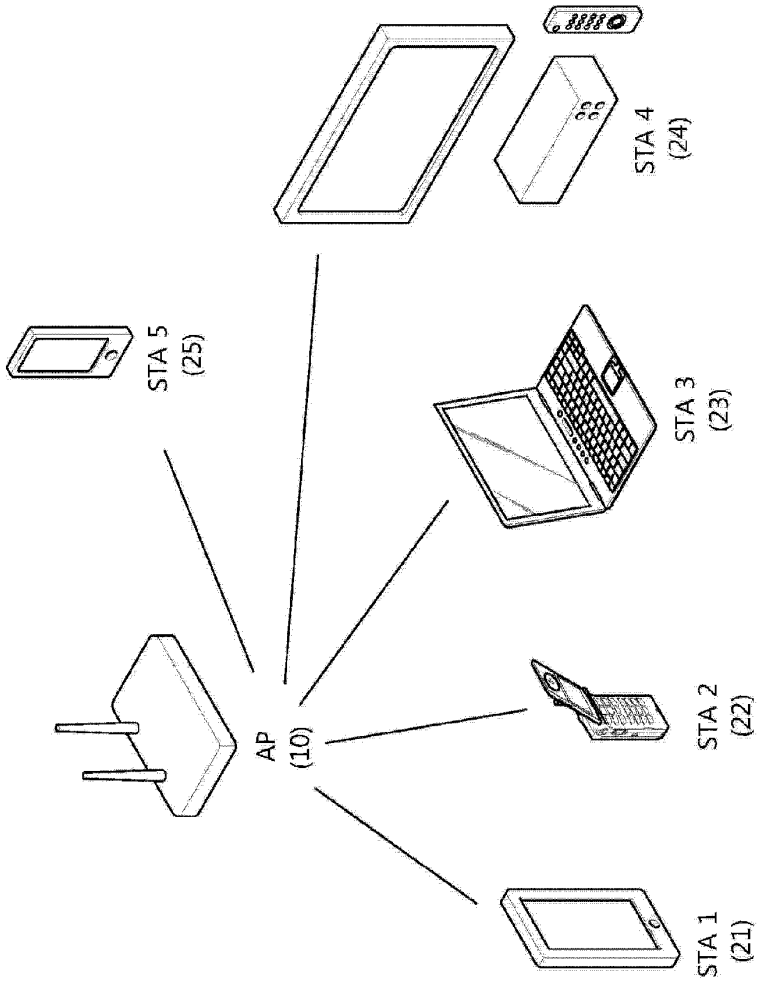


图 1

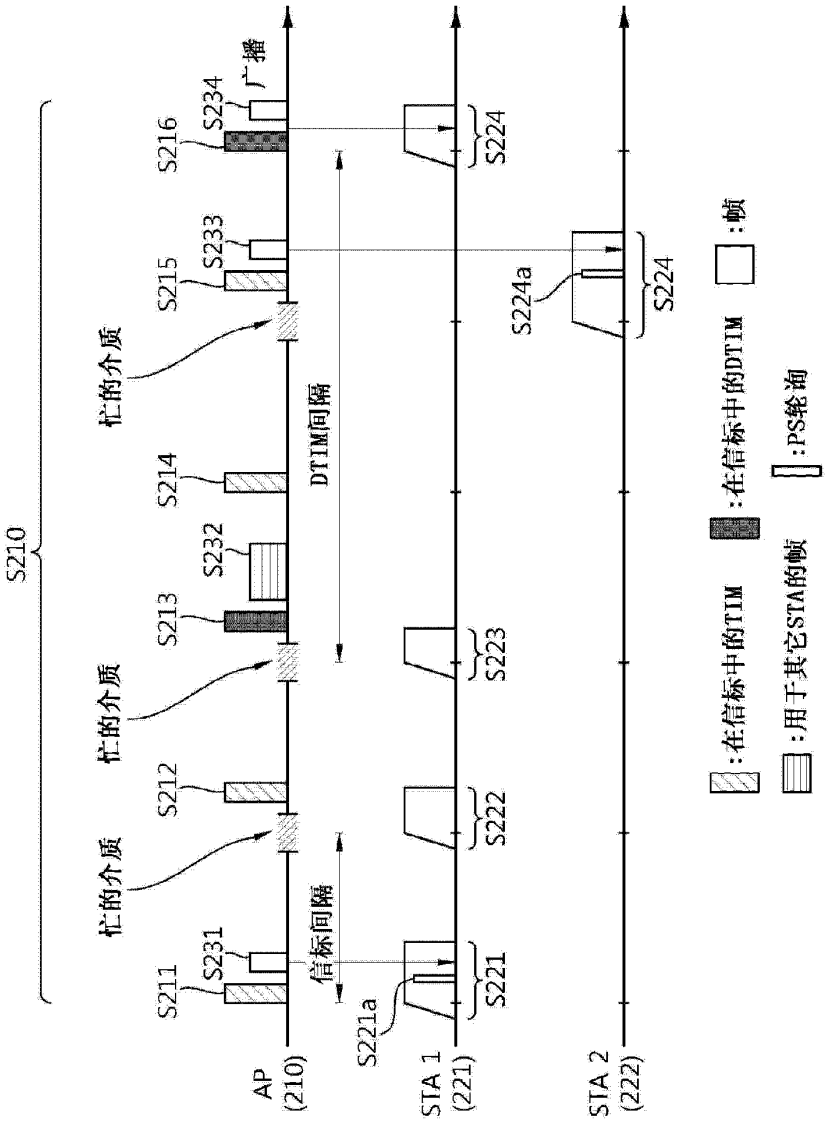

S210
S211
S231
忙的介质
S212
忙的介质
S213
S232
忙的介质
S214
S215
S233
忙的介质
S216
S234
广播
信标间隔
DTIM间隔
S221a
S221
S222
S223
S224
S224a
S224
AP (210)
STA 1 (221)
STA 2 (222)
:在信标中的TIM
:在信标中的DTIM
:帧
:用于其它STA的帧
:PS轮询

图 2

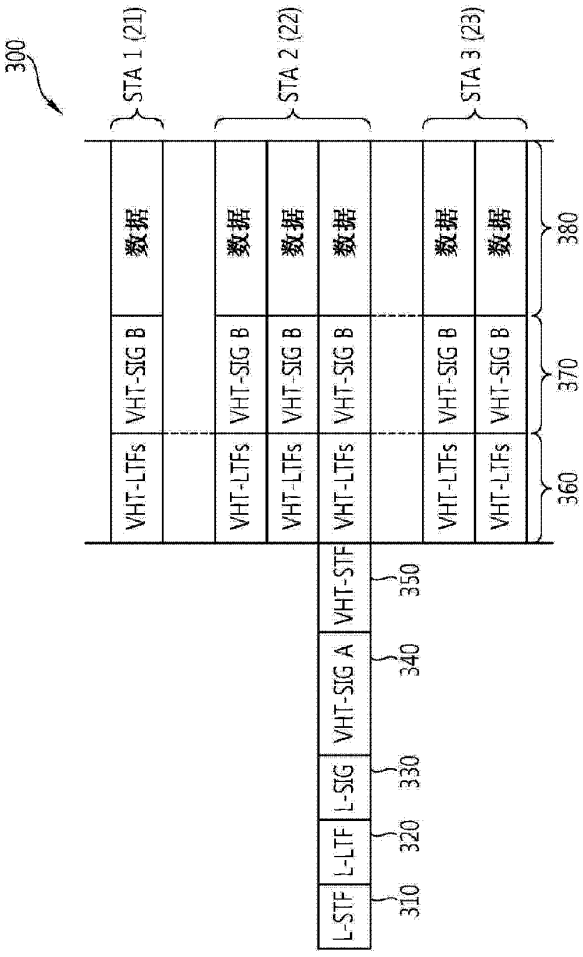

300
STA 1 (21)
STA 2 (22)
STA 3 (23)
L-STF
L-LTF
L-SIG
VHT-SIG A
VHT-STF
VHT-LTFs
VHT-SIG B
数据
310
320
330
340
350
360
370
380

图 3

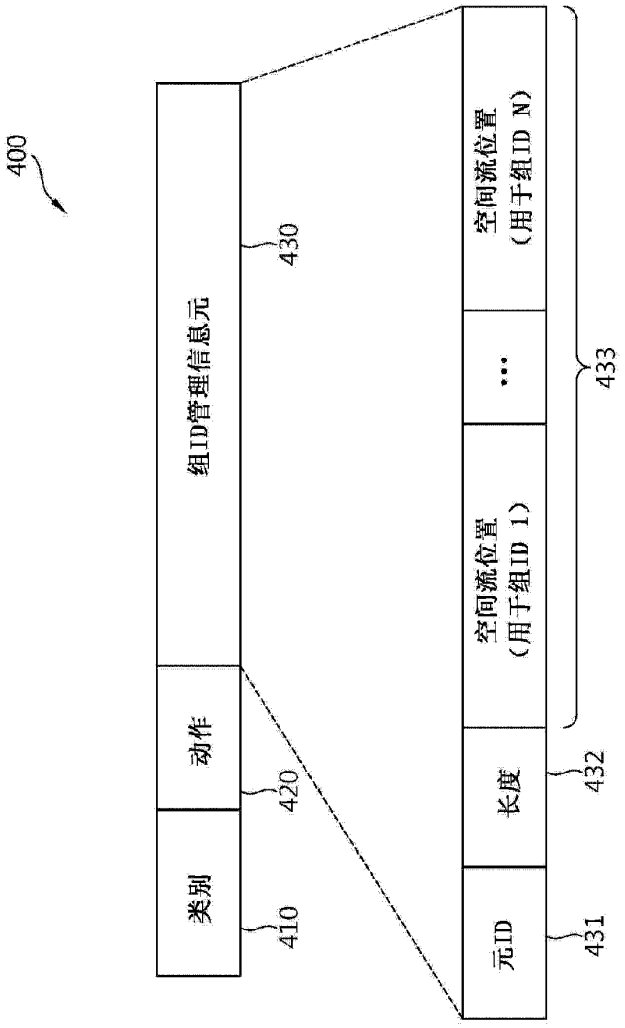

400
组ID管理信息元
430
类别
410
动作
420
元ID
431
长度
432
空间流位置
(用于组ID 1)
...
空间流位置
(用于组ID N)
433

图 4

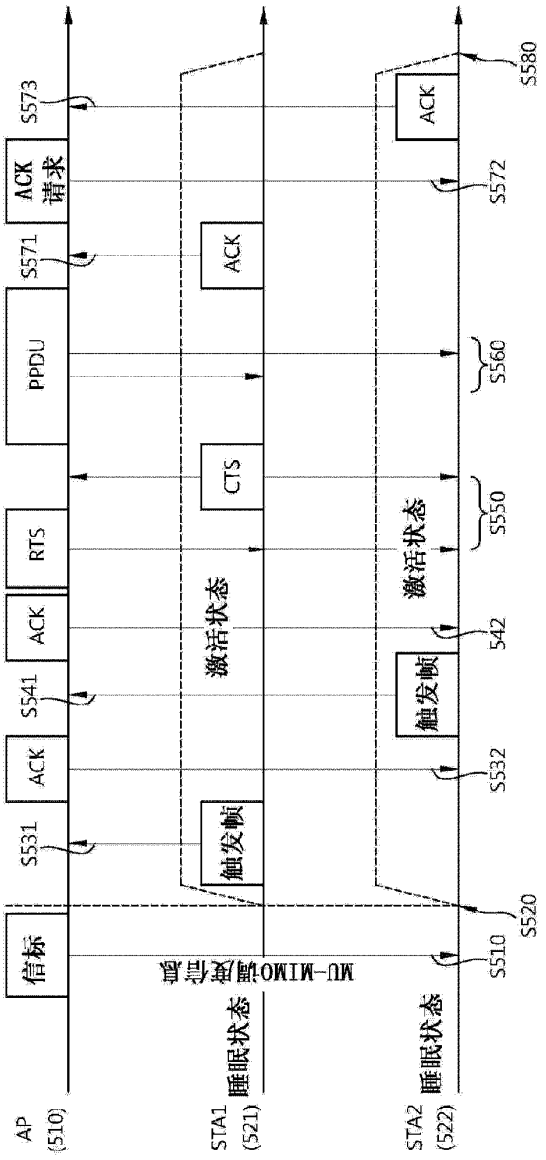

AP (510)
STA1 (521)
STA2 (522)
睡眠状态
睡眠状态
MU-MIMO调度信息
信标
触发帧
ACK
ACK
RTS
CTS
PPDU
ACK
ACK
触发帧
激活状态
激活状态
S510
S520
S531
S532
S541
542
S550
S560
S571
S572
S573
S580

图 5

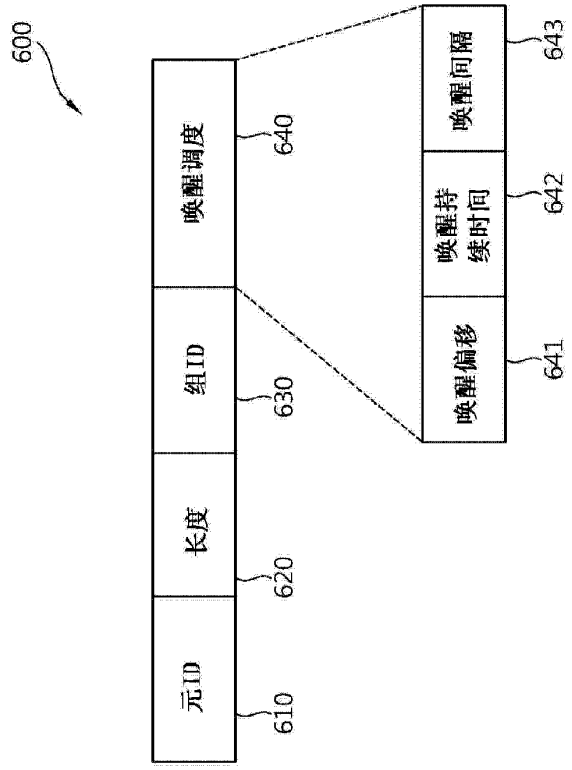

600
元ID
610
长度
620
组ID
630
唤醒调度
640
唤醒偏移
641
唤醒持续时间
642
唤醒间隔
643

图 6

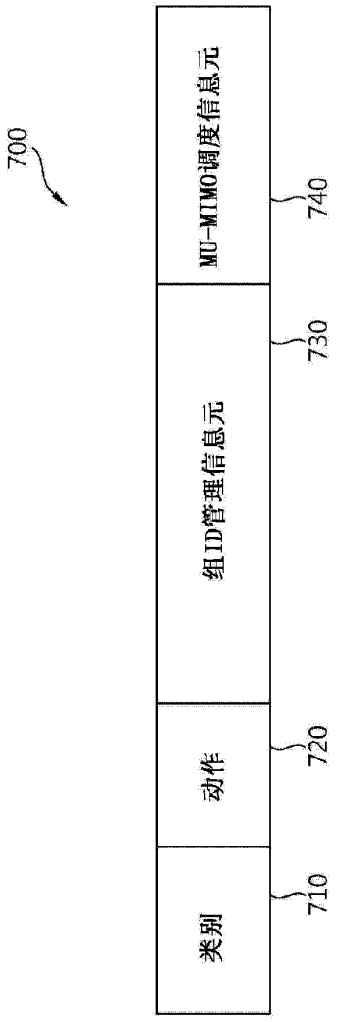

700
类别
710
动作
720
组ID管理信息元
730
MU-MIMO调度信息元
740

图 7

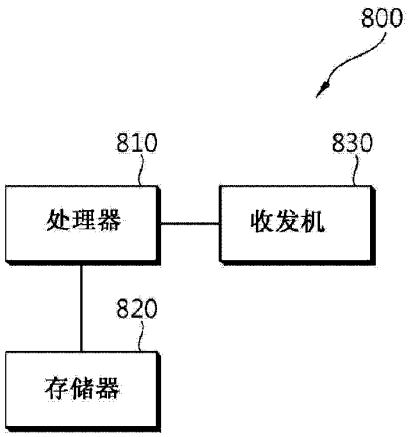


图 8

20

Electronic Acknowledgement Receipt

EFS ID:	44822501
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	25-JAN-2022
Filing Date:	25-JAN-2021
Time Stamp:	00:21:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2022-01-24_633016_IDS.pdf	241764 e02860aa04c54ed81c8a3a882ec9b139e24f da17	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Foreign Reference	Ref1_CN104321995A.pdf	5854602 e57e1e8f885fcf427cb036e125a22195e54e37a7	no	86
Warnings:					
Information:					
3	Foreign Reference	Ref2_CN103563457A.pdf	2451903 d30ab75adb8d9d3b717342ad2c53f7e725498fb8	no	41
Warnings:					
Information:					
4	Other Reference-Patent/App/Search documents	Ref_CN2017800418480_OA_12-9-21.pdf	1457739 88a18d5783e9ddee1374b7b880d77aa0463c258f	no	28
Warnings:					
Information:					
5	Other Reference-Patent/App/Search documents	Ref_EP178245684_NOA_12-13-21.pdf	405114 54edcda8cd6c889767c7e9b828c7c2becff8a5f5	no	7
Warnings:					
Information:					
6	Other Reference-Patent/App/Search documents	Ref_IN202128005900_12-27-2021.pdf	239685 f424d513f1c9266dd44efbef81ec40970659937a	no	6
Warnings:					
Information:					
		Total Files Size (in bytes):	10650807		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Central, Docket
	Art Unit: OPAP
Serial No.: 17/157,978	Conf. No.: 2451
Filing Date: January 25, 2021	Our Ref: B-10005CON1 633016-0
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Re: ***Information Disclosure Statement***
Date: January 24, 2022	

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[ ] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[x] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

[ ] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

- [ ] accompanied by the fee set forth in § 1.17(p), or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

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Additional Information

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[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

January 24, 2022
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

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Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE January 25, 2021
		GROUP NO. OPAP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated November 22, 2021 for Japanese Patent Application No. 2020-125359 and its English translation provided by Applicant's foreign counsel
	2.	Office Action dated November 22, 2021 for Japanese Patent Application No. 2020-125358 and its English translation provided by Applicant's foreign counsel

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	44636925
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	30-DEC-2021
Filing Date:	25-JAN-2021
Time Stamp:	01:37:49
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2021-12-29_633016_IDS.pdf	238347 70ff652a240fa50595119092b76db1b806f3ff29	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Other Reference-Patent/App/Search documents	Ref1_JP2020-125359_OA_11-22-21.pdf	226297 7b497039691ab46d0295a29723f49247808cf534	no	8
Warnings:					
Information:					
3	Other Reference-Patent/App/Search documents	Ref2_JP2020-125358_OA_11-22-21.pdf	211362 01f6909e984ed16ed6145e6597c8254da1ffdea3	no	6
Warnings:					
Information:					
		Total Files Size (in bytes):	676006		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Central, Docket
	Art Unit: OPAP
Serial No.: 17/157,978	Conf. No.: 2451
Filing Date: January 25, 2021	Our Ref: B-10005CON1 633016-0
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Re: ***Information Disclosure Statement***
Date: December 29, 2021	

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[ ] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[x] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

[ ] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

[ ] accompanied by the fee set forth in § 1.17(p), or

[ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

[ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

[ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

[ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

[ ] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

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[x] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and July 14, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

December 29, 2021
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
Attorney for Applicant
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Los Angeles, CA 90010
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Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE OR 371 (C) DATE January 25, 2021
		GROUP NO. OPAP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	2018/0145801	May 24, 2018	WANG et al.			
	2.	2016/0302229	Oct. 13, 2016	HEDAYAT			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	3.	Office Action dated October 25, 2021 for U.S. Patent Application No. 16/935,858.

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	44411298
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	02-DEC-2021
Filing Date:	25-JAN-2021
Time Stamp:	02:56:16
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2021-12-01_633016_IDS.pdf	213101 284460e0735b37767d8597129fdffedc7c7ce243	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Other Reference-Patent/App/Search documents	Ref1_US16935858_OA_10-25-21.pdf	921433 c5d4e9f162c9e069d0c568b668baddee19835dbc	no	20
Warnings:					
Information:					
		Total Files Size (in bytes):	1134534		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Central Docket
	Art Unit: OPAP
Serial No.: 17/157,978	Conf. No.: 2451
Filing or 371 (c) Date: January 25, 2021	Our Ref: B-10005CON1 633016-0
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Re: ***Information Disclosure Statement***
Date: December 1, 2021	

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

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[x] Before the mailing of a first Office Action on the merits, and no fee is due.

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- [ ] accompanied by the fee set forth in § 1.17(p), or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

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Items Disclosed

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[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

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[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

December 1, 2021
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
Attorney for Applicant
Registration No. 76,255
LADAS & PARRY LLP
Customer 158747
4525 Wilshire Blvd., Suite 240
Los Angeles, CA 90010
(323) 934-2300 voice

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE OR 371 (C) DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated April 19, 2021 for European Patent Application No. 17 824 568.4
	2.	Notice of Allowance dated April 20, 2021 for US Patent Application No. 16/596,674
	3.	Office Action dated June 1, 2021 for European Patent Application No. 17 884 228.2
	4.	Office Action dated June 14, 2021 for Japanese Patent Application No. 2020-125358 and its English translation provided by the Applicant's foreign counsel
	5.	Office Action dated June 14, 2021 for Japanese Patent Application No. 2020-125359 and its English translation provided by the Applicant's foreign counsel
	6.	Kiseon Ryu, "Ack Policy for UL MU Ack transmission", IEEE 802.11-15/1346r1, Internet URL:https://mentor.ieee.org/802.11/dcn/15/11-15-1346-01-00ax-ack-policy-for-ul-mu-ack-transmisssion.ppx, November 8, 2015
	7.	Po-Kai Huang (Intel), "Comment Resolution on Trigger Frame Format – MU-RTS Variant, IEEE 802.11-16/0808r0, Internet URL https://mentor.ieee.org/802.11/dcn/16/11-16-0808-00-00ax-comment-resolution-on-triceer-frame-format-mu-rts-variant.docs, June 28, 2016.
	8.	Office Action dated June 22, 2021 for Korean Patent Application No. 10-2021-7016873 and its English translation provided by the Applicant's foreign counsel

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. sInclude copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	43242103
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	14-JUL-2021
Filing Date:	25-JAN-2021
Time Stamp:	21:48:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2021-07-13_633016_IDS.pdf	157644 8bec096d78a23524 8e3 46766d653b1b137 5b5517	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description	**Start**	**End**		
	Transmittal Letter	1	3		
	Information Disclosure Statement (IDS) Form (SB08)	4	4		
Warnings:					
Information:					
2	Other Reference-Patent/App/Search documents	Ref1_EP178245684_OA_4-19-2021.pdf	551902 1c3f97fe1a8a0b70bbd95cece9708d4e0f739ac8	no	9
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Information:					
3	Other Reference-Patent/App/Search documents	Ref2_US16596674_NOA_4-20-2021.pdf	441493 8adc0c1b16b9770d1beb28f84455d9049db01d01	no	9
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Information:					
4	Other Reference-Patent/App/Search documents	Ref3_EP178842282_OA_6-1-2021.pdf	727405 854eb104fcd657d84ce62add06b3423c6a142528	no	11
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Information:					
5	Other Reference-Patent/App/Search documents	Ref4_JP2020-125358_OA_6-14-21.pdf	213298 58c64342d87639c12cf576cd5d28d27ea10c064f	no	6
Warnings:					
Information:					
6	Other Reference-Patent/App/Search documents	Ref5_JP2020-125359_OA_6-14-2021.pdf	221033 86c0bced98785e3e5655b4caa145ace817532999	no	6
Warnings:					
Information:					
7	Non Patent Literature	Ref7_Huang_NPL.pdf	257010 685f1c6cabf80ef8e353d56f370af7711e4a8d0d	no	5
Warnings:					

Information:					
8	Other Reference-Patent/App/Search documents	Ref8_KR10-2021-7016873_OA_6-22-2021.pdf	141750 ee90f1c3238fe4f0891135a01647f51aace7e06f	no	5
Warnings:					
Information:					
9	Non Patent Literature	Ref6_Ryu_802-11-15-1346r1.pdf	1352914 c550aba9b7cf1feb7633c52e8dc76e3a387ca3c4	no	20
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
			Total Files Size (in bytes):	4064449	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Not Yet Assigned
Serial No.: 17/157,978	Art Unit: 2476
Filing or 371 (c) Date: January 25, 2021	Conf. No.: 2451
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Our Ref: B-10005CON1 633016-0
Date: July 13, 2021	Re: ***Information Disclosure Statement***

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

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- [ ] accompanied by the fee set forth in § 1.17(p), or
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Items Disclosed

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[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

July 13, 2021
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
Attorney for Applicant
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LADAS & PARRY LLP
4525 Wilshire Blvd., Suite 240
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(323) 934-2300 voice

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE OR 371 (C) DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	1.	Office Action dated November 10, 2020 for Korean Patent Application No. 10-2019-7018255 and its English translation provided by Applicant's foreign counsel.
	2.	Jagit Singh Ashta et al.: "Performance improvement strategies for current and next generation Wi-Fi systems", June 13, 2012, pp. 1-151.

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	42844164
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	28-MAY-2021
Filing Date:	25-JAN-2021
Time Stamp:	01:20:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2021-05-27_633016_IDS.pdf	214600 b25d13df071ef57e7b4182149c7cfbac4f49b400	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	3
	Information Disclosure Statement (IDS) Form (SB08)	4	4
Warnings:			
Information:			

2	Other Reference-Patent/App/Search documents	Ref1_KR10-2019-7018255_11-10-2020.pdf	209217 72a4594c1b6f294bca4a579667ca13deb4ac5fb6	no	8
Warnings:					
Information:					
3	Non Patent Literature	Ref2_Performance_npl.pdf	4498375 90f1521386f0eeddda18b87a8f818da8084669bc	no	151
Warnings:					
Information:					
		Total Files Size (in bytes):	4922192		

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Not Yet Assigned
Serial No.: 17/157,978	Art Unit: 2476
Filing or 371 (c) Date: January 25, 2021	Conf. No.: 2451
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Our Ref: B-10005CON1 633016-0
Date: May 27, 2021	Re: ***Information Disclosure Statement***

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

May 27, 2021
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
Attorney for Applicant
Registration No. 76,255
LADAS & PARRY LLP
Customer 158747
4525 Wilshire Blvd., Suite 240
Los Angeles, CA 90010
(323) 934-2300 voice

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/157,978	01/25/2021	Woojin AHN	B-10005CON1 633016-0

CONFIRMATION NO. 2451

158747
LADAS & PARRY
E-MAIL
4525 WILSHIRE BOULEVARD
SUITE 240
LOS ANGELES, CA 90010

PUBLICATION NOTICE



Title:AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

Publication No.US-2021-0152275-A1
Publication Date:05/20/2021

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. 17/157,978
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	FILING DATE OR 371 (C) DATE January 25, 2021
		GROUP NO. 2476

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	9,179,354	Nov. 3, 2015	Rubin et al.			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	2.	Office Action dated February 19, 2021 for Indian Patent Application No. 201927025421.

EXAMINER	*DATE CONSIDERED*

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Electronic Acknowledgement Receipt

EFS ID:	42480630
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo/Azatuhi Chinaryan
Filer Authorized By:	Young Seok Koo
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	19-APR-2021
Filing Date:	25-JAN-2021
Time Stamp:	03:02:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2021-04-16_633016_IDS.pdf	213714 2053e6ec3f2a6f30d3f8159a31b4ba84e38188b1	yes	4

	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Transmittal Letter		1	3	
	Information Disclosure Statement (IDS) Form (SB08)		4	4	
Warnings:					
Information:					
2	Other Reference-Patent/App/Search documents	Ref2_IN201927025421_OA_2-19-21.pdf	281219 e4df20e313cb5fd040e92ca0d2fc0ab903e23466	no	8
Warnings:					
Information:					
		Total Files Size (in bytes):	494933		

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Not Yet Assigned
Serial No.: 17/157,978	Art Unit: 2476
Filing or 371 (c) Date: January 25, 2021	Conf. No.: 2451
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Our Ref: B-10005CON1 633016-0
Date: April 16, 2021	Re: ***Information Disclosure Statement***

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Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

[ ] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

Additional Information

[ ] Translations of the foreign-language documents are also enclosed as machine-translations, human-translations, or counterpart applications as noted. Machine translations were provided by the Japanese Patent Office, ESPACENET, Google Documents, Patent Fetcher® /ESPACENET, Google Translate or Google Translator Toolkit as noted and with OCR by Adobe Acrobat 9 or ABBYY PDF Transformer 3 if needed.

[ ] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[x] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on January 25, 2021 and therefore are not submitted in this IDS.

[ ] Other:

I hereby certify that this document is being transmitted to the Patent and Trademark Office via electronic filing.

April 16, 2021
(Date of Transmission)

Azatuhi Chinaryan
(Name of Person Transmitting)

/ Azatuhi Chinaryan /
(Signature)

Respectfully submitted,

/ Young Seok Koo 76,255 /

Young Seok Koo
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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/157,978	01/25/2021		1820	B-10005CON1 633016-0	14	2

CONFIRMATION NO. 2451

FILING RECEIPT

158747
LADAS & PARRY
E-MAIL
4525 Wilshire Boulevard
Suite 240
LOS ANGELES, CA 90010

OC000000123180598

Date Mailed: 02/09/2021

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Woojin AHN, Gyeonggi-do, KOREA, REPUBLIC OF;
Juhyung Son, Gyeonggi-do, KOREA, REPUBLIC OF;
Geonjung Ko, Gyeonggi-do, KOREA, REPUBLIC OF;
Jinsam Kwak, Gyeonggi-do, KOREA, REPUBLIC OF;

Applicant(s)

WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC., Gyeonggi-do, KOREA, REPUBLIC OF;
SK TELECOM CO., LTD., Seoul, KOREA, REPUBLIC OF;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 16/449,132 06/21/2019 PAT 10931396
which is a CON of PCT/KR2017/015265 12/21/2017

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
REPUBLIC OF KOREA 10-2016-0175999 12/21/2016 No Access Code Provided
REPUBLIC OF KOREA 10-2017-0048145 04/13/2017 No Access Code Provided
REPUBLIC OF KOREA 10-2017-0146357 11/04/2017 No Access Code Provided

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 02/04/2021
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/157,978**
Projected Publication Date: 05/20/2021
Non-Publication Request: No
Early Publication Request: No
Title

AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/157,978

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	14 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 480 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

PTO/SB/80 (11-08)
Approved for use through 11/30/2020. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☑ Practitioners associated with the Customer Number: 158747

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☑ The address associated with Customer Number: 158747

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.
5F 216 Hwangsaeul-ro Bundang-gu
Seongnam-si, Gyeonggi-do, 13595 Republic of Korea

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	Nov. 22. 2019
Name	JIN SAM KWAK	Telephone	82-10-8623
Title	CEO		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

☑ Practitioners associated with the Customer Number: 158747

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

☑ The address associated with Customer Number: 158747

OR

☐ Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address:

SK TELECOM CO., LTD.
65, Eulji-ro, Jung-gu
Seoul 04539 Republic of Korea

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	[signature]	Date	Nov. 21, 2018
Name	Bum Soo Shin	Telephone	82-2-6100-7465
Title	Director of IP2		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.

Application No./Patent No.: _____ Filed/Issue Date: _____

Titled: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC., a INSTITUTE

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☐ The assignee of the entire right, title, and interest.

2. ☑ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☑ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   SK TELECOM CO., LTD.

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 049556, Frame 0730, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

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5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Young Seok Koo 76,255/	January 22, 2021
Signature	Date
YOUNG SEOK KOO	76,255
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.

Application No./Patent No.: _____ Filed/Issue Date: _____

Titled: AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

SK TELECOM CO., LTD., a CORPORATION

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☐ The assignee of the entire right, title, and interest.

2. ☑ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☑ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 049556, Frame 0730, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Young Seok Koo 76,255/	January 22, 2021
Signature	Date
YOUNG SEOK KOO	76,255
Printed or Typed Name	Title or Registration Number

[Page 2 of 2]

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE ***Patent***

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	)	***Re.: Preliminary Amendment***
	)	Group: Not yet assigned
USSN: Not yet assigned	)	Examiner: Not yet assigned
Filing Date: Concurrently herewith	)	Our Ref.: B-10005CON1 633016-0
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	)	Date: January 25, 2021

PRELIMINARY AMENDMENT

Sir:

Prior to examination of the above-identified U.S. patent application, please enter the following amendments and remarks into the prosecution history of the above-identified U.S. patent application without prejudice or disclaimer.

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims begin on page 3 of this paper

Remarks begin on page 7 of this paper.

AMENDMENTS TO THE SPECIFICATION

Please insert the following paragraph and section entitled "CROSS-REFERENCE TO RELATED APPLICATIONS" on page 1, immediately after the title "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME" and before the section entitled "Technical Field", to read as follows:

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Patent Application No. 16/449,132 filed on June 21, 2019, which is a continuation of International Patent Application No. PCT/KR2017/015265 filed on December 21, 2017, which claims the priority to Korean Patent Application No. 10-2016-0175999 filed in the Korean Intellectual Property Office on December 21, 2016, Korean Patent Application No. 10-2017-0048145 filed in the Korean Intellectual Property Office on April 13, 2017, and Korean Patent Application No. 10-2017-0146357 filed in the Korean Intellectual Property Office on November 4, 2017, the entire contents of which are incorporated herein by reference.

* * *

AMENDMENTS TO THE CLAIMS

Please amend the claims to read as indicated in the following list of claims:

Listing of claim

1-16. (Cancelled).

17. (New) A wireless communication terminal, the terminal comprising:

a processor; and

a communication unit,

wherein the processor is configured to:

receive a PPDU(physical layer protocol data unit) including an A-MPDU in which one or more MPDUs are aggregated,

wherein the A-MPDU includes Ack policy information related to a block Ack for the ones or more MPDUs, and one or more subframes,

wherein each of the one or more subframes includes MPDU identifier information and an MPDU of the one or more MPDUs, and

wherein the MPDU identifier information includes an end of frame (EOF) field and a length field, and

transmit a response frame in response to the PPDU,

wherein a type of the response frame is determined according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information.

18. (New) The wireless communication terminal of claim 17,

wherein the A-MPDU further includes one or more TIDs (traffic IDs) corresponding to the one or more MPDUs.

19. (New) The wireless communication terminal of claim 18,

wherein the type of the response frame is determined by further considering a number of TIDs indicating an immediate response among the one or more TIDs.

20. (New) The wireless communication terminal of claim 19,

wherein the type of the response frame is an Ack frame when the A-MPDU includes only one TID indicating the immediate response and the Ack policy information indicates a normal Ack.

21. (New) The wireless communication terminal of claim 19,

wherein the type of the response frame is a compressed BlockAck frame when a number of the TIDs indicating the immediate response is one or more and the one or more TIDs are the same.

22. (New) The wireless communication terminal of claim 17,

wherein the MPDU delimiter information is first MPDU delimiter information in which a value of the EOF field is 1 and a value of the length field is non-zero, or second MPDU delimiter information in which the EOF field value is 0.

23. (New) The wireless communication terminal of claim 22,

wherein the type of the response frame is determined by further considering whether the A-MPDU includes a subframe including the first MPDU delimiter information, and whether the A-MPDU includes at least one subframe including the second MPDU identifier information.

24. (New) A wireless communication method of a wireless communication terminal, the method comprising:

receiving a PPDU(physical layer protocol data unit) including an A-MPDU in which one or more MPDUs are aggregated,

wherein the A-MPDU includes Ack policy information related to a block Ack for the ones or more MPDUs, and one or more subframes,

wherein each of the one or more subframes includes MPDU identifier information and an MPDU of the one or more MPDUs, and

wherein the MPDU identifier information includes an end of frame (EOF) field and a length field; and

transmitting a response frame in response to the PPDU,

wherein a type of the response frame is determined according to a combination of a type of the MPDU determined by the EOF field and the length field, and the Ack policy information.

25. (New) The wireless communication method of claim 24,

wherein the A-MPDU further includes one or more TIDs (traffic IDs) corresponding to the one or more MPDUs.

26. (New) The wireless communication method of claim 25,

wherein the type of the response frame is determined by further considering a number of TIDs indicating an immediate response among the one or more TIDs.

27. (New) The wireless communication method of claim 26,

wherein the type of the response frame is an Ack frame when the A-MPDU includes only one TID indicating the immediate response and the Ack policy information indicates a normal Ack.

28. (New) The wireless communication method of claim 26,

wherein the type of the response frame is a compressed BlockAck frame when a number of the TIDs indicating the immediate response is one or more and the one or more TIDs are the same.

29. (New) The wireless communication method of claim 24,

wherein the MPDU delimiter information is first MPDU delimiter information in which a value of the EOF field is 1 and a value of the length field is non-zero, or second MPDU delimiter information in which the EOF field value is 0.

30. (New) The wireless communication method of claim 29,

wherein the type of the response frame is determined by further considering whether the A-MPDU includes a subframe including the first MPDU delimiter information, and whether the A-MPDU includes at least one subframe including the second MPDU identifier information.

REMARKS

In this Preliminary Amendment, the section of the "CROSS-REFERENCE TO RELATED APPLICATIONS" is inserted to include reference to the earlier applications. This amendment is to comply with 37 C.F.R. §1.77. A substitute specification should not be required as this amendment only adds a benefit claim.

Claims 1-16 are cancelled and new claims 17-30 are added.

Amendment of the subject application is respectfully requested.

* * *

No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or may contain characterizations of claim scope or referenced art, the Applicant is not conceding that any previously pending claims are unpatentable in view of the cited reference(s). Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. The Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent child or related prosecution history shall not reasonably infer that the Applicant has made any disclaimers or disavowals of any subject matter supported by the present application.

Very truly yours,

/Young Seok Koo 76,255/

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LTD.	Examiner: Not Yet Assigned
Serial No.: Not Yet Assigned	Art Unit: N/A
Filing Date: Concurrently Herewith	Conf. No.: N/A
For: "AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME"	Our Ref: B-10005CON1 633016-0
Date: January 25, 2021	Re: ***Information Disclosure Statement***

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir/Madam:

This information disclosure statement is filed in accordance with 37 C.F.R. §§ 1.56, 1.97 and 1.98 to disclose information that may be relevant to the above-identified patent application. The Applicant requests the Examiner consider the documents listed on the enclosed form PTO-1449 (modified) in the examination of this application.

The filing of this Information Disclosure Statement (IDS) shall not be construed as a representation that a search has been made (37 C.F.R. 1.97(g)), an admission that the information cited is, or is considered to be, material to patentability, or that no other material information exists.

The filing of this Information Disclosure Statement shall not be construed as an admission against interest in any manner (37 C.F.R § 1.97(h)).

If any additional fee is required for this filing, the Applicant requests the Examiner contact a practitioner associated with the Customer Number listed below for authorization.

This information disclosure statement also includes the statements marked below. Failure to mark a statement should not be construed as a negative assertion.

Timing and Fees

This IDS is being filed:

[x] Concurrently with the application, and no fee is due.

[ ] Within three months of the filing of the national application, other than a continued prosecution application under § 1.53(d), and no fee is due.

[ ] Within three months of the date of entry of the national stage as set forth in § 1.491 in an international application, and no fee is due.

[ ] Before the mailing of a first Office Action on the merits, and no fee is due.

[ ] Before the mailing of a first Office Action after the filing of a request for continued examination under§ 1.114, and no fee is due.

[ ] After the periods described above, and before a final Office Action under § 1.113, a Notice of Allowance under § 1.311, or an action that otherwise closes prosecution in the application, and is

- [ ] accompanied by the fee set forth in § 1.17(p), or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1): That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or
- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2): That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] After the periods described above, and is accompanied by the fee set forth in § 1.17(p), and is

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(1), that each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; or

- [ ] filed with the statement set forth in 37 C.F.R. 1.97(e)(2), that no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in § 1.56(c) more than three months prior to the filing of the information disclosure statement.

[ ] Concurrently with a Request for Continued Examination, and no additional fee is due for this IDS.

Items Disclosed

At least one item listed on the enclosed form PTO-1449 (modified) was

[x] Cited in an Office Action for a related application, the application number of the related application and the issue date of the Office Action are provided below and the Office Action is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

---

[x] Cited in an International Search Report (ISR) or an International Preliminary Report on Patentability (IPRP) or a Written Opinion (WO) of the International Searching Authority (ISA) for the related PCT Application, the PCT application number and the issue date of the ISR/IPRP/WO are provided below and the ISR/IPRP/WO is enclosed.

Please see the enclosed form PTO-1449 (modified) for related application number(s) and issue date(s).

Additional Information

[x] Translations of the foreign-language documents are also enclosed as machine-translations, human-translations, or counterpart applications as noted. Machine translations were provided by the Japanese Patent Office, ESPACENET, Google Documents, Patent Fetcher® /ESPACENET, Google Translate or Google Translator Toolkit as noted and with OCR by Adobe Acrobat 9 or ABBYY PDF Transformer 3 if needed.

[x] English-language abstracts of foreign-language documents are provided.

[x] Documents listed on the enclosed ISR/IPRP/WO or the Office Action have relevance at least as described therein.

[ ] The documents with the following reference numbers were described in the specification of the present application; omission of a reference from this list does not indicate that it was not discussed in the specification of the present application.

[ ] At least one of the references cited in the Office Action listed on the attached PTO-1449 (modified) were previously submitted in an IDS or cited by the Examiner for the present application on _____ and therefore are not submitted in this IDS.

[x] Other: **In the attached Form PTO-1449 (modified), documents from the parent application (USSN: 16/449,132 (now published as U.S. 2019/0319738) are being cited.**

Please further note that the foreign references and non-patent documents listed in the attached were cited in the parent application, USSN 16/449,132 (now published as U.S. 2019/0319738). In accordance with 37 C.F.R. §1.98(d) (1) and (2), copies of the foreign references and non-patent documents listed in the enclosed Form PTO-1449 (modified) are not enclosed.

Respectfully submitted,

January 25, 2021

/ Young Seok Koo 76255 /

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Form PTO-1449 (Modified) Page 1 of 1	ATTY DOCKET NO. B-10005CON1 633016-0	U.S. SERIAL NO. N/A
LIST OF PATENTS AND PUBLICATIONS STATEMENT	APPLICANT WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC. & SK TELECOM CO., LDT..	FILING DATE Concurrently Herewith
		GROUP NO. N/A

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	ISSUE/PUBL. DATE	NAME	CLASS	SUB-CLASS	REMARKS
	1.	2015/0124689	May 7, 2015	MERLIN et al.			
	2.	2011/0268094	Nov. 3, 2011	Gong et al.			
	3.	2015/0295680	Oct. 15, 2015	Othman et al.			
	4.	2016/0315681	Oct. 27, 2016	Moon et al.			
	5.	2016/0360442	Dec. 8, 2016	Stacey et al.			
	6.	2016/0182205	Jun. 23, 2016	Asterjadhi et al.			
	7.	2018/0254861	Sep. 6, 2018	CHERIAN et al.			
	8.	2017/0150493	May 25, 2017	SEOK			
	9.	2017/0257196	Sept. 7, 2017	Ghosh et al.			
	10.	2017/0310446	Oct. 26, 2017	ASTERJADHI et al.			
	11.	2016/0080115	Mar. 17, 2016	Joshiam et al.			
	12.	2015/0124690	May 7, 2015	MERLIN et al.			
	13.	2017/0272138	Sep. 21, 2017	CHUN et al.			
	14.	2017/0303280	Oct. 19, 2017	CHUN et al.			
	15.	2017/0289911	Oct. 5, 2017	KIM et al.			
	16.	2019/0319738	Oct. 17, 2019	AHN et al.			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT NUMBER	PUBLICATION DATE	COUNTRY	CLASS	SUB-CLASS	TRANSLATION
	17.	10-2015-0111270	Oct. 5, 2015	KR			Espacenet/KIPRIS
	18.	10-2016-0039638	Apr. 11, 2016	KR			Espacenet/KIPRIS

	19.	2016/043538	Mar. 24, 2016	WO			Espacenet
	20.	2018/117697	Jun. 28, 2018	WO			Espacenet
	21.	2013-536599	Sep. 19, 2013	JP			Espacenet
	22.	2011/159831	Dec. 22, 2011	WO			
	23.	2015/066440	May 7, 2015	WO			
	24.	2016/007770	Jan. 14, 2016	WO			
	25.	2016/068572	May 6, 2016	WO			Espacenet

OTHER DOCUMENTS (Including Author, Title, Date, Pertinent Pages, Etc.)

EXAMINER INITIAL	REFERENCE NUMBER	DOCUMENT
	26.	International Search Report for PCT/KR2017/015265 mailed on April 10, 2018 and its English translation from WIPO (now published as WO 2018/117697)
	27.	Written Opinion of the International Searching Authority for PCT/KR2017/015265 mailed on April 10, 2018 and its English translation from WIPO (now published as WO 2018/117697)
	28.	Robert Stacey et al.: "IEEE P802.11 Wireless LANs Submission doc.: IEEE 802.11-17/16822r0", Comments on TXax/D2.0, November 5, 2017 https://mentor.ieee.org/802.11/dcn/17/11-17-1682-00-00ax-comments-on-tgax-d2-0.xlsx
	29.	Notice of Allowance dated June 18, 2020 for Korean Patent Application No. 10-2020-7002361 and its English machine translation by Global Dossier
	30.	Notice of Allowance dated June 22, 2020 for Japanese Patent Application No. 2019-500497 and its English translation provided by Applicant's foreign counsel
	31.	Office Action dated July 13, 2020 for Japanese Patent Application No. 2019-533391 and its English translation provided by Applicant's foreign counsel
	32.	Liwen Chu: "IEEE P802.11 Wireless LANs Submission doc.: IEEE 802.11-16_1185r1", Comments on TGax D0.1, September 12, 2016
	33.	George Cherian et al.: "IEEE P802.11 Wireless LANs Submission doc.: IEEE 802.11-16_0024r3", Comments on TGax D0.1, April 17, 2016
	34.	Office Action dated July 28, 2020 for U.S. Patent Application 16/596,674
	35.	Extended European Search Report dated August 5, 2020 for European Patent Application No. 17884228.2
	36.	Liwen Chu et al.: "Multi TID A-MPDU in MU Transmission". January 18, 2016, doc: 801.11-16/0069r0, XP068104841.
	37.	Alfred Asterjadhi et al.: "Block Ack generation and selection rules". May 14, 2016, doc: IPEEE 802.11-16/0616r2; XP068119447.
	38.	IPEE P802.11axTM/D1.0 "Draft Standard for Information Technology-Telecommunications and information exchange between systems Local and metropolitan area networks-Specific requirements", IEEE Standards Activities Department, Piscataway, NJ, USA; Nov., 2016; XP068137446.
	39.	Notice of Allowance dated September 15, 2020 for Korean Patent Application No. 10-2020-7026125 and its English translation by provided by Applicant's foreign counsel
	40.	Office Action dated February 3, 2020 for Japanese Patent Application No. 2019-500497 and its English translation provided by Applicant's foreign counsel
	41.	Extended European Search Report dated February 10, 2020 for European Patent Application No. 17824568.4
	42.	Robert Stacey, Spec Framework, IEEE 802.11-15/0132r17, (IEEE 802.11-15/0132r15) URL: https://mentor.ieee.org/802.11/dcn/15/11-15-0132-17-00ax-spec-framework.docs, May 2, 2016, pp. 1-61.

	43.	Chittabrata Ghosh (INTEL): "Signaling of Multi-TID Aggregation Limit", IEEE Draft: 11-16-0667-00-00AX-SIGNALING-OF-MULTI-TID-AGGREGATION-LIMIT, IEEE-SA MENTOR, Piscataway, NJ USA, vol. 802.11-16/0667r0, URL https://mentor.ieee.org/802.11/dcn/16/11-16-0667-00-00ax-signaling-of-multi-tid-aggregation-limit.pptx, June 16, 2016, pp. 11-15.
	44.	Chittabrata Ghosh (INTEL): "Multi-TID Aggregation Limit", IEEE Draft: 11-16-0362-01-00AX-MULTI-TID-AGGREGATION-LIMIT, IEEE-SA MENTOR, Piscataway, NJ USA, vol. 802.11-16/0362r1, March 15, 2016, slides 1-16.
	45.	IEEE P802.11ax™/D0.2: "Draft Standard for Information technology-Tele-communications and information exchange between systems Local and metropolitan area networks-Specific requirements. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Amendment 6: Enhancements for high efficiency in frequency bands between 1GHz and 6GHz", LAN/MAN Standards Committee of the IEE Computer Society, IEEE Draft: P802.11ax/D0.2, June 8, 2016, pp. 20-23, pp. 36-38. URL: www.ieee802.org/11/private/Draft_Standards/11ax/DraftP802.11ax_D0.2.pdf
	46.	International Preliminary Report on Patentability (Chapter I) issued on June 25, 2019 for PCT/KR2017/015265 and its English translation from WIPO
	47.	Notice of Allowance dated July 10, 2019 for U.S. Patent Application No. 16/233,078
	48.	Non-Final Office Action dated March 18, 2019 for U.S. Patent Application No. 16/233,078
	49.	Oren Kedem (INTEL): "IEEE P802.11 Wireless LANs", IEEE 802.11-15/TBD, November 2015, pp 1-5
	50.	Notice of Allowance dated October 20, 2020 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)
	51.	Final Office Action dated May 1, 2020 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)
	52.	Office Action dated January 16, 2020 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)
	53.	Office Action dated September 16, 2019 for U.S. Patent Application No. 16/449,132 (now published as US 2019/0319738)

EXAMINER	***DATE CONSIDERED***

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609; draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Woojin		AHN	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Gyeonggi-do	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	214-2803, 177 Anyangcheonseo-ro Manan-gu Anyang-si		
Address 2			
City	Gyeonggi-do	State/Province	
Postal Code	14038	Country [i]	KR

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Juhyung		SON	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Gyeonggi-do	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	308-1402, 7 Naesonsunhwan-ro Uiwang-si		
Address 2			
City	Gyeonggi-do	State/Province	
Postal Code	16024	Country [i]	KR

Inventor 3 Remove

Legal Name

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Geonjung		KO	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Gyeonggi-do	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	301-606, 36 Dongtanwoncheon-ro 915beon-gil		
Address 2	Yeongtong-gu Suwon-si		
City	Gyeonggi-do	State/Province	
Postal Code	16547	Country [i]	KR

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jinsam		KWAK	

Residence Information (Select One) ○ US Residency ◉ Non US Residency ○ Active US Military Service

City	Gyeonggi-do	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	102-1704, 213 Gwiin-ro Dongan-gu Anyang-si		
Address 2			
City	Gyeonggi-do	State/Province	
Postal Code	14071	Country [i]	KR

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	158747		
Email Address	LA_MAIL@LA.LADAS.COM	Add Email	Remove Email

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Application Information:

Title of the Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME		
Attorney Docket Number	B-10005CON1 633016-0	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	13	**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	158747		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16449132	2019-06-21
Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16449132	Continuation of	PCT/KR2017/015265	2017-12-21

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
10-2016-0175999	KR	2016-12-21	
			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
10-2017-0048145	KR	2017-04-13	
			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
10-2017-0146357	KR	2017-11-04	

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	WILUS INSTITUTE OF STANDARDS AND TECHNOLOGY INC.

Mailing Address Information For Applicant:

Address 1	5F 216 Hwangsaeul-ro Bundang-gu Seongnam-si		
Address 2			
City	Gyeonggi-do	**State/Province**	
Country	KR	Postal Code	13595
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Applicant 2

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	SK TELECOM CO., LTD.

Mailing Address Information For Applicant:

Address 1	65, Eulji-ro, Jung-gu		
Address 2			
City	Seoul	**State/Province**	
Country	KR	Postal Code	04539
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	B-10005CON1 633016-0
	Application Number	
Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME	

Organization Name			
Mailing Address Information For Assignee including Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.			

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Young Seok Koo 76255/			Date (YYYY-MM-DD)	2021-01-22
First Name	Young Seok	Last Name	Koo	Registration Number	76,255
Additional Signature may be generated within this form by selecting the Add button.					

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Filer:	Young Seok Koo/Azatuhi Chinaryan
Attorney Docket Number:	B-10005CON1 633016-0

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	320	320
UTILITY SEARCH FEE	1111	1	700	700
UTILITY EXAMINATION FEE	1311	1	800	800
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1820**

Electronic Acknowledgement Receipt	
EFS ID:	41739983
Application Number:	17157978
International Application Number:	
Confirmation Number:	2451
Title of Invention:	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME
First Named Inventor/Applicant Name:	Woojin AHN
Customer Number:	158747
Filer:	Young Seok Koo
Filer Authorized By:	
Attorney Docket Number:	B-10005CON1 633016-0
Receipt Date:	25-JAN-2021
Filing Date:	
Time Stamp:	23:16:19
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1820
RAM confirmation Number	E20211ON20348033
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		632109_EnglishSpecDrawings.pdf	990531 9759dd3f03cc70d3a7b7ef98b11d0b915416b4cd	yes	86
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Specification		1	67	
	Claims		68	72	
	Abstract		73	73	
	Drawings-other than black and white line drawings		74	86	
Warnings:					
Information:					
2	Oath or Declaration filed	632109_Declaration_Signed.pdf	584912 0db749daa90be5c8381764c0fc5a173663cfbdb7	no	2
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
3	Power of Attorney	633016_POA_All.pdf	893983 f0970a40298b1a98526c235dd5045a25b25e50c1	no	2
Warnings:					
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Information:					
4	Assignee showing of ownership per 37 CFR 3.73	633016_Statement373c.pdf	267774 a5c62a77cf35556df1faa94860f4004634bfb73f	no	6

Warnings:					
Information:					
5		633016_PreliminaryAmendment.pdf	111434 75c53bf3e16bc4784bb50803771672ecac66356e	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Specification	2	2
	Claims	3	6
	Applicant Arguments/Remarks Made in an Amendment	7	8

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6		633016_IDS.pdf	191669 97f4d89b5a0936af302fb210754cd288dd8f735b	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	4
	Information Disclosure Statement (IDS) Form (SB08)	5	7

Warnings:					
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7	Application Data Sheet	633016_ADS1.pdf	111117 a97c7a8503af8fcd460cca00d7dbe4e28efb6813	no	10
Warnings:					
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8	Fee Worksheet (SB06)	fee-info.pdf	35280 49ad9040442c8161db3f81f47a5b33b863cad4d1	no	2
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[DESCRIPTION]

[Invention Title]

AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

[Technical Field]

The present invention relates to a method for transmitting an aggregate MPDU and a response frame thereto and a wireless communication terminal using the same, and more particularly, to a wireless communication method and a wireless communication terminal for setting various formats of the aggregate MPDU and the response frame thereto and performing an efficient data communication by using the same.

[Background Art]

In recent years, with supply expansion of mobile apparatuses, a wireless LAN technology that can provide a rapid wireless Internet service to the mobile apparatuses has been significantly spotlighted. The wireless LAN technology allows mobile apparatuses including a smart phone, a smart pad, a laptop computer, a portable multimedia player, an embedded apparatus, and the like to wirelessly access the Internet in home or a company or a specific service providing area based on a wireless communication technology in a short range.

Institute of Electrical and Electronics Engineers (IEEE) 802.11 has commercialized or developed various technological standards since an initial wireless LAN technology is supported using frequencies of 2.4 GHz. First, the IEEE 802.11b supports a communication speed of a maximum of 11 Mbps while using frequencies of a 2.4 GHz band. IEEE 802.11a which is commercialized after the IEEE 802.11b uses

frequencies of not the 2.4 GHz band but a 5 GHz band to reduce an influence by interference as compared with the frequencies of the 2.4 GHz band which are significantly congested and improves the communication speed up to a maximum of 54 Mbps by using an OFDM technology. However, the IEEE 802.11a has a disadvantage in that a communication distance is shorter than the IEEE 802.11b. In addition, IEEE 802.11g uses the frequencies of the 2.4 GHz band similarly to the IEEE 802.11b to implement the communication speed of a maximum of 54 Mbps and satisfies backward compatibility to significantly come into the spotlight and further, is superior to the IEEE 802.11a in terms of the communication distance.

Moreover, as a technology standard established to overcome a limitation of the communication speed which is pointed out as a weak point in a wireless LAN, IEEE 802.11n has been provided. The IEEE 802.11n aims at increasing the speed and reliability of a network and extending an operating distance of a wireless network. In more detail, the IEEE 802.11n supports a high throughput (HT) in which a data processing speed is a maximum of 540 Mbps or more and further, is based on a multiple inputs and multiple outputs (MIMO) technology in which multiple antennas are used at both sides of a transmitting unit and a receiving unit in order to minimize a transmission error and optimize a data speed. Further, the standard can use a coding scheme that transmits multiple copies which overlap with each other in order to increase data reliability.

As the supply of the wireless LAN is activated and further, applications using the wireless LAN are diversified, the need for new wireless LAN systems for supporting a higher throughput (very high throughput (VHT)) than the data processing speed supported by the IEEE 802.11n has come into the spotlight. Among them, IEEE 802.11ac supports a wide bandwidth (80 to 160 MHz) in the 5 GHz frequencies. The

IEEE 802.11ac standard is defined only in the 5 GHz band, but initial 11ac chipsets will support even operations in the 2.4 GHz band for the backward compatibility with the existing 2.4 GHz band products. Theoretically, according to the standard, wireless LAN speeds of multiple stations are enabled up to a minimum of 1 Gbps and a maximum single link speed is enabled up to a minimum of 500 Mbps. This is achieved by extending concepts of a wireless interface accepted by 802.11n, such as a wider wireless frequency bandwidth (a maximum of 160 MHz), more MIMO spatial streams (a maximum of 8), multi-user MIMO, and high-density modulation (a maximum of 256 QAM). Further, as a scheme that transmits data by using a 60 GHz band instead of the existing 2.4 GHz/5 GHz, IEEE 802.11ad has been provided. The IEEE 802.11ad is a transmission standard that provides a speed of a maximum of 7 Gbps by using a beamforming technology and is suitable for high bit rate moving picture streaming such as massive data or non-compression HD video. However, since it is difficult for the 60 GHz frequency band to pass through an obstacle, it is disadvantageous in that the 60 GHz frequency band can be used only among devices in a short-distance space.

Meanwhile, in recent years, as next-generation wireless LAN standards after the 802.11ac and 802.11ad, discussion for providing a high-efficiency and high-performance wireless LAN communication technology in a high-density environment is continuously performed. That is, in a next-generation wireless LAN environment, communication having high frequency efficiency needs to be provided indoors/outdoors under the presence of high-density stations and access points (APs) and various technologies for implementing the communication are required.

[Disclosure]

[Technical Problem]

The present invention has an object to provide high-efficiency/high-

performance wireless LAN communication in a high-density environment as described above.

The present invention has an object to set various formats of the aggregate MPDU and the response frame thereto and to use them to perform efficient data communication.

[Technical Solution]

In order to achieve the objects, the present invention provides a wireless communication method and a wireless communication terminal as below.

First, an exemplary embodiment of the present invention provides a wireless communication terminal, including: a processor; and a communication unit, wherein the processor generates an aggregate MPDU (A-MPDU) containing one or more MAC protocol data unit(s) (MPDU(s)) soliciting an immediate response, transmits the generated A-MPDU to a recipient, receives a response frame corresponding to the A-MPDU from the recipient, and determines whether a transmission of the MPDU(s) contained in the A-MPDU is successful based on the received response frame.

The processor may determine whether the transmission of the MPDU(s) contained in the A-MPDU is successful by considering at least one of the number of traffic ID (TID) soliciting an immediate response or MPDU delimiter information in the one or more MPDUs constituting the A-MPDU, and the response frame transmitted corresponding to the A-MPDU.

The processor may determine that the transmission of the MPDU(s) contained in the A-MPDU has failed when the A-MPDU consists of MPDUs of a plurality of TIDs soliciting an immediate response and a response frame transmitted corresponding to the A-MPDU is an Ack frame.

The processor may retransmit the MPDU(s) contained in the A-MPDU of

which the transmission is determined to have failed.

The processor may determine that a channel access for a transmission of the A-MPDU is successful and reset at least one EDCA parameter of an access category used for the channel access.

The response frame for the A-MPDU may be generated based on at least one of the number of TIDs soliciting an immediate response in the MPDU(s) of the A-MPDU successfully received by the recipient or the MPDU delimiter information of the A-MPDU.

When the MPDU(s) successfully received by the recipient include MPDU soliciting an immediate response only one, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an end of frame (EOF) field equal to 1 and a value of an MPDU length field not equal to 0, the response frame for the A-MPDU may be an Ack frame.

When the MPDU(s) successfully received by the recipient include one or more MPDUs of only one TID soliciting an immediate response, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an EOF field equal to 0, the response frame for the A-MPDU may be a compressed BlockAck frame.

When the MPDU(s) successfully received by the recipient include MPDUs of a plurality of TIDs soliciting an immediate response or include MPDUs of one or more TIDs soliciting an immediate response and an Action frame, the response frame for the A-MPDU may be a multi-STA BlockAck frame.

When at least one MPDU or MPDU delimiter in the A-MPDU is not successfully received by the recipient, the response frame for the A-MPDU may be a multi-STA BlockAck frame.

When at least one MPDU or MPDU delimiter is not successfully received prior to a first received EOF padding in the A-MPDU, the response frame for the A-MPDU may be a multi-STA BlockAck frame.

The recipient may response to the A-MPDU by the multi-STA BlockAck frame when the recipient can transmit the multi-STA BlockAck frame within a duration indicated by a successfully received MPDU or within a length indicated by a trigger information received from the A-MPDU.

In addition, an exemplary embodiment of the present invention provides a wireless communication method of a wireless communication terminal, including: generating an aggregate MPDU (A-MPDU) containing one or more MAC protocol data unit(s) (MPDU(s)) soliciting an immediate response; transmitting the generated A-MPDU to a recipient; receiving a response frame corresponding to the A-MPDU from the recipient; and determining whether a transmission of the MPDU(s) contained in the A-MPDU is successful based on the received response frame.

Next, another embodiment of the present invention provides a wireless communication terminal, including: a processor; and a communication unit, wherein the processor receives an aggregate MPDU (A-MPDU) consisting of one or more MPDUs, determines a format of a response frame for the received A-MPDU, and transmits a response frame of the determined format.

The format of the response frame for the A-MPDU is determined based on at least one of the number of TIDs soliciting an immediate response in the MPDU(s) successfully received in the A-MPDU and MPDU delimiter information of the A-MPDU.

When the successfully received MPDU(s) include MPDU soliciting an immediate response only one, and the MPDU soliciting the immediate response follows

an MPDU delimiter with a value of an end of frame (EOF) field equal to 1 and a value of an MPDU length field not equal to 0, the response frame for the A-MPDU may be determined to be an Ack frame.

When the successfully received MPDU(s) include one or more MPDUs of only one TID soliciting an immediate response, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an EOF field equal to 0, the response frame for the A-MPDU may be determined to be a compressed BlockAck frame.

When the successfully received MPDU(s) include MPDUs of a plurality of TIDs soliciting an immediate response or include MPDUs of one or more TIDs soliciting an immediate response and an Action frame, the response frame for the A-MPDU may be determined to be a multi-STA BlockAck frame.

When at least one MPDU or MPDU delimiter in the A-MPDU is not successfully received by the recipient, the response frame for the A-MPDU may be a multi-STA BlockAck frame.

When at least one MPDU or MPDU delimiter is not successfully received prior to a first received EOF padding in the A-MPDU, the response frame for the A-MPDU may be determined to be a multi-STA BlockAck frame.

When the multi-STA BlockAck frame can be transmitted within a duration indicated by a successfully received MPDU in the A-MPDU or within a length indicated by a trigger information received in the A-MPDU, the response frame for the A-MPDU may be determined to be a multi-STA BlockAck frame.

When the successfully received MPDU(s) include only one MPDU soliciting an immediate response and a trigger frame, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an end of frame (EOF) field equal

to 1 and a value of an MPDU length field not equal to 0, the response frame for the A-MPDU may be determined to be an Ack frame.

In addition, another exemplary embodiment of the present invention provides a wireless communication method of a wireless communication terminal, including: receiving an aggregate MPDU (A-MPDU) consisting of one or more MPDUs; determining a format of a response frame for the received A-MPDU; and transmitting a response frame of the determined format.

[Advantageous Effects]

According to an embodiment of the present invention, it is possible to set an aggregate MPDU and a response frame thereto in various formats and to perform efficient data communication.

According to an embodiment of the present invention, it is possible to increase the total resource utilization rate in the contention-based channel access system and improve the performance of the wireless LAN system.

[Description of Drawings]

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

FIG. 2 illustrates a wireless LAN system according to another embodiment of the present invention.

FIG. 3 illustrates a configuration of a station according to an embodiment of the present invention.

FIG. 4 illustrates a configuration of an access point according to an embodiment of the present invention.

FIG. 5 schematically illustrates a process in which a STA and an AP set a link.

FIG. 6 illustrates an embodiment of an MPDU aggregation method of a

wireless LAN packet.

FIG. 7 illustrates an embodiment of an MPDU aggregation method of a wireless LAN packet in a non-legacy wireless LAN system.

FIG. 8 illustrates another embodiment of an MPDU aggregation method of a wireless LAN packet in a non-legacy wireless LAN system.

FIG. 9 illustrates yet another embodiment of an MPDU aggregation method of a wireless LAN packet in a non-legacy wireless LAN system.

FIG. 10 illustrates an embodiment of a response method according to the format of an A-MPDU.

FIG. 11 illustrates an embodiment of a method that a terminal transmits a response frame for an A-MPDU.

FIG. 12 illustrates another embodiment of a method that a terminal transmits a response frame for an A-MPDU.

FIG. 13 illustrates an embodiment of a method that an AP transmits a response frame for an A-MPDU.

FIG. 14 illustrates a method of transmitting a response frame according to another embodiment of the present invention.

FIG. 15 illustrates a method of transmitting an A-MPDU and a response frame according to an embodiment of the present invention.

FIG. 16 illustrates a method of transmitting an A-MPDU and a response frame according to another embodiment of the present invention.

FIG. 17 illustrates a method of transmitting an A-MPDU and a response frame according to yet another embodiment of the present invention.

FIG. 18 illustrates a method of transmitting an S-MPDU and a response frame in the non-legacy wireless LAN system according to an embodiment of the present

invention.

FIG. 19 illustrates a method of transmitting an S-MPDU and a response frame in the non-legacy wireless LAN system according to another embodiment of the present invention.

FIG. 20 illustrates an operation of a wireless communication terminal according to an embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

FIG. 21 illustrates an operation of a wireless communication terminal according to another embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

FIG. 22 illustrates an operation of a wireless communication terminal according to another embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

FIG. 23 illustrates an operation of a wireless communication terminal according to another embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

FIG. 24 illustrates an operation of a wireless communication terminal according to an embodiment of the present invention to set the maximum number of TIDs information of a trigger frame.

[Detailed Description of the Invention]

Terms used in the specification adopt general terms which are currently widely used by considering functions in the present invention, but the terms may be changed depending on an intention of those skilled in the art, customs, and emergence of new technology. Further, in a specific case, there is a term arbitrarily selected by an applicant and in this case, a meaning thereof will be described in a corresponding

description part of the invention. Accordingly, it should be revealed that a term used in the specification should be analyzed based on not just a name of the term but a substantial meaning of the term and contents throughout the specification.

Throughout this specification and the claims that follow, when it is described that an element is “coupled” to another element, the element may be “directly coupled” to the other element or “electrically coupled” to the other element through a third element. Further, unless explicitly described to the contrary, the word “comprise” and variations such as “comprises” or “comprising”, will be understood to imply the inclusion of stated elements but not the exclusion of any other elements. Moreover, limitations such as "or more” or “or less” based on a specific threshold may be appropriately substituted with “more than” or “less than”, respectively.

This application claims priority to and the benefit of Korean Patent Application Nos. 10-2016-0175999, 10-2017-0048145 and 10-2017-0146357 filed in the Korean Intellectual Property Office and the embodiments and mentioned items described in the respective application, which forms the basis of the priority, shall be included in the Detailed Description of the present application.

FIG. 1 is a diagram illustrating a wireless LAN system according to an embodiment of the present invention. The wireless LAN system includes one or more basic service sets (BSS) and the BSS represents a set of apparatuses which are successfully synchronized with each other to communicate with each other. In general, the BSS may be classified into an infrastructure BSS and an independent BSS (IBSS) and FIG. 1 illustrates the infrastructure BSS between them.

As illustrated in FIG. 1, the infrastructure BSS (BSS1 and BSS2) includes one or more stations STA1, STA2, STA3, STA4, and STA5, access points PCP/AP-1 and PCP/AP-2 which are stations providing a distribution service, and a distribution system

(DS) connecting the multiple access points PCP/AP-1 and PCP/AP-2.

The station (STA) is a predetermined device including medium access control (MAC) following a regulation of an IEEE 802.11 standard and a physical layer interface for a wireless medium, and includes both a non-access point (non-AP) station and an access point (AP) in a broad sense. Further, in the present specification, a term 'terminal' may be used to refer to a non-AP STA, or an AP, or to both terms. A station for wireless communication includes a processor and a communication unit and according to the embodiment, may further include a user interface unit and a display unit. The processor may generate a frame to be transmitted through a wireless network or process a frame received through the wireless network and besides, perform various processing for controlling the station. In addition, the communication unit is functionally connected with the processor and transmits and receives frames through the wireless network for the station. According to the present invention, a terminal may be used as a term which includes user equipment (UE).

The access point (AP) is an entity that provides access to the distribution system (DS) via wireless medium for the station associated therewith. In the infrastructure BSS, communication among non-AP stations is, in principle, performed via the AP, but when a direct link is configured, direct communication is enabled even among the non-AP stations. Meanwhile, in the present invention, the AP is used as a concept including a personal BSS coordination point (PCP) and may include concepts including a centralized controller, a base station (BS), a node-B, a base transceiver system (BTS), and a site controller in a broad sense. In the present invention, an AP may also be referred to as a base wireless communication terminal. The base wireless communication terminal may be used as a term which includes an AP, a base station, an eNB (i.e. eNodeB) and a transmission point (TP) in a broad sense. In addition, the base

wireless communication terminal may include various types of wireless communication terminals that allocate medium resources and perform scheduling in communication with a plurality of wireless communication terminals.

A plurality of infrastructure BSSs may be connected with each other through the distribution system (DS). In this case, a plurality of BSSs connected through the distribution system is referred to as an extended service set (ESS).

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, duplicative description of parts, which are the same as or correspond to the embodiment of FIG. 1, will be omitted.

Since a BSS3 illustrated in FIG. 2 is the independent BSS and does not include the AP, all stations STA6 and STA7 are not connected with the AP. The independent BSS is not permitted to access the distribution system and forms a self-contained network. In the independent BSS, the respective stations STA6 and STA7 may be directly connected with each other.

FIG. 3 is a block diagram illustrating a configuration of a station 100 according to an embodiment of the present invention. As illustrated in FIG. 3, the station 100 according to the embodiment of the present invention may include a processor 110, a communication unit 120, a user interface unit 140, a display unit 150, and a memory 160.

First, the communication unit 120 transmits and receives a wireless signal such as a wireless LAN packet, or the like and may be embedded in the station 100 or provided as an exterior. According to the embodiment, the communication unit 120 may include at least one communication module using different frequency bands. For example, the communication unit 120 may include communication modules having

different frequency bands such as 2.4 GHz, 5 GHz, and 60 GHz. According to an embodiment, the station 100 may include a communication module using a frequency band of 6 GHz or more and a communication module using a frequency band of 6 GHz or less. The respective communication modules may perform wireless communication with the AP or an external station according to a wireless LAN standard of a frequency band supported by the corresponding communication module. The communication unit 120 may operate only one communication module at a time or simultaneously operate multiple communication modules together according to the performance and requirements of the station 100. When the station 100 includes a plurality of communication modules, each communication module may be implemented by independent elements or a plurality of modules may be integrated into one chip. In an embodiment of the present invention, the communication unit 120 may represent a radio frequency (RF) communication module for processing an RF signal.

Next, the user interface unit 140 includes various types of input/output means provided in the station 100. That is, the user interface unit 140 may receive a user input by using various input means and the processor 110 may control the station 100 based on the received user input. Further, the user interface unit 140 may perform output based on a command of the processor 110 by using various output means.

Next, the display unit 150 outputs an image on a display screen. The display unit 150 may output various display objects such as contents executed by the processor 110 or a user interface based on a control command of the processor 110, and the like. Further, the memory 160 stores a control program used in the station 100 and various resulting data. The control program may include an access program required for the station 100 to access the AP or the external station.

The processor 110 of the present invention may execute various commands or

programs and process data in the station 100. Further, the processor 110 may control the respective units of the station 100 and control data transmission/reception among the units. According to the embodiment of the present invention, the processor 110 may execute the program for accessing the AP stored in the memory 160 and receive a communication configuration message transmitted by the AP. Further, the processor 110 may read information on a priority condition of the station 100 included in the communication configuration message and request the access to the AP based on the information on the priority condition of the station 100. The processor 110 of the present invention may represent a main control unit of the station 100 and according to the embodiment, the processor 110 may represent a control unit for individually controlling some component of the station 100, for example, the communication unit 120, and the like. That is, the processor 110 may be a modem or a modulator/demodulator for modulating and demodulating wireless signals transmitted to and received from the communication unit 120. The processor 110 controls various operations of wireless signal transmission/reception of the station 100 according to the embodiment of the present invention. A detailed embodiment thereof will be described below.

The station 100 illustrated in FIG. 3 is a block diagram according to an embodiment of the present invention, where separate blocks are illustrated as logically distinguished elements of the device. Accordingly, the elements of the device may be mounted in a single chip or multiple chips depending on design of the device. For example, the processor 110 and the communication unit 120 may be implemented while being integrated into a single chip or implemented as a separate chip. Further, in the embodiment of the present invention, some components of the station 100, for example, the user interface unit 140 and the display unit 150 may be optionally provided in the

station 100.

FIG. 4 is a block diagram illustrating a configuration of an AP 200 according to an embodiment of the present invention. As illustrated in FIG. 4, the AP 200 according to the embodiment of the present invention may include a processor 210, a communication unit 220, and a memory 260. In FIG. 4, among the components of the AP 200, duplicative description of parts which are the same as or correspond to the components of the station 100 of FIG. 2 will be omitted.

Referring to FIG. 4, the AP 200 according to the present invention includes the communication unit 220 for operating the BSS in at least one frequency band. As described in the embodiment of FIG. 3, the communication unit 220 of the AP 200 may also include a plurality of communication modules using different frequency bands. That is, the AP 200 according to the embodiment of the present invention may include two or more communication modules among different frequency bands, for example, 2.4 GHz, 5 GHz, and 60 GHz together. Preferably, the AP 200 may include a communication module using a frequency band of 6 GHz or more and a communication module using a frequency band of 6 GHz or less. The respective communication modules may perform wireless communication with the station according to a wireless LAN standard of a frequency band supported by the corresponding communication module. The communication unit 220 may operate only one communication module at a time or simultaneously operate multiple communication modules together according to the performance and requirements of the AP 200. In an embodiment of the present invention, the communication unit 220 may represent a radio frequency (RF) communication module for processing an RF signal.

Next, the memory 260 stores a control program used in the AP 200 and various resulting data. The control program may include an access program for

managing the access of the station. Further, the processor 210 may control the respective units of the AP 200 and control data transmission/reception among the units. According to the embodiment of the present invention, the processor 210 may execute the program for accessing the station stored in the memory 260 and transmit communication configuration messages for one or more stations. In this case, the communication configuration messages may include information about access priority conditions of the respective stations. Further, the processor 210 performs an access configuration according to an access request of the station. According to an embodiment, the processor 210 may be a modem or a modulator/demodulator for modulating and demodulating wireless signals transmitted to and received from the communication unit 220. The processor 210 controls various operations such as wireless signal transmission/reception of the AP 200 according to the embodiment of the present invention. A detailed embodiment thereof will be described below.

FIG. 5 is a diagram schematically illustrating a process in which a STA sets a link with an AP.

Referring to FIG. 5, the link between the STA 100 and the AP 200 is set through three steps of scanning, authentication, and association in a broad way. First, the scanning step is a step in which the STA 100 obtains access information of BSS operated by the AP 200. A method for performing the scanning includes a passive scanning method in which the AP 200 obtains information by using a beacon message (S101) which is periodically transmitted and an active scanning method in which the STA 100 transmits a probe request to the AP (S103) and obtains access information by receiving a probe response from the AP (S105).

The STA 100 that successfully receives wireless access information in the scanning step performs the authentication step by transmitting an authentication request

(S107a) and receiving an authentication response from the AP 200 (S107b). After the authentication step is performed, the STA 100 performs the association step by transmitting an association request (S109a) and receiving an association response from the AP 200 (S109b). In this specification, an association basically means a wireless association, but the present invention is not limited thereto, and the association may include both the wireless association and a wired association in a broad sense.

Meanwhile, an 802.1X based authentication step (S111) and an IP address obtaining step (S113) through DHCP may be additionally performed. In FIG. 5, the authentication server 300 is a server that processes 802.1X based authentication with the STA 100 and may be present in physical association with the AP 200 or present as a separate server.

Aggregate MPDU (A-MPDU)

FIG. 6 illustrates an embodiment of a MAC protocol data unit (MPDU) aggregation method of a wireless LAN packet. In a contention-based wireless LAN system, a terminal has to perform a contention for channel occupation whenever it attempts to transmit data. Therefore, as the density of the terminals in the BSS and the amount of transmission data per terminal increase, the efficiency of the actual data transmission amount compared to the contention time may be drastically reduced.

In order to solve such a problem and increase the data transmission efficiency of the terminals, an aggregate MPDU (A-MPDU) as illustrated in FIG. 6 may be used. The A-MPDU consists of one or more A-MPDU subframes and a variable amount of end of frame (EOF) padding in that order. Each A-MPDU subframe may contain an MPDU delimiter, and optionally contain an MPDU following it. The MPDU delimiter indicates information for the MPDU contained in the corresponding A-MPDU subframe. More specifically, the MPDU delimiter contains an end of frame (EOF) field, an MPDU

length field, a cyclic redundancy check (CRC) field, and an MPDU signature field. The EOF length field indicates the length of the MPDU. If no MPDU is present in the MPDU subframe, the MPDU length field is set to 0. In addition, the CRC field is used to detect errors of the MPDU delimiter, and the MPDU signature field represents the pattern which can be used by the recipient to detect the MPDU delimiter.

Hereinafter, in the embodiments of the present invention, an MPDU may also be used as a term indicating an A-MPDU subframe consisting of the corresponding MPDU for convenience. For example, an MPDU with the value of an EOF field set to 1 may indicate an A-MPDU subframe with the value of an EOF field set to 1 or an MPDU constituting that A-MPDU subframe. More specifically, an MPDU with the value of an EOF field set to 1 may indicate an A-MPDU subframe containing an MPDU delimiter with the value of an EOF field set to 1 or an MPDU constituting that A-MPDU subframe. Also, in the embodiments of the present invention, a recipient may be used as a term indicating a terminal receiving an A-MPDU and transmitting a response frame thereto.

FIG. 6(a) illustrates an embodiment of the configuration of an A-MPDU. As illustrated, the A-MPDU may contain one or more A-MPDU subframes (i.e., a pre-EOF padding portion) and an EOF padding portion. In the case of a traffic ID (TID) in which a Block Ack (BA) agreement has been performed, a plurality of data frames (or data MPDUs) may be transmitted together via a single A-MPDU. In this case, in the MPDU delimiter for each MPDU, the value of the EOF field is set to 0 and the value of the MPDU length field is set to a non-zero value. Referring to FIG. 6(a), a plurality of data MPDUs belonging to TID2 are transmitted via a single A-MPDU. In the EOF padding portion following the pre-EOF padding portion, one or more EOF delimiters with the value of the EOF field set to 1 and the value of the MPDU length field set to 0 are

transmitted to indicate the end of the A-MPDU transmission.

FIG. 6(b) illustrates an embodiment of the construction of a single MPDU (S-MPDU). The above-described configuration of the A-MPDU may be inefficient if the transmitter intends to transmit one MPDU. More specifically, if an A-MPDU is used, an MPDU delimiter should be inserted for every MPDU, and a BlockAck based response including a BA bitmap may be requested. Meanwhile, in the 802.11ac wireless LAN system, all data transmitted in the PHY protocol data unit (PPDU) format of the VHT PPDU is defined to be transmitted through an MPDU format of the A-MPDU. Therefore, in order to improve the inefficient transmission structure in the above situation, the S-MPDU format may be used when only one MPDU is transmitted in the PPDU. In the MPDU delimiter of the data MPDU solely transmitted in the S-MPDU format, the value of the EOF field is set to 1 and the value of the MPDU length field is set to a non-zero value. As in the A-MPDU format, EOF padding may also be used in the S-MPDU format. When an S-MPDU is received, the recipient may respond with a normal Ack rather than a BlockAck regardless of whether a Block Ack agreement has been performed between the transmitter and the recipient.

FIG. 7 illustrates an embodiment of an MPDU aggregation method of a wireless LAN packet in a non-legacy wireless LAN system. In the embodiment of the present invention, the non-legacy wireless LAN system may refer to a wireless LAN system conforming to an IEEE 802.11ax standard, and the non-legacy wireless LAN packet may refer to a high efficiency (HE) PPDU conforming to that standard. However, the present invention is not limited thereto.

In legacy wireless LAN systems prior to the IEEE 802.11ax standard, there was a restriction that all the MPDUs contained in an A-MPDU should belong to the same TID. For example, a data MPDU and an Action frame could not be aggregated

into a single A-MPDU. In addition, since MPDUs of different TIDs cannot be contained in the A-MPDU, if a data MPDU with the value of the EOF field of 1 is contained in the received A-MPDU, the recipient identified the corresponding data MPDU to be the only MPDU which is contained in the A-MPDU. Therefore, the recipient may regard the A-MPDU as an S-MPDU and respond with a general Ack.

However, in the non-legacy wireless LAN system, an A-MPDU in which MPDUs of a plurality of TIDs are aggregated may be transmitted in a multi-user (MU) transmission or a single-user (SU) transmission satisfying a certain condition. As such, the A-MPDU in which MPDUs of a plurality of TIDs are aggregated is called a multi-TID A-MPDU. The multi-TID A-MPDU of the non-legacy wireless LAN system may contain one or more A-MPDU subframes with the value of the EOF field set to 1.

Each MPDU of one or more A-MPDU subframes with the value of the EOF field set to 1 should belong to a different TID and should be the only MPDU of the corresponding TID in the A-MPDU. That is, the A-MPDU subframe containing the MPDU delimiter with the value of the EOF field set to 1 consists of an MPDU or an Action frame soliciting a response of the general Ack. As illustrated in FIG. 7(a), the EOF field value of an MPDU delimiter preceding the only MPDU of the specific TID (i.e., the MPDU of TID1 and the MPDU of TID3) in the A-MPDU may be set to 1. Here, even in the case of Quality of Service (QoS) data MPDU of a TID for which the Block Ack agreement has been performed, the EOF field value of the MPDU delimiter is set to 1 when the MPDU is the only MPDU of the TID in the A-MPDU. In addition, as illustrated in FIG. 7(b), the Action frame soliciting a response of the general Ack may also be aggregated with other data MPDUs. In this case, a maximum of one Action frame may be aggregated in the A-MPDU, and the value of the EOF field of the MPDU delimiter preceding the Action frame may be set to 1.

On the other hand, a data MPDU of a TID for which the Block Ack agreement is not performed may be aggregated together with a data MPDU of another TID by setting the value of the EOF field of the corresponding MPDU delimiter to 1. If the Block Ack agreement is not performed, frames of the corresponding TID do not basically support the response of BlockAck. However, since the multi-STA BlockAck (hereinafter, M-BA) supports the Ack context, the response to the MPDU of the corresponding TID can be performed using the M-BA. If the data MPDU of the TID for which the Block Ack agreement is not performed is transmitted via an A-MPDU, it is apparent that the MPDU is the only MPDU of the corresponding TID. Therefore, according to an embodiment of the present invention, when the data MPDU of the TID for which the Block Ack agreement is not performed is transmitted via the A-MPDU, the value of the EOF field of the corresponding MPDU delimiter may be set to 0. However, even in this case, when one or more other MPDUs aggregated together in the A-MPDU solicit an immediate response, the response to the MPDU of the corresponding TID may be performed using the M-BA.

In addition, one or more MPDUs of the TIDs for which the Block Ack agreement has been performed may be aggregated into the same A-MPDU by setting the value of the EOF field of the corresponding MPDU delimiter to 0. That is, one or more A-MPDU subframes with the value of the EOF field equal to 0 may be aggregated together with an A-MPDU subframe with the value of the EOF field equal to 1. In the legacy wireless LAN system, when the value of the EOF field of the first MPDU delimiter of the received A-MPDU is 1, the MPDU of the corresponding A-MPDU subframe may be regarded as the only MPDU transmitted via the A-MPDU. That is, the received A-MPDU could be regarded as the S-MPDU illustrated in FIG. 7(c). However, in the non-legacy wireless LAN system, whether the A-MPDU is an S-MPDU, a

(single-TID) A-MPDU, or a multi-TID A-MPDU can be determined after identifying the subsequent MPDU delimiters and MPDUs

The recipient of the above-described S-MPDU, A-MPDU, or multi-TID A-MPDU may transmit a response based on an acknowledgment context. According to the embodiment of the present invention, the acknowledgment context may include a BlockAck context, an Ack context, an All Ack context, and the like, and specific embodiments thereof will be described later. According to the embodiment of the present invention, an A-MPDU subframe in which the value of the EOF field is set to 1 may indicate the Ack context. If the MPDU of the A-MPDU subframe with the value of the EOF field equal to 1 is transmitted alone via the A-MPDU, the response to the corresponding MPDU may be performed using an Ack frame. However, if the MPDU of the A-MPDU subframe with the value of the EOF field equal to 1 is aggregated and transmitted together with other frames soliciting an immediate response, the response to the corresponding MPDU may be performed using an M-BA frame.

When a response to the MPDU of the A-MPDU subframe with the value of the EOF field equal to 1 is performed using the M-BA frame, the response to the MPDU is received through a per AID TID information field in which BA bitmap is omitted from the M-BA. More specifically, the acknowledgment context included in each per AID TID information in the M-BA frame may be indicated via an Ack type subfield in the per AID TID information field. According to an embodiment, a value of the Ack type subfield equal to 1 may indicate an Ack context, and a value of the Ack type subfield equal to 0 may indicate a BlockAck context. Accordingly, when a response to the MPDU of the A-MPDU subframe with the value of the EOF field equal to 1 is performed using the M-BA frame, the response to the MPDU may be received through a per AID TID Information field in which the value of the Ack type subfield is set to 1.

That is, the value of the Ack type subfield (i.e., Ack type subfield = 1) of the per AID TID information field including the response information for the MPDU is set differently from the value of the Ack type subfield (i.e., Ack type subfield = 0) of the other per AID TID information field soliciting an BA bitmap.

FIG. 8 illustrates another embodiment of an MPDU aggregation method of a wireless LAN packet in a non-legacy wireless LAN system. As described above, as the multi-TID A-MPDU is used in the non-legacy wireless LAN system, an A-MPDU subframe in which the value of the EOF field is set to 1 may exist at most one for each TID in one A-MPDU. That is, in one A-MPDU, an A-MPDU subframes in which the value of the EOF field is set to 1 and a plurality of A-MPDU subframes in which the value of the EOF field is set to 0 may coexist.

In the single-TID A-MPDU used in the legacy wireless LAN system, an MPDU delimiter with the EOF value equal to 0 could not follow an MPDU delimiter with the EOF value equal to 1. However, in the multi-TID A-MPDU used in the non-legacy wireless LAN system, since the A-MPDU subframe with the value of the EOF field equal to 0 and the A-MPDU subframe with the value of the EOF field equal to 1 are mixed, EOF values of the MPDU delimiters can be randomly arranged. According to an embodiment of the present invention, an arrangement method of a plurality of MPDUs in a multi-TID A-MPDU may be configured to comply with the conventional MPDU arrangement rule in an A-MPDU.

More specifically, according to an embodiment of the present invention, an A-MPDU subframe in which the value of the EOF field is set to 1 may be set to be located between an A-MPDU subframe in which the value of the EOF field is set to 0 and an EOF padding. More specifically, the arrangement of MPDU delimiters (or A-MPDU subframes) in the A-MPDU may be set in the following order.

First group: MPDU delimiters (MPDU delimiters for MPDUs of TID2 in the embodiment of FIG. 8) in which the value of the EOF field is set to 0 and the value of the MPDU length field is set to a non-zero value.

Second group: MPDU delimiter(s) (MPDU delimiter for MPDU of TID1, MPDU delimiter for MPDU of TID3, and MPDU delimiter for Action frame in the embodiment of FIG. 8) in which the value of the EOF field is set to 1 and the value of the MPDU length field is set to a non-zero value.

Third group: MPDU delimiter(s) (EOF padding portion in the embodiment of FIG. 8) in which the value of the EOF field is set to 1 and the value of the MPDU Length field is set to 0.

That is, the arrangement of the MPDU delimiters in the A-MPDU may be set in the order of the first group, the second group, and the third group. According to an embodiment, there may be no additional limitation on the arrangement order of the MPDUs within the first group and/or the arrangement order of the MPDUs within the second group. That is, the arrangement of a plurality of MPDUs belonging to the same group may not be continuous for each same TID, and there may be no restriction on the order of TIDs.

FIG. 9 illustrates yet another embodiment of an MPDU aggregation method of a wireless LAN packet in a non-legacy wireless LAN system. The A-MPDU may aggregate multiple MPDUs into one PHY service data unit (PPDU). In this case, MPDUs of various kinds of frames can be aggregated into the A-MPDU. More specifically, QoS data frame, QoS Null frame, Action frame, action No Ack frame, control frame, and the like can be aggregated into one A-MPDU. Among them, an A-MPDU containing the QoS data frame may be classified into a data enabled immediate response (DEIR) context and a data enabled no immediate response (DENIR) context

depending on whether a data frame solicits an immediate response.

Whether a data frame solicits an immediate response may be indicated through an Ack policy subfield of the QoS control field of the MAC header. According to an embodiment, the Ack policy subfield may indicate the acknowledgment policy for data via four different field values.

First, if the Ack policy subfield is set to the first value, the recipient responds to a data frame with a general Ack or an implicit BlockAck. If the acknowledgment policy is general Ack or implicit BlockAck, an immediate response to the data frame is solicited. That is, the recipient transmits an Ack frame or a BlockAck frame a SIFS after a PPDU carrying the data frame. In this case, the BlockAck frame may be transmitted individually or as a part of the A-MPDU.

Next, when the Ack policy subfield is set to the second value, a response to the corresponding data frame is not solicited. That is, when the Ack policy subfield is set to the second value, the acknowledgment policy may be identified as No Ack.

Next, when the Ack policy subfield is set to the third value, a non-explicit Ack is solicited. If the acknowledgment policy is non-explicit Ack, a response to the data frame is performed, but the response is not an Ack frame. According to a further embodiment of the present invention, if the Ack policy subfield is set to the third value, an HE TB PPDU (HTP) Ack may be solicited. If the data frame is transmitted through a PPDU soliciting a high efficiency trigger-based (HE TB) PPDU and the acknowledgment policy of the data frame is HTP Ack, the recipient responds to the data frame via the HE TB PPDU.

Finally, if the Ack policy subfield is set to the fourth value, a BlockAck is solicited. If the acknowledgment policy is BlockAck, the recipient takes no action, except to record its status upon receipt of the frame. The recipient may perform a

response when a BlockAck request frame is received.

Information indicating whether or not a data frame solicits an immediate response is designated in the form of QoSAck or QosNoAck through a service class for each TID in a MAC service access point (SAP) which is a part of an upper layer of the MAC. In a TID for which the service class is designated as QoSNoAck, the Block Ack agreement is not performed, and the value of the Ack policy subfield of a frame of the corresponding TID is set to indicate the second value, i.e., No Ack.

In a legacy wireless LAN system, MPDUs of only one TID could be transmitted through one A-MPDU. Therefore, when a QoS data frame or QoS Null frame of a TID soliciting an immediate response is aggregated, the corresponding A-MPDU is automatically classified into a DEIR context. In addition, when a QoS data frame or QoS Null frame of a TID not soliciting an immediate response is aggregated, the corresponding A-MPDU is automatically classified into a DENIR context. Therefore, in the legacy wireless LAN system, a frame of a TID for which the service class is QoSAck and a frame of the another TID for which the service class is QoSNoAck could not be aggregated into one A-MPDU. However, in the non-legacy wireless LAN system, aggregation of MPDUs of different TIDs is allowed through a multi-TID A-MPDU. Therefore, in the non-legacy wireless LAN system, it is necessary to modify the context for the A-MPDU in which the frame of the TID for which the service class is QoSAck and the frame of the another TID for which the service class is QoSNoAck are aggregated together.

First, FIG. 9(a) illustrates an A-MPDU of the DEIR context according to an embodiment of the present invention. An A-MPDU in which a frame of a TID for which the service class is QoSAck and a frame of another TID for which the service class is QoSNoAck are aggregated can be classified into a DEIR context because an immediate

response is solicited by the TID for which the service class is QoSAck. According to an embodiment of the present invention, a frame for which the acknowledgment policy is No Ack may be selectively aggregated into an A-MPDU of the DEIR context only if at least one of a frame for which the acknowledgment policy is Ack (or implicit BlockAck), a frame for which the acknowledgment policy is HTP Ack, a frame for which the acknowledgment policy is BlockAck, and an Action frame exists in the A-MPDU.

Next, FIG. 9(b) illustrates an A-MPDU of the DENIR context according to an embodiment of the present invention. According to the embodiment of the present invention, frames of a plurality of TIDs for which the acknowledgment policy is No Ack may be aggregated together in the A-MPDU of the DENIR context. In addition, frames of one or more TIDs for which the acknowledgment policy is No Ack and Action No Ack frames may be aggregated together in the A-MPDU of the DENIR context

Response frame for the A-MPDU

FIG. 10 illustrates an embodiment of a response method according to the format of an A-MPDU. As described above, in the non-legacy wireless LAN system, an A-MPDU having the following format can be used. i) A-MPDU in which a plurality of MPDUs belonging to different TIDs are aggregated (embodiment of FIG. 10(a)). ii) A-MPDU in which a plurality of MPDUs belonging to a single TID are aggregated (embodiment of FIG. 10(b)). iii) A-MPDU containing a signle MPDU (embodiment of FIG. 10(c)).

Therefore, the structure of the response frame may be different according to the format of the A-MPDU received by the recipient. According to the embodiment of the present invention, the following response frame may be transmitted for each format

of the A-MPDU.

1) Ack frame: If MPDU with the value of the EOF field set to 1 is present only one in the received A-MPDU. Alternatively, if MPDU soliciting an immediate response is present only one in the received A-MPDU.

2) Compressed BlockAck (C-BA) frame: Among the received A-MPDU, if MPDUs soliciting an immediate response belong to the same TID. Alternatively, if the received A-MPDU consists of MPDUs of only one TID soliciting an immediate response and frames of other TID not soliciting an immediate response. In this case, the frame not soliciting an immediate response may include an Action No Ack frame, a QoS data frame for which the acknowledgment policy is BlockAck or No Ack, a QoS Null frame for which the acknowledgment policy is BlockAck or No Ack, and the like.

3) Multi-STA BlockAck (M-BA) frame: If the received A-MPDU consists of MPDUs of two or more TIDs soliciting an immediate response. Alternatively, if the received A-MPDU is configured to include MPDUs of one or more TIDs soliciting an immediate response and an Action frame. When a response is transmitted via the M-BA frame, a response may be performed through the per AID TID information field which is independent for each TID. If an MPDU with the value of the EOF field set to 1 is present in the received A-MPDU, the value of the Ack type subfield of the per AID TID information field corresponding to the MPDU may be set to 1 so that the BA bitmap is omitted.

FIG. 11 illustrates an embodiment of a method that a terminal transmits a response frame for an A-MPDU. As described above, in a non-legacy wireless LAN system, a transmitter may transmit a multi-TID A-MPDU and a different acknowledgment policy can be designated for each TID in one A-MPDU. In addition, a recipient may transmit a response using either an Ack frame, a BlockAck frame, or a M-

BA frame based on the format of the received A-MPDU. A non-AP STA may not simultaneously receive data from a plurality of terminals unlike an AP. Therefore, the STA may perform a response for the A-MPDU based on information included in the received A-MPDU, the presence of uplink multi-user trigger information in the A-MPDU, and the like.

FIG. 11 illustrates embodiments of a response method of a STA when MPDU with the acknowledgment policy set to HTP Ack is not present in the received A-MPDU. The A-MPDU transmitted by the AP may be carried via a high efficiency single-user (HE SU) PPDU or a high efficiency multi-user (HE MU) PPDU, and the STA receives the PPDU. If the acknowledgment policy of the MPDU contained in the received A-MPDU is set to HTP Ack, the recipient should perform a response in HE-TB PPDU format. However, if MPDU with the acknowledgment policy set to HTP Ack is not present in the received A-MPDU, the STA may perform a response in HE SU PPDU format.

In this case, the STA may respond with either an Ack frame, a BlockAck frame, or an M-BA frame carried in the HE SU PPDU based on the format of the received A-MPDU. According to an embodiment, the STA may determine the format of the response frame considering, in the successfully received MPDU(s) of the A-MPDU, the number of TIDs soliciting an immediate response, the MPDU delimiter information of the A-MPDU, and the like. More specifically, the STA may determine the format of the response frame based on a combination of at least one of the following information included in the successfully received MPDU(s) in the A-MPDU. i) The number of TIDs soliciting an immediate response, ii) the presence or the number of MPDU delimiters with the value of the EOF field equal to 1 and the value of the MPDU length field not equal to 0, iii) the number of MPDUs soliciting a response in the Ack context, and iv)

the number of MPDUs with no Block Ack agreement.

First, FIG. 11(a) illustrates an embodiment in which the STA responds to an A-MPDU with an Ack frame carried in an HE SU PPDU. According to the embodiment of the present invention, if the MPDU successfully received in the A-MPDU is the only MPDU soliciting an immediate response of the Ack context (i.e., the received A-MPDU is identified as the S-MPDU), the STA responds with the Ack frame. Also, if the MPDU(s) successfully received in the A-MPDU include only one MPDU soliciting an immediate response of the Ack context and one or more other MPDUs not soliciting an immediate response, the STA responds with the Ack frame. That is, if the MPDU(s) successfully received in the A-MPDU include only one MPDU soliciting an immediate response, the STA responds with the Ack frame.

In this case, the MPDU soliciting an immediate response of the Ack context may include an Action frame, a QoS data frame in which the acknowledgment policy is general Ack, a QoS Null frame in which the acknowledgment policy is general Ack, and the like. According to an embodiment of the present invention, the MPDU soliciting an immediate response of the Ack context may follow an MPDU delimiter with the value of the EOF field equal to 1 and the value of the MPDU length field not equal to 0. Further, the MPDU not soliciting an immediate response may include an Action No Ack frame, a QoS data frame in which the acknowledgment policy is BlockAck or No Ack, a QoS Null frame in which the acknowledgment policy is BlockAck or No Ack, and the like.

According to a further embodiment of the present invention, the STA may respond with an M-BA frame if the received A-MPDU is identified as containing only one MPDU soliciting an immediate response of the Ack context. In this case, the STA may insert only one per AID TID information field in the M-BA frame to perform the

response of the Ack context. However, since the length of the M-BA frame is longer than the length of the Ack frame, the STA may response with the M-BA frame only when transmission is possible using a modulation and coding scheme (MCS) according to a specified rule within a duration indicated by the received MPDU.

Next, FIG. 11(b) illustrates an embodiment in which the STA responds to an A-MPDU with a compressed BlockAck (C-BA) frame carried in an HE SU PPDU. According to the embodiment of the present invention, when the received A-MPDU is identified as a single-TID A-MPDU, the STA responds with a compressed BlockAck (C-BA) frame. That is, if the MPDU(s) successfully received in the A-MPDU include one or more MPDUs of only one TID soliciting an immediate response, the STA responds with the C-BA frame. Also, if the MPDU(s) successfully received in the A-MPDU include one or more MPDUs of only one TID soliciting an immediate response and one or more other MPDUs not soliciting an immediate response, the STA responds with the C-BA frame. In other words, if all of the MPDUs soliciting an immediate response among the successfully received MPDU(s) of the A-MPDU belong to the same TID, the STA responds with the C-BA frame.

In this case, the MPDU soliciting an immediate response may include a QoS data frame in which the acknowledgment policy is implicit BlockAck, a QoS Null frame in which the acknowledgment policy is implicit BlockAck, and the like. According to an embodiment of the present invention, a frame in which the acknowledgment policy is implicit BlockAck may solicit an immediate response of the BlockAck context. According to an embodiment, the MPDU soliciting an immediate response of the BlockAck context may follow an MPDU delimiter with the value of the EOF field equal to 0 and the value of the MPDU length field not equal to 0. Further, the MPDU not soliciting an immediate response may include an Action No Ack frame, a QoS data

frame in which the acknowledgment policy is BlockAck or No Ack, a QoS Null frame in which the acknowledgment policy is BlockAck or No Ack, and the like. According to a further embodiment of the present invention, the STA may also respond with an M-BA frame if the received A-MPDU is identified as a single-TID A-MPDU.

Next, FIG. 11(c) illustrates an embodiment in which the STA responds to an A-MPDU with a multi-STA BlockAck (M-BA) frame carried in an HE SU PPDU.

According to the embodiment of the present invention, when the received A-MPDU is identified as a multi-TID A-MPDU, the STA responds with a multi-STA BlockAck (M-BA) frame. That is, if the MPDU(s) successfully received in the A-MPDU include MPDUs of two or more TIDs soliciting an immediate response, the STA responds with the M-BA frame. Also, if the MPDU(s) successfully received in the A-MPDU include MPDUs of one or more TIDs soliciting an immediate response and an Action frames, the STA responds with the M-BA frame.

According to a further specific embodiment, the STA may respond with the M-BA frame if the received A-MPDU satisfies at least one of the following conditions: i) The A-MPDU contains MPDUs of two or more TIDs soliciting an immediate response of the BlockAck context. ii) The A-MPDU contains MPDUs of one or more TIDs soliciting an immediate response of the BlockAck context and MPDUs of one or more TIDs soliciting an immediate response of the Ack context. iii) The A-MPDU contains MPDUs of two or more TIDs soliciting an immediate response of the Ack context. iv) The A-MPDU contains MPDUs of one or more TIDs soliciting an immediate response of the BlockAck context or Ack context and an Action frame.

In this case, the MPDU soliciting an immediate response of the BlockAck context may include a QoS data frame in which the acknowledgment policy is implicit BlockAck, a QoS Null frame in which the acknowledgment policy is implicit BlockAck,

and the like. According to an embodiment, the MPDU soliciting an immediate response of the BlockAck context may follow an MPDU delimiter with the value of the EOF field equal to 0 and the value of the MPDU length field not equal to 0. Further, the MPDU soliciting an immediate response of the Ack context may include an Action frame, a QoS data frame in which the acknowledgment policy is general Ack, a QoS Null frame in which the acknowledgment policy is general Ack, and the like. According to an embodiment of the present invention, the MPDU soliciting an immediate response of the Ack context may follow an MPDU delimiter with the value of the EOF field equal to 1 and the value of the MPDU length field not equal to 0.

When the response is transmitted with the M-BA frame, the response may be performed through the per AID TID information field which is independent for each TID. In this case, in the response to the Action frame, the TID value of the per AID TID information field is set to '1111'. If an MPDU of the Ack context is present in the received A-MPDU, the value of the Ack type subfield of the per AID TID information field corresponding to the MPDU may be set to 1 so that the BA bitmap is omitted. Also, if all the MPDUs contained in the received A-MPDU are successfully received, the STA may perform a response of the All Ack context by inserting only one per AID TID information field in the M-BA frame. In this case, the TID value of only one per AID TID information field inserted in the M-BA frame may be set to '1110' to indicate the response of the All Ack context.

FIG. 12 illustrates another embodiment of a method that a terminal transmits a response frame for an A-MPDU. In the embodiment of FIG. 12, the same or corresponding parts as those of the embodiment of FIG. 11 described above will be omitted.

FIG. 12 illustrates embodiments of a response method of a STA when an

MPDU with the acknowledgment policy set to HTP Ack is present in the received A-MPDU. The A-MPDU transmitted by the AP may be carried via a high efficiency single-user (HE SU) PPDU or a high efficiency multi-user (HE MU) PPDU, and the STA receives the PPDU. If the acknowledgment policy of the MPDU contained in the received A-MPDU is set to HTP Ack, the recipient should perform a response in HE-TB PPDU format. In this case, the STA receiving the MPDU with the acknowledgment policy set to HTP Ack may respond in HE TB PPDU format only if one of the following conditions is satisfied. i) When an A-MPDU containing a trigger frame in which the receiver address field is set to the address of the STA is received. ii) When an A-MPDU containing a QoS data frame or a QoS null frame in which an uplink multi-user response scheduling (UMRS) control field is included and the receiver address field is set to the address of the STA is received. If at least one of the trigger frame and the UMRS control field is not received, the STA cannot respond to the MPDU for which the acknowledgment policy is set to HTP Ack. The STA may respond with either an Ack frame, a BlockAck frame, or an M-BA frame carried in the HE-TB PPDU based on the format of the received A-MPDU.

First, FIG. 12(a) illustrates an embodiment in which the STA responds to an A-MPDU with an Ack frame carried in a HE-TB PPDU. According to the embodiment of the present invention, if the MPDU successfully received in the A-MPDU is the only MPDU soliciting an immediate response of the Ack context (i.e., the received A-MPDU is identified as the S-MPDU) and contains a UMRS control field, the STA responds with the Ack frame. Also, if the MPDU(s) successfully received in the A-MPDU include only one MPDU soliciting an immediate response of the Ack context, zero or more other MPDUs not soliciting an immediate response, and the trigger frame, the STA responds with the Ack frame. That is, if the MPDU(s) successfully received in the

A-MPDU include only one MPDU soliciting an immediate response, and contains a UMRS control field or a trigger frame, the STA responds with the Ack frame.

In this case, the MPDU soliciting an immediate response of the Ack context may include an Action frame, a QoS data frame in which the acknowledgment policy is HTP Ack, a QoS Null frame in which the acknowledgment policy is HTP Ack, and the like. According to an embodiment of the present invention, the MPDU soliciting an immediate response of the Ack context may follow an MPDU delimiter with the value of the EOF field equal to 1 and the value of the MPDU length field not equal to 0. Further, the MPDU not soliciting an immediate response may include an Action No Ack frame, a QoS data frame in which the acknowledgment policy is BlockAck or No Ack, a QoS Null frame in which the acknowledgment policy is BlockAck or No Ack, and the like.

According to a further embodiment of the present invention, the STA may respond with an M-BA frame if the received A-MPDU is identified as containing only one MPDU soliciting an immediate response of the Ack context. In this case, the STA may insert only one per AID TID information field in the M-BA frame to perform the response of the Ack context. However, since the length of the M-BA frame is longer than the length of the Ack frame, the STA may response with the M-BA frame only when transmission is possible using a modulation and coding scheme (MCS) according to a specified rule within a length indicated by the trigger information contained in the received MPDU. In this case, the length indicated by the trigger information may be represented through a length field of the common information field of the trigger frame or an HE TB PPDU length field of the UMRS control field of the MPDU.

Next, FIG. 12(b) illustrates an embodiment in which the STA responds to an A-MPDU with a compressed BlockAck (C-BA) frame carried in an HE TB PPDU.

According to the embodiment of the present invention, when the received A-MPDU is identified as a single-TID A-MPDU, the STA responds with a compressed BlockAck (C-BA) frame. That is, if the MPDU(s) successfully received in the A-MPDU include a plurality of MPDUs of only one TID soliciting an immediate response of the BlockAck context, and contains a UMRS control field or a trigger frame, the STA responds with the C-BA frame. Also, if the MPDU(s) successfully received in the A-MPDU include a plurality of MPDUs of only one TID soliciting an immediate response of the BlockAck context and one or more other MPDUs not soliciting an immediate response, and contains a UMRS control field or a trigger frame, the STA responds with the C-BA frame. In other words, if all of the MPDUs soliciting an immediate response of the BlockAck context among the successfully received MPDU(s) of the A-MPDU belong to the same TID and the A-MPDU contains a UMRS control field or a trigger frame, the STA responds with the C-BA frame.

In this case, the MPDU soliciting an immediate response of the BlockAck context may include a QoS data frame in which the acknowledgment policy is HTP Ack, a QoS Null frame in which the acknowledgment policy is HTP Ack, and the like. According to an embodiment, the MPDU soliciting an immediate response of the BlockAck context may follow an MPDU delimiter with the value of the EOF field equal to 0 and the value of the MPDU length field not equal to 0. Further, the MPDU not soliciting an immediate response may include an Action No Ack frame, a QoS data frame in which the acknowledgment policy is BlockAck or No Ack, a QoS Null frame in which the acknowledgment policy is BlockAck or No Ack, and the like. According to a further embodiment of the present invention, the STA may respond with an M-BA frame if the received A-MPDU is identified as a single-TID A-MPDU.

Next, FIG. 12(c) illustrates an embodiment in which the STA responds to an

A-MPDU with a multi-STA BlockAck (M-BA) frame carried in an HE TB PPDU.

According to the embodiment of the present invention, when the received A-MPDU is identified as a multi-TID A-MPDU, the STA responds with a multi-STA BlockAck (M-BA) frame. That is, if the MPDU(s) successfully received in the A-MPDU include MPDUs of two or more TIDs soliciting an immediate response, and contains a UMRS control field or a trigger frame, the STA responds with the M-BA frame. Also, if the MPDU(s) successfully received in the A-MPDU include MPDUs of one or more TIDs soliciting an immediate response and an Action frame, and contains a UMRS control field or a trigger frame, the STA responds with the M-BA frame.

According to a further specific embodiment, the STA may respond with the M-BA frame if the received A-MPDU contains a UMRS control field or a trigger frame, satisfying at least one of the following conditions: i) The A-MPDU contains MPDUs of two or more TIDs soliciting an immediate response of the BlockAck context. ii) The A-MPDU contains MPDUs of one or more TIDs soliciting an immediate response of the BlockAck context and MPDUs of one or more TIDs soliciting an immediate response of the Ack context. iii) The A-MPDU contains MPDUs of two or more TIDs soliciting an immediate response of the Ack context. iv) The A-MPDU contains MPDUs of one or more TIDs soliciting an immediate response of the BlockAck context or Ack context and an Action frame.

In this case, the MPDU soliciting an immediate response of the BlockAck context may include a QoS data frame in which the acknowledgment policy is HTP Ack, a QoS Null frame in which the acknowledgment policy is HTP Ack, and the like. According to an embodiment, the MPDU soliciting an immediate response of the BlockAck context may follow an MPDU delimiter with the value of the EOF field equal to 0 and the value of the MPDU length field not equal to 0. Further, the MPDU

soliciting an immediate response of the Ack context may include an Action frame, a QoS data frame in which the acknowledgment policy is HTP Ack, a QoS Null frame in which the acknowledgment policy is HTP Ack, and the like. According to an embodiment of the present invention, an MPDU soliciting an immediate response of the Ack context may follow an MPDU delimiter with the value of the EOF field equal to 1 and the value of the MPDU length field not equal to 0.

When the response is transmitted with the M-BA frame, the response may be performed through the per AID TID information field which is independent for each TID. A specific embodiment thereof is as described in the embodiment of FIG. 11(c).

FIG. 13 illustrates an embodiment of a method that an AP transmits a response frame for an A-MPDU. In a non-legacy wireless LAN system, an AP may receive PPDUs transmitted by one or more STAs through an uplink multi-user (UL MU) transmission. Accordingly, the format of a response frame and the format of a PPDU carrying the response frame may be determined according to the A-MPDU configuration of the PPDU received by the AP from the one or more STAs.

First, FIG. 13(a) illustrates an embodiment in which the AP receives an A-MPDU transmitted by one or more STAs and responds with a response frame carried in an HE MU PPDU. The AP receives A-MPDUs transmitted by one or more STAs and constructs a response frame for each STA according to the above-described embodiment. When a plurality of A-MPDUs of the received A-MPDUs solicit an immediate response, the AP may perform a response in HE MU PPDU format. The AP may generate a response frame of either Ack frame, BlockAck frame or M-BA frame for each received A-MPDU, and transmit the generated multiple response frames in HE MU PPDU format. A specific embodiment for determining the format of the response frame for each received A-MPDU is as described above in FIG. 11. The AP may

transmit the response frame through a resource unit assigned to each STA. According to an embodiment of the present invention, each response frame carried in the HE MU PPDU may be transmitted via the resource unit on which the A-MPDU of each STA is transmitted.

Next, FIG. 13(b) illustrates an embodiment in which the AP receives an A-MPDU transmitted by one or more STAs and responds with a response frame carried in an HE SU PPDU. When an HE SU PPDU transmitted by one STA is received or only one A-MPDU among A-MPDUs transmitted by a plurality of STAs solicits an immediate response, the AP may perform a response in HE SU PPDU format. The AP may generate a response frame of either Ack frame, BlockAck frame, or M-BA frame for the A-MPDU requiring an immediate response, and transmit the generated response frame in HE SU PPDU format. A specific embodiment for determining the format of the response frame for the received A-MPDU is as described above in FIG. 11.

According to a further embodiment of the present invention, when a plurality of A-MPDUs of the received A-MPDUs solicit an immediate response, the AP may also perform a response in HE SU PPDU format. In this case, the response frame carried in the HE SU PPDU may be a group-addressed M-BA frame. The group-addressed M-BA frame may represent response information for each STA and each TID through the per AID TID information field.

FIG. 14 illustrates a method of transmitting a response frame according to another embodiment of the present invention. According to the embodiment of FIG. 14, a response may be performed with an M-BA frame for A-MPDU and S-MPDU of all formats soliciting an immediate response carried in an HE PPDU. In other words, the terminal may consistently respond with an M-BA frame for the multi-TID A-MPDU illustrated in FIG. 14(a), the single-TID A-MPDU illustrated in FIG. 14(b), and the S-

MPDU illustrated in FIG. 14(c). When the terminal consistently responds with an M-BA frame, the implementation is simple and it is possible to eliminate the possibility that the transmitter receives a response frame in an unexpected format. However, if it is clear that an S-MPDU has been transmitted, there is a disadvantage that a response should be performed with an M-BA frame having a larger amount of data than the Ack frame.

Operation method in reception failure of some MPDUs in an A-MPDU

FIGS. 15 to 19 illustrate a method of operation of a terminal when a transmission of at least some MPDUs in an A-MPDU has failed. In the embodiments of FIGS. 15 to 19, the same or corresponding parts as those of the embodiments of the previous drawings will be omitted.

As in the embodiments described above, the terminal may generate an A-MPDU containing one or more MPDU(s) soliciting an immediate response, and may transmit the generated A-MPDU. The recipient of the A-MPDU determines the format of the response frame based on the number of TIDs soliciting an immediate response in the successfully received MPDU(s) and transmits the response frame in the determined format. That is, the response frame for the A-MPDU may be generated based on the number of TIDs soliciting an immediate response in the MPDU(s) successfully received by the recipient. According to an embodiment, an Action frame included in the successfully received MPDU(s) may be considered as an individual TID. The terminal receives a response frame of the recipient corresponding to the A-MPDU, and determines whether the transmission of the MPDU(s) contained in the A-MPDU is successful based on the received response frame. When a response frame of an expected format is received for the A-MPDU transmitted by the terminal according to the above-described embodiment, the terminal may determine whether or not each MPDU is

successfully transmitted based on the response information for each MPDU contained in the response frame.

Meanwhile, the recipient may fail to receive at least some MPDUs of the transmitted A-MPDU depending on the communication status. If the reception of at least some MPDUs has failed, the recipient may not be able to determine which of the S-MPDU, the single-TID A-MPDU and the multi-TID A-MPDU has been received. In particular, in uplink/downlink (UL/DL) OFDMA PPDUs used in the non-legacy wireless LAN system, a large amount of EOF padding may be included to align the length of PPDUs. This may cause a situation more frequently where the recipient cannot successfully receive at least part of the received data and cannot determine the configuration of the A-MPDU. Therefore, subsequent operation methods of the communication terminals should be defined in the above situation of reception failure of some MPDUs.

According to the embodiment of the present invention, the terminal may determine whether the transmission of the MPDU(s) contained in the A-MPDU is successful by comparing the format of the response frame expected for the transmitted A-MPDU and the format of the response frame that is actually transmitted from the recipient. As in the above-described embodiments, the format of the response frame expected for the A-MPDU may be determined based on, in the one or more MPDU(s) constituting the A-MPDU, at least one of the number of TIDs soliciting an immediate response or the MPDU delimiter information. Accordingly, the terminal may determine success or failure of MPDU(s) contained in the A-MPDU by considering, in the one or more MPDU(s) constituting the A-MPDU, at least one of the number of TIDs soliciting an immediate response or the MPDU delimiter information, and considering the response frame transmitted corresponding to the A-MPDU.

FIG. 15 illustrates a method of transmitting an A-MPDU and a response frame according to an embodiment of the present invention. FIG. 15(a) illustrates an embodiment in which the terminal transmits an S-MPDU and the recipient fails to receive some EOF padding portion contained in the S-MPDU. Further, FIG. 15(b) illustrates an embodiment in which the terminal transmits a multi-TID A-MPDU and the recipient fails to receive an MPDU of some TID (i.e., TID3).

Referring to FIG. 15(a), the recipient receives an S-MPDU transmitted by the terminal and transmits an Ack frame in response thereto. Since the response to the S-MPDU is expected to be an Ack frame, the terminal may determine that the transmission of the S-MPDU is successful.

On the other hand, referring to FIG. 15(b), the recipient successfully receives only some MPDUs of the multi-TID A-MPDUs transmitted by the terminal. More specifically, although the A-MPDU transmitted by the terminal contains MPDUs of two different TIDs (i.e., TID2 and TID3) soliciting an immediate response of the Ack context, the recipient successfully receives only one of the MPDUs. Here, the MPDU soliciting an immediate response of the Ack context may follow an MPDU delimiter with the value of the EOF field equal to 1 and the value of the MPDU length field not equal to 0. That is, the MPDU (and MPDU delimiter) of the specific TID (i.e., TID2) in the multi-TID A-MPDU is successfully received, but the MPDU (and MPDU delimiter) of the other TID (i.e., TID3) is not successfully received. In the embodiment of 15(b), since the recipient successfully receives only one MPDU soliciting an immediate response of the Ack context among the multi-TID A-MPDU transmitted by the terminal, it may determine that an S-MPDU has been received. Therefore, the recipient responds with an Ack frame to the multi-TID A-MPDU.

The terminal receives the Ack frame transmitted as a response. However,

since the Ack frame does not include a block Ack information field or a TID information field indicating the TID of the response information, the terminal cannot determine which MPDU the received Ack frame is for. Therefore, according to the embodiment of the present invention, when the terminal that has transmitted a multi-TID A-MPDU receives a response of the Ack frame, the terminal determines that the transmission of the multi-TID A-MPDU has failed. In other words, when the transmitted A-MPDU consists of MPDUs of a plurality of TIDs soliciting an immediate response and a response frame transmitted corresponding to the A-MPDU is an Ack frame, it is determined that the transmission of MPDU(s) contained in the A-MPDU has failed. Therefore, the terminal may retransmit the MPDU(s) contained in the A-MPDU of which the transmission is determined to have failed.

However, according to the embodiment of the present invention, apart from the determination that the transmission of the MPDU(s) contained in the A-MPDU has failed, since a response of an Ack frame to the A-MPDU is received, the terminal may determine that the channel access for the transmission of the A-MPDU is successful. Thus, the terminal may reset at least one of EDCA parameters of the access category used for the channel access for the A-MPDU transmission. In this case, the EDCA parameter may include a contention window, a QoS short retry counter (QSRC), a QoS long retry counter (QLRC), and the like.

FIG. 16 illustrates a method of transmitting an A-MPDU and a response frame according to another embodiment of the present invention. More specifically, FIG. 16(a) illustrates a transmission method of a response frame for an A-MPDU according to the above-described embodiments, FIG. 16(b) illustrates a transmission method of a response frame for an A-MPDU according to a further embodiment of the present invention.

According to the embodiment of FIG. 16(a), if the recipient successfully receives only one MPDU soliciting an immediate response of the Ack context among the multi-TID A-MPDU transmitted by the terminal, the recipient responds with an Ack frame. However, since the Ack frame does not include the block Ack information field or the TID information field indicating the TID of the response information, the terminal cannot determine which MPDU the received Ack frame is for.

Therefore, according to the embodiment of FIG. 16(b), the recipient may determine the format of the response frame based on the reception state of each MPDU of the A-MPDU. As described above, each MPDU follows an MPDU delimiter in an A-MPDU, and the MPDU delimiter indicates length information of the MPDU. Since each MPDU delimiter indicates the length information of the MPDU, the recipient may determine whether or not each MPDU and MPDU delimiter contained in the A-MPDU are successfully received. If the recipient has successfully received only one MPDU soliciting an immediate response and has not successfully receive at least some MPDUs, there is a possibility that another data soliciting an immediate response was present in the MPDU that was not successfully received.

According to the embodiment of the present invention, if there is a possibility that an MPDU that is not successfully received is an MPDU soliciting an immediate response, the recipient may respond with an M-BA frame. For example, if at least one MPDU or MPDU delimiter in an A-MPDU is not successfully received, the recipient may respond with an M-BA frame. More specifically, if at least one MPDU or MPDU delimiter is not successfully received prior to the first received EOF padding in the A-MPDU, the MPDU that is not successfully received may be an MPDU soliciting an immediate response. Thus, the recipient may respond with an M-BA frame. That is, even if only one MPDU soliciting an immediate response of the Ack context is

successfully received, if at least one MPDU or MPDU delimiter is not successfully received prior to the first received EOF padding in the A-MPDU, the recipient responds with an M-BA frame instead of an Ack frame. In this case, in the per AID TID information field of the M-BA frame, the value of the TID subfield may be set to the TID of the successfully received MPDU, and the value of the Ack type subfield may be set to 1 so that the BA bitmap is omitted. That is, if an A-MPDU presumed to be an S-MPDU is received and it is identified as an incomplete A-MPDU, the recipient may respond with an M-BA frame instead of an Ack frame.

On the other hand, if there is a portion that was not successfully received only after the first received EOF padding in the A-MPDU, the portion that was not successfully received may be another EOF padding. Thus, the response of the recipient may not be forced into the M-BA frame. In addition, since the above-described problem occurs only when an error occurs in the received A-MPDU and the recipient responds with an Ack frame, the response may not be forced into the M-BA frame in a situation where the recipient should respond with a C-BA frame.

According to an embodiment of the present invention, the recipient may respond with an M-BA frame only when it can transmit the M-BA frame within a duration indicated by a successfully received MPDU or a length indicated by a trigger frame received in an A-MPDU. In this case, the recipient may respond with the M-BA frame only when it is possible to transmit the M-BA frame within the duration or length using an MCS according to the specified rule.

According to another embodiment of the present invention, if an A-MPDU presumed to be an S-MPDU is received and at least a part of the A-MPDU is not successfully received, the recipient may regard the A-MPDU as a multi-TID A-MPDU. Since the response to the multi-TID A-MPDU is performed via an M-BA frame, the

recipient may respond with an M-BA frame to the A-MPDU.

According to a further embodiment of the present invention, the use of the M-BA frame as a response to the HE PPDU may be extended. In the non-legacy wireless LAN system, the M-BA frame is able to respond to the A-MPDU of the most various configurations and is able to change its form so that an efficient response can be performed. Thus, according to a further embodiment of the present invention, the M-BA frame may be used universally as a response frame except for a situation that an Ack frame is sent as a response. For example, the non-legacy wireless LAN terminal may respond with the M-BA frame if at least some MPDUs of the A-MPDU are not successfully received and one or more successfully received MPDUs solicit an immediate response. Alternatively, if the at least some MPDUs of the A-MPDU are not successfully received and one or more successfully received MPDUs solicit an immediate response, the non-legacy wireless LAN terminal may regard the A-MPDU as a multi-TID A-MPDU. Accordingly, the non-legacy wireless LAN terminal responds with an M-BA frame according to the response procedure for a multi-TID A-MPDU.

FIG. 17 illustrates a method of transmitting an A-MPDU and a response frame according to yet another embodiment of the present invention. According to the embodiment of FIG. 17, a response frame transmission method which does not change the operation of the conventional receiving terminal may be used in order to reduce the complexity of the implementation.

More specifically, when a terminal that has transmitted an A-MPDU consisting of MPDUs of a plurality of TIDs soliciting an immediate response receives a response of an Ack frame, the terminal may ignore the response of the Ack frame. Therefore, the terminal should retransmit all the MPDUs constituting the A-MPDU. However, since the terminal has received the response frame for the transmitted A-

MPDU, it may determine that the transmission of the A-MPDU has not failed. According to an embodiment of the present invention, the terminal may regard the enhanced distributed channel access function (EDCAF) of the access category used for the channel access in the transmission of the previous A-MPDU as not failed. Accordingly, the terminal may resume the backoff operation while maintaining the EDCA parameters such as a contention window of the access category, a QoS short retry counter (QSRC), and a QoS long retry counter (QLRC) as the previous values. According to another embodiment of the present invention, since the response of the Ack frame for the A-MPDU has been received, the terminal may determine that the channel access (i.e., EDCAF) for the A-MPDU transmission is successful. Thus, the terminal may reset at least one EDCA parameter of the access category used for the channel access for the A-MPDU transmission.

Additional embodiments of a method of transmitting an S-MPDU and a response frame

FIGS. 18 and 19 illustrate a method of transmitting an S-MPDU and a response frame in the non-legacy wireless LAN system according to a further embodiment of the present invention.

FIG. 18 illustrates a method of transmitting an S-MPDU and a response frame in the non-legacy wireless LAN system according to an embodiment of the present invention. As described above, the configuration of the multi-TID A-MPDU was not allowed in the legacy wireless LAN system. Further, since the A-MPDU subframe in which the value of the EOF field is set to 1 can be present only one for each TID in the A-MPDU, it was obvious that the A-MPDU subframe in which the value of the EOF field is set to 1 is the only A-MPDU subframe within the A-MPDU. Thus, the recipient could respond with an Ack frame, with the exception of other possibilities.

However, the configuration of the multi-TID A-MPDU is allowed in the non-legacy wireless LAN system. Therefore, in addition to the MPDU soliciting an immediate response of the Ack context, an MPDU of another TID soliciting an immediate response of the Ack context, a plurality of MPDUs in which the value of the EOF field is set to 0, an Action frame, a QoS data/Null frame, an Action No Ack frame, and the like are allowed to be aggregated and transmitted.

In the legacy wireless LAN system, if the received A-MPDU contains only one MPDU and the MPDU solicits an immediate response of the Ack context, the A-MPDU can be classified into an S-MPDU. Thus, the recipient could respond with an Ack frame. However, in the non-legacy wireless LAN system, even if the received A-MPDU contains only one MPDU soliciting an immediate response, it may be classified into an A-MPDU rather than an S-MPDU when it is aggregated with one or more other MPDUs not soliciting an immediate response. In this case, the MPDU not soliciting an immediate response may include an Action No Ack frame, a QoS data frame in which the acknowledgment policy is BlockAck or No Ack, a QoS Null frame in which the acknowledgment policy is BlockAck or No Ack, a control response (e.g., Ack, BlockAck), and the like. Therefore, in the above situation, the recipient cannot respond with the Ack frame. In addition, since the recipient should respond with a C-BA frame when the A-MPDU is regarded as a single-TID A-MPDU, it is impossible to omit the BA bitmap through the setting of the Ack type subfield, which may be inefficient.

Thus, according to an embodiment of the present invention illustrated in FIG. 18(a), when the received A-MPDU contains MPDU soliciting an immediate response of the Ack context only one, the recipient may regard the A-MPDU as an S-MPDU even if one or more other MPDUs not soliciting an immediate response are aggregated together. Thus, the recipient responds with an Ack frame.

According to another embodiment of the present invention illustrated in FIG. 18(b), when the received A-MPDU contains only one MPDU soliciting an immediate response of the Ack context and one or more other MPDUs not soliciting an immediate response, the STA may regard the A-MPDU as a multi-TID A-MPDU. Thus, the recipient responds with an M-BA frame. However, the value of the Ack type subfield of the per AID TID information field corresponding to the MPDU soliciting an immediate response may be set to 1 so that the BA bitmap is omitted.

FIG. 19 illustrates a method of transmitting an S-MPDU and a response frame in the non-legacy wireless LAN system according to another embodiment of the present invention. If the A-MPDU is carried in a downlink HE MU PPDU, in order to make the recipient to respond, the trigger information should be transmitted together with the exception of MPDUs in which the acknowledgment policy is general Ack. In this case, the trigger information may be transmitted through a trigger frame or a UMRS control field included in the MAC header. However, a terminal which cannot receive the UMRS control field may respond only when receiving an MPDU soliciting an immediate response of the Ack context together with the trigger frame.

Therefore, according to an embodiment of the present invention, when the received A-MPDU contains MPDU soliciting an immediate response of the Ack context only one, the recipient may regard the A-MPDU as an S-MPDU even if the trigger frame is aggregated together. Thus, the recipient responds with an Ack frame.

More specifically, referring to FIG. 19(a), when the received A-MPDU contains only one MPDU soliciting an immediate response of the Ack context and a trigger frame, the STA may regard the A-MPDU as an S-MPDU. Further, referring to FIG. 19(b), even if the received A-MPDU contains only one MPDU soliciting an immediate response of the Ack context, one or more other MPDUs not soliciting an

immediate response, and a trigger frame, the STA may regard the A-MPDU as an S-MPDU. Therefore, the recipient responds with an Ack frame to the received A-MPDU.

According to another embodiment of the present invention illustrated in FIG. 19(c), in the situation illustrated in FIG. 19(a) or 19(b), the recipient may regard the A-MPDU as a multi-STA A-MPDU. Thus, the recipient responds with an M-BA frame. However, the value of the Ack type subfield of the per AID TID information field corresponding to the MPDU soliciting an immediate response may be set to 1 so that the BA bitmap is omitted.

TID aggregation limit

The AP may use the trigger information to indicate the maximum number of TIDs that can be aggregated in the A-MPDU to be transmitted by each wireless communication terminal. In this case, the trigger information may be transmitted through at least one of the trigger frame and the UMRS control field included in the MAC header. Referring to FIGS. 20 to 24, an operation of the AP to indicate the maximum number of TIDs that can be aggregated in the A-MPDU to be transmitted by each wireless communication terminal by using the trigger frame will be described.

FIG. 20 illustrates an operation of a wireless communication terminal according to an embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

The AP may use the trigger frame to indicate information on the type of an MPDU included in the A-MPDU to be transmitted to the AP by the wireless communication terminal. As described above, the AP may use the trigger frame to indicate the maximum number of TIDs that the A-MPDU that the wireless communication terminal transmits to the AP is capable of having. Specifically, the AP may use the User Info field of the trigger frame to indicate the maximum TID to be

transmitted by the wireless communication terminal corresponding to the User Info field. In a specific embodiment, the AP may use the TID Aggregation Limit of the User Info field of the trigger frame to indicate the maximum TID to be transmitted by the wireless communication terminal corresponding to the User Info field. At this time, the wireless communication terminal receiving the trigger frame may set the number of TIDs that the A-MPDU is capable of having based on the trigger frame. Specifically, the wireless communication terminal receiving the trigger frame may set the number of TIDs of the MPDU included in the A-MPDU to transmit based on the maximum number of TIDs indicated by the trigger frame, and transmit the A-MPDU to the AP. For example, the wireless communication terminal receiving the trigger frame may set the number of TIDs of the MPDU included in the A-MPDU to transmit, which does not exceed the maximum number of TIDs indicated by the trigger frame, and transmit the A-MPDU to the AP. Through this, the AP may efficiently manage the scoreboard. In addition, BA bitmap lengths for each of a plurality of wireless communication terminals may be adjusted.

In a specific embodiment, the value of the TID Aggregation Limit field may indicate the maximum number of TIDs that the A-MPDU that the wireless communication terminal receiving the trigger frame transmits to the AP is capable of having. For example, when the TID Aggregation Limit field is a 3-bit field and has a value from 0 to 7, each of the values 0 to 7 may indicate that the maximum number of TIDs of the A-MPDU to be transmitted to the AP corresponds to any one of 1 to 8.

In another specific embodiment, the AP may use the trigger frame to indicate that the wireless communication terminal indicated in the trigger frame is not allowed to generate the A-MPDU to be transmitted to the AP by aggregating the MPDU having the TID. Specifically, the AP may set the TID Aggregation Limit to 0 to indicate that the

wireless communication terminal indicated in the trigger frame is not allowed to generate the A-MPDU to be transmitted to the AP by aggregating the MPDU having the TID. However, when the A-MPDU includes an MPDU soliciting an immediate response even when the MPDU does not have a TID, the size of the BA frame transmitted by the recipient in response to the A-MPDU may be increased. Also, the burden of managing the scoreboard of the recipient may be increased. At this time, an immediate response may indicate that the recipient transmits a response to the originator within a predetermined time period in the same Transmission Opportunity (TXOP). Specifically, the predetermined period may be a Short Inter-Frame Space (SIFS).

In another specific embodiment, the AP may use the trigger frame to indicate that the wireless communication terminal indicated by the trigger frame is not allowed to generate the A-MPDU to be transmitted to the AP by aggregating the MPDUs that solicit an immediate response. At this time, the MPDU soliciting an immediate response may include an MPDU including Quality of Service (QoS) data having a TID. In addition, an MPDU soliciting an immediate response may include a Management MPDU (MMPDU) soliciting an immediate response. Specifically, an MPDU soliciting an immediate response may include an Action frame. The AP sets the value of the TID Aggregation Limit field of the User Info field of the trigger frame to 0 to indicate that the wireless communication terminal corresponding to the User Info field is not allowed to generate the A-MPDU to be transmitted to the AP by aggregating MPDUs that solicit an immediate response. When the TID Aggregation Limit field value indicates a value other than 0, it may indicate the maximum number of TIDs that the A-MPDU to be transmitted by the wireless communication terminal indicated by the trigger frame to the AP may have. Also, when the trigger frame indicates that the wireless communication terminal is not allowed to generate an A-MPDU to be transmitted to the AP by

aggregating MPDUs that solicit an immediate response, the wireless communication terminal may generate an A-MPDU to be transmitted to the AP by aggregating MPDUs not soliciting an immediate response. Specifically, when the TID Aggregation Limit field value of the User Info field corresponding to the wireless communication terminal of the trigger frame is 0, the wireless communication terminal may generate an A-MPDU to be transmitted to the AP by aggregating MPDUs not soliciting an immediate response. In a specific embodiment, an MPDU not soliciting an immediate response may include an MPDU including QoS data with the ACK Policy set to No Ack. When the ACK Policy is set to No Ack, the ACK Policy may represent that no ACK is solicited for the corresponding frame. In addition, an MPDU not soliciting an immediate response may include a QoS null frame. At this time, the QoS Null frame may be a QoS Null frame in which ACK Policy is set to No Ack. In addition, an MPDU not soliciting an immediate response may include an Action No Ack frame.

In another specific embodiment, the AP may use the trigger frame to indicate that the wireless communication terminal indicated by the trigger frame is allowed to aggregate MPDUs without the number of TIDs limitation to generate an A-MPDU, and transmit the generated A-MPDU to the AP. Specifically, the AP sets the value of the TID Aggregation Limit field of the User Info field of the trigger frame to 7 to indicate that the wireless communication terminal corresponding to the User Info Field is allowed to aggregate MPDUs without the number of TIDs limitation to generate an A-MPDU, and transmit the generated A-MPDU to the AP.

In the embodiment of FIG. 20, the AP sets the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame to 3 to indicate that the maximum number of TIDs that the A-MPDU to be transmitted to the AP by the third station STA3 is 3. The third station STA3 determines the number

of TIDs of the A-MPDU to be transmitted to the AP based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. Specifically, the third station STA3 determines the number of TIDs of the A-MPDU to be transmitted to the AP as 3 based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. The third station STA1 aggregates an MPDU having a TID of 1, an MPDU having a TID of 2, an MPDU having a TID of 3, an Action frame, and a QoS null frame to generate an A-MPDU to be transmitted to the AP. The third station STA3 transmits the generated A-MPDU to the AP. The AP transmits an M-BA frame to a plurality of wireless communication terminals including the third station STA3 based on the A-MPDU received from the third station SAT3. Through this embodiment, the AP adjusts the duration of the M-BA frame. In the embodiment of FIG. 20, the third station STA3 treats MPDUs having no TID, such as a QoS Null frame and an Action frame, as being not included in the number of TIDs indicated by the maximum number of TIDs. However, when there is no block acknowledgment agreement for a specific TID, the response to the MPDU having the corresponding TID may not affect the M-BA frame. Also, as described above, even an MPDU that does not correspond to a specific TID may solicit an immediate response. Therefore, there is a need for a specific embodiment for comparing the number of TIDs and the maximum number of TIDs of the A-MPDU to be transmitted to the AP by the wireless communication terminal. This will be described in detail with reference to FIGS. 21 to 24.

FIG. 21 illustrates an operation of a wireless communication terminal according to another embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

The AP may use the trigger frame to indicate the maximum number of TIDs

with the block acknowledgment agreement that the A-MPDU to be transmitted by the wireless communication terminal is capable of having. The wireless communication terminal may calculate the number of TIDs of the A-MPDU based on the number of TIDs with the block acknowledgment agreement. In the embodiments described above, when the wireless communication terminal compares the number of TIDs of the A-MPDU to be transmitted to the AP and the maximum number of TIDs, the wireless communication terminal may compare the number of TIDs with the block acknowledgment agreement to the maximum number of TIDs. Specifically, when the wireless communication terminal compares the number of TIDs of the A-MPDU to be transmitted to the AP and the maximum number of TIDs, the wireless communication terminal may not calculate the TID with no block acknowledgment agreement as the number of TIDs of the A-MPDU. That is because, since the recipient directly transmits the data corresponding to the TID with no block acknowledgment agreement to the upper layer without storing the data corresponding to the TID in the buffer, data reception corresponding to the TID with no block acknowledgment agreement may not affect the management of the score board. Also, this is because, when the wireless communication terminal calculates the TID with no block acknowledgment agreement as the number of TIDs, the buffer management and the A-MPDU configuration may be restricted. Specifically when the value of the TID Aggregation Limit field is 1 to 6, the wireless communication terminal may generate an A-MPDU having the number of TIDs with block acknowledgment agreement smaller than or equal to the value of the TID Aggregation Limit field, and may transmit the generated A-MPDU to the AP. At this time, the wireless communication terminal may add the MPDU corresponding to the TID with no block acknowledgment agreement to the A-MPDU regardless of the value of the TID Aggregation Limit field. Further, the AP sets the value of the TID

Aggregation Limit field of Per User Info of the trigger frame trigger frame to 0 to indicate that the wireless communication terminal corresponding to the Per User Info field is allowed to aggregate MPDUs not soliciting an immediate response regardless of the TID with block acknowledgment agreement to generate an A-MPDU and transmit the generated A-MPDU to the AP. Specifically, when the TID Aggregation Limit field value of the User Info field corresponding to the wireless communication terminal of the trigger frame is 0, the wireless communication terminal may generate an A-MPDU to be transmitted to the AP by aggregating MPDUs not soliciting an immediate response.

In the embodiment of FIG. 21, the AP sets the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame to 3 to indicate that the maximum number of TIDs with block acknowledgment agreement that the A-MPDU to be transmitted to the AP by the third station STA3 is 3. The third station STA3 determines the number of TIDs with block acknowledgment agreement of the A-MPDU to be transmitted to the AP based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. The third station STA3 determines that the A-MPDU to be transmitted to the AP has three TIDs with block acknowledgment agreement based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. There is a block acknowledgment agreement for TID 1, 2, and 4, and there is no block acknowledgment agreement for TID 5. Accordingly, the third station STA3 aggregates an MPDU having a TID of 1, an MPDU having a TID of 2, an MPDU having a TID of 3, an MPDU having a TID of 5, an action No Ack frame, and a QoS null frame to generate an A-MPDU to be transmitted to the AP. The third station STA3 transmits the generated A-MPDU to the AP. The AP transmits an M-BA frame to a plurality of wireless communication terminals including the third station STA3 based on

the A-MPDU received from the third station SAT3. Through this embodiment, the AP adjusts the duration of the M-BA frame.

Data corresponding to a TID with no block acknowledgment agreement may also solicit an ACK frame transmission. At this time, the recipient may transmit the M-BA frame including the Per AID TID field that does not include the BA bitmap in response to the MPDU corresponding to the TID with no block acknowledgment agreement. Therefore, even the MPDU corresponding to the TID with no block acknowledgment agreement may affect the duration of the M-BA frame. Thus, the maximum number of TIDs that an A-MPDU may have may be calculated based on the number of TIDs soliciting an immediate response and the number of frames without a TID soliciting an immediate response. This will be described in more detail with reference to FIG. 10.

FIG. 22 illustrates an operation of a wireless communication terminal according to another embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

The AP may use the trigger frame to limit the number of MPDUs soliciting an immediate response that an A-MPDU to be transmitted by a wireless communication terminal may have. The AP may use the trigger frame to limit the number of MPDUs soliciting an immediate response that an A-MPDU to be transmitted by a wireless communication terminal is capable of having. The wireless communication terminal may calculate the number of TIDs of the A-MPDU based on the number of TIDs soliciting an immediate response. In the embodiments described above, when the wireless communication terminal compares the number of TIDs of the A-MPDU to be transmitted to the AP and the maximum number of TIDs, the wireless communication terminal may compare the number of TIDs soliciting an immediate response of the A-

MPDU to the maximum number of TIDs. When the wireless communication terminal compares the number of TIDs of the A-MPDU to be transmitted to the AP and the maximum number of TIDs, it is possible to calculate the number of TIDs of the A-MPDU without considering an MPDU not soliciting an immediate response. Therefore, the wireless communication terminal may aggregate MPDUs corresponding to TIDs not soliciting an immediate response regardless of the maximum number of TIDs. Also, the wireless communication terminal may aggregate frames without a TID not soliciting an immediate response regardless of the maximum number of TIDs. Also, the number of TIDs soliciting an immediate response may be the sum of the number of frames having no TID soliciting an immediate response included in the A-MPDU and the number of TIDs soliciting an immediate response included in the A-MPDU. The number of frames without a TID may indicate the type of frame without a TID. Also, an Action frame in which the TID is 15 in the per AID TID field of the M-BA frame may be one of frames without a TID soliciting an immediate response. The MPDU corresponding to the TID not soliciting an immediate response may be the MPDU corresponding to the TID in which ACK policy is set to No Ack. Also, an MPDU corresponding to a TID not soliciting an immediate response may be a QoS null frame. At this time, the ACK policy of the QoS Null frame may be No Ack. Also, a frame without a TID not soliciting an immediate response may be an Action No Ack frame.

As described above, the AP sets the value of the TID Aggregation Limit field of Per User Info of the trigger frame trigger frame to 0 to indicate that the wireless communication terminal corresponding to the Per User Info field is allowed to aggregate MPDUs not soliciting an immediate response regardless of the TID with block acknowledgment agreement to generate an A-MPDU and transmit the generated A-MPDU to the AP. Specifically, when the TID Aggregation Limit field value of the

User Info field corresponding to the wireless communication terminal of the trigger frame is 0, the wireless communication terminal may generate an A-MPDU to be transmitted to the AP by aggregating MPDUs not soliciting an immediate response.

In the embodiment of FIG. 22, the AP sets the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame to 3 to indicate that the maximum value of the sum of the number of TIDs that the A-MPDU to be transmitted to the AP by the third station STA3 may have and the number of frames without a TID soliciting an immediate response included in the A-MPDU is 3. The third station STA3 determines the number of sums of the number of TIDs soliciting an immediate response of the A-MPDU to be transmitted to the AP and the number of frames without a TID soliciting an immediate response based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. The third station STA3 determines as 3 the sum of the number of TIDs soliciting an immediate response of the A-MPDU to be transmitted to the AP and the number of frames without a TID soliciting an immediate response based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. TIDs 1 and 2 solicit an immediate response, and TIDs 4 and 5 have the ACK policy set to No Ack. Also, the Action frame solicits an immediate response. Accordingly, the third station STA1 aggregates an MPDU having a TID of 1, an MPDU having a TID of 2, an MPDU having a TID of 4, an MPDU having a TID of 5, an Action frame, an action No Ack frame, and a QoS null frame to generate an A-MPDU to be transmitted to the AP. The third station STA3 transmits the generated A-MPDU to the AP. The AP transmits an M-BA frame to a plurality of wireless communication terminals including the third station STA3 based on the A-MPDU received from the third station SAT3. Through this embodiment, the AP adjusts the duration of the M-BA

frame.

FIG. 23 illustrates an operation of a wireless communication terminal according to another embodiment of the present invention to transmit an A-MPDU based on the maximum number of TIDs information.

The Multi-TID A-MPDU may not include a plurality of Action frames. Accordingly, the Multi-TID A-MPDU may include only one Action frame. Also, when the A-MPDU additionally includes an Action frame, the length of the M-BA frame is increased by two octets. Therefore, the change in the M-BA duration due to the addition of the Action frame to the A-MPDU is insignificant. Also, it may be seen that the Action frame is more important than the QoS data frame.

When the wireless communication terminal compares the number of TIDs of the A-MPDU to be transmitted to the AP and the maximum number of TIDs, the wireless communication terminal may not calculate the number of Action frames as the number of TIDs of the A-MPDU. Specifically, when the value of the TID Aggregation Limit field is within a predetermined range, the wireless communication terminal may generate an A-MPDU to be transmitted to the AP by aggregating Action frames regardless of the value of the TID Aggregation Limit field. Specifically, in the embodiments of FIGS. 20 to 22, the wireless communication terminal may not calculate the number of Action frames as the number of TIDs of the A-MPDU.

In the embodiment of FIG. 23, the AP sets the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame to 2 to indicate that the maximum value of the sum of the number of TIDs that the A-MPDU to be transmitted to the AP by the third station STA3 is capable of having and the number of frames without a TID soliciting an immediate response included in the A-MPDU excluding an Action frame is 3. At this time, the Action frame is excluded from

the maximum value calculation. The third station STA3 determines the number of sums of the number of TIDs soliciting an immediate response of the A-MPDU to be transmitted to the AP and the number of frames without a TID soliciting an immediate response included in the A-MPDU excluding an Action frame based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. The third station STA3 determines that the A-MPDU to be transmitted to the AP has two TIDs soliciting an immediate response based on the value of the TID Aggregation Limit field of the User Info field corresponding to the third station of the trigger frame. TIDs 1 and 2 solicit an immediate response, and TIDs 4 and 5 have the ACK policy set to No Ack. Also, Action frames are excluded from counting. Accordingly, the third station STA1 aggregates an MPDU having a TID of 1, an MPDU having a TID of 2, an MPDU having a TID of 4, an MPDU having a TID of 5, an Action frame, an action No Ack frame, and a QoS null frame to generate an A-MPDU to be transmitted to the AP. The third station STA3 transmits the generated A-MPDU to the AP. The AP transmits an M-BA frame to a plurality of wireless communication terminals including the third station STA3 based on the A-MPDU received from the third station SAT3. Through this embodiment, the AP adjusts the duration of the M-BA frame.

The AP may use the trigger information to instruct the wireless communication terminal transmitting the response to the trigger information to perform channel sensing before transmitting the response. Specifically, the AP may set the CS Required field value of the trigger information to instruct the wireless communication terminal transmitting the response to the trigger information to perform channel sensing before transmitting the response. The CS Required field indicates whether channel sensing is required when the wireless communication terminal transmits a response to

the trigger information. At this time, when the value of the CS Required field is 1, the CS Required field may indicate that channel sensing is required. In addition, when transmitting the response to the trigger information, the wireless communication terminal receiving the trigger information may determine whether to perform channel sensing based on the CS Required field of the trigger information. Specifically, when the value of the CS Required field of the trigger information is 1, the wireless communication terminal receiving the trigger information may perform channel sensing when transmitting a response to the trigger information. At this time, the channel sensing may indicate whether the channel to transmit the response to the trigger information is idle or not. Also, channel sensing may indicate CCA operation.

FIG. 24 illustrates an operation of a wireless communication terminal according to an embodiment of the present invention to set the maximum number of TIDs information of a trigger frame.

When the AP triggers an immediate response to the data transmission using the trigger information, the AP may use the trigger information to indicate that no channel sensing is required when the wireless communication terminal transmits a response to the trigger information. Specifically, when the AP triggers an immediate response to the data transmission using the trigger information and the value of the length field of the common info field of the trigger information is less than or equal to the predetermined value, the AP may use the trigger information to indicate that no channel sensing is required when the wireless communication terminal transmits a response to the trigger information. At this time, the length field indicates information on the length of the trigger-based PPDU. Specifically, the length field may indicate information on the length of the trigger-based PPDU. In addition, the predetermined value may be 418 bytes. Through this, the AP may prevent the wireless communication

terminal transmitting the response to the trigger information from not transmitting an immediate response due to the channel sensing. At this time, there is an operational problem that the wireless communication terminal transmits a response to the trigger information and data together. This is because, when a wireless communication terminal operating as an EDCA transmits data, the wireless communication terminal may be required to transmit data after performing channel sensing. Further, this is because, when a wireless communication terminal transmitting a response to the trigger information transmits an MPDU soliciting an immediate response, an additional transmission sequence is required.

In the case where channel sensing is not required when the wireless communication terminal indicated by the trigger frame transmits a response to the trigger information, the terminal may generate an A-MPDU by aggregating MPDUs not soliciting an immediate response and transmit the generated A-MPDU. Specifically, in the case where channel sensing is not required when the wireless communication terminal indicated by the trigger frame transmits a response to the trigger information, the AP may set the value of the TID Aggregation Limit field of the User Info field of the trigger frame to 0 to indicate that the wireless communication terminal indicated by the User Info field is not allowed to aggregate the MPDUs soliciting an immediate response to generate an A-MPDU. Specifically, when the AP triggers an immediate response to the data transmission using the trigger information and the value of the length field of the common info field of the trigger information is less than or equal to the predetermined value, it may indicate that the wireless communication terminal indicated by the trigger frame is not allowed to aggregate the MPDUs soliciting an immediate response to generate an A-MPDU and transmit the generated A-MPDU. In these embodiments, the wireless communication terminal may aggregate MPDUs not

soliciting an immediate response to generate an A-MPDU and transmit the generated A-MPDU to the AP.

In the embodiment of FIG. 24, the AP transmits HE MU PPDU to a plurality of stations. At this time, the HE MU PPDU includes a trigger frame soliciting an immediate response to the data MPDU included in the HE MU PPDU. Also, the value of the length field of the Common Info field of the trigger frame is 418. In addition, the CS Required bit of the trigger frame is set to 0. Therefore, the AP sets the value of the TID Aggregation Limit field of the User Info field of the trigger frame to 0. The wireless communication terminal receiving the trigger frame in which the CS Required bit is set to 0 transmits a response to the data MPDU included in the HE MU PPDU and an A-MPDU including the MPDU not soliciting an immediate response together. At this time, the value of the length field of the trigger frame triggering the trigger-based PPDU (HE TB PPDU) including the A-MPDU is less than or equal to 418. Therefore, the first station transmits the A-MPDU including the MPDU including the BA frame and the data in which the ACK Policy is No Ack. The second station transmits an A-MPDU including a BA frame and an action No Ack frame. The third station and the fourth station transmit an A-MPDU including a BA frame and a QoS null frame.

Although the present invention is described by using the wireless LAN communication as an example, the present invention is not limited thereto and the present invention may be similarly applied even to other communication systems such as cellular communication, and the like. Further, the method, the apparatus, and the system of the present invention are described in association with the specific embodiments, but some or all of the components and operations of the present invention may be implemented by using a computer system having universal hardware architecture.

The detailed described embodiments of the present invention may be implemented by various means. For example, the embodiments of the present invention may be implemented by a hardware, a firmware, a software, or a combination thereof.

In case of the hardware implementation, the method according to the embodiments of the present invention may be implemented by one or more of Application Specific Integrated Circuits (ASICSs), Digital Signal Processors (DSPs), Digital Signal Processing Devices (DSPDs), Programmable Logic Devices (PLDs), Field Programmable Gate Arrays (FPGAs), processors, controllers, micro-controllers, micro-processors, and the like.

In case of the firmware implementation or the software implementation, the method according to the embodiments of the present invention may be implemented by a module, a procedure, a function, or the like which performs the operations described above. Software codes may be stored in a memory and operated by a processor. The processor may be equipped with the memory internally or externally and the memory may exchange data with the processor by various publicly known means.

The description of the present invention is used for exemplification and those skilled in the art will be able to understand that the present invention can be easily modified to other detailed forms without changing the technical idea or an essential feature thereof. Thus, it is to be appreciated that the embodiments described above are intended to be illustrative in every sense, and not restrictive. For example, each component described as a single type may be implemented to be distributed and similarly, components described to be distributed may also be implemented in an associated form.

The scope of the present invention is represented by the claims to be described below rather than the detailed description, and it is to be interpreted that the

meaning and scope of the claims and all the changes or modified forms derived from the equivalents thereof come within the scope of the present invention.

[Industrial Applicability]

Various exemplary embodiments of the present invention have been described with reference to an IEEE 802.11 system, but the present invention is not limited thereto and the present invention can be applied to various types of mobile communication apparatus, mobile communication system, and the like.

[CLAIMS]

1. A wireless communication terminal, the terminal comprising:

a processor; and

a communication unit,

wherein the processor is configured to:

receive, through the communication unit, an aggregate MPDU (A-MPDU) consisting of one or more MAC protocol data units (MPDUs),

determine a format of a response frame for the received A-MPDU, and

transmit, through the communication unit, a response frame of the determined format,

wherein the format of the response frame for the A-MPDU is determined based on at least one of the number of traffic IDs (TIDs) soliciting an immediate response in MPDU(s) successfully received in the A-MPDU and MPDU delimiter information of the A-MPDU.

2. The wireless communication terminal of claim 1, wherein the MPDU delimiter information includes the presence or the number of MPDU delimiters with a value of an end of frame (EOF) field equal to 1 and a value of an MPDU length field not equal to 0.

3. The wireless communication terminal of claim 1, wherein when the successfully received MPDU(s) include MPDU soliciting an immediate response only one, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an EOF field equal to 1 and a value of an MPDU length field not equal to 0, the response frame for the A-MPDU is determined to be an Ack frame.

4. The wireless communication terminal of claim 1, wherein when the successfully received MPDU(s) include one or more MPDUs of only one TID soliciting an immediate response, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an EOF field equal to 0, the response frame for the A-MPDU is determined to be a compressed BlockAck frame.

5. The wireless communication terminal of claim 1, wherein when the successfully received MPDU(s) include MPDUs of a plurality of TIDs soliciting an immediate response or include MPDUs of one or more TIDs soliciting an immediate response and an Action frame, the response frame for the A-MPDU is determined to be a multi-STA BlockAck frame.

6. The wireless communication terminal of claim 1, wherein when an MPDU in which an acknowledgment policy is set to HE TB PPDU (HTP) Ack is not present in the A-MPDU, the response frame is carried in an high efficiency single-user PHY protocol data unit (HE SU PPDU).

7. The wireless communication terminal of claim 1, wherein when the A-MPDU contains a trigger frame or the A-MPDU contains a QoS data frame or a QoS null frame with an uplink multi-user response scheduling (UMRS) control field, the response frame is carried in an high efficiency trigger-based PHY protocol data unit (HE TB PPDU).

8. The wireless communication terminal of claim 7, wherein an MPDU

soliciting an immediate response and contained in the A-MPDU includes at least one of a QoS data frame in which an acknowledgment policy is set to HTP Ack and a QoS Null frame in which an acknowledgment policy is set to HTP Ack.

9. A wireless communication method of a wireless communication terminal, the method comprising:

receiving an aggregate MPDU (A-MPDU) consisting of one or more MPDUs;

determining a format of a response frame for the received A-MPDU; and

transmitting a response frame of the determined format,

wherein the format of the response frame for the A-MPDU is determined based on at least one of the number of traffic IDs (TIDs) soliciting an immediate response in MPDU(s) successfully received in the A-MPDU and MPDU delimiter information of the A-MPDU.

10. The wireless communication method of claim 9, wherein the MPDU delimiter information includes the presence or the number of MPDU delimiters with a value of an end of frame (EOF) field equal to 1 and a value of an MPDU length field not equal to 0.

11. The wireless communication method of claim 9, wherein when the successfully received MPDU(s) include MPDU soliciting an immediate response only one, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an EOF field equal to 1 and a value of an MPDU length field not equal to 0, the response frame for the A-MPDU is determined to be an Ack frame.

12. The wireless communication method of claim 9, wherein when the successfully received MPDU(s) include one or more MPDUs of only one TID soliciting an immediate response, and the MPDU soliciting the immediate response follows an MPDU delimiter with a value of an EOF field equal to 0, the response frame for the A-MPDU is determined to be a compressed BlockAck frame.

13. The wireless communication method of claim 9, wherein when the successfully received MPDU(s) include MPDUs of a plurality of TIDs soliciting an immediate response or include MPDUs of one or more TIDs soliciting an immediate response and an Action frame, the response frame for the A-MPDU is determined to be a multi-STA BlockAck frame.

14. The wireless communication method of claim 9, wherein when an MPDU in which an acknowledgment policy is set to HE TB PPDU (HTP) Ack is not present in the A-MPDU, the response frame is carried in an high efficiency single-user PHY protocol data unit (HE SU PPDU).

15. The wireless communication method of claim 9, wherein when the A-MPDU contains a trigger frame or the A-MPDU contains a QoS data frame or a QoS null frame with an uplink multi-user response scheduling (UMRS) control field, the response frame is carried in an high efficiency trigger-based PHY protocol data unit (HE TB PPDU).

16. The wireless communication method of claim 15, wherein an MPDU soliciting an immediate response and contained in the A-MPDU includes at least one of

a QoS data frame in which an acknowledgment policy is set to HTP Ack and a QoS Null frame in which an acknowledgment policy is set to HTP Ack.

[ABSTRACT]

The present invention relates to a method for transmitting an aggregate MPDU and a response frame thereto and a wireless communication terminal using the same, and more particularly, to a wireless communication method and a wireless communication terminal for setting various formats of the aggregate MPDU and the response frame thereto and performing an efficient data communication by using the same. To this end, provided are a wireless communication terminal including: a processor; and a communication unit, wherein the processor receives an aggregate MPDU (A-MPDU) consisting of one or more MAC protocol data units (MPDUs), determines a format of a response frame for the received A-MPDU, and

transmits a response frame of the determined format, wherein the format of the response frame for the A-MPDU is determined based on at least one of the number of traffic IDs (TIDs) soliciting an immediate response in MPDU(s) successfully received in the A-MPDU and MPDU delimiter information of the A-MPDU and a wireless communication method using the same.

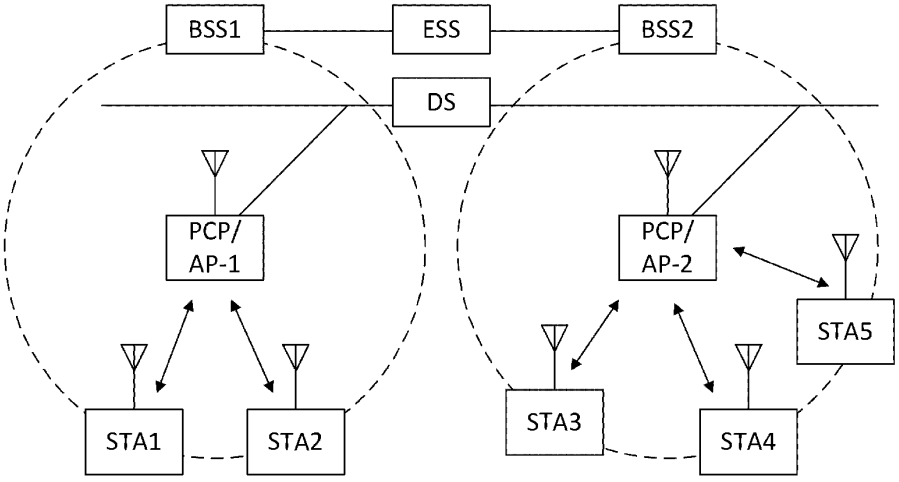

BSS1
ESS
BSS2
DS
PCP/
AP-1
PCP/
AP-2
STA5
STA1
STA2
STA3
STA4

FIG. 1

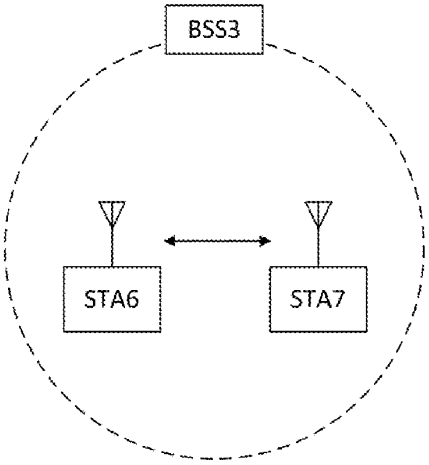

BSS3
STA6
STA7

FIG. 2

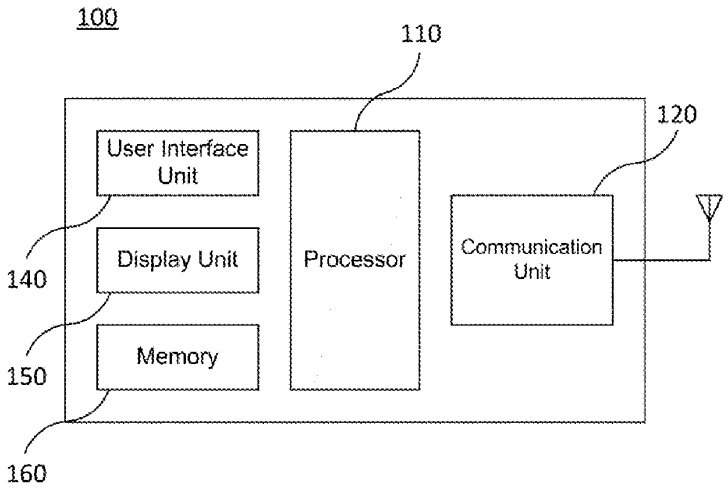

100
110
120
User Interface Unit
Display Unit
Memory
Processor
Communication Unit
140
150
160

FIG. 3

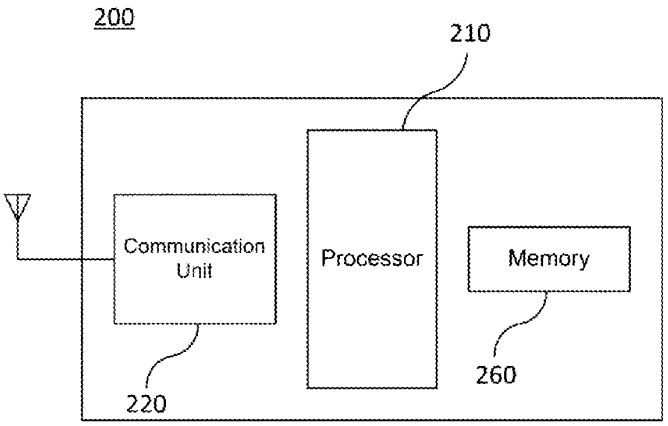

200
210
Communication Unit
Processor
Memory
220
260

FIG. 4

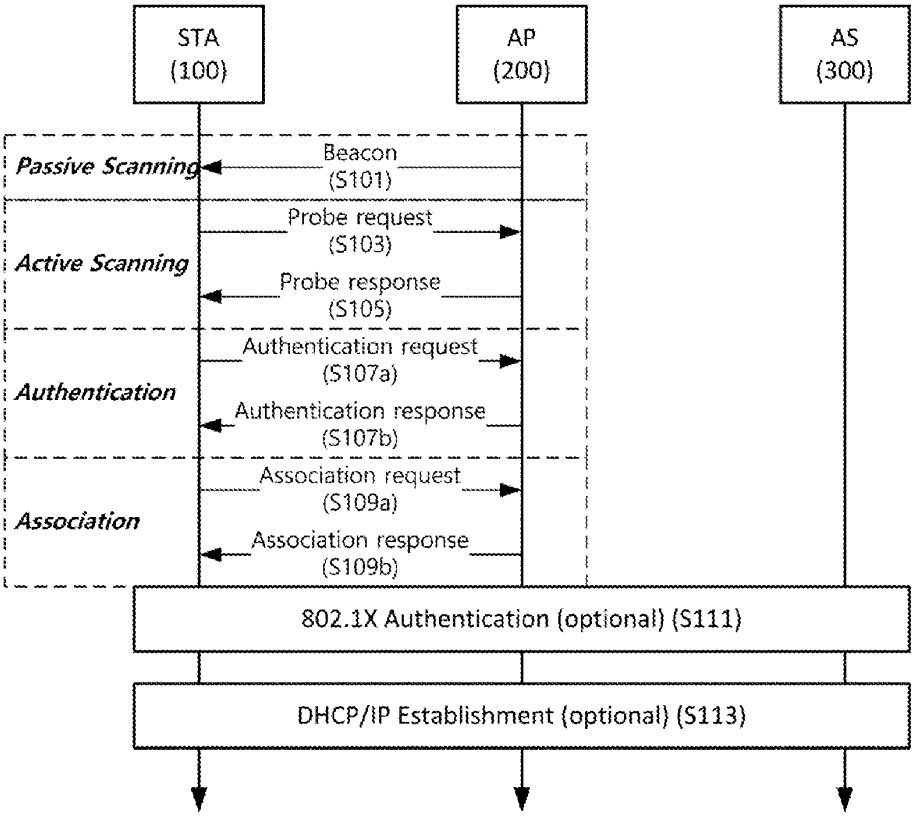

STA
(100)
AP
(200)
AS
(300)
Passive Scanning
Beacon
(S101)
Active Scanning
Probe request
(S103)
Probe response
(S105)
Authentication
Authentication request
(S107a)
Authentication response
(S107b)
Association
Association request
(S109a)
Association response
(S109b)
802.1X Authentication (optional) (S111)
DHCP/IP Establishment (optional) (S113)

FIG. 5

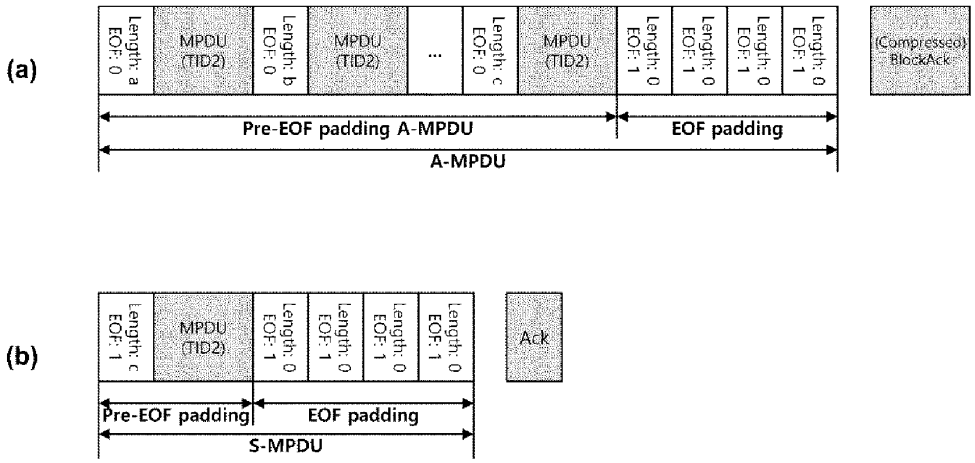

(a)
Length: a EOF: 0
MPDU (TID2)
Length: b EOF: 0
MPDU (TID2)
...
Length: c EOF: 0
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
(Compressed) BlockAck
Pre-EOF padding A-MPDU
EOF padding
A-MPDU
(b)
Length: c EOF: 1
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack
Pre-EOF padding
EOF padding
S-MPDU

FIG. 6

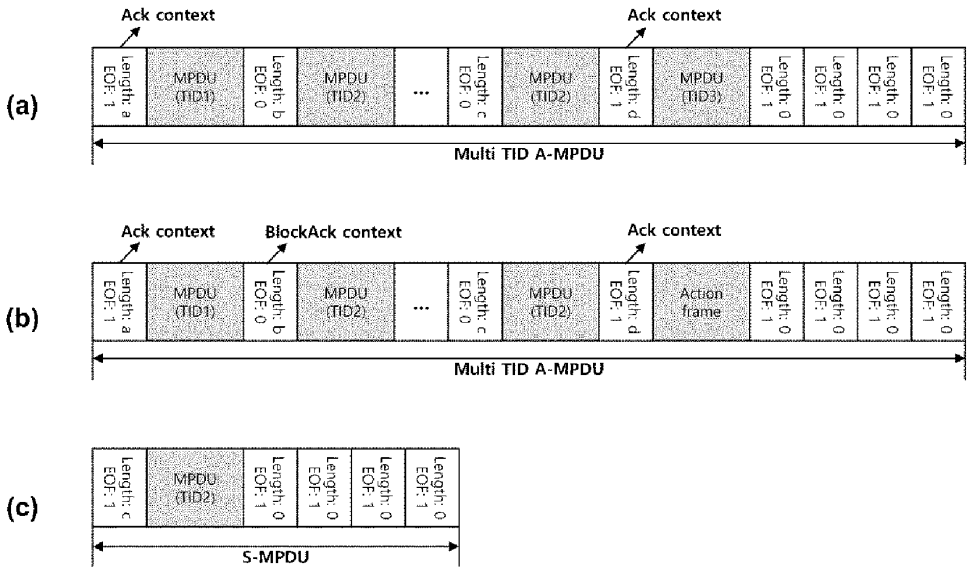

(a)
Ack context
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
MPDU (TID2)
...
Length: c EOF: 0
MPDU (TID2)
Length: d EOF: 1
MPDU (TID3)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Multi TID A-MPDU
(b)
Ack context
BlockAck context
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
MPDU (TID2)
...
Length: c EOF: 0
MPDU (TID2)
Length: d EOF: 1
Action frame
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Multi TID A-MPDU
(c)
Length: c EOF: 1
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
S-MPDU

FIG. 7

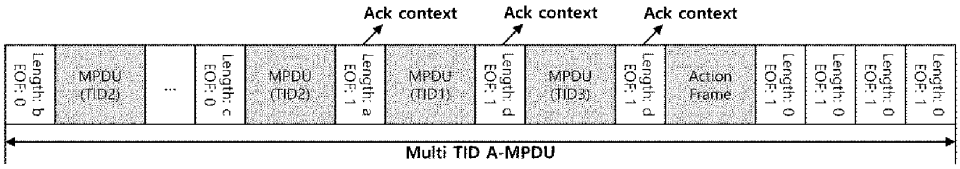
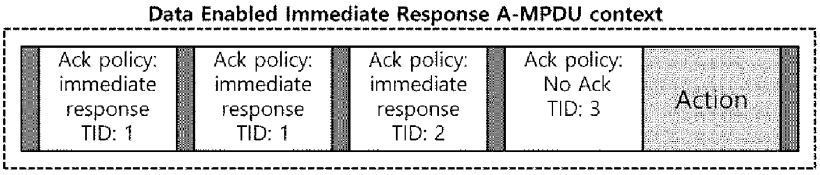

Ack context
Ack context
Ack context
Length: b EOF: 0
MPDU (TID2)
...
Length: c EOF: 0
MPDU (TID2)
Length: a EOF: 1
MPDU (TID1)
Length: d EOF: 1
MPDU (TID3)
Length: d EOF: 1
Action Frame
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Multi TID A-MPDU

FIG. 8

(a)


Data Enabled Immediate Response A-MPDU context
Ack policy: immediate response TID: 1
Ack policy: immediate response TID: 1
Ack policy: immediate response TID: 2
Ack policy: No Ack TID: 3
Action

(b)

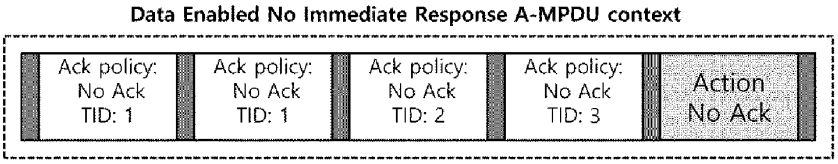

Data Enabled No Immediate Response A-MPDU context
Ack policy: No Ack TID: 1
Ack policy: No Ack TID: 1
Ack policy: No Ack TID: 2
Ack policy: No Ack TID: 3
Action No Ack

FIG. 9

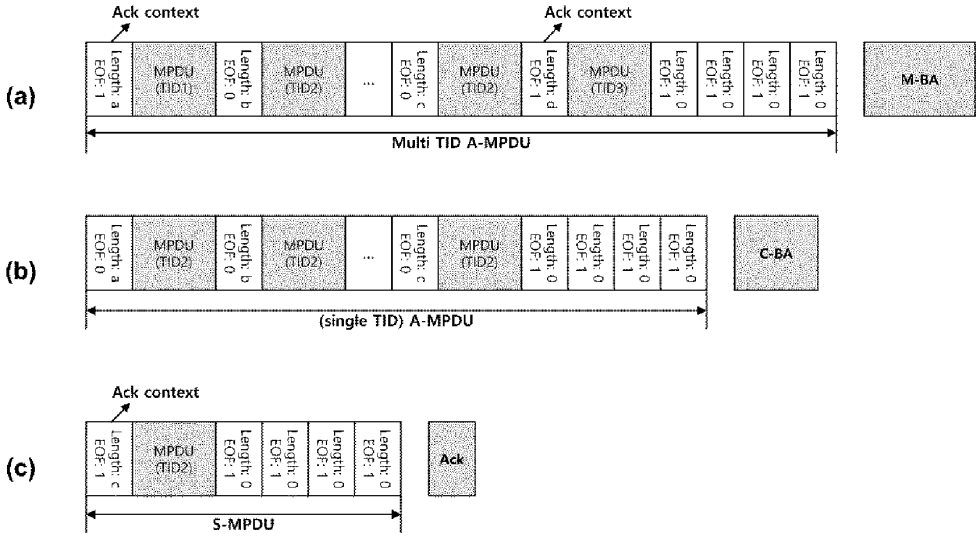

(a)
Ack context
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
MPDU (TID2)
Length: c EOF: 0
MPDU (TID2)
Length: d EOF: 1
MPDU (TID3)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
M-BA
Multi TID A-MPDU
(b)
Length: a EOF: 0
MPDU (TID2)
Length: b EOF: 0
MPDU (TID2)
Length: c EOF: 0
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
C-BA
(single TID) A-MPDU
(c)
Ack context
Length: c EOF: 1
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack
S-MPDU

FIG. 10

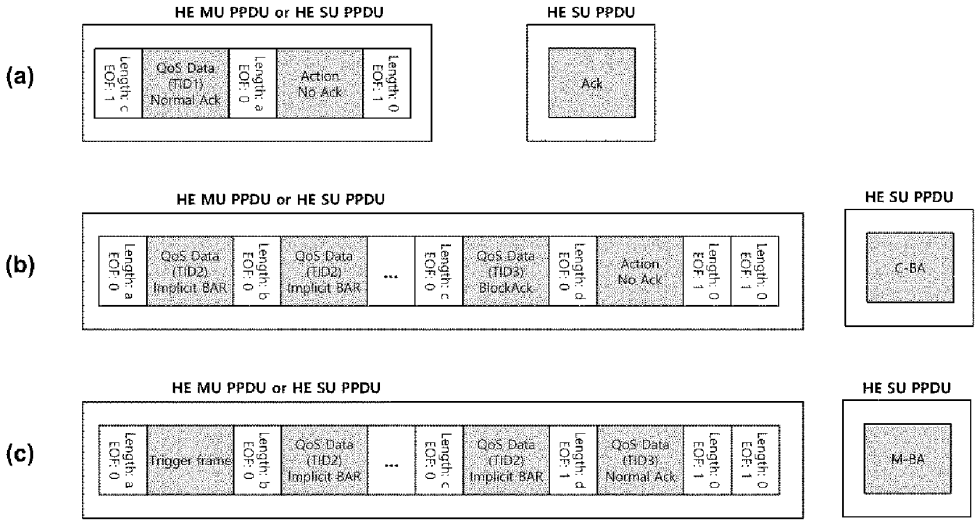

(a)
HE MU PPDU or HE SU PPDU
Length: c EOF: 1
QoS Data (TID1) Normal Ack
Length: a EOF: 0
Action No Ack
Length: 0 EOF: 1
HE SU PPDU
Ack
(b)
HE MU PPDU or HE SU PPDU
Length: a EOF: 0
QoS Data (TID2) Implicit BAR
Length: b EOF: 0
QoS Data (TID2) Implicit BAR
...
Length: c EOF: 0
QoS Data (TID3) BlockAck
Length: d EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
HE SU PPDU
C-BA
(c)
HE MU PPDU or HE SU PPDU
Length: a EOF: 0
Trigger frame
Length: b EOF: 0
QoS Data (TID2) Implicit BAR
...
Length: c EOF: 0
QoS Data (TID2) Implicit BAR
Length: d EOF: 1
QoS Data (TID3) Normal Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
HE SU PPDU
M-BA

FIG. 11

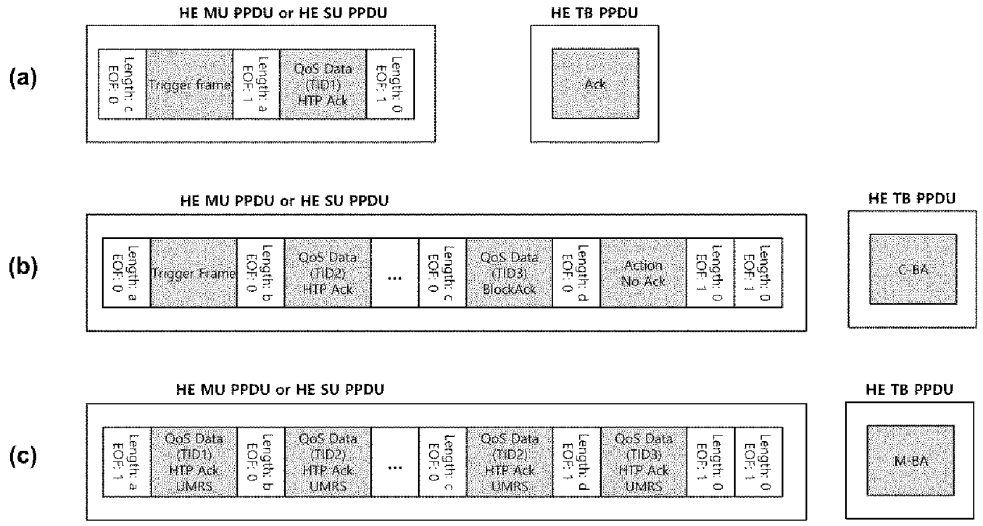

(a)
HE MU PPDU or HE SU PPDU
Length: c EOF: 0
Trigger frame
Length: a EOF: 1
QoS Data (TID1) HTP Ack
Length: 0 EOF: 1
HE TB PPDU
Ack
(b)
HE MU PPDU or HE SU PPDU
Length: a EOF: 0
Trigger Frame
Length: b EOF: 0
QoS Data (TID2) HTP Ack
...
Length: c EOF: 0
QoS Data (TID3) BlockAck
Length: d EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
HE TB PPDU
C-BA
(c)
HE MU PPDU or HE SU PPDU
Length: a EOF: 1
QoS Data (TID1) HTP Ack UMRS
Length: b EOF: 0
QoS Data (TID2) HTP Ack UMRS
...
Length: c EOF: 0
QoS Data (TID2) HTP Ack UMRS
Length: d EOF: 1
QoS Data (TID3) HTP Ack UMRS
Length: 0 EOF: 1
Length: 0 EOF: 1
HE TB PPDU
M-BA

FIG. 12

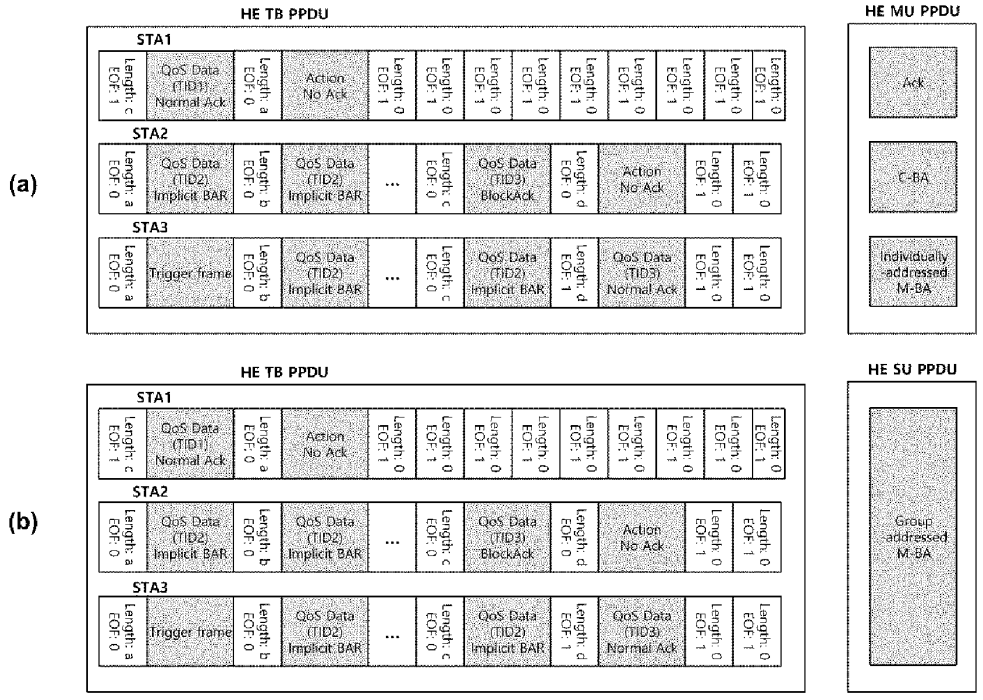

(a)
HE TB PPDU
STA1
Length: c EOF: 1
QoS Data (TID1) Normal Ack
Length: a EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
STA2
Length: a EOF: 0
QoS Data (TID2) Implicit BAR
Length: b EOF: 0
QoS Data (TID2) Implicit BAR
...
Length: c EOF: 0
QoS Data (TID3) BlockAck
Length: d EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
STA3
Length: a EOF: 0
Trigger frame
Length: b EOF: 0
QoS Data (TID2) Implicit BAR
...
Length: c EOF: 0
QoS Data (TID2) Implicit BAR
Length: d EOF: 1
QoS Data (TID3) Normal Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
HE MU PPDU
Ack
C-BA
Individually addressed M-BA
(b)
HE TB PPDU
STA1
Length: c EOF: 1
QoS Data (TID1) Normal Ack
Length: a EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
STA2
Length: a EOF: 0
QoS Data (TID2) Implicit BAR
Length: b EOF: 0
QoS Data (TID2) Implicit BAR
...
Length: c EOF: 0
QoS Data (TID3) BlockAck
Length: d EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
STA3
Length: a EOF: 0
Trigger frame
Length: b EOF: 0
QoS Data (TID2) Implicit BAR
...
Length: c EOF: 0
QoS Data (TID2) Implicit BAR
Length: d EOF: 1
QoS Data (TID3) Normal Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
HE SU PPDU
Group addressed M-BA

FIG. 13

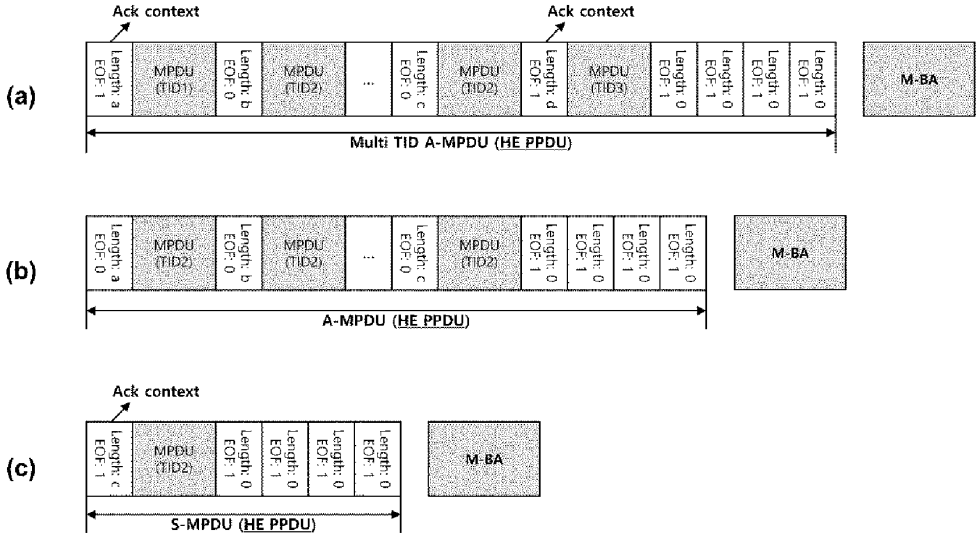

(a)
Ack context
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
MPDU (TID2)
Length: c EOF: 0
MPDU (TID2)
Length: d EOF: 1
MPDU (TID3)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
M-BA
Multi TID A-MPDU (HE PPDU)
(b)
Length: a EOF: 0
MPDU (TID2)
Length: b EOF: 0
MPDU (TID2)
Length: c EOF: 0
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
M-BA
A-MPDU (HE PPDU)
(c)
Ack context
Length: c EOF: 1
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
M-BA
S-MPDU (HE PPDU)

FIG. 14

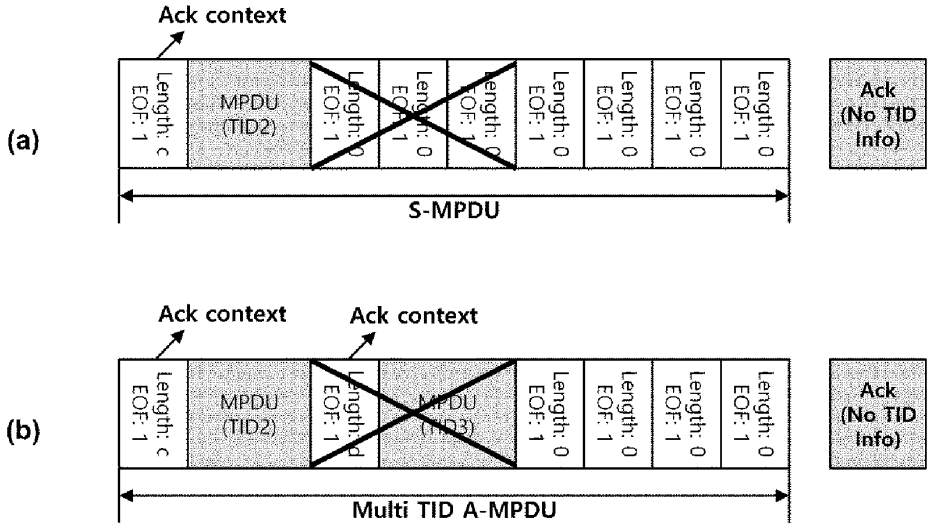

(a)
Ack context
Length: c EOF: 1
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack (No TID Info)
S-MPDU
(b)
Ack context
Ack context
Length: c EOF: 1
MPDU (TID2)
Length: d EOF: 1
MPDU (TID3)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack (No TID Info)
Multi TID A-MPDU

FIG. 15

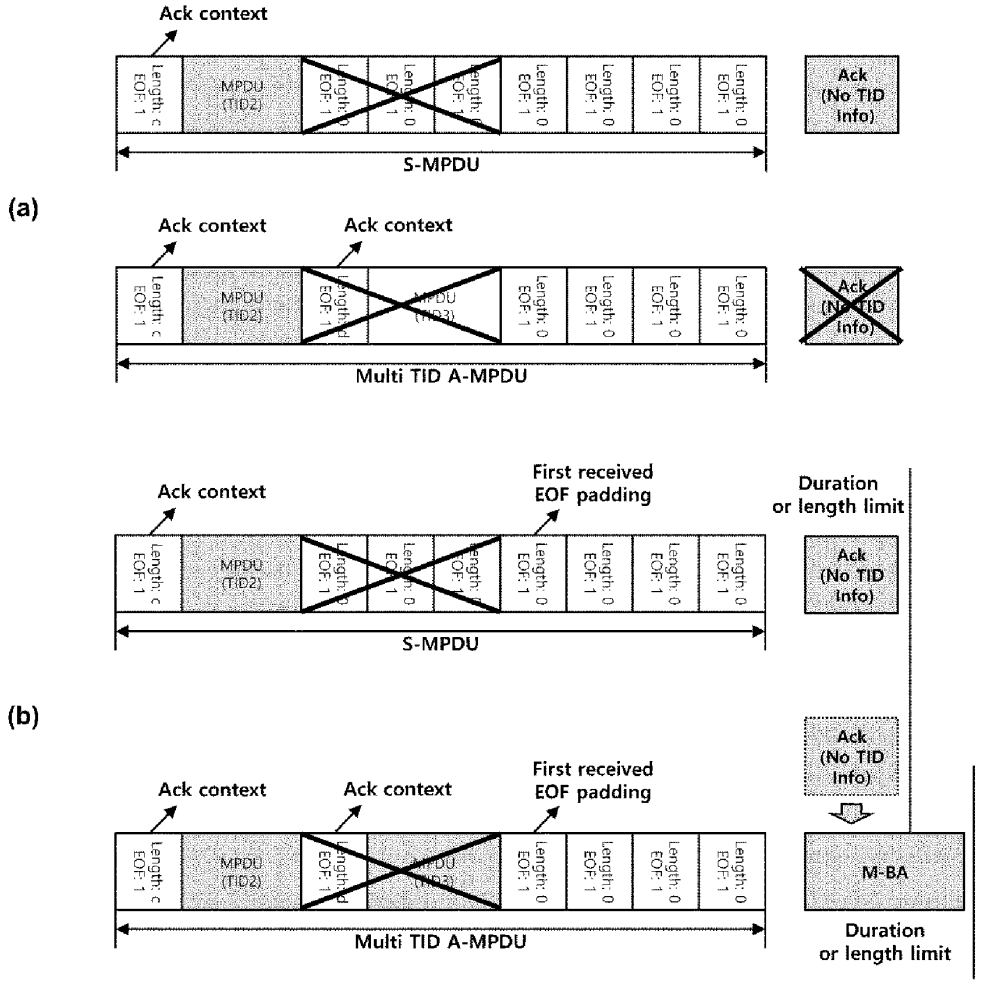

(a)
Ack context
Length: c EOF: 1
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack (No TID Info)
S-MPDU
Ack context
Ack context
Length: c EOF: 1
MPDU (TID2)
Length: d EOF: 1
MPDU (TID3)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack (No TID Info)
Multi TID A-MPDU
(b)
Ack context
First received EOF padding
Duration or length limit
Length: c EOF: 1
MPDU (TID2)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack (No TID Info)
S-MPDU
Ack (No TID Info)
Ack context
Ack context
First received EOF padding
Length: c EOF: 1
MPDU (TID2)
Length: d EOF: 1
MPDU (TID3)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
M-BA
Duration or length limit
Multi TID A-MPDU

FIG. 16

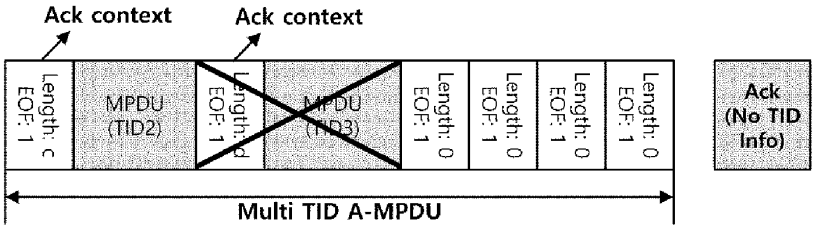

Ack context
Ack context
Length: c EOF: 1
MPDU (TID2)
Length: d EOF: 1
MPDU (TID3)
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack (No TID Info)
Multi TID A-MPDU

FIG. 17

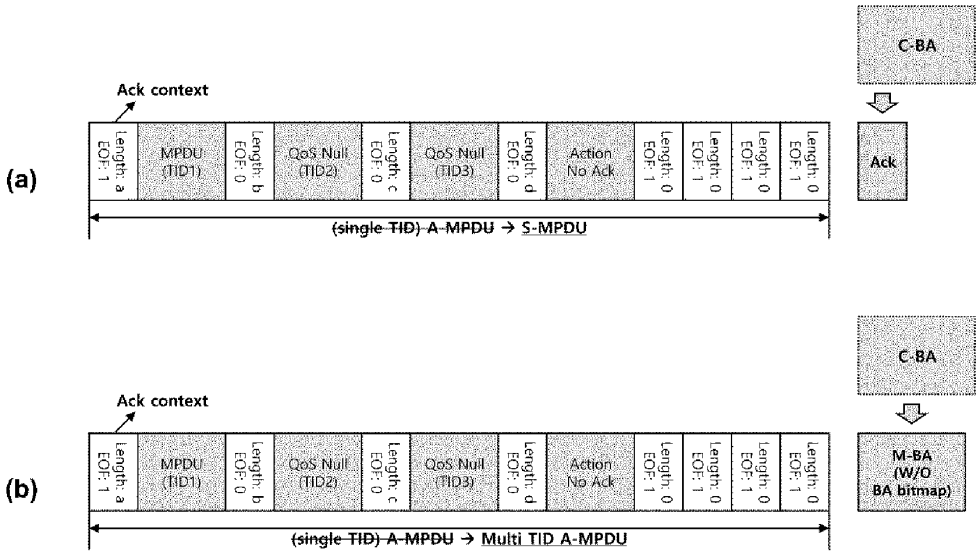

(a)
C-BA
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
QoS Null (TID2)
Length: c EOF: 0
QoS Null (TID3)
Length: d EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack
(single TID) A-MPDU → S-MPDU
(b)
C-BA
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
QoS Null (TID2)
Length: c EOF: 0
QoS Null (TID3)
Length: d EOF: 0
Action No Ack
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
M-BA (W/O BA bitmap)
(single TID) A-MPDU → Multi TID A-MPDU

FIG. 18

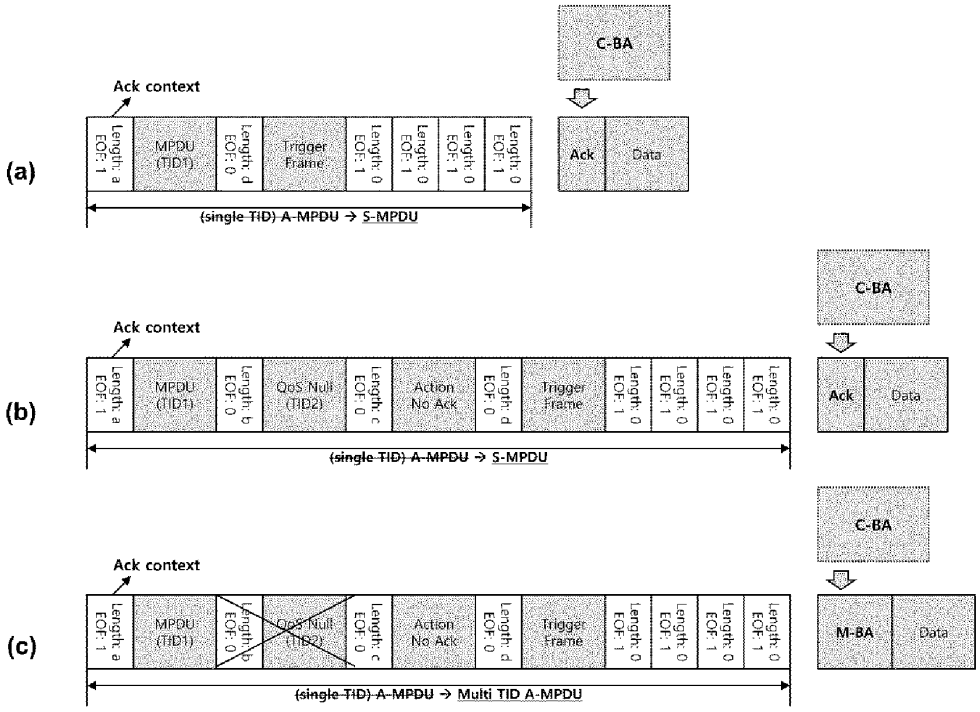

(a)
C-BA
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: d EOF: 0
Trigger Frame
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack
Data
(single TID) A-MPDU → S-MPDU
(b)
C-BA
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
QoS Null (TID2)
Length: c EOF: 0
Action No Ack
Length: d EOF: 0
Trigger Frame
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Ack
Data
(single TID) A-MPDU → S-MPDU
(c)
C-BA
Ack context
Length: a EOF: 1
MPDU (TID1)
Length: b EOF: 0
QoS Null (TID2)
Length: c EOF: 0
Action No Ack
Length: d EOF: 0
Trigger Frame
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
Length: 0 EOF: 1
M-BA
Data
(single TID) A-MPDU → Multi TID A-MPDU

FIG. 19

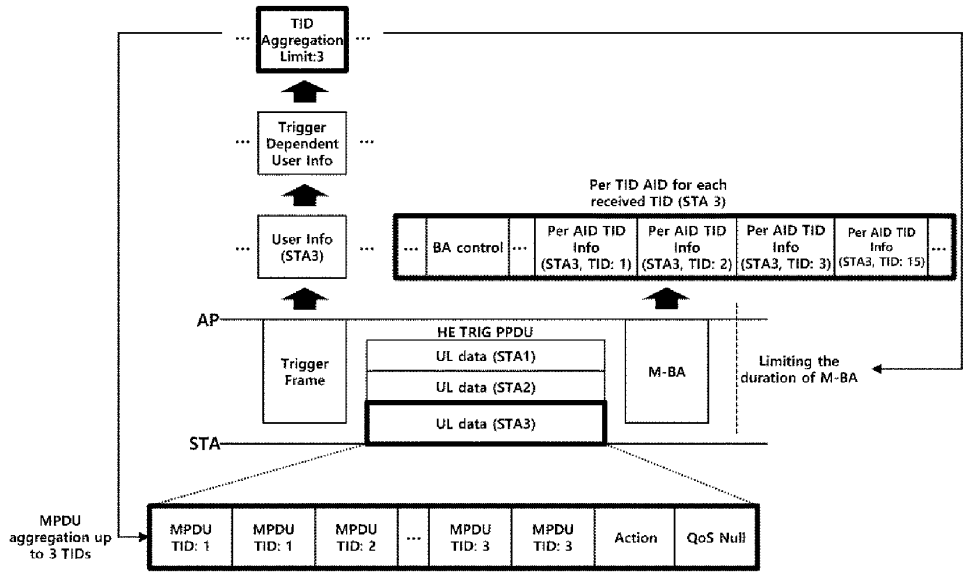

TID Aggregation Limit:3
Trigger Dependent User Info
User Info (STA3)
Per TID AID for each received TID (STA 3)
BA control
Per AID TID Info (STA3, TID: 1)
Per AID TID Info (STA3, TID: 2)
Per AID TID Info (STA3, TID: 3)
Per AID TID Info (STA3, TID: 15)
AP
Trigger Frame
HE TRIG PPDU
UL data (STA1)
UL data (STA2)
UL data (STA3)
M-BA
Limiting the duration of M-BA
STA
MPDU aggregation up to 3 TIDs
MPDU TID: 1
MPDU TID: 1
MPDU TID: 2
MPDU TID: 3
MPDU TID: 3
Action
QoS Null

FIG. 20

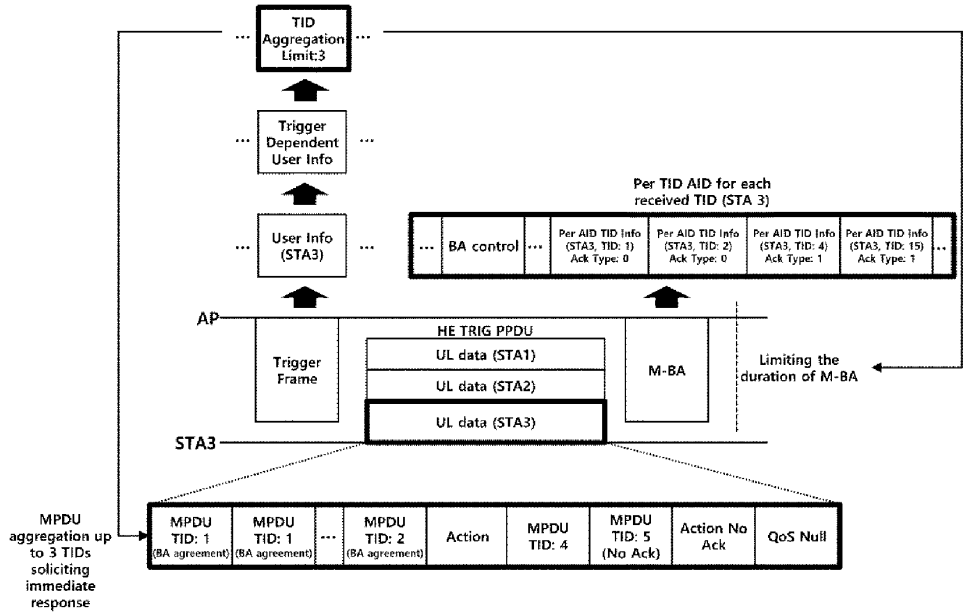

TID Aggregation Limit:3
Trigger Dependent User Info
User Info (STA3)
Per TID AID for each received TID (STA 3)
BA control
Per AID TID Info (STA3, TID: 1) Ack Type: 0
Per AID TID Info (STA3, TID: 2) Ack Type: 0
Per AID TID Info (STA3, TID: 4) Ack Type: 1
Per AID TID Info (STA3, TID: 15) Ack Type: 1
AP
Trigger Frame
HE TRIG PPDU
UL data (STA1)
UL data (STA2)
UL data (STA3)
M-BA
Limiting the duration of M-BA
STA3
MPDU aggregation up to 3 TIDs soliciting immediate response
MPDU TID: 1 (BA agreement)
MPDU TID: 1 (BA agreement)
MPDU TID: 2 (BA agreement)
Action
MPDU TID: 4
MPDU TID: 5 (No Ack)
Action No Ack
QoS Null

FIG. 21

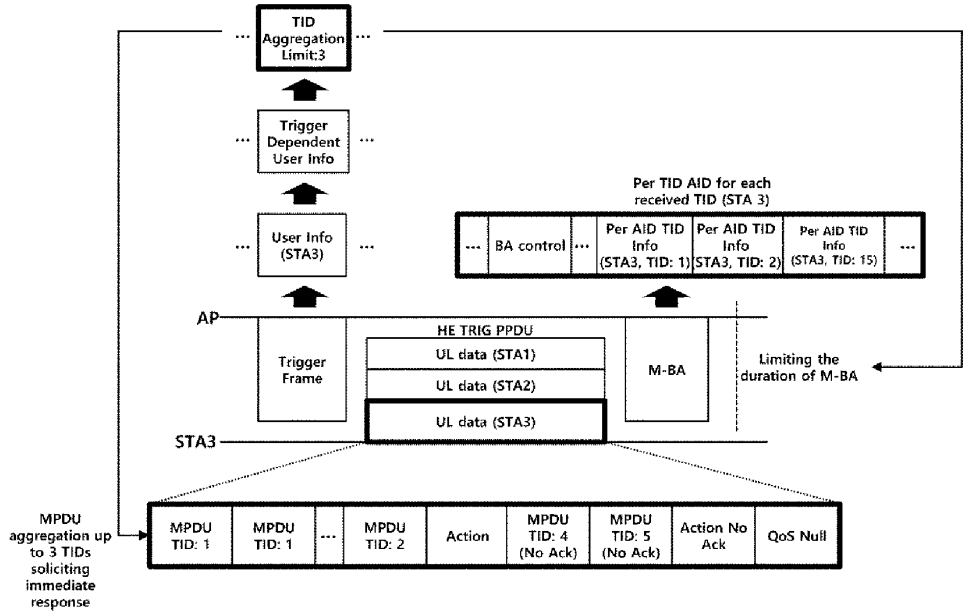

TID Aggregation Limit:3
Trigger Dependent User Info
User Info (STA3)
Per TID AID for each received TID (STA 3)
BA control
Per AID TID Info (STA3, TID: 1)
Per AID TID Info (STA3, TID: 2)
Per AID TID Info (STA3, TID: 15)
AP
Trigger Frame
HE TRIG PPDU
UL data (STA1)
UL data (STA2)
UL data (STA3)
M-BA
Limiting the duration of M-BA
STA3
MPDU aggregation up to 3 TIDs soliciting immediate response
MPDU TID: 1
MPDU TID: 1
MPDU TID: 2
Action
MPDU TID: 4 (No Ack)
MPDU TID: 5 (No Ack)
Action No Ack
QoS Null

FIG. 22

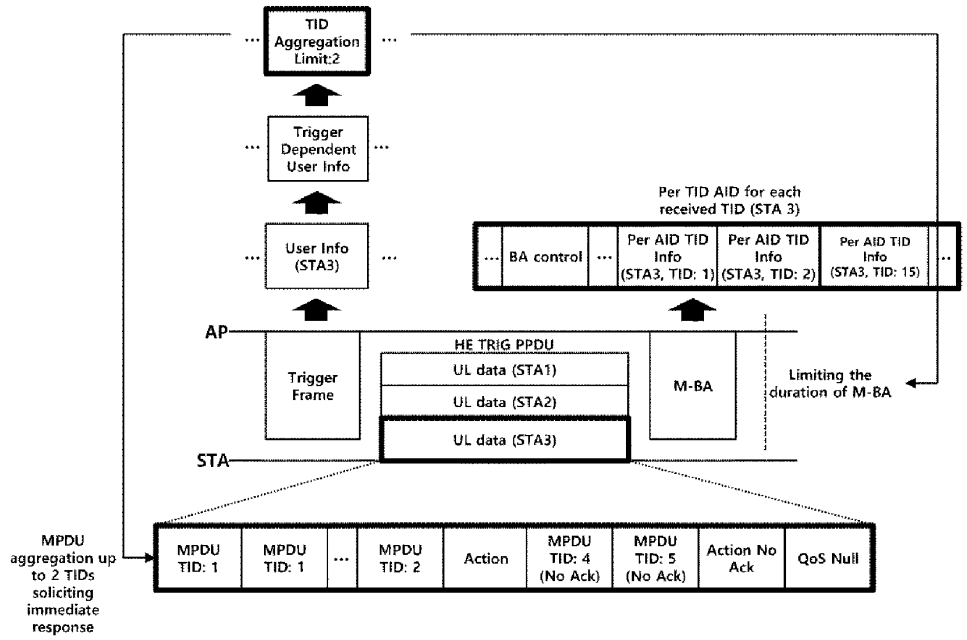

TID Aggregation Limit:2
Trigger Dependent User Info
User Info (STA3)
Per TID AID for each received TID (STA 3)
BA control
Per AID TID Info (STA3, TID: 1)
Per AID TID Info (STA3, TID: 2)
Per AID TID Info (STA3, TID: 15)
AP
Trigger Frame
HE TRIG PPDU
UL data (STA1)
UL data (STA2)
UL data (STA3)
M-BA
Limiting the duration of M-BA
STA
MPDU aggregation up to 2 TIDs soliciting immediate response
MPDU TID: 1
MPDU TID: 1
MPDU TID: 2
Action
MPDU TID: 4 (No Ack)
MPDU TID: 5 (No Ack)
Action No Ack
QoS Null

FIG. 23

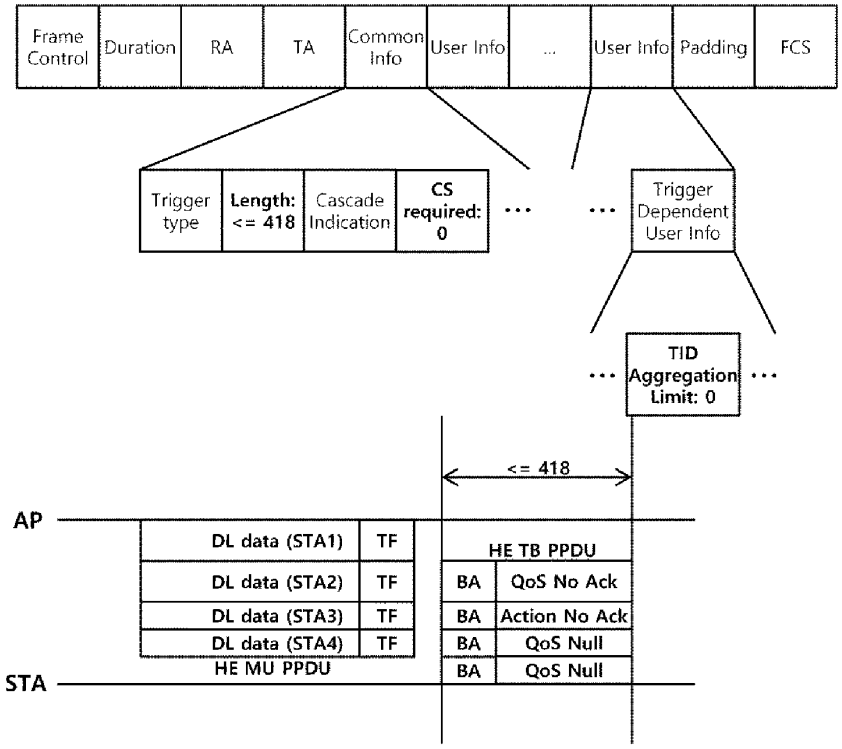

Frame Control
Duration
RA
TA
Common Info
User Info
...
User Info
Padding
FCS
Trigger type
Length: <= 418
Cascade Indication
CS required: 0
Trigger Dependent User Info
TID Aggregation Limit: 0
<= 418
AP
STA
DL data (STA1)
DL data (STA2)
DL data (STA3)
DL data (STA4)
TF
HE MU PPDU
HE TB PPDU
BA
QoS No Ack
Action No Ack
QoS Null

FIG. 24

NOTE: 37 CFR 1.63(c) states, "A person may not execute an oath or declaration unless the person has reviewed and understands the contents of the application, including the claims and is aware of the duty to disclose to the Office all information known to be material to patentability as defined in § 1.56."

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	AGGREGATED-MPDU, METHOD FOR TRANSMITTING RESPONSE FRAME THERETO, AND WIRELESS COMMUNICATION TERMINAL USING SAME

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☒ The attached application, or
- ☐ United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR (1)

Inventor: Woojin AHN Date (Optional): 5. June 2019

Signature: _____

LEGAL NAME OF INVENTOR (2)

Inventor: Juhyung SON Date (Optional): 5. June 2019

Signature: _____

LEGAL NAME OF INVENTOR (3)

Inventor: Geonjung KO Date (Optional): June 5, 2019

Signature:

LEGAL NAME OF INVENTOR (4)

Inventor: Jinsam KWAK Date (Optional): June 7, 2019

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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