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Schmitt-Nilson Schraud Waibel Wohlfrom
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Pelkovenstraße 143
80992 München
ALLEMAGNE

Date
25.10.2023

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 / 3567911
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Communication regarding the expiry of the time limit within which notice of opposition may be filed

You are hereby informed that on expiry of the nine-month time limit from the publication of the mention of the grant of European patent No. 3567911 no notice of opposition had reached the files.

The entry in the Register of European Patents will be automatically generated by the electronic data processing system.

For the Examining Division

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EPPU 02: 21.12.22 1215

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ALLEMAGNE

Date
11.01.2023

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 / 3567911
Applicant/Proprietor Wilus Institute of Standards and Technology Inc., et al	

Transmission of the certificate for a European patent pursuant to Rule 74 EPC

The certificate for a European patent is herewith transmitted.

The European patent specification can be downloaded from the EPO publication server **https://data.epo.org/publication-server/** (see OJ EPO 2005, 126).

Note:
A corrected title page of the European patent specification will be published, if the bibliographic data have been changed after completion of the technical preparations.

For the Examining Division

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Schmitt-Nilson Schraud Waibel Wohlfrom
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ALLEMAGNE

Date
04.01.2023

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 / 3567911
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Refund of fees

The following fee has been paid in respect of application No. 18736375.9:

Fee	Reference	Voucher No.	Date	Currency	Amount
Renewal fee	036	60864809	14.11.22	EUR	1 125,00

The fee was paid by CPA Computer Patent Annuities Ltd.

Amount refundable:	Reference	Currency	Amount	Voucher No.
	036	EUR	1.125,00	10222010

Refund order

1. Reason for refund: Renewal fee no longer payable to EPO

2. In accordance with the information on file, the refund:

(x) will be credited to EPO deposit account number 28003100

The authorizing Officer
Ragni, Marie-Astrid

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Date
24.11.2022

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 / 3567911
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Decision to grant a European patent pursuant to Article 97(1) EPC

Following examination of European patent application No. 18736375.9 a European patent with the title and the supporting documents indicated in the communication pursuant to Rule 71(3) EPC (EPO Form 2004C) or in the information (EPO Form 2004W, cf. Notice from the EPO dated 8 June 2015, OJ EPO 2015, A52) dated 04.07.22 is hereby granted in respect of the designated Contracting States.

Patent No. : 3567911
Date of filing : 09.01.18
Priority claimed : 09.01.17/KRA 20170003147
18.01.17/KRA 20170008927

Designated Contracting States and Proprietor(s) : AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Wilus Institute of Standards and Technology Inc.
5F, 216 Hwangsaeul-ro
Bundang-gu
Seongnam-si, Gyeonggi-do 13595/KR

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
SK Telecom Co., Ltd
65 Eulji-ro
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Seoul 04539/KR

This decision will take effect on the date on which the European Patent Bulletin mentions the grant (Art. 97(3) EPC).

The mention of the grant will be published in European Patent Bulletin 22/51 of 21.12.22.

Registered Letter

to EPO postal service: 18.11.22

Examining Division

Brezmes Alonso, Javi | Iavarone, Federico | Tyszka, Krzysztof

ANMERKUNG ZUR ENTSCHEIDUNG ÜBER DIE ERTEILUNG
EINES EUROPÄISCHEN PATENTS (EPA Form 2006)

1. **EPA Informationsbroschüre "Nationales Recht zum EPÜ"**
Diese Broschüre enthält nützliche Informationen zu den formalen Erfordernissen und den Handlungen, die vor den Patentbehörden der Vertragsstaaten vorzunehmen sind, um Rechte in diesen Staaten zu erlangen. Da diese Handlungen einem ständigen Wandel unterworfen sind, sollte immer nur die neueste Ausgabe der Broschüre benutzt werden. Nachträgliche Informationen werden im Amtsblatt veröffentlicht.

2. **Übersetzung der europäischen Patentschrift nach Artikel 65 (1) des Europäischen Patentübereinkommens**
Sie werden erneut darauf hingewiesen, dass bestimmte Vertragsstaaten nach Artikel 65 (1) EPÜ eine Übersetzung der europäischen Patentschrift verlangen; hierauf wird in der Mitteilung gemäß Regel 71 (5) EPÜ verwiesen. Die Nichteinreichung dieser Übersetzung kann zur Folge haben, dass das Patent in dem betreffenden Staat/in den betreffenden Staaten als von Anfang an nicht eingetreten gilt. Weitere Einzelheiten entnehmen Sie bitte der oben genannten Broschüre.

3. **Zahlung von Jahresgebühren für europäische Patente**
Nach Artikel 141 EPÜ können "nationale" Jahresgebühren für das europäische Patent für die Jahre erhoben werden, die an das Jahr anschließen, in dem der Hinweis auf die Erteilung des europäischen Patents im "Europäischen Patentblatt" bekanntgemacht wird. Weitere Einzelheiten entnehmen Sie bitte der oben genannten Broschüre.

NOTE RELATING TO THE DECISION TO GRANT A
EUROPEAN PATENT (EPO Form 2006)

1. **EPO Information Brochure "National law relating to the EPC"**
This brochure provides useful information regarding formal requirements and the steps to be taken before the patent authorities of the Contracting States in order to acquire rights in those states. Since the necessary steps are subject to change the latest edition of the brochure should always be used. Subsequent information is published in the Official Journal.

2. **Translation of the European patent application under Article 65(1) of the European Patent Convention**
Your attention is again drawn to the requirements regarding translation of the European patent specification laid down by a number of Contracting States under Article 65(1) EPC, to which reference is made in the communication under Rule 71(5) EPC. Failure to supply such translation(s) may result in the patent being deemed to be void "ab initio" in the State(s) in question. For further details you are recommended to consult the above-mentioned brochure.

3. **Payment of renewal fees for European patents**
Under Article 141 EPC "national" renewal fees in respect of a European patent may be imposed for the years which follow that in which the mention of the grant of the European patent is published in the "European Patent Bulletin". For further details you are recommended to consult the above-mentioned brochure.

REMARQUE RELATIVE A LA DECISION DE DELIVRANCE
D'UN BREVET EUROPEEN (OEB Form 2006)

1. **Brochure d'information de l'OEB "Droit national relatif à la CBE"**
Cette brochure fournit d'utiles renseignements sur les conditions de forme requises et sur les actes à accomplir auprès des offices de brevet des Etats contractants aux fins d'obtenir des droits dans les Etats contractants. Etant donné que les actes indispensables sont susceptibles de modifications, il serait bon de toujours consulter la dernière édition de la brochure. Toute information ultérieure est publiée au Journal Officiel.

2. **Traduction du fascicule du brevet européen en vertu de l'article 65(1) de la Convention sur le brevet européen**
Votre attention est de nouveau attirée sur l'obligation faite par certains Etats contractants, en vertu de l'article 65(1) CBE, de fournir une traduction du fascicule du brevet européen, à laquelle il est fait référence dans la notification établie conformément à la règle 71(5) CBE. Si la(les) traduction(s) n'est(ne sont) pas fournie(s), le brevet européen peut, dès l'origine, être réputé sans effet dans cet(ces) Etat(s). Pour plus de détails, nous vous renvoyons à la brochure susmentionnée.

3. **Paiement des taxes annuelles pour le brevet européen**
Conformément à l'article 141 CBE des taxes annuelles "nationales" dues au titre du brevet européen peuvent être perçues pour les années suivant celle au cours de laquelle la mention de la délivrance du brevet européen est publiée au "Bulletin européen des brevets. Pour plus de détails, nous vous renvoyons à la brochure susmentionnée.

SCHMITT-NILSON
SCHRAUD
WAIBEL
WOHLFROM

Patentanwälte
European Patent Attorneys
European Trademark & Design Attorneys

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07. Nov. 2022

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18 736 375.9	M24159.0 sp	04/11/2022
Ihr Zeichen / Your Ref.	S2W2 Zeichen / S2W2 Ref.	Tag / Date

Patent Application 18 736 375.9 in Europe
1. Wilus Institute of Standards and Technology Inc.
2. SK Telecom Co., Ltd.

In reply to the Communication under Rule 71(3) EPC dated July 4, 2022 applicant herewith approves of the text on the basis of which the Examining Division intends to grant a European patent.

The translations of the patent claims into German and French are herewith filed.

The fees for grant and publication in the amount of EUR 990.00 were paid by online payment. A copy of the payment receipt is also enclosed herewith.

Respectfully submitted,

Axel Schmitt-Nilson
European Patent Attorney

Encl.
DE and FR claims translations
payment receipt

REVENDICATIONS

1. Terminal de communication sans fil (100), le terminal comprenant :

une unité de télécommunication (120) ; et

un processeur (110) qui est configuré pour traiter des signaux qui ont été transmis et qui ont été reçus par l'intermédiaire de l'unité de télécommunication (120) ;

dans lequel le processeur (110) est configuré pour :

la réception, par l'intermédiaire de l'unité de télécommunication (120), d'une unité de données de protocole de couche physique (PHY), à haut rendement, du type à utilisateurs multiples, HE MU PPDU ;

dans lequel un préambule de la HE MU PPDU englobe un champ de signaux A du type à haut rendement, HE-SIG-A, et un champ de signaux B du type à haut rendement, HE-SIG-B ;

dans lequel le champ HE-SIG-A englobe un sous-champ de compression SIG-B, un sous-champ de liaisons montantes/liaisons descendantes et un certain nombre de sous-champs de symboles HE-SIG-B ; et

dans lequel le nombre de champs de symboles HE-SIG-B désigne un nombre d'utilisateurs MU-MIMO ou un nombre de symboles OFDM dans le champ HE-SIG-B en conformité avec une valeur du sous-champ de compression SIG-B ; et

le décodage de la HE MU PPDU reçue, en se basant sur les informations que l'on obtient à partir du HE-SIG-HA ;

dans lequel un champ spécifique à un utilisateur qui est inclus dans le champ HE-SIG-B est constitué par un champ d'utilisateur pour une attribution MU-MIMO ou pour une attribution non-MU-MIMO qui dépend du fait de savoir si le nombre de champs de symboles HE-SIG-B désigne le nombre d'utilisateurs MU-MIMO ou le nombre de symboles dans le champ HE-SIG-B.

2. Terminal de communication sans fil (100) selon la revendication 1,

dans lequel une configuration du champ spécifique à un utilisateur du champ HE-SIG-B est identifiée en se basant sur le nombre d'utilisateurs MU-MIMO désigné par le nombre de champs de symboles HE-SIG-B, lorsque le sous-champ de compression SIG-B du champ HE-SIG-A indique une transmission MU-MIMO pleine bande passante.

3. Terminal de communication sans fil (100) selon la revendication 2,

dans lequel le champ spécifique à un utilisateur du champ HE-SIG-B englobe un certain nombre de champs d'utilisateurs pour une attribution MU-MIMO lorsque le nombre d'utilisateurs MU-MIMO indiqué par le nombre de champs de symboles HE-SIG-B est égal à deux utilisateurs ou plus ; et

dans lequel le champ spécifique à un utilisateur du champ HE-SIG-B englobe un champ d'utilisateurs pour une attribution non-MU-MIMO lorsque le nombre d'utilisateurs MU-MIMO indiqué par le nombre de champs de symboles HE-SIG-B représente un utilisateur unique.

4. Terminal de communication sans fil (100) selon la revendication 3,

dans lequel chacun desdits plusieurs champs d'utilisateurs pour l'attribution MU-MIMO englobe un champ de configuration spatiale qui désigne le nombre total de flux spatiaux dans l'attribution MU-MIMO et le nombre de flux spatiaux pour chaque terminal dans l'attribution MU-MIMO ; et

dans lequel le champ destiné à un utilisateur unique pour l'attribution non-MU-MIMO englobe un certain nombre de flux spatiotemporels, NSTS.

5. Terminal de communication sans fil (100) selon la revendication 3,

dans lequel le champ destiné à un utilisateur unique pour l'attribution non-MU-MIMO représente un champ d'utilisateur qui se base sur une attribution du type à accès multiple par répartition orthogonale de la fréquence, OFDMA.

6. Terminal de communication sans fil (100) selon la revendication 1,

dans lequel le sous-champ de liaisons montantes/liaisons descendantes indique le fait de savoir si la PPDU a été transmise sur une liaison montante ou a été transmise sur une liaison descendante ; et

dans lequel au moins un sous-champ inclus dans le champ HE-SIG-A de la PPDU désigne différentes informations qui se basent sur le fait de savoir si le sous-champ de liaisons montantes/liaisons descendantes indique une transmission sur la liaison montante ou une transmission sur la liaison descendante.

7. Terminal de communication sans fil (100) selon la revendication 1,

dans lequel le sous-champ de compression SIG-B indique le fait de savoir si un champ commun est présent dans le HE-SIG-B.

8. Terminal de communication sans fil (100) selon la revendication 7,

dans lequel le nombre de champs de symboles HE-SIG-B désigne le nombre d'utilisateurs MU-MIMO, lorsque le sous-champ de compression SIG-B est réglé à une valeur qui indique que le champ commun n'est pas présent ; et

dans lequel le nombre de champs de symboles HE-SIG-B désigne le nombre de symboles OFDM dans le HE-SIG-B lorsque le sous-

champ de compression SIG-B est réglé à une valeur qui indique que le champ commun est présent.

9. Procédé de communication sans fil d'un terminal de communication sans fil (100), le procédé comprenant le fait de :

recevoir une unité de données de protocole PHY, à haut rendement, du type à utilisateurs multiples, HE MU PPDU ;

dans lequel un préambule de la HE MU PPDU englobe un champ de signaux A du type à haut rendement, HE-SIG-A, et un champ de signaux B du type à haut rendement, HE-SIG-B ;

dans lequel le champ HE-SIG-A englobe un sous-champ de compression SIG-B, un sous-champ de liaisons montantes/liaisons descendantes et un certain nombre de sous-champs de symboles HE-SIG-B ; et

dans lequel le nombre de champs de symboles HE-SIG-B désigne un nombre d'utilisateurs MU-MIMO ou un nombre de symboles OFDM dans le champ HE-SIG-B en conformité avec une valeur du sous-champ de compression SIG-B ; et

décoder la HE MU PPDU reçue, en se basant sur les informations que l'on obtient à partir du HE-SIG-A ;

dans lequel un champ spécifique à un utilisateur qui est inclus dans le champ HE-SIG-B est constitué par un champ d'utilisateur pour une attribution MU-MIMO ou pour une attribution non-MU-MIMO qui dépend du fait de savoir si le nombre de champs de symboles HE-SIG-

B désigne le nombre d'utilisateurs MU-MIMO ou le nombre de symboles dans le champ HE-SIG-B.

10. Procédé de communication sans fil selon la revendication 9,

dans lequel on identifie une configuration du champ spécifique à un utilisateur du champ HE-SIG-B en se basant sur le nombre d'utilisateurs MU-MIMO désigné par le nombre de champs de symboles HE-SIG-B, lorsque le sous-champ de compression SIG-B du champ HE-SIG-A indique une transmission MU-MIMO pleine bande passante.

11. Procédé de communication sans fil selon la revendication 10,

dans lequel le champ spécifique à un utilisateur du champ HE-SIG-B englobe un certain nombre de champs d'utilisateurs pour une attribution MU-MIMO lorsque le nombre d'utilisateurs MU-MIMO indiqué par le nombre de champs de symboles HE-SIG-B est égal à deux utilisateurs ou plus ; et

dans lequel le champ spécifique à un utilisateur du champ HE-SIG-B englobe un champ d'utilisateurs pour une attribution non-MU-MIMO lorsque le nombre d'utilisateurs MU-MIMO indiqué par le nombre de champs de symboles HE-SIG-B représente un utilisateur unique.

12. Procédé de communication sans fil selon la revendication 11,

dans lequel chacun desdits plusieurs champs d'utilisateurs pour une attribution MU-MIMO englobe un champ de configuration spatiale qui désigne le nombre total de flux spatiaux dans l'attribution MU-MIMO et le nombre de flux spatiaux pour chaque terminal dans l'attribution MU-MIMO ; et

dans lequel le champ destiné à un utilisateur unique pour l'attribution non-MU-MIMO englobe un certain nombre de flux spatiotemporels, NSTS.

13. Procédé de communication sans fil selon la revendication 11,

dans lequel le champ destiné à un utilisateur unique pour l'attribution non-MU-MIMO représente un champ d'utilisateur qui se base sur une attribution du type à accès multiple par répartition orthogonale de la fréquence, OFDMA.

14. Procédé de communication sans fil selon la revendication 9,

dans lequel le sous-champ de liaisons montantes/liaisons descendantes indique le fait de savoir si la PPDU a été transmise sur une liaison montante ou a été transmise sur une liaison descendante ; et

dans lequel au moins un sous-champ inclus dans le champ HE-SIG-A de la PPDU désigne différentes informations qui se basent sur le fait de savoir si le sous-champ de liaisons montantes/liaisons descendantes indique une transmission sur la liaison montante ou une transmission sur la liaison descendante.

Patentansprüche

1. Drahtloskommunikationsendgerät (100), wobei das Endgerät aufweist:

eine Kommunikationseinheit (120); und

einen Prozessor (110), der dazu ausgelegt ist, durch die Kommunikationseinheit (120) gesendete und empfangene Signale zu verarbeiten,

wobei der Prozessor (110) ausgelegt ist zum:

Empfangen, durch die Kommunikationseinheit (120), einer Hocheffizienz-Mehrbenutzer-PHY-Protokolldateneinheit (HE MU PPDU),

wobei eine Präambel der HE MU PPDU ein Hocheffizienz-Signal A(HE-SIG-A)-Feld und ein Hocheffizienz-Signal B(HE-SIG-B)-Feld umfasst,

wobei das HE-SIG-A-Feld ein SIG-B-Kompressions-Teilfeld, ein Uplink/Downlink-Teilfeld und ein Teilfeld für eine Anzahl von HE-SIG-B Symbolen umfasst und

wobei das Feld für die Anzahl von HE-SIG-B-Symbolen eine Anzahl von MU-MIMO-Benutzern oder eine Anzahl von OFDM-Symbolen in dem HE-SIG-B-Feld gemäß einem Wert des SIG-B-Kompressions-Teilfelds angibt, und

Dekodieren der empfangenen HE MU PPDU auf Grundlage von von dem HE-SIG-A erlangter Information,

wobei ein in dem HE-SIG-B-Feld enthaltenes benutzerspezifisches Feld aus einem Benutzerfeld für MU-MIMO-Zuweisung oder Nicht-MU-MIMO-Zuweisung besteht, je nachdem, ob das Feld für die Anzahl von HE-SIG-B-Symbolen die Anzahl von MU-MIMO-Benutzern oder die Anzahl von Symbolen in dem HE-SIG-B-Feld angibt.

2. Drahtloskommunikationsendgerät (100) nach Anspruch 1,

wobei eine Konfiguration des benutzerspezifischen Felds des HE-SIG-B-Felds auf Grundlage der Anzahl von MU-MIMO-Benutzern identifiziert wird, die durch das Feld für die Anzahl von HE-SIG-B-Symbolen angegeben wird, wenn das SIG-B-

Kompressions-Teilfeld des HE-SIG-A-Felds MU-MIMO-Übertragung mit voller Bandbreite angibt.

3. Drahtloskommunikationsendgerät (100) nach Anspruch 2,

wobei das benutzerspezifische Feld des HE-SIG-B-Felds eine Mehrzahl von Benutzerfeldern für MU-MIMO-Zuweisung umfasst, wenn die durch das Feld für die Anzahl von HE-SIG-B-Symbolen angegebene Anzahl von MU-MIMO-Benutzern zwei oder mehr Benutzer beträgt, und

wobei das benutzerspezifische Feld des HE-SIG-B-Felds ein Benutzerfeld für Nicht-MU-MIMO-Zuweisung umfasst, wenn die durch das Feld für die Anzahl von HE-SIG-B Symbolen angegebene Anzahl von MU-MIMO-Benutzern ein einziger Benutzer ist.

4. Drahtloskommunikationsendgerät (100) nach Anspruch 3,

wobei jedes der Mehrzahl von Benutzerfeldern für die MU-MIMO-Zuweisung ein Feld für räumliche Konfiguration umfasst, das die Gesamtanzahl von räumlichen Strömen in der MU-MIMO-Zuweisung und die Anzahl von räumlichen Strömen für jedes Endgerät in der MU-MIMO-Zuweisung angibt, und

wobei das eine Benutzerfeld für die Nicht-MU-MIMO-Zuweisung ein Feld für die Anzahl von Raum-Zeit-Strömen (NSTS) umfasst.

5. Drahtloskommunikationsendgerät (100) nach Anspruch 3,

wobei das eine Benutzerfeld für die Nicht-MU-MIMO-Zuweisung ein Benutzerfeld auf Grundlage einer Zuweisung mit orthogonalem Frequenzmultiplexverfahren(OFDMA) ist.

6. Drahtloskommunikationsendgerät (100) nach Anspruch 1,

wobei das Uplink/Downlink-Teilfeld angibt, ob die PPDU auf einem Uplink übertragen wird oder auf einem Downlink übertragen wird, und

wobei mindestens ein in dem HE-SIG-A-Feld der PPDU enthaltenes Teilfeld unterschiedliche Informationen angibt, je nachdem, ob das Uplink/Downlink-Teilfeld eine Uplink-Übertragung oder eine Downlink-Übertragung angibt.

7. Drahtloskommunikationsendgerät (100) nach Anspruch 1,

wobei das SIG-B-Kompressions-Teilfeld angibt, ob ein gemeinsames Feld in dem HE-SIG-B vorhanden ist.

8. Drahtloskommunikationsendgerät (100) nach Anspruch 7,

wobei das Feld für die Anzahl von HE-SIG-B-Symbolen die Anzahl von MU-MIMO-Benutzern angibt, wenn das SIG-B-Kompressions-Teilfeld auf einen Wert eingestellt ist, der angibt, dass das gemeinsame Feld nicht vorhanden ist, und

wobei das Feld für die Anzahl von HE-SIG-B-Symbolen die Anzahl von OFDM-Symbolen in dem HE-SIG-B angibt, wenn das SIG-B-Kompressions-Teilfeld auf einen Wert eingestellt ist, der angibt, dass das gemeinsame Feld vorhanden ist

9. Drahtloskommunikationsverfahren eines Drahtloskommunikationsendgerätes (100), wobei das Verfahren aufweist:

Empfangen einer Hocheffizienz-Mehrbenutzer-PHY-Protokolldateneinheit (HE MU PPDU),

wobei eine Präambel der HE MU PPDU ein Hocheffizienz-Signal A(HE-SIG-A)-Feld und ein Hocheffizienz-Signal B(HE-SIG-B)-Feld umfasst,

wobei das HE-SIG-A-Feld ein SIG-B-Kompressions-Teilfeld, ein Uplink/Downlink-Teilfeld und ein Feld für die Anzahl von HE-SIG-B-Symbolen umfasst und

wobei das Feld für die Anzahl von HE-SIG-B-Symbolen eine Anzahl von MU-MIMO-Benutzern oder eine Anzahl von Symbolen in dem HE-SIG-B-Feld gemäß einem Wert des SIG-B-Kompressions-Teilfelds angibt; und

Dekodieren der empfangenen HE MU PPDU auf Grundlage von von dem HE-SIG-A erlangter Information,

wobei ein in dem HE-SIG-B-Feld enthaltenes benutzerspezifisches Feld aus einem Benutzerfeld für MU-MIMO-Zuweisung oder Nicht-MU-MIMO-Zuweisung besteht, je nachdem, ob das Feld für die Anzahl von HE-SIG-B-Symbolen die Anzahl von MU-MIMO-Benutzern oder die Anzahl von Symbolen in dem HE-SIG-B-Feld angibt.

10. Drahtloskommunikationsverfahren nach Anspruch 9,

wobei eine Konfiguration des benutzerspezifischen Felds des HE-SIG-B-Felds auf Grundlage der Anzahl von MU-MIMO-Benutzern identifiziert wird, die durch das Feld für die Anzahl der HESIG-B-Symbole angegeben wird, wenn das SIG-B-Kompressions-Teilfeld des HE-SIG-A-Felds MU-MIMO-Übertragung mit voller Bandbreite angibt.

11. Drahtloskommunikationsverfahren nach Anspruch 10,

wobei das benutzerspezifische Feld des HE-SIG-B-Felds eine Mehrzahl von Benutzerfeldern für MU-MIMO-Zuweisung umfasst, wenn die durch das Feld für die Anzahl von HE-SIG-B-Symbolen angegebene Anzahl von MU-MIMO-Benutzern zwei oder mehr Benutzer beträgt, und

wobei das benutzerspezifische Feld des HE-SIG-B-Felds ein Benutzerfeld für Nicht-MU-MIMO-Zuweisung umfasst, wenn die durch das Feld für die Anzahl von HE-SIG-B-Symbolen angegebene Anzahl von MU-MIMO-Benutzern ein einziger Benutzer ist.

12. Drahtloskommunikationsverfahren nach Anspruch 11,

wobei jedes der Mehrzahl von Benutzerfeldern für die MU-MIMO-Zuweisung ein Feld für räumliche Konfiguration umfasst, das die Gesamtanzahl von räumlichen Strömen in der MU-MIMO-Zuweisung und die Anzahl von räumlichen Strömen für jedes Endgerät in der MU-MIMO-Zuweisung angibt, und

wobei das eine Benutzerfeld für die Nicht-MU-MIMO-Zuweisung ein Feld für die Anzahl von Raum-Zeit-Strömen (NSTS) umfasst

13. Drahtloskommunikationsverfahren nach Anspruch 11,

wobei das eine Benutzerfeld für die Nicht-MU-MIMO-Zuweisung ein Benutzerfeld auf Grundlage einer Zuweisung mit orthogonalem Frequenzmultiplexverfahren (OFDMA) ist.

14. Drahtloskommunikationsverfahren nach Anspruch 9,

wobei das Downlink/Uplink-Teilfeld angibt, ob die PPDU auf einem Uplink oder auf einem Downlink übertragen wird, und

wobei mindestens ein in dem HE-SIG-A-Feld der PPDU enthaltenes Teilfeld unterschiedliche Informationen angibt, je nachdem, ob das Downlink/Uplink-Teilfeld eine Uplink-Übertragung oder eine Downlink-Übertragung angibt.

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Annex to EPO Form 2004, Communication pursuant to Rule 71(3) EPC

Bibliographical data of European patent application No. 18 736 375.9

For the intended grant of the European patent, the bibliographical data are set out below, for information:

Title of invention:	- DRAHTLOSKOMMUNIKATIONSVERFAHREN UND DRAHTLOSKOMMUNIKATIONSENDGERÄT ZUR SIGNALISIERUNG VON MEHRBENUTZERPAKETEN - WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET - PROCÉDÉ DE COMMUNICATION SANS FIL ET TERMINAL DE COMMUNICATION SANS FIL POUR SIGNALISATION DE PAQUETS MULTI-UTILISATEURS
Classification:	INV. H04B7/0452 H04L27/26
Date of filing:	09.01.2018
Priority claimed:	KR / 09.01.2017 / KRA20170003147 KR / 18.01.2017 / KRA20170008927
Contracting States* for which fees have been paid:	AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Extension States* for which fees have been paid:	
Validation States* for which fees have been paid:	
Applicant(s):**	Wilus Institute of Standards and Technology Inc. 5F, 216 Hwangsaeul-ro Bundang-gu Seongnam-si, Gyeonggi-do 13595 KR SK Telecom Co., Ltd 65 Eulji-ro Jung-gu Seoul 04539 KR
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*) If the time limit for the payment of designation fees according to Rule 39(1) EPC has not yet expired and the applicant has not withdrawn any designation, **all Contracting States/Extension States/Validation States** are currently still deemed to be designated. See also Rule 71a(3) EPC and, if applicable, the above Note to users of the automatic debiting procedure.

**) If two or more applicants have designated different Contracting States, this is indicated here.

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Application No.	Ref.	Date
18 736 375.9 - 1215	M24159.0	04.07.2022
Applicant: Wilus Institute of Standards and Technology Inc., et al		

Communication under Rule 71(3) EPC

1. Intention to grant

You are informed that the examining division intends to grant a European patent on the basis of the above application, with the text and drawings and the related bibliographic data as indicated below.

A copy of the relevant documents is enclosed.

1.1 In the text for the Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Description, Pages

1, 2, 6-59	filed with entry into the regional phase before the EPO			
3, 3a, 60	received on	01-03-2021	with letter of	01-03-2021

Claims, Numbers

1-14	filed in electronic form on	20-09-2021

Drawings, Sheets

1/12-12/12	filed with entry into the regional phase before the EPO

With the following amendments to the above-mentioned documents proposed by the division

Description, Pages	3a, 6-10, 13-15, 19-22, 25-29, 31-58, 60
	Delete Previous: 4, 5

Registered letter
EPO Form 2004C 07.20CXP

Comments

DESCRIPTION
Page 3(a): Mention of relevant prior art in the description (Rule 42(1) EPC)
Pages 3(a), 6-10, 13-15, 19-22, 25-29, 31-58: Description adapted to amended claims (Art. 84 EPC)
Pages 4, 5: (PAGE DELETED) - Description adapted to amended claims (Art. 84 EPC)
Page 9: Deletion of 'incorporated herein by reference' (Guidelines F-III, 8)
Page 60: General statement deleted (Guidelines F-IV 4.4)

1.2 Bibliographic data

The title of the invention in the three official languages of the European Patent Office, the international patent classification, the designated contracting states, the registered name(s) of the applicant(s) and the other bibliographic data are shown on **EPO Form 2056** (enclosed).

2. Invitation

You are invited, **within a non-extendable period of four months** of notification of this communication,

2.1 to EITHER approve the text communicated above and verify the bibliographic data (Rule 71(5) EPC)

(1) by filing a translation of the claim(s) in the other two official languages of the EPO

		Fee code	EUR
(2a)	by paying the fee for grant including the fee for publication:	**007**	990.00
	minus any amount already paid (Rule 71a(5) EPC):		0.00
		Total amount:	990.00
(3)	by paying additional claims fees under Rule 71(4) EPC; number of claims fees payable: 0	**016**	0.00
	minus any amount already paid (Rule 71a(5) EPC):		0.00
		Total amount:	0.00

Important: If the translations of the claims and fees have already been filed and paid respectively in reply to a previous communication under Rule 71(3) EPC, e.g. in the case of resumption of examination after approval (see Guidelines C-V, 6), **agreement as to the text to be granted** (Rule 71a(1) EPC) must be expressed within the same time limit (e.g. by approving the text and verifying the bibliographic data, by confirming that grant proceedings can go ahead with the documents on file and/or by stating which translations of the claims already on file are to be used).

Note 1: See "Notes concerning fee payments" below.
Note 2: Any overpaid "minus" amounts will be refunded when the decision to grant (EPO Form 2006A) has been issued.
Note 3: For the calculation of the grant fee under Article 2(2), No. 7, RFees (old fee structure), the number of pages is determined on the basis of a clean copy of the application documents, in which text deleted as a result of any amendments by the examining division is not shown. Such clean copy is made available via on-line file inspection only.

2.2 OR, in the case of disapproval, to request reasoned amendments or corrections to the text communicated above or keep to the latest text submitted by you (Rule 71(6) EPC).

In this case the translations of the claims and fee payments mentioned under point 2.1 above are NOT due.

The terms "amendment(s)" and "correction(s)" refer only to amendments or corrections of the application documents and not of other documents (e.g. bibliographic data, the designation of the inventor, etc.).

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 (Rule 137(4) EPC).

2.3 Bibliographic data

Where you request a change or correction of bibliographic data in response to the Rule 71(3) communication, this will **not** cause the sending of a further communication under Rule 71(3) EPC. You will still have to pay the fees and file translations in reply to the Rule 71(3) communication in the case of 2.1 above, unless you also file a reasoned request for amendments or corrections in response to the Rule 71(3) communication (see case 2.2 above).

3. Loss of rights

If neither of the two possible actions above (see points 2.1 or 2.2) is performed in due time, the European patent application will be deemed to be withdrawn (Rule 71(7) EPC).

4. Further procedure

4.1 In the case of point 2.1 above

4.1.1 The decision to grant the European patent will be issued, and the **mention of the grant** of the patent will be published in the European Patent Bulletin, if the requirements concerning the translation of the claims and the payment of all fees are fulfilled and there is agreement as to the text to be granted (Rule 71a(1) EPC).

Note on payment of the renewal fee:
If a renewal fee becomes due before the next possible date for publication of the mention of the grant of the European patent, publication will be effected only after the renewal fee and any additional fee have been paid (Rule 71a(4) EPC).

Under Article 86(2) EPC, the obligation to pay renewal fees to the European Patent Office terminates with the payment of the renewal fee due in respect of the year in which the mention of the grant of the European patent is published.

Note on payment of the designation fee(s):
If the designation fee(s) become(s) due after the communication under Rule 71(3) EPC, the mention of the grant of the European patent will not be published until these fees have been paid (Rule 71a(3) EPC).

4.1.2 After publication, the **European patent specification** can be downloaded free of charge from the EPO publication server https://data.epo.org/publication-server.

4.1.3 Filing of translations in the contracting states

As regards translation requirements prescribed by the contracting states under Article 65(1) EPC, please consult the website of the European Patent Office
www.epo.org ➞Law & practice ➞Legal texts, National law relating to the EPC
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In the case of a valid extension or validation

As regards translation requirements prescribed by the extension or validation states, please consult the website of the European Patent Office
www.epo.org ➞Law & practice ➞Legal texts, National law relating to the EPC

Failure to supply a prescribed translation in a contracting state, or in an extension or validation state may result in the patent being deemed to be void *ab initio* in the state concerned (Art. 65(3) EPC).

4.2 In the case of 2.2 above

If the present communication under Rule 71(3) EPC is based on an auxiliary request and, within the time limit, you maintain the main request or a higher ranking request which is not allowable, the application will be refused (Art. 97(2) EPC).

If the examining division gives its consent to the requested amendments or corrections, it will issue a new communication under Rule 71(3) EPC; otherwise, it shall resume the examination proceedings (Rule 71(6) EPC).

5. Filing of a divisional application

Any divisional application relating to this European patent application must be filed directly with the European Patent Office in Munich, The Hague or Berlin and will be in the language of the proceedings for the present application, or if the latter was not in an official language of the EPO, the divisional application may be filed in the language of the present application as filed (see Article 76(1) and Rule 36(2) EPC). Any such divisional application must be filed while the present application is still pending (Rule 36(1) EPC; Guidelines A-IV, 1.1.1).

6. Notes concerning fee payments

6.1 Making payments

For payments made via deposit account, please note that as from 1 December 2017 debit orders will only be carried out if filed in an electronically processable format (xml), using an accepted means of filing as laid down in the Arrangements for deposit accounts (ADA), published in the Supplementary publication in the Official Journal.

All relevant information related to the modes of payment of fees to the EPO can be retrieved from the EPO website at "**Making Payments**".

6.2 Information concerning fee amounts

Procedural fees are usually adjusted every two years, on even years, with effect from 1 April. Therefore, before making a payment, parties should verify the amounts actually due on the date of payment using the applicable version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, available on the EPO website (**www.epo.org**) at **www.epo.org/schedule-of-fees**. The "Schedule of fees" table allows the viewing, downloading and searching of individual fee amounts, both current and previous.

6.3 Note to users of the automatic debiting procedure

The fee for grant, including the fee for publication, and any additional claims fees due under Rule 71(4) EPC will be debited automatically on the date of filing of the translations of the claims, or on the last day of the period of this communication. However, if the designation fee(s) become(s) due as set out in Rule 71a(3) EPC and/or a renewal fee becomes due as set out in Rule 71a(4) EPC, these should be paid separately by another permitted way of payment in order not to delay the publication of the mention of the grant. The same applies in these circumstances to the payment of extension and validation fees. The same applies in these circumstances to the payment of extension and validation fees.

Examining Division:

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Enclosures: Text intended for grant

EPO Form 2056

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Application No.: EP18736375

Intention to grant a European patent

Electronically authenticated

04.07.2022

Date

Krzysztof Tyszka	Francisco Brezmes Alonso	Federico Iavarone
Chairperson	1st examiner	2nd examiner

M24159.0

[DESCRIPTION]

[Invention Title]

WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET

[Technical Field]

The present invention relates to a wireless communication method and a wireless communication terminal for signaling a multi-user packet.

[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.

"High Efficiency (HE) PHY specification", IEEE DRAFT; TGAX_CL_26, IEEE-SA, PISCATAWAY, NJ USA, vol. 802.11ax drafts, no D0.5 1 October 2016 (2016-10-01), pages 1-207 discloses in section 26.3.3.7.4 that an AP that transmits an HE MU PPDU shall set the UL/DL field in the HE-SIG-A field to 0. A fully bandwidth MU MIMO transmission using HE MU PPDU format has a value of 1 for the SIGB Compression field in HE-SIG-A and the SIGB Common field is not present. If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and

the number of STAs on each RU for SU/MU-MIMO transmission. The number of users in RU r for MU-MIMO transmission is indicated together with the RU allocation as defined in RU allocation signaling.

Documents WO 2016/087917 A1, US 2016/330300 A1 and KR 2016 0063282 A disclose other examples of the prior art.

[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.

[Technical Solution]

Embodiments of the invention include a wireless communication terminal in accordance with claim 1 and a wireless communication method of a wireless communication terminal in accordance with claim 9. Further embodiments are given in the dependent claims.

[Advantageous Effects]

A header field of a physical layer of a wireless LAN packet supporting simultaneous multi-user transmission in an indoor/outdoor environment can be efficiently configured.

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.

FIG. 2 illustrates another wireless LAN system.

FIG. 3 illustrates a configuration of a station.

FIG. 4 illustrates a configuration of an access point.

FIG. 5 schematically illustrates a process in which a STA and an AP set a link.

FIG. 6 illustrates a carrier sense multiple access (CSMA)/collision avoidance (CA) method used in wireless LAN communication.

FIG. 7 illustrates a method for performing a distributed coordination function (DCF) using a request to send (RTS) frame and a clear to send (CTS) frame.

FIGS. 8 and 9 illustrate multi-user transmission methods.

FIG. 10 illustrates an embodiment of a legacy PPDU format and a non-legacy PPDU format.

FIG. 11 illustrates various HE PPDU formats and an indication method thereof.

FIG. 12 illustrates an embodiment of a configuration of an HE-SIG-A field according to the HE PPDU format.

FIG. 13 illustrates a configuration of an HE-SIG-B field.

FIGS. 14 to 15 illustrate specific embodiments in which a single STA transmits an UL MU PPDU to an AP.

FIG. 16 illustrates an encoding structure and a transmission method of the HE-SIG-B.

FIG. 17 illustrates a non-contiguous channel allocation method.

FIG. 18 illustrates a wideband access method.

FIG. 19 illustrates an embodiment of a method of exchanging and signaling BQRP and BQR for transmitting a non-contiguous PPDU.

FIG. 20 illustrates another embodiment of a method of transmitting and signaling BQR for transmitting a non-contiguous PPDU.

FIG. 21 illustrates a configuration of a BQR.

[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. 10-2017-0003147 and 10-2017-0008927 filed in the Korean Intellectual Property Office.

FIG. 1 is a diagram illustrating a wireless LAN system.

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.

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, 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, 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. As illustrated in FIG. 4, the AP 200 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 includes the communication unit 220 for operating the BSS in at least one frequency band. As described in 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 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. 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. 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. 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.

A detailed example 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.

FIG. 6 is a diagram illustrating a carrier sense multiple access (CSMA)/collision avoidance (CA) method used in wireless LAN communication.

A terminal that performs a wireless LAN communication checks whether a channel is busy by performing carrier sensing before transmitting data. When a wireless signal having a predetermined strength or more is sensed, it is determined that the corresponding channel is busy and the terminal delays the access to the corresponding channel. Such a process is referred to as clear channel assessment (CCA) and a level to decide whether the corresponding signal is sensed is referred to as a CCA threshold. When a wireless signal having the CCA threshold or more, which is received by the terminal, indicates the corresponding terminal as a receiver, the terminal processes the received wireless signal. Meanwhile, when a wireless signal is not sensed in the corresponding channel or a wireless signal having a strength smaller than the CCA threshold is sensed, it is determined that the channel is idle.

When it is determined that the channel is idle, each terminal having data to be transmitted performs a backoff procedure after an inter frame space (IFS) time depending on a situation of each terminal, for instance, an arbitration IFS (AIFS), a PCF IFS (PIFS), or the like elapses. According to the embodiment, the AIFS may be used as a component which substitutes for the existing DCF IFS (DIFS). Each terminal stands by while decreasing slot time(s) as long as a random number determined by the corresponding terminal during an interval of an idle state of the channel and a terminal that completely exhausts the slot time(s) attempts to access the corresponding channel. As such, an interval in which each terminal performs the backoff procedure is referred to as a contention window interval.

When a specific terminal successfully accesses the channel, the corresponding

terminal may transmit data through the channel. However, when the terminal which attempts the access collides with another terminal, the terminals which collide with each other are assigned with new random numbers, respectively to perform the backoff procedure again. According to an embodiment, a random number newly assigned to each terminal may be decided within a range (2*CW) which is twice larger than a range (a contention window, CW) of a random number which the corresponding terminal is previously assigned. Meanwhile, each terminal attempts the access by performing the backoff procedure again in a next contention window interval and in this case, each terminal performs the backoff procedure from slot time(s) which remained in the previous contention window interval. By such a method, the respective terminals that perform the wireless LAN communication may avoid a mutual collision for a specific channel.

FIG. 7 is a diagram illustrating a method for performing a distributed coordination function using a request to send (RTS) frame and a clear to send (CTS) frame.

The AP and STAs in the BSS contend in order to obtain an authority for transmitting data. When data transmission at the previous step is completed, each terminal having data to be transmitted performs a backoff procedure while decreasing a backoff counter (alternatively, a backoff timer) of a random number assigned to each terminal after an AFIS time. A transmitting terminal in which the backoff counter expires transmits the request to send (RTS) frame to notify that corresponding terminal has data to transmit. According to an exemplary embodiment of FIG. 7, STA1 which holds a lead in contention with minimum backoff may transmit the RTS frame after the backoff counter expires. The RTS frame includes information on a receiver address, a transmitter address, and duration. A receiving terminal (i.e., the AP in FIG. 7) that

receives the RTS frame transmits the clear to send (CTS) frame after waiting for a short IFS (SIFS) time to notify that the data transmission is available to the transmitting terminal STA1. The CTS frame includes the information on a receiver address and duration. In this case, the receiver address of the CTS frame may be set identically to a transmitter address of the RTS frame corresponding thereto, that is, an address of the transmitting terminal STA1.

The transmitting terminal STA1 that receives the CTS frame transmits the data after a SIFS time. When the data transmission is completed, the receiving terminal AP transmits an acknowledgment (ACK) frame after a SIFS time to notify that the data transmission is completed. When the transmitting terminal receives the ACK frame within a predetermined time, the transmitting terminal regards that the data transmission is successful. However, when the transmitting terminal does not receive the ACK frame within the predetermined time, the transmitting terminal regards that the data transmission is failed. Meanwhile, adjacent terminals that receive at least one of the RTS frame and the CTS frame in the course of the transmission procedure set a network allocation vector (NAV) and do not perform data transmission until the set NAV is terminated. In this case, the NAV of each terminal may be set based on a duration field of the received RTS frame or CTS frame.

In the course of the aforementioned data transmission procedure, when the RTS frame or CTS frame of the terminals is not normally transferred to a target terminal (i.e., a terminal of the receiver address) due to a situation such as interference or a collision, a subsequent process is suspended. The transmitting terminal STA1 that transmitted the RTS frame regards that the data transmission is unavailable and participates in a next contention by being assigned with a new random number. In this case, the newly assigned random number may be determined within a range (2*CW)

twice larger than a previous predetermined random number range (a contention window, CW).

Basic sequence of UL-MU/DL-MU transmission

FIGS. 8 and 9 illustrate multi-user transmission methods.

When using orthogonal frequency division multiple access (OFDMA) or multi-input multi-output (MIMO), one wireless communication terminal can simultaneously transmit data to a plurality of wireless communication terminals. Further, one wireless communication terminal can simultaneously receive data from a plurality of wireless communication terminals. For example, a downlink multi-user (DL-MU) transmission in which an AP simultaneously transmits data to a plurality of STAs, and an uplink multi-user (UL-MU) transmission in which a plurality of STAs simultaneously transmit data to the AP may be performed.

FIG. 8 illustrates a UL-MU transmission process.

In order to perform the UL-MU transmission, the channel to be used and the transmission start time of each STA that performs uplink transmission should be adjusted. In order to efficiently schedule the UL-MU transmission, state information of each STA needs to be transmitted to the AP. Information for scheduling of a UL-MU transmission may be indicated through a predetermined field of a preamble of a packet and/or a predetermined field of a MAC header. For example, a STA may indicate information for UL-MU transmission scheduling through a predetermined field of a preamble or a MAC header of an uplink transmission packet, and may transmit the information to an AP. In this case, the information for UL-MU transmission scheduling includes at least one of buffer status information of each STA, and channel state information measured by each STA. The buffer status information of the STA may

indicate at least one of whether the STA has uplink data to be transmitted, the access category (AC) of the uplink data and the size (or the transmission time) of the uplink data.

The UL-MU transmission process may be managed by the AP. The UL-MU transmission may be performed in response to a trigger frame transmitted by the AP. The STAs simultaneously transmit uplink data a predetermined IFS (e.g., SIFS) time after receiving the trigger frame. The trigger frame solicits UL-MU transmission of STAs and may inform channel (or subchannel) information allocated to the uplink STAs. Upon receiving the trigger frame from the AP, a plurality of STAs transmit uplink data through each allocated channel (or, subchannel) in response thereto. After the uplink data transmission is completed, the AP transmits an ACK to the STAs that have successfully transmitted the uplink data. In this case, the AP may transmit a predetermined multi-STA block ACK (M-BA) as an ACK for a plurality of STAs.

In the non-legacy wireless LAN system, subcarriers of a specific number, for example, 26, 52, or 106 tones may be used as a resource unit (RU) for a subchannel-based access in a channel of 20 MHz band. Accordingly, the trigger frame may indicate identification information of each STA participating in the UL-MU transmission and information of the allocated resource unit. The identification information of the STA includes at least one of an association ID (AID), a partial AID, and a MAC address of the STA. Further, the information of the resource unit includes the size and placement information of the resource unit.

On the other hand, in the non-legacy wireless LAN system, a UL-MU transmission may be performed based on a contention of a plurality of STAs for a specific resource unit. For example, if an AID field value for a specific resource unit is

set to a specific value (e.g., 0) that is not assigned to STAs, a plurality of STAs may attempt random access (RA) for the corresponding resource unit.

FIG. 9 illustrates a DL-MU transmission process. RTS and/or CTS frames of a predetermined format may be used for NAV setting in the DL-MU transmission process. First, the AP transmits a multi-user RTS (MU-RTS) frame for NAV setting in the DL-MU transmission process. The duration field of the MU-RTS frame is set to a time until the end of the DL-MU transmission session. That is, the duration field of the MU-RTS frame is set based on a period until the downlink data transmission of the AP and ACK frame transmissions of the STAs are completed. The neighboring terminals of the AP set a NAV until the end of the DL-MU transmission session based on the duration field of the MU-RTS frame transmitted by the AP. The MU-RTS frame may be configured in the format of a trigger frame and requests simultaneous CTS (sCTS) frame transmissions of the STAs.

STAs (e.g., STA1 and STA2) receiving the MU-RTS frame from the AP transmit the sCTS frame. The sCTS frames transmitted by a plurality of STAs have the same waveform. That is, the sCTS frame transmitted by the STA1 on the first channel has the same waveform as the sCTS frame transmitted by the STA2 on the first channel. According to an embodiment, the sCTS frame is transmitted on the channel indicated by the MU-RTS frame. The duration field of the sCTS frame is set to a time until the DL-MU transmission session is terminated based on the information of the duration field of the MU-RTS frame. That is, the duration field of the sCTS frame is set based on the period until the downlink data transmission of the AP and the ACK frame transmissions of the STAs are completed. In FIG. 9, neighboring terminals of STA1 and STA2 set a NAV until the end of the DL-MU transmission session based on the duration field of the

sCTS frame.

The MU-RTS frame and the sCTS frame may be transmitted on a 20 MHz channel basis. Accordingly, the neighboring terminals including legacy terminals can set the NAV by receiving the MU-RTS frame and/or the sCTS frame. When the transmission of the MU-RTS frame and the sCTS frame is completed, the AP performs a downlink transmission. FIG. 9 illustrates that the AP transmits DL-MU data to STA1 and STA2, respectively. The STAs receive the downlink data transmitted by the AP and transmit an uplink ACK in response thereto.

PPDU format

FIG. 10 illustrates a legacy PHY Protocol Data Unit (PPDU) format and a non-legacy PPDU format. More specifically, FIG. 10(a) illustrates a legacy PPDU format based on 802.11a/g, and FIG. 10(b) illustrates a non-legacy PPDU based on 802.11ax. In addition, FIG. 10(c) illustrates the detailed field configuration of L-SIG and RL-SIG commonly used in the PPDU formats.

Referring to FIG. 10(a), the preamble of the legacy PPDU includes a legacy short training field (L-STF), a legacy long training field (L-LTF), and a legacy signal field (L-SIG). The L-STF, L-LTF and L-SIG may be referred to as a legacy preamble. Referring to FIG. 10(b), the preamble of the HE PPDU includes a repeated legacy short training field (RL-SIG), a high efficiency signal A field (HE-SIG-A), a high efficiency signal B field, a high efficiency short training field (HE-STF), and a high efficiency long training field (HE-LTF) in addition to the legacy preamble. The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF and HE-LTF may be referred to as a non-legacy preamble.

The detailed configuration of the non-legacy preamble may be modified according to the HE PPDU format. For example, HE-SIG-B may only be used in some formats among the HE PPDU formats.

A 64 FFT OFDM is applied to the L-SIG included in the preamble of the PPDU and the L-SIG consists of 64 subcarriers in total. Among these, 48 subcarriers excluding guard subcarriers, a DC subcarrier and pilot subcarriers are used for data transmission of the L-SIG. If a modulation and coding scheme (MCS) of BPSK, Rate = 1/2 is applied, the L-SIG may include information of a total of 24 bits. FIG. 10(c) illustrates a configuration of 24-bit information of the L-SIG.

Referring to FIG. 10(c), the L-SIG includes an L_RATE field and an L_LENGTH field. The L_RATE field consists of 4 bits and represents the MCS used for data transmission. More specifically, the L_RATE field represents one of the transmission rates of 6/9/12/18/24/24/36/48/54Mbps by combining the modulation scheme such as BPSK/QPSK/16-QAM/64-QAM with the code rate such as 1/2, 2/3, 3/4. When combining the information of the L_RATE field and the L_LENGTH field, the total length of the corresponding PPDU can be represented. The non-legacy PPDU sets the L_RATE field to a 6 Mbps which is the minimum rate.

The L_LENGTH field consists of 12 bits, and may represent the length of the corresponding PPDU by a combination with the L_RATE field. In this case, the legacy terminal and the non-legacy terminal may interpret the L_LENGTH field in different ways.

First, a method of interpreting the length of a PPDU using a L_LENGTH field by a legacy terminal or a non-legacy terminal is as follows. When the L_RATE field is set to 6 Mbps, 3 bytes (i.e., 24 bits) can be transmitted for 4 us, which is one symbol duration of 64 FFT. Therefore, by adding 3 bytes corresponding to the SVC field and

the Tail field to the value of the L_LENGTH field and dividing it by 3 bytes, which is the transmission amount of one symbol, the number of symbols after the L-SIG is obtained on the 64FFT basis. The length of the corresponding PPDU, that is, the reception time (i.e., RXTIME) is obtained by multiplying the obtained number of symbols by 4us, which is one symbol duration, and then adding a 20us which is for transmitting L-STF, L-LTF and L-SIG. This can be expressed by the following Equation 1.

[Equation 1]

$$\mathbf{PPDU\_LENGTH(us)} = \left(\mathbf{1} + \left\lceil \frac{\mathbf{L\_LENGTH}}{\mathbf{3}} \right\rceil\right) \times \mathbf{4} + \mathbf{20}$$

In this case, $\lceil x \rceil$ denotes the smallest natural number greater than or equal to x. Since the maximum value of the L_LENGTH field is 4095, the length of the PPDU can be set up to 5.464ms. The non-legacy terminal transmitting the PPDU should set the L_LENGTH field as shown in Equation 2 below.

[Equation 2]

$$\mathbf{RXTIME(us)} = \left(\left\lceil \frac{\mathbf{L\_LENGTH+3}}{\mathbf{3}} \right\rceil\right) \times \mathbf{4} + \mathbf{20}$$

Herein, TXTIME is the total transmission time constituting the corresponding PPDU, and is expressed by Equation 3 below. In this case, TX represents the transmission time of X.

[Equation 3]

$$\mathbf{L\_LENGTH(byte)} = \left(\left\lceil \frac{\mathbf{TXTIME-20}}{\mathbf{4}} \right\rceil\right) \times \mathbf{3} - \mathbf{3}$$

With reference to the above equations, the length of the PPDU is calculated based on the round-up value of L_LENGTH/3. Therefore, for any value of k, three

different values of L_LENGTH = {3k+1, 3k+2, 3(k+1)} indicate the same PPDU length. According to an embodiment of the present invention, the non-legacy terminal may perform additional signaling using three different L_LENGTH values indicating the same PPDU length information. More specifically, values corresponding to 3k+1 and 3k+2 among the three different L_LENGTH values may be used to indicate the HE PPDU format.

FIG. 11 illustrates various HE PPDU formats and an indication method thereof. The

HE PPDU format may be indicated based on

the L_LENGTH field and HE-SIG-A of the corresponding PPDU. More specifically, the HE PPDU format is indicated based on at least one of the value of the L_LENGTH field and the modulation scheme applied to the HE-SIG-A symbol.

First, referring to FIG. 11(a), when the value of the L_LENGTH field is 3k+1 (i.e., when mod3 = 1), the corresponding PPDU is an HE SU PPDU or an HE Trigger-based PPDU. The HE SU PPDU is a PPDU used for a single-user transmission between an AP and a single STA. Furthermore, the HE Trigger-based PPDU is an uplink PPDU used for a transmission that is a response to a trigger frame. HE SU PPDU and HE Trigger-based PPDU have the same preamble format. In the cases of the HE SU PPDU and the HE Trigger-based PPDU, two symbols of HE-SIG-A are modulated with BPSK and BPSK, respectively.

According to FIG.

11(b), when the value of the L_LENGTH field is 3k+1 and the two symbols of HE-SIG-A are modulated with BPSK and QBPSK, respectively, the corresponding PPDU is an extended PPDU. The extended PPDU is used as a new PPDU format other than the PPDU formats supported by 802.11ax.

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Next, when the value of the L_LENGTH field is 3k+2 (i.e., when mod3 = 2), the corresponding PPDU is an HE MU PPDU or an HE Extended Range (ER) SU PPDU. The HE MU PPDU is a PPDU used for a transmission to one or more terminals. The HE MU PPDU format is illustrate in FIG. 11(c) and additionally includes HE-SIG-B in the non-legacy preamble. In the case of the HE MU PPDU, the two symbols of HE-SIG-A are modulated with BPSK and BPSK, respectively. On the other hand, HE ER SU PPDU is used for a single-user transmission with a terminal in an extended range. The HE ER SU PPDU format is illustrated in FIG. 11(d), where HE-SIG-A of the non-legacy preamble is repeated on the time axis. In the case of the HE ER SU PPDU, the first two symbols of HE-SIG-A are modulated with BPSK and QBPSK, respectively. Thus, the non-legacy terminal can signal the PPDU format through the modulation scheme used for the two symbols of HE-SIG-A in addition to the value of the L_LENGTH field.

The HE MU PPDU illustrated in FIG. 11(c) may be used by an AP to perform a downlink transmission to a plurality of STAs. In this case, the HE MU PPDU may include scheduling information for a plurality of STAs to simultaneously receive the corresponding PPDU. In addition, the HE MU PPDU may be used by a single STA to perform an uplink transmission to the AP. In this case, the HE MU PPDU may transmit AID information of the receiver and/or the transmitter of the corresponding PPDU through a user specific field of the HE-SIG-B. Therefore, terminals receiving the HE MU PPDU may perform a spatial reuse operation based on the AID information obtained from the preamble of the corresponding PPDU. In addition, data transmission through some narrowband may be performed using the HE MU PPDU. Here, the narrowband may be a frequency band of less than 20 MHz. The HE MU PPDU may indicate allocation information of resource unit(s)

to be used for a narrowband transmission through the HE-SIG-B.

More specifically, the resource unit allocation (RA) field of HE-SIG-B contains information on the resource unit partition type in a specific bandwidth (e.g., 20 MHz) of the frequency domain. Further, information of a STA assigned to each partitioned resource unit may be transmitted through the user specific field of the HE-SIG-B. The user specific field includes one or more user fields corresponding to each partitioned resource unit.

When a narrowband transmission using a part of the partitioned resource units is performed, the resource unit used for the transmission may be indicated through the user specific field of the HE-SIG-B. An AID of a receiver or a transmitter may be contained in a user field corresponding to resource unit(s) on which data transmission is performed among a plurality of partitioned resource units. In addition, a predetermined Null STA ID may be contained in user field(s) corresponding to the remaining resource unit(s) in which data transmission is not performed. The narrowband transmission may be signaled through a first user field corresponding to a resource unit in which data transmission is not performed and a second user field corresponding to a resource unit in which data transmission is performed. More specifically, a predetermined null STA ID may be contained in the first user field, and the placement information of the resource unit(s) on which data transmission is performed may be indicated through the remaining subfields of the corresponding user field. Next, the AID of the receiver or transmitter may be contained in the second user field. Thus, the terminal may signal the narrowband transmission through the location information contained in the first user field and the AID information contained in the second user field. In this case, since user fields less than the number of partitioned resource units are

used, the signaling overhead can be reduced.

Configuration of HE-SIG-A field and HE-SIG-B field in an HE PPDU

FIG. 12 illustrates a configuration of an HE-SIG-A field according to the HE PPDU format. HE-SIG-A consists of two symbols of 64 FFT, and indicates common information for reception of the HE PPDU. The first symbol of the HE-SIG-A is modulated with BPSK, and the second symbol of the HE-SIG-A is modulated with BPSK or QBPSK. In the HE ER SU PPDU, two symbols of the HE-SIG-A may be repeatedly transmitted. That is, the HE-SIG-A of the HE ER SU PPDU consists of four symbols, the first symbol and the second symbol of which have the same data bit, and the third symbol and the fourth symbol of which have the same data bit.

First, FIG. 12(a) illustrates a subfield configuration of the HE-SIG-A field of the HE SU PPDU. According to an embodiment, the HE-SIG-A field of the HE ER SU PPDU may be configured similarly. The function of each field included in HE-SIG-A will be described as follows.

The UL/DL field indicates a transmission direction of the corresponding PPDU. That is, the corresponding field indicates whether the corresponding PPDU is transmitted with uplink or is transmitted with downlink. The format field is used to differentiate an HE SU PPDU from an HE Trigger-based PPDU. The BSS color field consists of 6 bits and indicates an identifier of the BSS corresponding to a terminal that transmitted the corresponding PPDU. The spatial reuse field carries information such as signal to interference plus noise ratio (SINR), transmission power, etc., which can be referred to by terminals to perform spatial reuse transmission during the transmission of the corresponding PPDU.

The TXOP duration field indicates duration information for TXOP protection

and NAV setting. The corresponding field sets the duration of the TXOP interval in which consecutive transmission is to be performed after the corresponding PPDU, so that the neighboring terminals set a NAV for the corresponding duration. The bandwidth field indicates the total bandwidth in which the corresponding PPDU is transmitted. The bandwidth field may consist of 2 bits and indicate one of 20 MHz, 40 MHz, 80 MH and 160 MHz (including 80+80 MHz). The MCS field indicates an MCS value applied to the data field of the corresponding PPDU. The CP+LTF size field indicates the duration of the cyclic prefix (CP) or guard interval (GI) and the size of the HE-LTF. More specifically, the corresponding field indicates the combination of the HE-LTF size used among 1x, 2x, and 4x HE-LTF, and the CP (or GI) value used in the data field among 0.8us, 1.6us, and 3.2us.

The coding field may indicate which coding scheme is used between binary convolutional code (BCC) and low density parity check (LDPC). In addition, the corresponding field may indicate whether an extra OFDM symbol for LDPC is present. The number of space time streams (NSTS) field indicates the number of space-time streams used for MIMO transmission. The space time block coding (STBC) field indicates whether space-time block coding is used. The transmit beamforming (TxBF) field indicates whether beamforming is applied to the transmission of the corresponding PPDU. The dual carrier modulation (DCM) field indicates whether dual carrier modulation is applied to the data field. The dual carrier modulation transmits the same information through two subcarriers in order to cope with narrowband interference. The packet extension field indicates which level of packet extension is applied to the PPDU. The beam change field indicates whether the part before the HE-STF of the corresponding PPDU is mapped spatially different from the HE-LTF. The CRC field and the tail field are used to determine the authenticity of the HE-SIG-A field

information and to initialize the BCC decoder, respectively.

Next, FIG. 12(b) illustrates a subfield configuration of the HE-SIG-A field of the HE MU PPDU. Among the subfields shown in FIG. 12(b), the same subfields as those shown in FIG. 12(a) will not be described.

The UL/DL field indicates the transmission direction of the corresponding PPDU. That is, the corresponding field indicates whether the corresponding PPDU is transmitted with uplink or is transmitted with downlink. The bandwidth field of the HE MU PPDU may indicate extra bandwidths in addition to the bandwidths of the HE SU PPDU. That is, the bandwidth field of the HE MU PPDU consists of 3 bits and indicates one of 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz), and predetermined non-contiguous bands. The specific embodiments of the predetermined non-contiguous bands will be described later.

The SIG-B MCS field indicates the MCS applied to the HE-SIG-B field. Depending on the amount of information that requires signaling, variable MCS between MSC0 and MSC5 can be applied to the HE-SIG-B. The CP+LTF size field indicates the duration of the CP or GI and the size of the HE-LTF. The corresponding field indicates the combination of the HE-LTF size used among 2x and 4x HE-LTF, and the CP (or GI) value used in the data field among 0.8us, 1.6us, and 3.2us.

The SIG-B compression field indicates whether to use a compression mode of the HE-SIG-B field. When the HE MU PPDU is transmitted using an MU-MIMO in the full bandwidth, the resource unit allocation information for each 20 MHz band becomes unnecessary. Therefore, in the full bandwidth MU-MIMO transmission, the SIG-B compression field indicates the compression mode of the HE-SIG-B field. In this case, the common field containing the resource unit allocation field is not present in the HE-SIG-B field. The SIG-B DCM field indicates whether the HE-SIG-B field is modulated

with the DCM for reliable transmission of the HE-SIG-B field. The number of HE-SIG-B symbols field indicates information on the number of OFDM symbols in the HE-SIG-B field.

On the other hand, when the HE MU PPDU is transmitted in a band of 40 MHz or more as described later, the HE-SIG-B may consist of two kinds of content channels in units of 20 MHz. The content channels are referred to as HE-SIG-B content channel 1 and HE-SIG-B content channel 2, respectively. The number of HE-SIG-B symbols in each channel can be kept similar by differentiating MCSs applied to the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2, respectively. The HE-SIG-A field of the HE MU PPDU may include a SIG-B dual MCS field. In this case, it is indicated through the corresponding field whether the MCSs applied to the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 are different with each other.

When the SIG-B compression field indicates the compression mode of the HE-SIG-B field (i.e., when the full bandwidth MU-MIMO transmission is indicated), a specific field of the HE-SIG-A may indicate information on the number of MU-MIMO users. For example, when the full bandwidth MU-MIMO transmission is performed, the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 do not need to distribute the amount of information through different MCSs. Therefore, when the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the SIG-B dual MCS field of the HE-SIG-A may indicate information on the number of MU-MIMO users. Likewise, when the full bandwidth MU-MIMO transmission is performed, information on the number of symbols in each HE-SIG-B content channel need not be delivered separately. Therefore, when the SIG-B compression field indicates the compression mode of the

HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the information on the number of MU-MIMO users. As described above, in the compression mode in which the resource unit allocation field of the HE-SIG-B is omitted, information on the number of MU-MIMO users may be indicated through a specific subfield of the HE-SIG-A.

According to a further embodiment of the present invention, some of the subfields of the HE-SIG-A field of the HE MU PPDU may signal information different from the above teaching through a combination of a plurality of subfields. As described above, the HE MU PPDU may not only be used by the AP to perform a downlink transmission to a plurality of STAs, but may also be used by a single STA to perform an uplink transmission to the AP. Information based on the value indicated by the UL/DL field, the specific subfield of the HE-SIG-A field of the HE MU PPDU may be set differently from each other or indicate different information.

First, the bandwidth field may indicate different information based on the value indicated by the UL/DL field. When the UL/DL field indicates downlink transmission, the bandwidth field indicates any one of 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz), and predetermined non-contiguous bands. In a 3-bit bandwidth field, values of 0 to 3 indicate 20 MHz, 40 MHz, 80 MHz, and 160 MHz (including 80+80 MHz), respectively, and any one of values 4 to 7 indicates one of the predetermined non-contiguous bands. However, a PPDU with non-contiguous bandwidth may only be used for downlink transmission. Therefore, specific values of the bandwidth field (i.e., one or more values among 4 to 7) may indicate different information between when the UL/DL field indicates downlink transmission and when it indicates uplink transmission.

For example, if the UL/DL field indicates an uplink transmission, the bandwidth field indicates any one of 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz), and a predetermined narrow bandwidths. That is, in the 3-bit bandwidth field, values of 0 to 3 indicate 20 MHz, 40 MHz, 80 MHz, and 160 MHz (including 80+80 MHz), respectively, and any one of values 4 to 7 may indicate one of the predetermined narrow bandwidths. The predetermined narrow bandwidth may include a left-106-tone and a right-106-tone. In this case, among the 242-tone constituting a 20 MHz primary channel, the left-106-tone indicates the low-frequency 106-tone resource unit, and the right-106-tone indicates the high-frequency 106-tone resource unit. However, the present invention is not limited thereto, and the predetermined narrow bandwidth may include one or more of a 26-tone resource unit, a 52-tone resource unit, a 106-tone resource unit, or a combination thereof.

As described above, data transmission through a predetermined narrowband within the 20 MHz band may be performed when the UL MU PPDU is transmitted. The allocation information of the resource unit to be used for the narrowband transmission may be indicated through the resource unit allocation field and the user specific field of the HE-SIG-B. However, in this case, the signaling overhead may be large. Thus, the uplink narrowband transmission may be indicated through the bandwidth field of the HE-SIG-A of the HE MU PPDU.

Next, the SIG-B compression field may be set differently based on the value indicated by the UL/DL field. The SIG-B compression field indicates whether to use the compression mode of the HE-SIG-B field. When the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the common field containing the resource unit allocation field is not present in the HE-SIG-B field.

The SIG-B compression field may be set according to different rules between when the UL/DL field indicates downlink transmission and when it indicates uplink transmission.

More specifically, when the UL/DL field indicates downlink transmission, the SIG-B compression field indicates whether to perform the full bandwidth MU-MIMO transmission. That is, when the full-bandwidth MU-MIMO transmission is performed, the value of the SIG-B compression field is set to 1. Otherwise, the value of the SIG-B compression field is set to 0. However, the signaling of the resource unit allocation field may be unnecessary when a UL MU PPDU is transmitted by a single STA. Therefore, when the UL/DL field indicates uplink transmission, the value of the SIG-B compression field may be always set to 1. That is, when the UL/DL field indicates uplink transmission, the SIG-B compression field may always indicate that the common field is not present in the HE-SIG-B field. Although the full bandwidth MU-MIMO transmission is not performed, the compression mode of the HE-SIG-B field may be used to reduce the signaling overhead of the HE-SIG-B of the uplink transmission. Therefore, the common field may be omitted from the HE-SIG-B field of the UL MU PPDU.

According to the embodiments of the invention, the number of HE-SIG-B symbols field indicates different information based at least in part on the value indicated by the UL/DL field. More specifically, the number of HE-SIG-B symbols field indicates different information based on the value indicated by the UL/DL field and the value of the SIG-B compression field.

The number of HE-SIG-B symbols field basically indicates the number of OFDM symbols in the HE-SIG-B field. However, as in the examples described above, when the UL/DL field indicates downlink transmission and the SIG-B

compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A indicates the information on the number of MU-MIMO user. In this case, the user specific field of the HE-SIG-B field consists of a user field for MU-MIMO allocation. Meanwhile, when the value of the SIG-B compression field in the UL MU PPDU is set to 1, it may be intended to omit the resource unit allocation field rather than to indicate the full bandwidth MU-MIMO transmission. Therefore, when the UL/DL field indicates uplink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A indicates the number of OFDM symbols in the HE-SIG-B field as in the basic definition. In this case, the user specific field of the HE-SIG-B field consists of a user field for non-MU-MIMO allocation. Since the UL MU PPDU is transmitted to a single AP, the user specific field of the HE-SIG-B field may include only one user field for the non-MU-MIMO allocation.

Next, FIG. 12(c) illustrates a subfield configuration of the HE-SIG-A field of the HE trigger-based PPDU. Among the subfields shown in FIG. 12(c), the same subfields as those shown in FIG. 12(a) or 12(b) will not be described.

The format field is used to differentiate an HE SU PPDU from an HE Trigger-based PPDU. Also, the HE Trigger-based PPDU includes the above-described BSS color field and TXOP duration field. The spatial reuse field of the HE Trigger-based PPDU consists of 16 bits and carries information for spatial reuse operation in units of 20 MHz or 40 MHz according to the total bandwidth. The bandwidth field consists of 2 bits and may indicate one of 20 MHz, 40 MHz, 80 MHz and 160 MHz (including 80+80 MHz).

FIG. 13 illustrates a configuration of an HE-SIG-B field.

The HE-SIG-B field is present in the HE MU PPDU and is transmitted in units of 20 MHz. In addition, the HE-SIG-B field indicates information necessary for receiving the HE MU PPDU. As illustrated in FIG. 13(a), the HE-SIG-B consists of a common field and a user specific field.

FIG. 13(b) illustrates a subfield configuration of the common field of the HE-SIG-B. First, the common field includes a resource unit allocation (RA) field. FIG. 13(c) illustrates an embodiment of the RA field.

Referring to FIG. 13(c), the RA field contains information on resource unit allocation of a specific bandwidth (e.g., 20 MHz) in the frequency domain. More specifically, the RA field consists in units of 8 bits, and indexes the size of the resource units constituting the specific bandwidth and their placement in the frequency domain. Further, the RA field may indicate the number of users in each resource unit. When the total bandwidth through which the PPDU is transmitted is greater than a predetermined bandwidth (e.g., 40 MHz), the RA field may be set to a multiple of 8 bits to carry information in units of the specific bandwidth.

Each partitioned resource unit is generally assigned to one user. However, resource units of a certain bandwidth (e.g., 106-tones) or more can be assigned to a plurality of users using MU-MIMO. In this case, the RA field may indicate the number of users in the corresponding resource unit. In addition, the RA field may indicate, through a predetermined index, a specific resource unit in which a user specific field is not transmitted, i.e., a specific resource unit (i.e., an empty RU) that is not assigned to the user. The specific resource unit includes a resource unit (RU) having a bandwidth of a multiple of 20 MHz channels, i.e., 242-tone RU, 484-tone RU, 996-tone RU, and the like. In an empty RU indicated by the index value, data transmission is not performed. In this manner, the terminal may signal non-

contiguous channel allocation information in units of 20 MHz through a predetermined index of the RA field of the HE-SIG-B.

When a PPDU is transmitted through a total bandwidth of 80 MHz or more, the common field further includes a field (hereinafter, referred to as C26 field) indicating whether a user is allocated to a center 26-tone RU of 80 MHz. The C26 field may consist of a 1-bit indicator before or after the RA field in the common field.

On the other hand, the user specific field consists of a plurality of user fields, and carries information for a designated STA to each allocated resource unit. The total number of user fields to be included in the user specific field may be determined based on the RA field and the C26 field. A plurality of user fields are transmitted in units of a user block field. The user block field is made up of an aggregation of two user fields, a CRC field and a tail field. Depending on the total number of user fields, the last user block field may contain information for one or two STAs. For example, if a total of three users (i.e., STA1, STA2, and STA3) are designated, information for STA1 and STA2 may be coded and transmitted along with the CRC/tail field in the first user block field, and information for STA3 may be coded and transmitted along with the CRC/tail field in the last user block field.

FIGS. 13(d)-1 and 13(d)-2 illustrate examples of the subfield configuration of the user field of the HE-SIG-B, respectively. FIG. 13(d)-1 illustrates a user field for an OFDMA transmission, and FIG. 13(d)-2 illustrates a user field for a MU-MIMO transmission. Each user field indicates a receiver AID of the corresponding resource unit. Exceptionally, when the HE MU PPDU is used for an uplink transmission, the user field may indicate a transmitter AID. When one user is allocated to one resource unit (i.e., non-MU-MIMO allocation), the user field includes a number of

spatial streams (NSTS) field, a TxBF field, an MCS field, a DCM field and a coding field as illustrated in FIG. 13(d)-1. On the other hand, when a plurality of users are allocated to one resource unit (i.e., MU-MIMO allocation), the user field includes a spatial configuration field (SCF), an MCS field, a DCM field, and a coding field as illustrated in FIG. 13(d)-2. Each STA that receives a PPDU through an MU-MIMO allocation should identify the location and number of spatial streams for it in the corresponding resource unit. To this end, the user field for the MU-MIMO transmission includes a spatial configuration field (SCF).

FIG. 13(e) illustrates the SCF of the HE-SIG-B. The SCF indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation. Each STA identifies the OFDMA and/or MIMO allocation of the corresponding PPDU through the RA field and identifies whether the STA receives data through the MU-MIMO allocation according to the order indicated in the user specific field. When the STA receives data through the non-MU-MIMO allocation, the user field is interpreted according to the format of FIG. 13(d)-1. However, when the STA receives data through the MU-MIMO allocation, the user field is interpreted according to the format of FIG. 13(d)-2. On the other hand, when the SIG-B compression field indicates the full bandwidth MU-MIMO, the RA field is not present in the HE-SIG-B. In this case, since all the STAs signaled in the user specific field receive data through the MU-MIMO allocation, the STAs interpret the user field according to the format of FIG. 13(d)-2.

As described in the above examples, when the SIG-B compression field indicates the full bandwidth MU-MIMO, the specific subfield of the HE-SIG-A may indicate the information on the number of MU-MIMO users. That is, when the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number

of HE-SIG-B symbols field of the HE-SIG-A may indicate the information on the number of MU-MIMO users. When the SIG-B compression field indicates the full bandwidth MU-MIMO, the configuration of the user specific field of the HE-SIG-B may be identified based on the information on the number of MU-MIMO users indicated by the number of HE-SIG-B symbols field. For example, the type of the user field constituting the user specific field may be determined to be either a user field for MU-MIMO allocation or a user field for non-MU-MIMO allocation based on the information on the number of MU-MIMO users.

More specifically, when the SIG-B compression field indicates the full bandwidth MU-MIMO and the number of HE-SIG-B symbols field indicates two or more users, the user specific field of the HE-SIG-B consists of user fields for MU-MIMO allocation. The number of HE-SIG-B symbols field may be set to a value of 1 or more when it indicates two or more users. In this case, the receiving terminal of the corresponding PPDU may receive data through the MU-MIMO allocation.

However, when the SIG-B compression field indicates the full bandwidth MU-MIMO and the number of HE-SIG-B symbols field indicates a single user, the user specific field of the HE-SIG-B consists of one user field for non-MU-MIMO allocation. The number of HE-SIG-B symbols field may be set to 0 when it indicates a single user. In this case, the receiving terminal of the corresponding PPDU may receive data through non-MU-MIMO allocation. It is because the transmission is not interpreted as an MU-MIMO transmission when the SIG-B compression field indicates full bandwidth MU-MIMO but a single recipient is indicated. When only one user is allocated for MU-MIMO transmission, spatial stream

information for the single user cannot be signaled through the SCF of the user field for MU-MIMO allocation shown in FIGS. 13(d) and 13(e). Thus, when the full bandwidth MU-MIMO is indicated with a single user, the user specific field of the HE-SIG-B may consist of a user field for non-MU-MIMO allocation. The configuration of the user specific field of the HE-SIG-B based on the information on the number of MU-MIMO users can be applied to both the uplink and downlink MU PPDUs.

In the UL MU PPDU, the common field may not always be present in the HE-SIG-B field. Signaling of the C26 field and the RA field in the common field may be unnecessary when a single STA transmits a UL MU PPDU. Therefore, when the UL/DL field indicates uplink transmission, the common field is not present in the HE-SIG-B field. According to an embodiment, the value of the SIG-B compression field of the HE-SIG-A in the UL MU PPDU may be set to 1 to explicitly signal that the common field is not included in the HE-SIG-B. However, in this case, the full bandwidth MU-MIMO transmission is not performed, but the compression mode of the HE-SIG-B field may be used to reduce the signaling overhead of the HE-SIG-B in the uplink transmission. In the UL MU PPDU, the compression mode of the HE-SIG-B field may be implicitly indicated regardless of the value of the SIG-B compression field, so that the common field is not present in the HE-SIG-B field.

Also, the user specific field of the HE-SIG-B in the UL MU PPDU may consist of one user field for non-MU-MIMO allocation. That is, even if the value of the SIG-B compression field of the UL MU PPDU is set to 1 so that the compression mode of the HE-SIG-B field (or the full bandwidth MU-MIMO) is indicated, the user specific field of the HE-SIG-B may consist of a user field for non-MU-MIMO allocation. In this way, when a single STA

performs uplink transmission to a single AP, a non-MU-MIMO-based (or OFDMA-based) user field is transmitted instead of a MU-MIMO-based user field so that information on the number of space-time streams to be received by the receiving terminal can be accurately transmitted.

A terminal may generate an HE MU PPDU including an HE-SIG-A field and an HE-SIG-B field configured according to the above-described methods, and transmit the generated HE MU PPDU. The terminal receiving the HE MU PPDU may decode the corresponding PPDU based on information obtained from the HE-SIG-A field of the received PPDU. In addition, the terminal may decode the HE-SIG-B field based on the information obtained from the HE-SIG-A field of the received HE MU PPDU. As described above, the configuration of the HE-SIG-B may be identified based on information obtained from at least one subfield of the HE-SIG-A. For example, the configuration of the HE-SIG-B may be identified based on at least one of the number of HE-SIG-B symbols field, the SIG-B compression field, and a combination thereof.

FIGS. 14 to 15 illustrate specific embodiments in which a single STA transmits an UL MU PPDU to an AP.

First, FIG. 14 illustrates an example in which the STA performs a UL MU PPDU transmission through a narrowband. Here, the narrowband may be a resource unit less than a 20 MHz bandwidth. As shown in FIG. 14(a), the STA can increase the transmission distance of data by concentrating the transmission power on a specific resource unit of a narrowband. FIGS. 14(b) to 14(d) illustrate various embodiments for signaling such narrowband transmission.

First, the narrowband transmission may be signaled through at least one subfield of the HE-SIG-A as shown in FIG. 14(b). When the HE MU PPDU is used for

uplink transmission, the bandwidth field of the HE-SIG-A may indicate either 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz) or a predetermined narrow bandwidth. That is, in the 3-bit bandwidth field, values of 0 to 3 indicate 20 MHz, 40 MHz, 80 MHz, and 160 MHz (including 80+80 MHz), respectively, and any one of values 4 to 7 indicates one of the predetermined narrow bandwidths. The predetermined narrow bandwidth may include a left-106-tone and a right-106-tone. In this case, among the 242-tone constituting a 20 MHz primary channel, the left-106-tone indicates the low-frequency 106-tone resource unit, and the right-106-tone indicates the high-frequency 106-tone resource unit. However, the present invention is not limited thereto, and the predetermined narrow bandwidth may include one or more of a 26-tone resource unit, a 52-tone resource unit, a 106-tone resource unit, or a combination thereof.

Next, the narrowband transmission may be signaled through a null STA ID contained in the user field of the HE-SIG-B as shown in FIG. 14(c). More specifically, the RA field of the HE-SIG-A may indicate information on the resource unit partition type in a particular channel. For example, if the bandwidth of 20 MHz is partitioned into two 106-tone resource units based on the OFDMA and the center 26-tone resource unit is not used, then the RA field may signal "0110zzzz" as shown in FIG. 14(c). In this case, an AID of the receiver or the transmitter may be inserted into the user field corresponding to the resource unit used for uplink data transmission between the partitioned two 106-tone resource units. On the other hand, a null STA ID may be inserted into the user fields corresponding to the remaining resource units through which data transmission is not performed. For example, if data is transmitted only through the second RU between two 106-tone resource units, a null STA ID may be inserted into the first user field.

As shown in FIG. 14(d), index values of the uplink resource unit allocation may be newly defined in the RA field of the HE-SIG-B for the narrowband transmission. More specifically, the RA field of the HE-SIG-B may index a specific 106-tone RU on which uplink transmission is performed. In this case, since only one user field corresponding to the resource unit indicated in the RA field is carried, the signaling overhead can be greatly reduced. The index values of the uplink resource unit allocation may be used among the unassigned (i.e., TBD) indices of the RA field configuration for DL-MU transmission. The index values of the uplink resource unit allocation may be newly defined in the RA field.

FIG. 15 illustrates an example in which the STA performs UL MU PPDU transmission through a bandwidth of 20 MHz or more. As shown in FIG. 15(a), the uplink transmission using the HE MU PPDU may be performed not only through the narrowband but also through the full bandwidth of 20 MHz, 40 MHz, 80 MHz or 160 MHz (including 80+80 MHz). In this case, the bandwidth field of the HE-SIG-A indicates the total bandwidth of the PPDU. In addition, the SIG-B compression field may be always set to 1 as shown in FIG. 15(b) so that the common field is omitted from the HE-SIG-B field.

As described above, when the UL/DL field indicates downlink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field of the HE-SIG-A may indicate the information on the number of MU-MIMO users. In this case, the user specific field of the HE-SIG-B field may consist of user fields for MU-MIMO allocation. However, when the UL/DL field indicates uplink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field as in the

embodiment of FIG. 15, the number of HE-SIG-B symbols field may indicate the number of OFDM symbols in the HE-SIG-B field as in the basic definition. In this case, the user specific field of the HE-SIG-B field may consist of a user field for non-MU-MIMO allocation.

FIG. 16 illustrates an encoding structure and a transmission method of the HE-SIG-B FIG. 16(a) illustrates the encoding structure of the HE-SIG-B, and FIG. 16(b) illustrates the transmission method of the HE-SIG-B in a bandwidth of 40 MHz or more.

Referring to FIG. 16(a), the HE-SIG-B consists of a common field and a user specific field. The detailed configuration of the common field and the user specific field is as described in the embodiment of FIG. 13. Each user field of the user specific field is arranged in order of allocated users in the resource unit arrangement indicated by the RA field of the common field.

The user specific field consists of a plurality of user fields, and a plurality of user fields are transmitted in units of a user block field. As described above, the user block field is made up of an aggregation of two user fields, a CRC field, and a tail field. If the total number of user fields is odd, the last user block field may contain one user field. At the end of the HE-SIG-B, padding may be added along the OFDM symbol boundary.

Referring to FIG. 16(b), HE-SIG-B is separately encoded on each 20 MHz band. In this case, the HE-SIG-B may consist of a maximum of two contents in units of 20 MHz, that is, an HE-SIG-B content channel 1 and an HE-SIG-B content channel 2. In the embodiment of FIG. 16(b), each box represents a 20 MHz band, and "1" and "2" in the boxes represent the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2, respectively. Each HE-SIG-B content channel in the total band is arranged in

order of the physical frequency band. That is, the HE-SIG-B content channel 1 is transmitted in the lowest frequency band, and the HE-SIG-B content channel 2 is transmitted in the next higher frequency band. Such a content channel configuration is then duplicated through content duplication in the next higher frequency bands. For example, for the first to fourth channels with an increasing order of the frequency constituting the entire 80 MHz band, the HE-SIG-B content channel 1 is transmitted on the first channel and the third channel, and the HE-SIG-B content channel 2 is transmitted on the second channel and the fourth channel. Likewise, for the first to eighth channels with an increasing order of the frequency constituting the entire 160 MHz band, the HE-SIG-B content channel 1 is transmitted on the first channel, the third channel, the fifth channel and the seventh channel, and the HE-SIG-B content channel 2 is transmitted on the second channel, the fourth channel, the sixth channel and the eighth channel. When the terminal can decode the HE-SIG-B content channel 1 through at least one channel and decode the HE-SIG-B content channel 2 through the other at least one channel, information on the MU PPDU configuration of the total bandwidth can be obtained. On the other hand, when the total bandwidth is 20 MHz, only one SIG-B content channel is transmitted.

Non-contiguous channel allocation

Hereinafter, a non-contiguous channel allocation method and a signaling method thereof will be described with reference to FIGS. 17 to 21. Non-contiguous channel allocation refers to channel allocation in which a band occupied by the transmitted packet (i.e., PPDU) includes at least one non-contiguous channel (or non-contiguous resource unit). However, a full bandwidth 80+80 MHz channel is regarded as a contiguous channel like a full bandwidth 160 MHz channel. Thus, a non-

contiguous channel (or non-contiguous PPDU) in the embodiments of the present invention may refer to non-contiguous channels except for the full bandwidth 80+80 MHz channel.

In the following examples and drawings, the P20 channel indicates a 20 MHz primary channel, the S20 channel indicates a 20 MHz secondary channel, the S40 channel indicates a 40 MHz secondary channel, and the S80 channel indicates an 80 MHz secondary channel, respectively. Also, the S40A channel indicates the first 20MHz channel constituting the S40 channel, and the S40B channel indicates the second 20MHz channel constituting the S40 channel. Similarly, the S80A channel, the S80B channel, the S80C channel, and the S80D channel indicate the first 20MHz channel, the second 20MHz channel, the third 20MHz channel, and the fourth 20MHz channel constituting the S80 channel, respectively.

A transmitter (e.g., an AP) signals non-contiguous channel allocation information through embodiments illustrated in each figure or combinations thereof. The transmitter may perform a CCA of multiple channels for a wideband packet transmission. In this case, the wideband may refer to a band having a total bandwidth of 40 MHz or more, but the present invention is not limited thereto. The transmitter transmits a packet through at least one channel which is idle based on the result of performing the CCA of multiple channels. In this case, when the packet is transmitted through a non-contiguous channel, the transmitter signals non-contiguous channel allocation information via a non-legacy preamble of the packet. As such, the transmitter transmits a wireless packet in which non-contiguous channel allocation information is signaled. A receiver (e.g., a STA) receives the wireless packet and obtains the non-contiguous channel allocation information from the received packet. The receiver decodes the received packet based on the obtained non-contiguous channel

allocation information. In this case, the received packet may be an HE MU PPDU, but the present invention is not limited thereto.

FIG. 17 illustrates a non-contiguous channel allocation method.

According to the example of FIG. 17, the location where at least one of the HE-SIG-B content channels is transmitted may be variable. In this case, the receiver should be able to variably set the decoding channel for receiving the HE-SIG-B content channel. In the example of FIG. 17, it is assumed that the HE-SIG-B content channel 1 is transmitted through the P20 channel and the channel through which the HE-SIG-B content channel 2 is transmitted may vary. However, depending on the physical frequency order of the P20 channel within the P40 channel, the HE-SIG-B content channel 2 may be transmitted through the P20 channel. In this case, the channel through which the HE-SIG-B content channel 1 is transmitted may vary depending on the channel configuration. The non-contiguous channel allocation information according to the embodiment of the present invention may support at least some configurations among the channel configurations listed in FIG. 17.

FIG. 17(a) illustrates a channel configuration in which only the P20 channel is allocated among the P80 (i.e., primary 80 MHz) band. In this case, the HE-SIG-B content channel 2 is not transmitted in the P80 band. FIG. 17(b) illustrates a channel configuration in which the P40 channel is basically allocated among the P80 band. In this case, both the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 may be transmitted through at least the P40 channel. A non-contiguous channel in which any one among the two 20 MHz channels, that is, the S40A channel and the S40B channel of the S40 channel is allocated may be used. When both the S40A channel and the S40B channel are allocated, a contiguous channel of 80 MHz or 160 MHz bandwidth is configured.

FIG. 17(c) illustrates a channel configuration in which only the P20 channel and the S40 channel are allocated among the P80 band. In this case, the HE-SIG-B content channel 1 may be transmitted through the P20 channel and the S40A channel, and the HE-SIG-B content channel 2 may be transmitted through the S40B channel. In the embodiments of FIG. 17(c), the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 may be transmitted based on the HE-SIG-B content channel transmission rule.

Meanwhile, due to the limitation of the number of bits in the bandwidth field of the HE-SIG-A, the bandwidth field may indicate some configurations among the above channel configurations. When the bandwidth field consists of 3 bits, the bandwidth field may index four additional non-contiguous channel allocation information. The bandwidth field may indicate the total bandwidth information through which the PPDU is transmitted and some channel information to be punctured within the total bandwidth. In this case, the total bandwidth may be either 80 MHz bandwidth or 160 MHz (or 80+80 MHz) bandwidth. The bandwidth field may index puncturing of the S20 channel shown in FIG. 17(c), and puncturing of at least one of two 20 MHz channels in the S40 channel shown in FIG. 17(b), respectively. In the channel configuration indicated by the bandwidth field of the HE-SIG-A, additional puncturing information may be indicated via the RA field of the HE-SIG-B. For example, when the bandwidth field indicates puncturing of one of two 20 MHz channels in the S40 channel at the total bandwidth of 80 MHz (e.g., the third and fifth channel configuration in FIG. 17(b)), the resource unit allocation field may indicate which 20 MHz channel in the S40 channel is punctured. Also, when the bandwidth field indicates puncturing of at least

one of two 20 MHz channels in the S40 channel at the total bandwidth of 160 MHz or 80+80 MHz (e.g., the second, fourth and sixth channel configurations in FIG. 17(b)), the resource unit allocation field may indicate which 20 MHz channel in the S40 channel is punctured. In addition, when the bandwidth field indicates puncturing of at least one of two 20 MHz channels in the S40 channel in a total bandwidth of 160 MHz or 80+80 MHz (e.g., the second, fourth and sixth channel configurations in FIG. 17(b)), the resource unit allocation field may indicate additional puncturing in the S80 channel. Further, when the bandwidth field indicates puncturing of the S20 channel in the total bandwidth of 160 MHz or 80+80 MHz (e.g., the second channel configuration in FIG. 17(c)), the resource unit allocation field may indicate additional puncturing in the S80 channel.

Channels in which puncturing is indicated as described above are not assigned to the user. A terminal receiving the non-contiguous PPDU may obtain the total bandwidth information through which the PPDU is transmitted and the channel information to be punctured within the total bandwidth via the bandwidth field of the HE-SIG-A of the corresponding PPDU. Further, the terminal may obtain additional channel puncturing information via the RA field of the HE-SIG-B of the corresponding PPDU. The terminal decodes the PPDU based on the obtained non-contiguous channel allocation information.

FIG. 18 illustrates a wideband acces method.

After the transmission of the previous PPDU is completed, the

terminal having data to be transmitted performs a backoff procedure on the P20 channel. The backoff procedure may be started when the P20 channel is idle for an AIFS time. The terminal obtains a backoff counter within a range of a contention window (CW) for the backoff procedure. The terminal performs a CCA and decreases the backoff counter

by one when the channel is idle. If the channel is busy, the terminal suspends the backoff procedure and resumes the backoff procedure an AIFS time after when the channel is idle again. When the backoff counter expires through the backoff procedure, the terminal may transmit data. In this case, the terminal performs a CCA for the secondary channels to transmit data for a PIFS time before the backoff counter expires.

FIG. 18 shows a situation in which the S40A channel and the S80B channel are busy in the 160 MHz band in which the CCA is performed. If at least a part of the secondary channels on which the CCA is performed is busy, the PPDU transmission band of the terminal may be determined based on the physical layer CCA indication information. The physical layer CCA indication information may be represented by a PHY-CCA.indication primitive defined in the wireless LAN standard.

More specifically, the PHY-CCA.indication is a primitive for the PHY to represent the current state of a channel (or medium) to the local MAC entity, and includes a state indicator and a channel indicator. The state indicator indicates a busy state or an idle state. If it is determined that the channel cannot be used as a result of the channel assessment by the physical layer, the value of the state indicator is set to the busy state. Otherwise, the value of the state indicator is the idle state. The channel indicator indicates a channel set including channel(s) in the busy state. If the value of the state indicator for a particular channel set is idle, the corresponding channel indicator is not present in the PHY-CCA.indication primitive.

FIG. 18(a) illustrates a wideband access method. The physical layer CCA indication information may be represented by the PHY-CCA.indication primitive defined in the legacy wireless LAN system. That is, the channel indicator of the PHY-CCA.indication primitive may indicate only one of the

four values of primary, secondary, secondary40, and secondary80. Thus, the channel indicator of the PHY-CCA.indication primitive indicates the first channel set including channel(s) in the busy state along the channel set order of P20 channel, S20 channel, S40 channel and S80 channel. According to the example of FIG. 18(a), the channel indicator of the PHY-CCA.indication primitive indicates the S40 channel including the S40A channel in the busy state. That is, the physical layer may report the PHY-CCA.indication (BUSY, {secondary40}) to the MAC layer. The terminal may transmit the PPDU through the 40MHz band (i.e., P40 channel) combining the P20 channel and the S20 channel determined to be idle.

However, in order to transmit the MU PPDU through the non-contiguous channel allocation as described in FIG. 17, it is necessary to transmit more detailed physical layer CCA indication information. In order to solve the problem, FIG. 18(b) illustrates a wideband access method.

The physical layer CCA indication information may be represented by the newly defined PHY-CCA.indication primitive. The units of the channel set for which the CCA result is reported may be subdivided into each 20 MHz channel. That is, the channel indicator of the PHY-CCA.indication primitive may indicate at least one of primary, secondary, secondary40A, secondary40B, secondary80A, secondary80B, secondary80C, secondary80D, or similar types of 20 MHz channels.

The channel indicator of the PHY-CCA.indication primitive reports all of the 20 MHz channel(s) determined to be busy, among eight 20 MHz channels constituting the 160 MHz band. According to the example of FIG. 18(b), the channel indicator of the PHY-CCA.indication

primitive indicates S40A channel and S80B channel which are in busy state. That is, the physical layer may report the PHY-CCA.indication (BUSY, {secondary40A, secondary80B}) to the MAC layer. The terminal transmits a PPDU using channels that are not busy. Referring to FIG. 18(b), the terminal may transmit a non-contiguous PPDU through channels (i.e., P20, S20, S40B, S80A, S80C, and S80D) other than the S40A channel and the S80B channel which are determined to be busy.

The CCA result per 20 MHz channel may be reported in a bitmap representation. That is, the channel indicator of the PHY-CCA.indication primitive may indicate the busy/idle state for each 20 MHz channel in a bitmap form. For example, the channel indicator of the PHY-CCA.indication primitive may consist of a bitmap having a length of 8 bits. Herein, each bit is set to 1 if the corresponding 20 MHz channel is busy and each bit is set to 0 if the corresponding 20 MHz channel is idle. In this case, the first to eighth bits of the bitmap indicate the busy/idle state of each of the eight 20 MHz channels in the order of the lowest frequency to the highest frequency within the 160 MHz (80+80 MHz) bandwidth.

The physical layer may report the CCA results per 20 MHz channel only if the P20 channel is idle. That is, the channel indicator of the PHY-CCA.indication primitive indicates all of the 20 MHz secondary channel(s) determined to be busy among the eight 20 MHz channels constituting the 160 MHz band only when the P20 channel is idle. Also, if the CCA result per 20 MHz channel is reported in a bitmap representation, the bit corresponding to the P20 channel in the bitmap may be set to 0. If the P20 channel is busy, the channel indicator of the PHY-CCA.indication primitive does not indicate secondary channel information in units of 20 MHz. That is, the channel indicator of the PHY-

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CCA.indication primitive indicates only the first channel set including the busy channel(s) as in the legacy wireless LAN system.

FIG. 19 illustrates a method of exchanging and signaling BQRP and BQR for transmitting a non-contiguous PPDU. Referring to FIG. 19, an AP that intends to transmit a DL MU PPDU may perform a CCA in a physical layer and transmit the DL MU PPDU using channels determined to be idle based on the CCA result. An MU-RTS frame may be transmitted to one or more STAs before transmission of the DL MU PPDU, and sCTS frames may be transmitted from STAs that have received the MU-RTS frame. However, the MU-RTS may only be transmitted in the form of PPDUs based on contiguous channel allocation such as non-HT, non-HT duplicate or HE SU PPDU. Therefore, when the S40A channel and the S80B channel are busy as in the embodiment of FIG. 19, the MU-RTS may be transmitted only through the 40 MHz band (i.e., the P40 channel) including the P20 channel and the S20 channel. The AP can receive sCTS frames transmitted in response to the MU-RTS frame from the STAs, but cannot identify the available channel of each STA only by exchanging the MU-RTS frame and the sCTS frame.

Therefore, the AP may transmit a bandwidth query report poll (BQRP) to help efficient resource allocation for MU PPDU transmission, and STAs may transmit a bandwidth query report (BQR) in response thereto . The BQR may include an available channel bitmap field representing available channel information of the corresponding STA. The BQR may be carried via the control field of the MAC header. The STA may implicitly carry the BQR through the BQR control field of a frame transmitted to the AP, or may explicitly carry the BQR through a frame transmitted in response to the BQRP trigger frame of the AP. The

BQR transmitted in response to a BQRP trigger frame may be referred to as a solicited BQR, and the BQR transmitted regardless of the reception of the BQRP trigger frame may be referred to as an unsolicited BQR.

The AP may transmit a BQRP frame using an MU PPDU format capable of non-contiguous channel allocation-based transmission. The AP may determine whether each channel is available to the STA based on the BQR received from each STA. Through the BQRP/BQR transmission sequence, the AP may perform a non-contiguous channel allocation-based DL MU PPDU transmission by checking the available channel information of the STAs. Referring to the embodiment of FIG. 19, among the channels determined to be idle, the AP transmits the BQRP respectively to STA1 through the P40 channel, to STA2 through the S40B channel, to STA3 through the S80A channel, to STA4 through the S80C channel, and to STA 5 through the S80D channel. The BQRP transmitted to STA1, STA2, STA3, STA4 and STA5 can be carried via a non-contiguous MU PPDU. The AP receives BQR from STA1, STA3 and STA5 in response to BQRP. Thus, the AP can identify that the P40 channel is available to STA1, the S80A channel is available to STA3, and the S80D channel is available to STA5, respectively. However, the AP does not receive the BQR in response to BQRP from STA2 and STA4. Thus, the AP can identify that the S40B channel is not available to STA2, and the S80C channel is not available to STA4, respectively. The AP can perform DL MU PPDU transmission based on the collected available channel information of each STA.

FIG. 20 illustrates another example of a method of transmitting and signaling BQR for transmitting a non-contiguous PPDU. As described above, the STA may implicitly carry the BQR through the BQR control field of the frame transmitted to the AP. The AP can perform a non-contiguous channel allocation-based DL MU PPDU

transmission by checking the available channel information of each STA through the unsolicited BQR received from the STAs at any time.

First, referring to FIG. 20(a), the BQR may be transmitted through a UL SU PPDU. The STA that intends to transmit a UL SU PPDU may perform a CCA in the physical layer and transmit the UL SU PPDU using channels determined to be idle based on the CCA result. However, the HE SU PPDU may only be transmitted on a contiguous channel allocation basis. Therefore, when the S40A channel and the S80B channel are busy as in the example of FIG. 20(a), the UL SU PPDU may be transmitted through the 40 MHz band including the P20 channel and the S20 channel. In this case, the BQR may be carried via the BQR control field of the frame transmitted through the UL SU PPDU. The BQR may contain available channel information based on the CCA result detected by the corresponding STA.

Next, referring to FIG. 20(b), the BQR may be transmitted through an HE trigger-based (TB) PPDU. The STA that intends to transmit an HE-TB PPDU may perform a CCA in the physical layer and transmit the HE TB PPDU using channels determined to be idle based on the CCA result. In this case, the BQR may be carried via the BQR control field of the frame transmitted through the HE TB PPDU. The BQR may contain available channel information based on the CCA result detected by the corresponding STA.

As described above, the AP receiving the UL SU PPDU or the HE TB PPDU containing the BQR may check the available channel information of the corresponding STA and perform a DL PPDU transmission. Meanwhile, the BQR may indicate the available channel information according to various examples. A specific exampe thereof will be described with reference to FIG. 21.

FIG. 21 illustrates a configuration of a BQR.

The available channel information in the BQR may be represented by an available channel bitmap field. The BQR includes a bandwidth indication field and an available channel bitmap field (or a bandwidth bitmap field). However, the bandwidth indication field may be omitted from the BQR according to an embodiment.

The bandwidth indication field may represent the total bandwidth through which the available channel information is carried. According to an embodiment, the bandwidth indication field may consist of 2 bits and may indicate either 20 MHz, 40 MHz, 80 MHz or 160 MHz (including 80+80 MHz). In addition, the available channel bitmap field may consist of 8 bits and may indicate availability (or busy/idle state) of each 20 MHz channel. When the BQR reports available channel information in a total bandwidth of 20 MHz, the bandwidth indication field indicates 20 MHz (or P20 channel). In addition, when the BQR reports available channel information in a total bandwidth of 40 MHz, the bandwidth indication field indicates 40 MHz (or P40 channel). In this case, the first bit and the second bit of the available channel bitmap field indicate availability of each of the two 20 MHz channels in the order of the low frequency to the high frequency within the 40 MHz bandwidth. Next, when the BQR reports available channel information in a total bandwidth of 80 MHz, the bandwidth indication field indicates 80 MHz (or P80 channel). In this case, the first to fourth bits of the available channel bitmap field indicate availability of each of the four 20MHz channels in the order from the lowest frequency to the highest frequency within the 80MHz bandwidth. Next, when the BQR reports available channel information in a total bandwidth of 160 MHz (80+80 MHz), the bandwidth indication field indicates 160 MHz (80+80 MHz) (or P160 channel). In this case, the first to eighth bits of the available channel bitmap field indicate availability of each of the eight 20MHz channels

in the order of the lowest frequency to the highest frequency within the 160MHz (80+80MHz) bandwidth.

Meanwhile, the BQR may include only the available channel bitmap field without the bandwidth indication field. In this case, the available channel bitmap field may consist of 8 bits, and may indicate availability (or busy/idle state) of each 20 MHz channel. When a 20 MHz channel in which the CCA is not performed according to the CCA performance capability of the STA is present, the value of the bit of the available channel bitmap field corresponding to the channel may be set to 1 (i.e., busy state).

The BQR may indicate the available channel information in various ways. The STA may explicitly signal, through the bandwidth indication field, bandwidth information through which the STA can perform the CCA before transmitting a PPDU including the BQR, and may indicate availability of each channel within the corresponding bandwidth through the available channel bitmap. For example, if the STA performed a CCA only for the corresponding 40 MHz bandwidth before transmitting the 40 MHz PPDU, the bandwidth indication field may indicate 40 MHz and the available channel bitmap field may carry only the CCA results of two 20 MHz channels. However, if the STA performs a CCA for a 160 MHz bandwidth that is wider than the bandwidth of the corresponding PPDU before transmitting the 40 MHz PPDU, the bandwidth indication field may indicate 160 MHz and the available channel bitmap field may carry the CCA result of eight 20 MHz channels. In such an embodiment, the STA may autonomously set the indicated bandwidth of the available channel bitmap field of the BQR based on its CCA performance capability.

Next, the STA may perform a CCA for the entire band through which the BQRP trigger frame is

received or the entire band through which the PPDU including the BQR is transmitted, and may indicate the availability of each channel within the corresponding bandwidth through the available channel bitmap. In this case, since the bandwidth information for which the available channel information is transmitted is obvious to the transmitter and the receiver, the bandwidth indication field may be omitted from the BQR. If there is a 20 MHz channel in which the CCA is not performed according to the CCA performance capability of the STA among the entire bandwidth in which the PPDU is transmitted, the STA may not perform the transmission of the unsolicited BQR. According to another embodiment, if there is a 20 MHz channel in which the CCA is not performed according to the CCA performance capability of the STA among the entire bands in which the PPDU is transmitted, the value of the bit of the available channel bitmap field corresponding to the channel may be set to 1 (i.e., busy state).

Next, the STA

may perform a CCA for the total band operated by the BSS to which the corresponding STA is associated, and may indicate the availability of each channel within the corresponding bandwidth through the available channel bitmap. If the bandwidth that the STA can perform the CCA is smaller than the total bandwidth operated by the BSS according to the CCA performance capability of the STA, the availability of each channel within the bandwidth in which the STA can perform the CCA may be indicated through the available channel bitmap. That is, the STA may indicate the availability of each channel through the available channel bitmap based on a smaller value between the total bandwidth operated by the BSS and the bandwidth that the STA can perform the CCA, regardless of the entire band in which the BQRP trigger frame is received or the entire band in which the PPDU including the BQR is transmitted. In this case, since the bandwidth information for which the available channel information is transmitted is

obvious to the transmitter and the receiver, the bandwidth indication field may be omitted from the BQR. Therefore, the AP may transmit the DL MU PPDU based on the available channel information of the STA within the entire bandwidth regardless of the transmission bandwidth of the PPDU carrying the BQRP or BQR.

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.

[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.

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Claims

1. 1. A wireless communication terminal (100), the terminal comprising:

a communication unit (120); and

a processor (110) configured to process signals transmitted and received through the communication unit (120),

wherein the processor (110) is configured to:

receive, through the communication unit (120), a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols subfield, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of OFDM symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

2. The wireless communication terminal (100) of claim 1,

wherein a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the Number of HE'-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

3. The wireless communication terminal (100) of claim 2,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is a single user.

4. The wireless communication terminal (100) of claim 3,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

5. The wireless communication terminal (100) of claim 3,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

6. The wireless communication terminal (100) of claim 1,

wherein the uplink/downlink subfield indicates whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the uplink/downlink subfield indicates uplink transmission or downlink transmission.

7. The wireless communication terminal (100) of claim 1,

wherein the SIG-B compression subfield indicates whether a common field is present in the HE-SIG-B.

8. The wireless communication terminal (100) of claim 7,

wherein the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users when the SIG-B compression subfield is set to a value indicating that the common field is not present, and

wherein the Number of HE-SIG-B Symbols field indicates the number of OFDM symbols in the HE-SIG-B when the SIG-B compression subfield is set to a value indicating that the common field is present.

9. A wireless communication method of a wireless communication terminal (100), the method comprising:

receiving a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols field, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield; and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

10. The wireless communication method of claim 9,

wherein a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

11. The wireless communication method of claim 10,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is a single user.

12. The wireless communication method of claim 11,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in

the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

13. The wireless communication method of claim 11,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

14. The wireless communication method of claim 9,

wherein the downlink/uplink subfield indicates whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the downlink/upilnk subfield indicates uplink transmission or downlink transmission.

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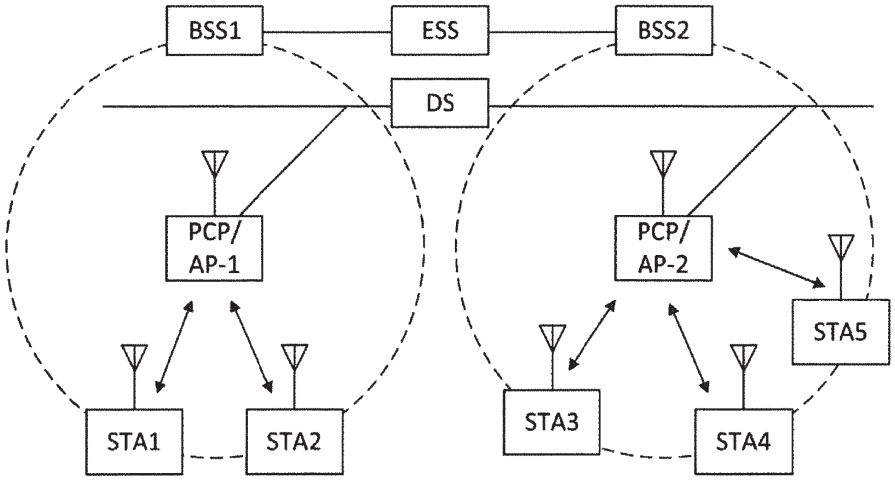


FIG. 1

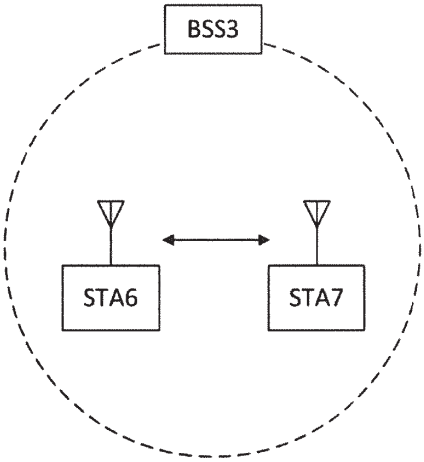


FIG. 2

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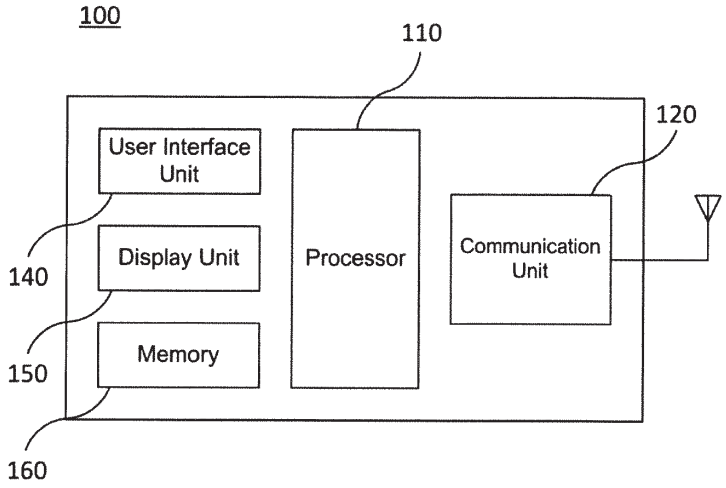


FIG. 3

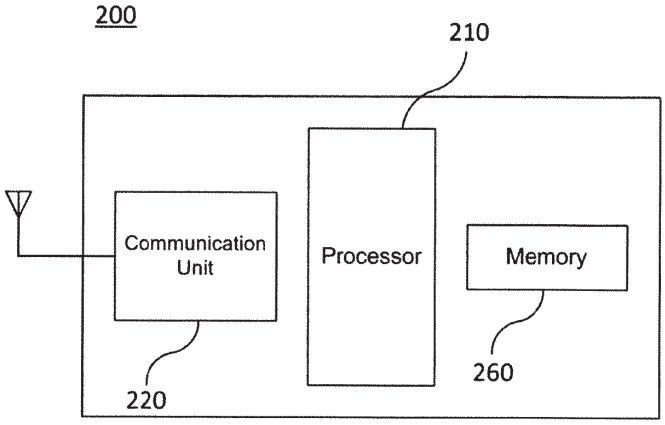


FIG. 4

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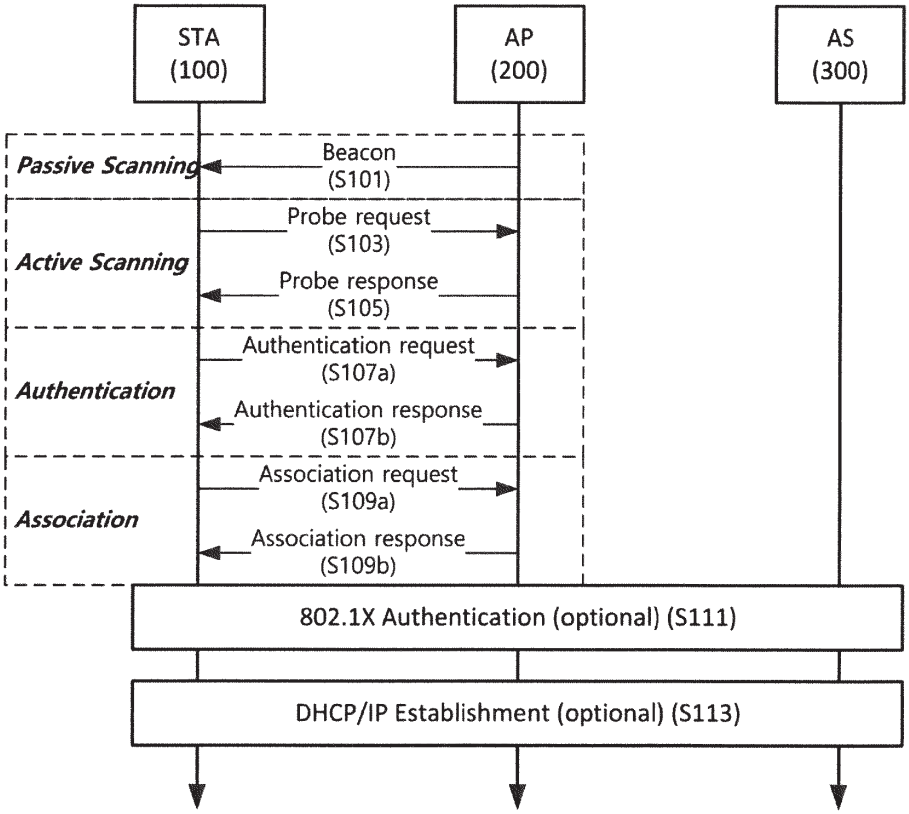


FIG. 5

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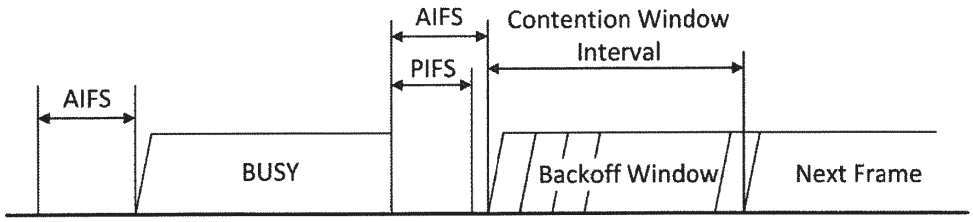


FIG. 6

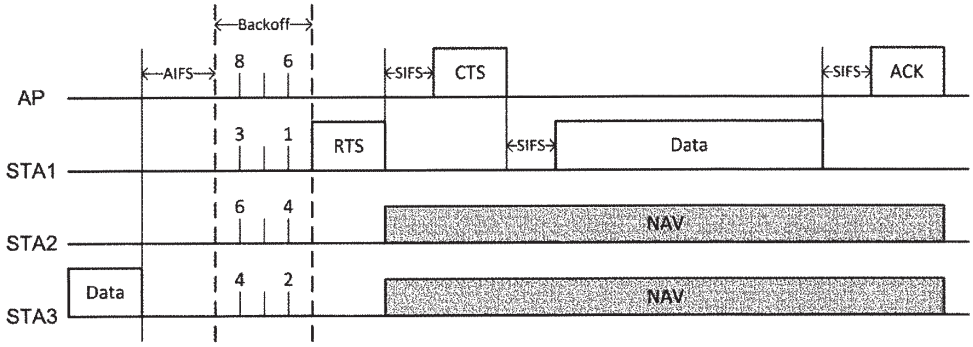


FIG. 7

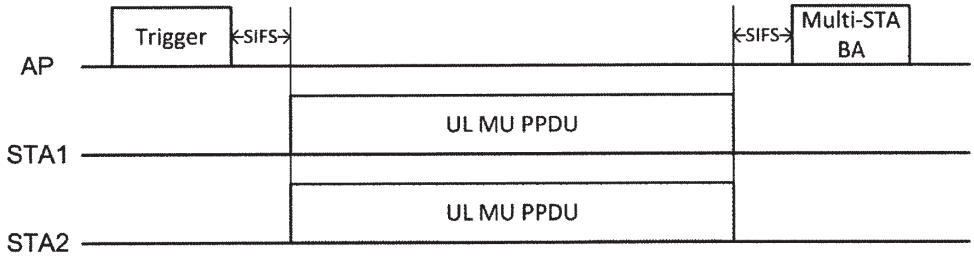


FIG. 8

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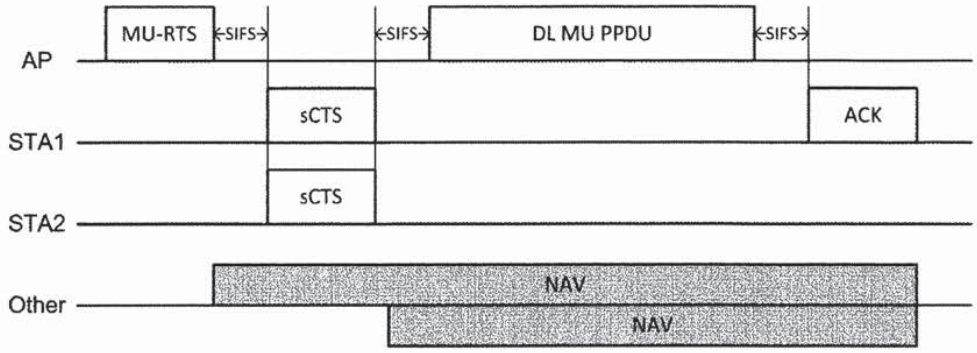


FIG. 9

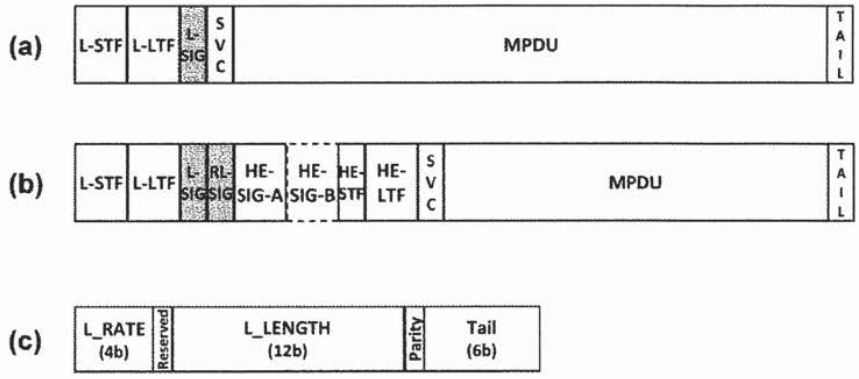


FIG. 10

M24159.0

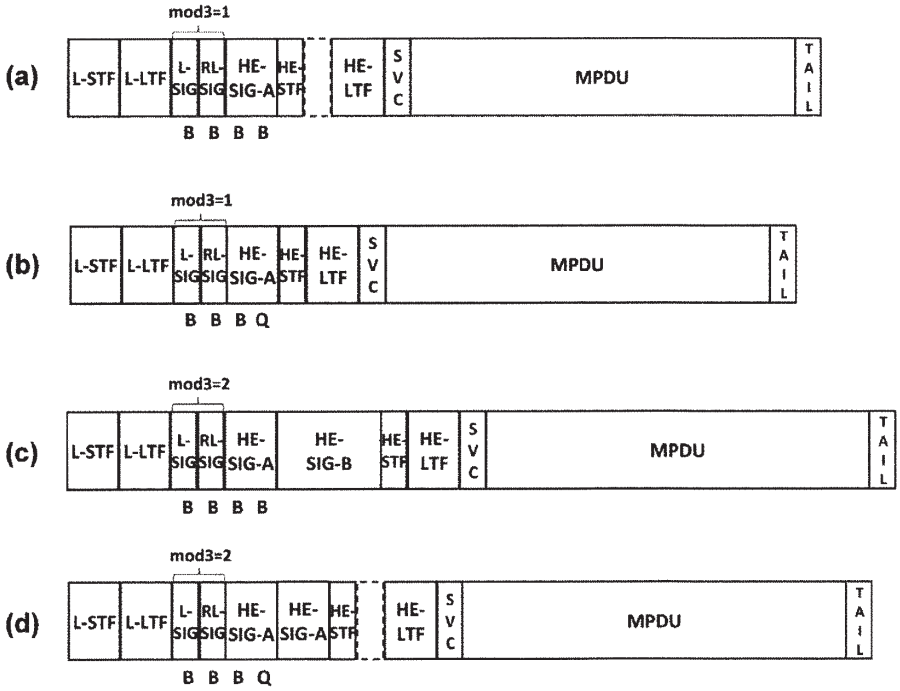
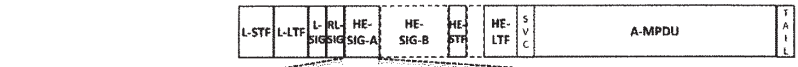


FIG. 11

M24159.0



Field	Bit	Descriptions
Format	1	0: Trigger-based PPDU, 1: SU PPDU
Beam Change	1	
UL/DL	1	0:DL, 1:UL
MCS	4	
DCM	1	Dual carrier modulation
BSS Color	6	BSS Identification info
Reserved	1	
Spatial Reuse	4	TBD
Bandwidth	2	20/40/80/160(80+80)MHz
GI+LTF Size	3	1x_LTF+0.8us_GI 2x_LTF+0.8us_GI 2x_LTF+1.6us_GI 4x_LTF+3.2us_GI
NSTS	3	1~8 space time streams
TXOP Duration	7	
Coding	1	0:BCC, 1:LDPC
LDPC Extra Sym.	1	
STBC	1	Space Time Block Coding
TxBF	1	Beamforming
Pre-FEC Padding	2	Padding Length
Padding Disam.	1	Padding Disambiguity
Reserved	1	
Doppler	1	
CRC	4	
Tail	6	

(a)

Field	Bit	Descriptions
UL/DL	1	0:DL, 1:UL
SIGB MCS	3	MCS0~MCS5
SIGB DCM	1	Dual carrier modulation
BSS Color	6	BSS Identification info
Spatial Reuse	4	TBD
Bandwidth	3	(DL) 20/40/80/160(80+80), 80A, 80B, 160A, 160B (UL) 20/40/80/160(80+80), left-106tone, right-106tone, reserved
Num of SIG-B Sym	4	if SIG-B Compression is 1 (DL) Num of MU-MIMO Users (UL) Num of SIG-B Sym
SIG-B Compression	1	(DL) Set to 1 in Full BW MU-MIMO (UL) Always set to 1 to remove RU Allocation subfield
GI+LTF Size	3	2x_LTF+0.8us_GI 2x_LTF+1.6us_GI 4x_LTF+3.2us_GI
Doppler	1	
TXOP Duration	7	
Reserved	1	
Num of HE-LTF Sym	3	1, 2, 4, 6, 8
LDPC Extra Sym.	1	
STBC	1	Space Time Block Coding
Pre-FEC Padding	2	Padding Length
Padding Disam.	1	Padding Disambiguity
CRC	4	
Tail	6	

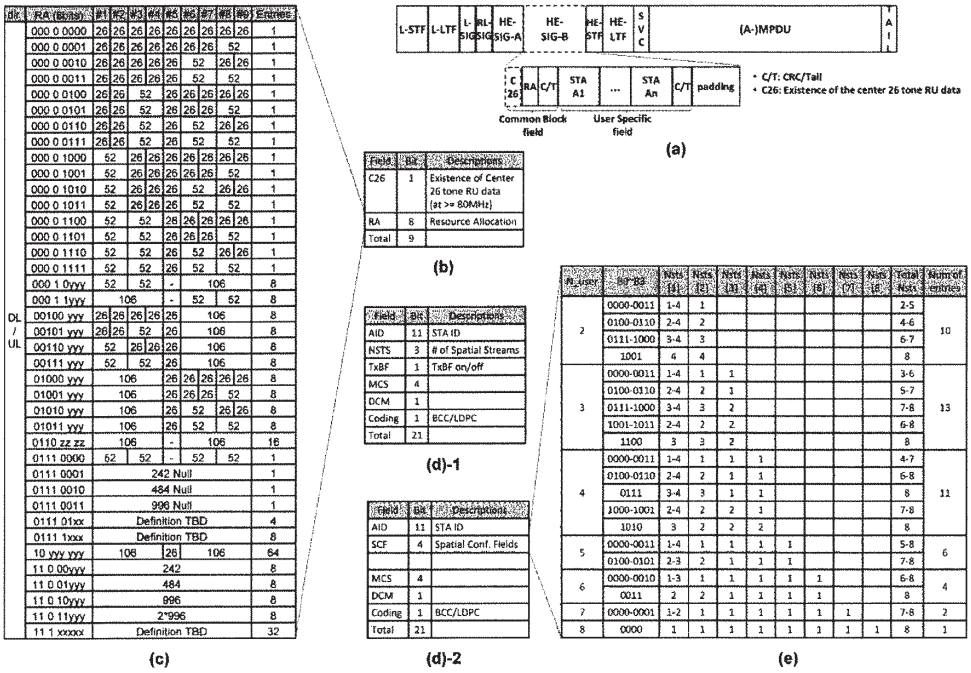
(b)

Field	Bit	Descriptions
Format	1	0: Trigger-based PPDU, 1: SU PPDU
BSS Color	6	BSS identification info
Spatial Reuse1	4	Spatial Reuse Parameter
Spatial Reuse2	4	Spatial Reuse Parameter
Spatial Reuse3	4	Spatial Reuse Parameter
Spatial Reuse4	4	Spatial Reuse Parameter
Reserved	1	
Bandwidth	2	20/40/80/160(80+80)MHz
TXOP Duration	7	
Reserved	9	
CRC	4	
Tail	6	

(c)

FIG. 12

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dir.	RA (B8:B0)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Entries
DL / UL	000 0 0000	26	26	26	26	26	26	26	26		1
	000 0 0001	26	26	26	26	26	26	52			1
	000 0 0010	26	26	26	26	26	52	26	26		1
	000 0 0011	26	26	26	26	26	52	52			1
	000 0 0100	26	26	52	26	26	26	26	26		1
	000 0 0101	26	26	52	26	26	26	52			1
	000 0 0110	26	26	52	26	52	26	26			1
	000 0 0111	26	26	52	26	52	52				1
	000 0 1000	52	26	26	26	26	26	26			1
	000 0 1001	52	26	26	26	26	26	52			1
	000 0 1010	52	26	26	26	52	26	26			1
	000 0 1011	52	26	26	26	52	52				1
	000 0 1100	52	52	26	26	26	26	26			1
	000 0 1101	52	52	26	26	26	52				1
	000 0 1110	52	52	26	52	26	26				1
	000 0 1111	52	52	26	52	52					1
	000 1 0yyy	52	52	-	106						8
	000 1 1yyy	106		-	52	52					8
	00100 yyy	26	26	26	26	26	106				8
	00101 yyy	26	26	52	26	106					8
	00110 yyy	52	26	26	26	106					8
	00111 yyy	52	52	26	106						8
	01000 yyy	106		26	26	26	26	26			8
	01001 yyy	106		26	26	26	52				8
	01010 yyy	106		26	52	26	26				8
	01011 yyy	106		26	52	52					8
	0110 zz zz	106		-	106						16
	0111 0000	52	52	-	52	52					1
	0111 0001	242 Null									1
	0111 0010	484 Null									1
	0111 0011	996 Null									1
	0111 01xx	Definition TBD									4
	0111 1xxx	Definition TBD									8
	10 yyy yyy	106		26	106						64
	11 0 00yyy	242									8
	11 0 01yyy	484									8
	11 0 10yyy	996									8
	11 0 11yyy	2*996									8
	11 1 xxxxx	Definition TBD									32

(c)

Field	Bit	Descriptions
C26	1	Existence of Center 26 tone RU data (at >= 80MHz)
RA	8	Resource Allocation
Total	9	

(b)

Field	Bit	Descriptions
AID	11	STA ID
NSTS	3	# of Spatial Streams
TxBF	1	TxBF on/off
MCS	4	
DCM	1	
Coding	1	BCC/LDPC
Total	21	

(d)-1

Field	Bit	Descriptions
AID	11	STA ID
SCF	4	Spatial Conf. Fields
MCS	4	
DCM	1	
Coding	1	BCC/LDPC
Total	21	

(d)-2

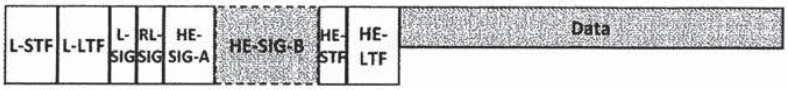
# User	RU' RU	Nsts [1]	Nsts [2]	Nsts [3]	Nsts [4]	Nsts [5]	Nsts [6]	Nsts [7]	Nsts [8]	Total Nsts	Num of entries
2	0000-0011	1-4	1							2-5	10
	0100-0110	2-4	2							4-6	
	0111-1000	3-4	3							6-7	
	1001	4	4							8	
3	0000-0011	1-4	1	1						3-6	13
	0100-0110	2-4	2	1						5-7	
	0111-1000	3-4	3	2						7-8	
	1001-1011	2-4	2	2						6-8	
	1100	3	3	2						8	
4	0000-0011	1-4	1	1	1					4-7	11
	0100-0110	2-4	2	1	1					6-8	
	0111	3-4	3	1	1					8	
	1000-1001	2-4	2	2	1					7-8	
	1010	3	2	2	2					8	
5	0000-0011	1-4	1	1	1	1				5-8	6
	0100-0101	2-3	2	1	1	1				7-8	
6	0000-0010	1-3	1	1	1	1	1			6-8	4
	0011	2	2	1	1	1	1			8	
7	0000-0001	1-2	1	1	1	1	1	1		7-8	2
8	0000	1	1	1	1	1	1	1	1	8	1

(e)

FIG. 13

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(a)



(b)

Field	Bit	Descriptions
BW	3	**DL HE MU PPDU case** - 20/40/80/160(80+80)MHz - 80A, 80B, 160A, 160B (Preamble Puncturing) **UL HE MU PPDU case** - 20/40/80/160(80+80)MHz **- 20MHz-left 106 tone** **- 20MHz-right 106 tone**



(OFDMA User Specific Info)

(c)

RA (8bits)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Entries
others	x	x	x	x	x	x	x	x	x	x
0110zzzz	106				-	106				16



(OFDMA User Specific Info)

(d)

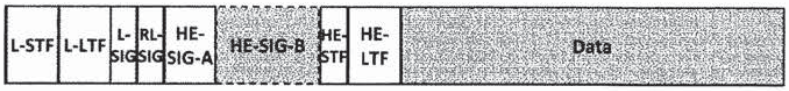
RA (8bits)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Entries
others	x	x	x	x	x	x	x	x	x	x
TBD	106				-					1
TBD	-				106					1



(OFDMA User Specific Info)

FIG. 14

(a)



(b)

Field	Bit	Descriptions
SIG-B Compression	1	**DL HE MU PPDU case** - "0"refer RA field in SIG-B **- "1" MU-MIMO user specific info** **UL HE MU PPDU case** - Always set to "1" **- Use OFDMA user specific info**

FIG. 15

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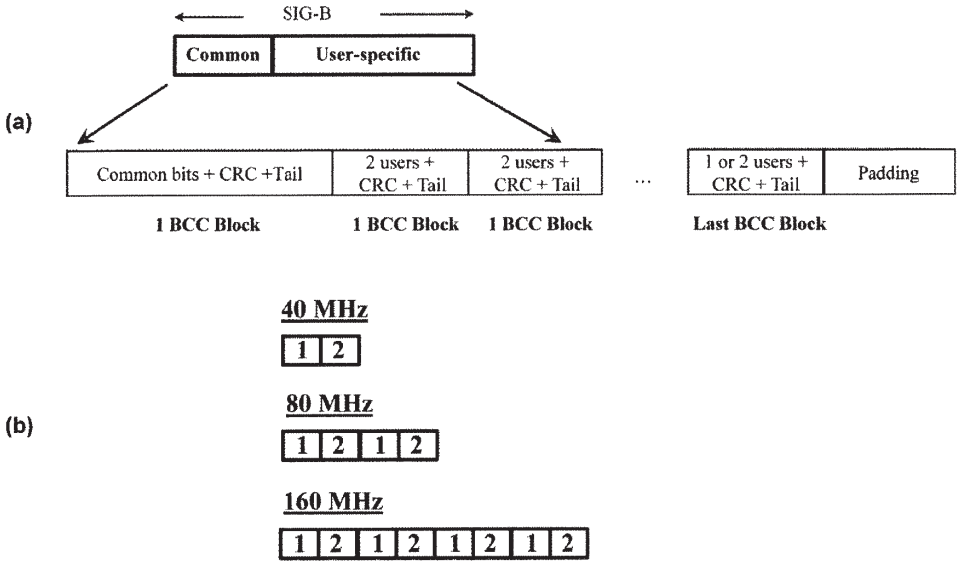


FIG. 16

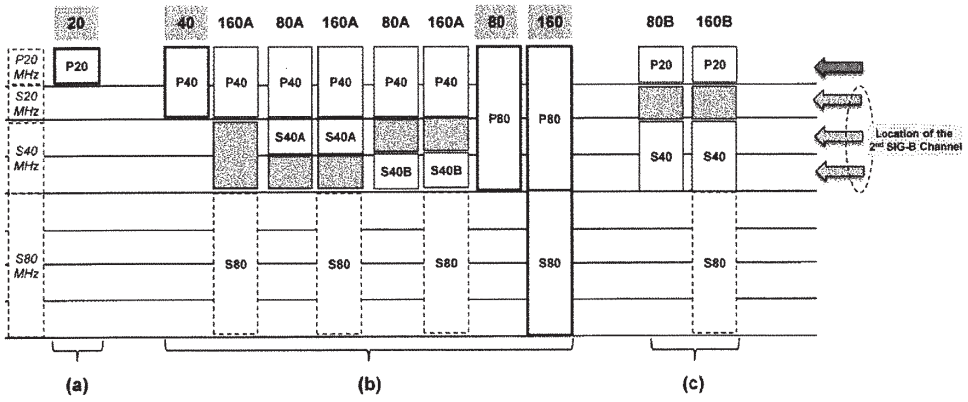


FIG. 17

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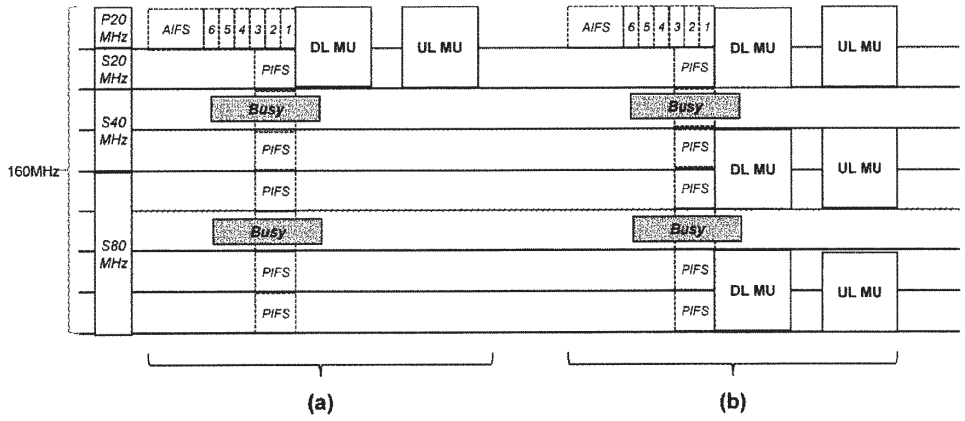


FIG. 18

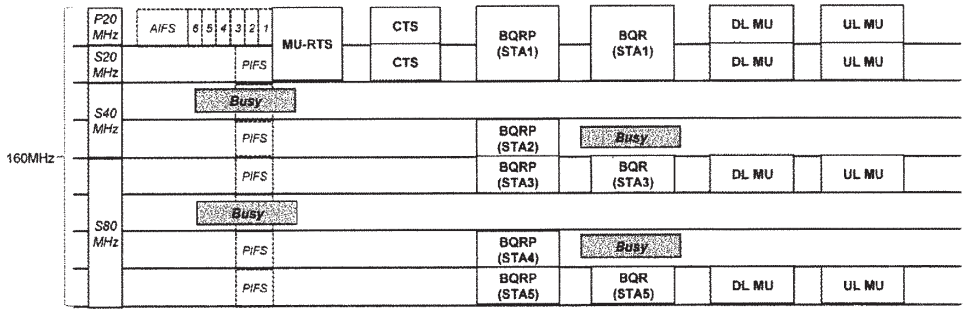


FIG. 19

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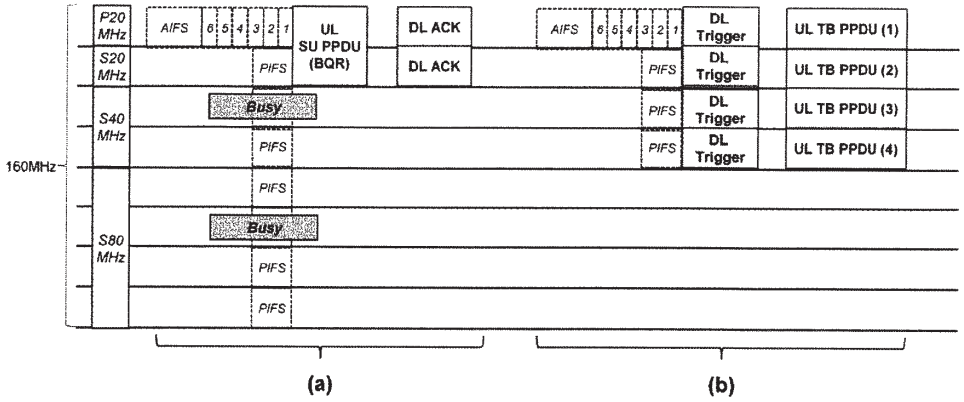
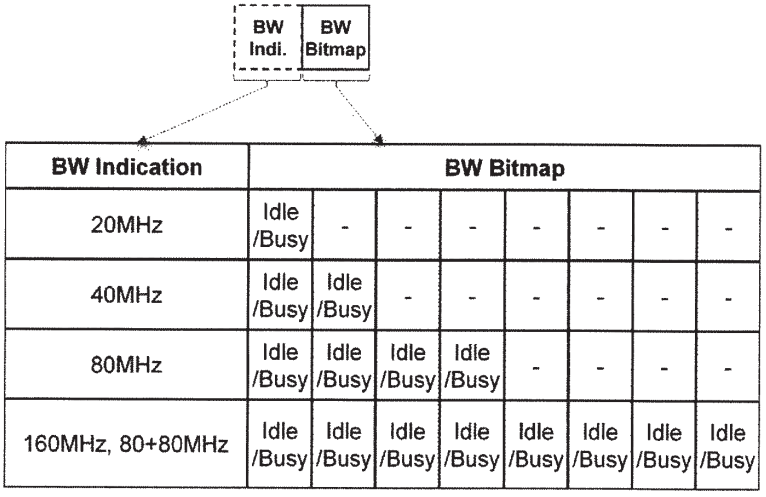


FIG. 20



BW Indication	BW Bitmap							
20MHz	Idle /Busy	-	-	-	-	-	-	-
40MHz	Idle /Busy	Idle /Busy	-	-	-	-	-	-
80MHz	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	-	-	-	-
160MHz, 80+80MHz	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy

FIG. 21

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[DESCRIPTION]

[Invention Title]

WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET

[Technical Field]

The present invention relates to a wireless communication method and a wireless communication terminal for signaling a multi-user packet.

[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.

"High Efficiency (HE) PHY specification", IEEE DRAFT; TGAX_CL_26, IEEE-SA, PISCATAWAY, NJ USA, vol. 802.11ax drafts, no D0.5 1 October 2016 (2016-10-01), pages 1-207 discloses in section 26.3.3.7.4 that an AP that transmits an HE MU PPDU shall set the UL/DL field in the HE-SIG-A field to 0. A fully bandwidth MU MIMO transmission using HE MU PPDU format has a value of 1 for the SIGB Compression field in HE-SIG-A and the SIGB Common field is not present. If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and

the number of STAs on each RU for SU/MU-MIMO transmission. The number of users in RU r for MU-MIMO transmission is indicated together with the RU allocation as defined in RU allocation signaling. ¶

Documents WO 2016/087917 A1, US 2016/330300 A1 and KR 2016 0063282 A disclose other examples of the prior art. 2

[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.

[Technical Solution]

Embodiments of the invention include a wireless communication terminal in accordance with claim 1 and a wireless communication method of a wireless communication terminal in accordance with claim 9. Further embodiments are given in the dependent claims.

~~In order to achieve the objects, the present invention provides a wireless communication method and a wireless communication terminal as below.~~

~~The predetermined narrow band may include at least one of a left 106-tone and a right 106-tone.~~

~~A SIG-B compression field of the HE-SIG-A may indicate whether to perform a full bandwidth MU-MIMO transmission in which a common field is not present in an HE-SIG-B field when the UL/DL field indicates a downlink transmission. The SIG-B compression field of the HE-SIG-A may always indicate that the common field is not present in the HE-SIG-B field when the UL/DL field indicates an uplink transmission.~~

~~When a SIG-B compression field of the HE-SIG-A indicates a compression mode of an HE-SIG-B field, a number of HE-SIG-B symbols field in the HE-SIG-A may indicate information on the number of MU-MIMO users if the UL/DL field indicates a downlink transmission, and the number of HE-SIG-B symbols field in the HE-SIG-A may indicate information on the number of OFDM symbols in the HE-SIG-B field.~~

[Advantageous Effects]

~~According to an embodiment of the present invention, a~~ header field of a physical layer of a wireless LAN packet supporting simultaneous multi-user transmission in an indoor/outdoor environment can be efficiently configured.

~~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. ~~system according to an embodiment of the present invention.~~

FIG. 2 illustrates another wireless LAN system. ~~system according to another embodiment of~~

~~the present invention~~

FIG. 3 illustrates a configuration of a ⌐ station. ⌐ ~~station according to an embodiment of the present invention.~~

FIG. 4 illustrates a configuration of an access ⌐ point. ⌐ ~~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 a carrier sense multiple access (CSMA)/collision avoidance (CA) method used in wireless LAN communication.

FIG. 7 illustrates a method for performing a distributed coordination function (DCF) using a request to send (RTS) frame and a clear to send (CTS) frame.

FIGS. 8 and 9 illustrate multi-user transmission ⌐ methods. ⌐ ~~methods according to an embodiment of the present invention.~~

FIG. 10 illustrates an embodiment of a legacy PPDU format and a non-legacy PPDU format.

FIG. 11 illustrates various HE PPDU formats and an indication method ⌐ thereof. ⌐ ~~thereof according to an embodiment of the present invention.~~

FIG. 12 illustrates an embodiment of a configuration of an HE-SIG-A field according to the HE PPDU format.

FIG. 13 illustrates a configuration of an HE-SIG-B ⌐ field. ⌐ ~~field according to an embodiment of the present invention.~~

FIGS. 14 to 15 illustrate specific embodiments in which a single STA transmits an UL MU PPDU to an AP.

FIG. 16 illustrates an encoding structure and a transmission method of the ⌐ HE-SIG-B. ⌐ ~~HE-SIG-B according to an embodiment of the present invention.~~

FIG. 17 illustrates a non-contiguous channel allocation ⌐ method. ⌐ ~~method according to~~

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~~an embodiment of the present invention~~.

FIG. 18 illustrates a wideband access ƨ method. ƨ ~~method according an embodiment of the present invention.~~

FIG. 19 illustrates an embodiment of a method of exchanging and signaling BQRP and BQR for transmitting a non-contiguous PPDU.

FIG. 20 illustrates another embodiment of a method of transmitting and signaling BQR for transmitting a non-contiguous PPDU.

FIG. 21 illustrates a configuration of a ƨ BQR. ƨ ~~BQR according to an embodiment of the present invention.~~

[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

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appropriately substituted with "more than" or "less than", respectively.

This application claims priority to and the benefit of Korean Patent Application Nos. 10-2017-0003147 and 10-2017-0008927 filed in the Korean Intellectual Property Office.

~~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.

~~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 2 system. 2 ~~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

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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, ¬ ~~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. ¬ ~~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

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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. ƨ ▛ The ▟ ƨ

~~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. ƨ ▛ The ▟ ƨ

~~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. ƨ ▛ The ▟ ƨ

~~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

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220. The processor 210 controls various operations such as wireless signal transmission/reception of the AP 200. ~~200 according to the embodiment of the present invention.~~A detailed example ~~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.

FIG. 6 is a diagram illustrating a carrier sense multiple access (CSMA)/collision avoidance (CA) method used in wireless LAN communication.

A terminal that performs a wireless LAN communication checks whether a channel is busy by performing carrier sensing before transmitting data. When a wireless signal having a predetermined strength or more is sensed, it is determined that the corresponding channel is busy and the terminal delays the access to the corresponding channel. Such a process is referred to as clear channel assessment (CCA) and a level to decide whether the corresponding signal is sensed is referred to as a CCA threshold. When a wireless signal having the CCA threshold or more, which is received by the terminal, indicates the corresponding terminal as a receiver, the terminal processes the received wireless signal. Meanwhile, when a wireless signal is not sensed in the corresponding channel or a wireless signal having a strength smaller than the CCA threshold is sensed, it is determined that the channel is idle.

When it is determined that the channel is idle, each terminal having data to be transmitted performs a backoff procedure after an inter frame space (IFS) time depending on a situation of each terminal, for instance, an arbitration IFS (AIFS), a PCF IFS (PIFS), or the like elapses. According to the embodiment, the AIFS may be used as a component which substitutes for the existing DCF IFS (DIFS). Each terminal stands by while decreasing slot time(s) as long as a random number determined by the corresponding terminal during an interval of an idle state of the channel and a terminal that completely exhausts the slot time(s) attempts to access the corresponding channel. As such, an interval in which each terminal performs the backoff procedure is referred to as a contention window interval.

When a specific terminal successfully accesses the channel, the corresponding

terminal may transmit data through the channel. However, when the terminal which attempts the access collides with another terminal, the terminals which collide with each other are assigned with new random numbers, respectively to perform the backoff procedure again. According to an embodiment, a random number newly assigned to each terminal may be decided within a range (2*CW) which is twice larger than a range (a contention window, CW) of a random number which the corresponding terminal is previously assigned. Meanwhile, each terminal attempts the access by performing the backoff procedure again in a next contention window interval and in this case, each terminal performs the backoff procedure from slot time(s) which remained in the previous contention window interval. By such a method, the respective terminals that perform the wireless LAN communication may avoid a mutual collision for a specific channel.

FIG. 7 is a diagram illustrating a method for performing a distributed coordination function using a request to send (RTS) frame and a clear to send (CTS) frame.

The AP and STAs in the BSS contend in order to obtain an authority for transmitting data. When data transmission at the previous step is completed, each terminal having data to be transmitted performs a backoff procedure while decreasing a backoff counter (alternatively, a backoff timer) of a random number assigned to each terminal after an AFIS time. A transmitting terminal in which the backoff counter expires transmits the request to send (RTS) frame to notify that corresponding terminal has data to transmit. According to an exemplary embodiment of FIG. 7, STA1 which holds a lead in contention with minimum backoff may transmit the RTS frame after the backoff counter expires. The RTS frame includes information on a receiver address, a transmitter address, and duration. A receiving terminal (i.e., the AP in FIG. 7) that

receives the RTS frame transmits the clear to send (CTS) frame after waiting for a short IFS (SIFS) time to notify that the data transmission is available to the transmitting terminal STA1. The CTS frame includes the information on a receiver address and duration. In this case, the receiver address of the CTS frame may be set identically to a transmitter address of the RTS frame corresponding thereto, that is, an address of the transmitting terminal STA1.

The transmitting terminal STA1 that receives the CTS frame transmits the data after a SIFS time. When the data transmission is completed, the receiving terminal AP transmits an acknowledgment (ACK) frame after a SIFS time to notify that the data transmission is completed. When the transmitting terminal receives the ACK frame within a predetermined time, the transmitting terminal regards that the data transmission is successful. However, when the transmitting terminal does not receive the ACK frame within the predetermined time, the transmitting terminal regards that the data transmission is failed. Meanwhile, adjacent terminals that receive at least one of the RTS frame and the CTS frame in the course of the transmission procedure set a network allocation vector (NAV) and do not perform data transmission until the set NAV is terminated. In this case, the NAV of each terminal may be set based on a duration field of the received RTS frame or CTS frame.

In the course of the aforementioned data transmission procedure, when the RTS frame or CTS frame of the terminals is not normally transferred to a target terminal (i.e., a terminal of the receiver address) due to a situation such as interference or a collision, a subsequent process is suspended. The transmitting terminal STA1 that transmitted the RTS frame regards that the data transmission is unavailable and participates in a next contention by being assigned with a new random number. In this case, the newly assigned random number may be determined within a range (2*CW)

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twice larger than a previous predetermined random number range (a contention window, CW).

Basic sequence of UL-MU/DL-MU transmission

FIGS. 8 and 9 illustrate multi-user transmission methods. ~~methods according to an embodiment of the present invention.~~ When using orthogonal frequency division multiple access (OFDMA) or multi-input multi-output (MIMO), one wireless communication terminal can simultaneously transmit data to a plurality of wireless communication terminals. Further, one wireless communication terminal can simultaneously receive data from a plurality of wireless communication terminals. For example, a downlink multi-user (DL-MU) transmission in which an AP simultaneously transmits data to a plurality of STAs, and an uplink multi-user (UL-MU) transmission in which a plurality of STAs simultaneously transmit data to the AP may be performed.

FIG. 8 illustrates a UL-MU transmission process. ~~process according to an embodiment of the present invention.~~ In order to perform the UL-MU transmission, the channel to be used and the transmission start time of each STA that performs uplink transmission should be adjusted. In order to efficiently schedule the UL-MU transmission, state information of each STA needs to be transmitted to the AP. Information ~~According to an embodiment of the present invention, information~~ for scheduling of a UL-MU transmission may be indicated through a predetermined field of a preamble of a packet and/or a predetermined field of a MAC header. For example, a STA may indicate information for UL-MU transmission scheduling through a predetermined field of a preamble or a MAC header of an uplink transmission packet, and may transmit the information to an AP. In this case, the information for UL-MU transmission scheduling includes at least one of buffer status information of each STA, and channel state information measured by each STA. The buffer status information of the STA may

indicate at least one of whether the STA has uplink data to be transmitted, the access category (AC) of the uplink data and the size (or the transmission time) of the uplink data.

The ~~According to an embodiment of the present invention, the~~ UL-MU transmission process may be managed by the AP. The UL-MU transmission may be performed in response to a trigger frame transmitted by the AP. The STAs simultaneously transmit uplink data a predetermined IFS (e.g., SIFS) time after receiving the trigger frame. The trigger frame solicits UL-MU transmission of STAs and may inform channel (or subchannel) information allocated to the uplink STAs. Upon receiving the trigger frame from the AP, a plurality of STAs transmit uplink data through each allocated channel (or, subchannel) in response thereto. After the uplink data transmission is completed, the AP transmits an ACK to the STAs that have successfully transmitted the uplink data. In this case, the AP may transmit a predetermined multi-STA block ACK (M-BA) as an ACK for a plurality of STAs.

In the non-legacy wireless LAN system, subcarriers of a specific number, for example, 26, 52, or 106 tones may be used as a resource unit (RU) for a subchannel-based access in a channel of 20 MHz band. Accordingly, the trigger frame may indicate identification information of each STA participating in the UL-MU transmission and information of the allocated resource unit. The identification information of the STA includes at least one of an association ID (AID), a partial AID, and a MAC address of the STA. Further, the information of the resource unit includes the size and placement information of the resource unit.

On the other hand, in the non-legacy wireless LAN system, a UL-MU transmission may be performed based on a contention of a plurality of STAs for a specific resource unit. For example, if an AID field value for a specific resource unit is

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set to a specific value (e.g., 0) that is not assigned to STAs, a plurality of STAs may attempt random access (RA) for the corresponding resource unit.

FIG. 9 illustrates a DL-MU transmission process. ~~process according to an embodiment of the present invention. According to an embodiment of the present invention, RTS~~ and/or CTS frames of a predetermined format may be used for NAV setting in the DL-MU transmission process. First, the AP transmits a multi-user RTS (MU-RTS) frame for NAV setting in the DL-MU transmission process. The duration field of the MU-RTS frame is set to a time until the end of the DL-MU transmission session. That is, the duration field of the MU-RTS frame is set based on a period until the downlink data transmission of the AP and ACK frame transmissions of the STAs are completed. The neighboring terminals of the AP set a NAV until the end of the DL-MU transmission session based on the duration field of the MU-RTS frame transmitted by the AP. The ~~According to an embodiment, the~~ MU-RTS frame may be configured in the format of a trigger frame and requests simultaneous CTS (sCTS) frame transmissions of the STAs.

STAs (e.g., STA1 and STA2) receiving the MU-RTS frame from the AP transmit the sCTS frame. The sCTS frames transmitted by a plurality of STAs have the same waveform. That is, the sCTS frame transmitted by the STA1 on the first channel has the same waveform as the sCTS frame transmitted by the STA2 on the first channel. According to an embodiment, the sCTS frame is transmitted on the channel indicated by the MU-RTS frame. The duration field of the sCTS frame is set to a time until the DL-MU transmission session is terminated based on the information of the duration field of the MU-RTS frame. That is, the duration field of the sCTS frame is set based on the period until the downlink data transmission of the AP and the ACK frame transmissions of the STAs are completed. In FIG. 9, neighboring terminals of STA1 and STA2 set a NAV until the end of the DL-MU transmission session based on the duration field of the

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sCTS frame.

The

~~According to an embodiment of the present invention, the~~ MU-RTS frame and the sCTS frame may be transmitted on a 20 MHz channel basis. Accordingly, the neighboring terminals including legacy terminals can set the NAV by receiving the MU-RTS frame and/or the sCTS frame. When the transmission of the MU-RTS frame and the sCTS frame is completed, the AP performs a downlink transmission. FIG. 9 illustrates that

~~an embodiment in which~~ the AP transmits DL-MU data to STA1 and STA2, respectively. The STAs receive the downlink data transmitted by the AP and transmit an uplink ACK in response thereto.

PPDU format

FIG. 10 illustrates ~~an embodiment of~~ a legacy PHY Protocol Data Unit (PPDU) format and a non-legacy PPDU format. More specifically, FIG. 10(a) illustrates ~~an embodiment of~~ a legacy PPDU format based on 802.11a/g, and FIG. 10(b) illustrates ~~an embodiment of~~ a non-legacy PPDU based on 802.11ax. In addition, FIG. 10(c) illustrates the detailed field configuration of L-SIG and RL-SIG commonly used in the PPDU formats.

Referring to FIG. 10(a), the preamble of the legacy PPDU includes a legacy short training field (L-STF), a legacy long training field (L-LTF), and a legacy signal field (L-SIG). The

~~In an embodiment of the present invention, the~~ L-STF, L-LTF and L-SIG may be referred to as a legacy preamble. Referring to FIG. 10(b), the preamble of the HE PPDU includes a repeated legacy short training field (RL-SIG), a high efficiency signal A field (HE-SIG-A), a high efficiency signal B field, a high efficiency short training field (HE-STF), and a high efficiency long training field (HE-LTF) in addition to the legacy preamble. The

~~In an embodiment of the present invention, the~~ RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF and HE-LTF may be referred to as a non-legacy preamble.

The detailed configuration of the non-legacy preamble may be modified according to the HE PPDU format. For example, HE-SIG-B may only be used in some formats among the HE PPDU formats.

A 64 FFT OFDM is applied to the L-SIG included in the preamble of the PPDU and the L-SIG consists of 64 subcarriers in total. Among these, 48 subcarriers excluding guard subcarriers, a DC subcarrier and pilot subcarriers are used for data transmission of the L-SIG. If a modulation and coding scheme (MCS) of BPSK, Rate = 1/2 is applied, the L-SIG may include information of a total of 24 bits. FIG. 10(c) illustrates a configuration of 24-bit information of the L-SIG.

Referring to FIG. 10(c), the L-SIG includes an L_RATE field and an L_LENGTH field. The L_RATE field consists of 4 bits and represents the MCS used for data transmission. More specifically, the L_RATE field represents one of the transmission rates of 6/9/12/18/24/24/36/48/54Mbps by combining the modulation scheme such as BPSK/QPSK/16-QAM/64-QAM with the code rate such as 1/2, 2/3, 3/4. When combining the information of the L_RATE field and the L_LENGTH field, the total length of the corresponding PPDU can be represented. The non-legacy PPDU sets the L_RATE field to a 6 Mbps which is the minimum rate.

The L_LENGTH field consists of 12 bits, and may represent the length of the corresponding PPDU by a combination with the L_RATE field. In this case, the legacy terminal and the non-legacy terminal may interpret the L_LENGTH field in different ways.

First, a method of interpreting the length of a PPDU using a L_LENGTH field by a legacy terminal or a non-legacy terminal is as follows. When the L_RATE field is set to 6 Mbps, 3 bytes (i.e., 24 bits) can be transmitted for 4 us, which is one symbol duration of 64 FFT. Therefore, by adding 3 bytes corresponding to the SVC field and

the Tail field to the value of the L_LENGTH field and dividing it by 3 bytes, which is the transmission amount of one symbol, the number of symbols after the L-SIG is obtained on the 64FFT basis. The length of the corresponding PPDU, that is, the reception time (i.e., RXTIME) is obtained by multiplying the obtained number of symbols by 4us, which is one symbol duration, and then adding a 20us which is for transmitting L-STF, L-LTF and L-SIG. This can be expressed by the following Equation 1.

[Equation 1]

$$\mathbf{PPDU\_LENGTH(us)} = \left(\mathbf{1} + \left\lceil \frac{\mathbf{L\_LENGTH}}{\mathbf{3}} \right\rceil\right) \times \mathbf{4} + \mathbf{20}$$

In this case, $\lceil x \rceil$ denotes the smallest natural number greater than or equal to x. Since the maximum value of the L_LENGTH field is 4095, the length of the PPDU can be set up to 5.464ms. The non-legacy terminal transmitting the PPDU should set the L_LENGTH field as shown in Equation 2 below.

[Equation 2]

$$\mathbf{RXTIME(us)} = \left(\left\lceil \frac{\mathbf{L\_LENGTH+3}}{\mathbf{3}} \right\rceil\right) \times \mathbf{4} + \mathbf{20}$$

Herein, TXTIME is the total transmission time constituting the corresponding PPDU, and is expressed by Equation 3 below. In this case, TX represents the transmission time of X.

[Equation 3]

$$\mathbf{L\_LENGTH(byte)} = \left(\left\lceil \frac{\mathbf{TXTIME-20}}{\mathbf{4}} \right\rceil\right) \times \mathbf{3} - \mathbf{3}$$

With reference to the above equations, the length of the PPDU is calculated based on the round-up value of L_LENGTH/3. Therefore, for any value of k, three

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different values of L_LENGTH = {3k+1, 3k+2, 3(k+1)} indicate the same PPDU length. According to an embodiment of the present invention, the non-legacy terminal may perform additional signaling using three different L_LENGTH values indicating the same PPDU length information. More specifically, values corresponding to 3k+1 and 3k+2 among the three different L_LENGTH values may be used to indicate the HE PPDU format.

FIG. 11 illustrates various HE PPDU formats and an indication method thereof. ~~thereof according to an embodiment of the present invention. According to an embodiment of the present invention, the~~ HE PPDU format may be indicated based on the L_LENGTH field and HE-SIG-A of the corresponding PPDU. More specifically, the HE PPDU format is indicated based on at least one of the value of the L_LENGTH field and the modulation scheme applied to the HE-SIG-A symbol.

First, referring to FIG. 11(a), when the value of the L_LENGTH field is 3k+1 (i.e., when mod3 = 1), the corresponding PPDU is an HE SU PPDU or an HE Trigger-based PPDU. The HE SU PPDU is a PPDU used for a single-user transmission between an AP and a single STA. Furthermore, the HE Trigger-based PPDU is an uplink PPDU used for a transmission that is a response to a trigger frame. HE SU PPDU and HE Trigger-based PPDU have the same preamble format. In the cases of the HE SU PPDU and the HE Trigger-based PPDU, two symbols of HE-SIG-A are modulated with BPSK and BPSK, respectively.

According to ~~a further embodiment of the present invention illustrated in~~ FIG. 11(b), when the value of the L_LENGTH field is 3k+1 and the two symbols of HE-SIG-A are modulated with BPSK and QBPSK, respectively, the corresponding PPDU is an extended PPDU. The extended PPDU is used as a new PPDU format other than the PPDU formats supported by 802.11ax.

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Next, when the value of the L_LENGTH field is 3k+2 (i.e., when mod3 = 2), the corresponding PPDU is an HE MU PPDU or an HE Extended Range (ER) SU PPDU. The HE MU PPDU is a PPDU used for a transmission to one or more terminals. The HE MU PPDU format is illustrate in FIG. 11(c) and additionally includes HE-SIG-B in the non-legacy preamble. In the case of the HE MU PPDU, the two symbols of HE-SIG-A are modulated with BPSK and BPSK, respectively. On the other hand, HE ER SU PPDU is used for a single-user transmission with a terminal in an extended range. The HE ER SU PPDU format is illustrated in FIG. 11(d), where HE-SIG-A of the non-legacy preamble is repeated on the time axis. In the case of the HE ER SU PPDU, the first two symbols of HE-SIG-A are modulated with BPSK and QBPSK, respectively. Thus, the non-legacy terminal can signal the PPDU format through the modulation scheme used for the two symbols of HE-SIG-A in addition to the value of the L_LENGTH field.

The HE MU PPDU illustrated in FIG. 11(c) may be used by an AP to perform a downlink transmission to a plurality of STAs. In this case, the HE MU PPDU may include scheduling information for a plurality of STAs to simultaneously receive the corresponding PPDU. In addition, the HE MU PPDU may be used by a single STA to perform an uplink transmission to the AP. In this case, the HE MU PPDU may transmit AID information of the receiver and/or the transmitter of the corresponding PPDU through a user specific field of the HE-SIG-B. Therefore, terminals receiving the HE MU PPDU may perform a spatial reuse operation based on the AID information obtained from the preamble of the corresponding PPDU. In addition, data transmission through some narrowband may be performed using the HE MU PPDU. Here, the narrowband may be a frequency band of less than 20 MHz. 2 The 2 ~~According to an embodiment, the~~ HE MU PPDU may indicate allocation information of resource unit(s)

to be used for a narrowband transmission through the HE-SIG-B.

More specifically, the resource unit allocation (RA) field of HE-SIG-B contains information on the resource unit partition type in a specific bandwidth (e.g., 20 MHz) of the frequency domain. Further, information of a STA assigned to each partitioned resource unit may be transmitted through the user specific field of the HE-SIG-B. The user specific field includes one or more user fields corresponding to each partitioned resource unit.

When a narrowband transmission using a part of the partitioned resource units is performed, the resource unit used for the transmission may be indicated through the user specific field of the HE-SIG-B. 2 An 2

~~According to an embodiment, an~~ AID of a receiver or a transmitter may be contained in a user field corresponding to resource unit(s) on which data transmission is performed among a plurality of partitioned resource units. In addition, a predetermined Null STA ID may be contained in user field(s) corresponding to the remaining resource unit(s) in which data transmission is not performed. 2 The 2

~~According to another embodiment of the present invention, the~~ narrowband transmission may be signaled through a first user field corresponding to a resource unit in which data transmission is not performed and a second user field corresponding to a resource unit in which data transmission is performed. More specifically, a predetermined null STA ID may be contained in the first user field, and the placement information of the resource unit(s) on which data transmission is performed may be indicated through the remaining subfields of the corresponding user field. Next, the AID of the receiver or transmitter may be contained in the second user field. Thus, the terminal may signal the narrowband transmission through the location information contained in the first user field and the AID information contained in the second user field. In this case, since user fields less than the number of partitioned resource units are

used, the signaling overhead can be reduced.

Configuration of HE-SIG-A field and HE-SIG-B field in an HE PPDU

FIG. 12 illustrates ~~an embodiment of~~ a configuration of an HE-SIG-A field according to the HE PPDU format. HE-SIG-A consists of two symbols of 64 FFT, and indicates common information for reception of the HE PPDU. The first symbol of the HE-SIG-A is modulated with BPSK, and the second symbol of the HE-SIG-A is modulated with BPSK or QBPSK. In the HE ER SU PPDU, two symbols of the HE-SIG-A may be repeatedly transmitted. That is, the HE-SIG-A of the HE ER SU PPDU consists of four symbols, the first symbol and the second symbol of which have the same data bit, and the third symbol and the fourth symbol of which have the same data bit.

First, FIG. 12(a) illustrates a subfield configuration of the HE-SIG-A field of the HE SU PPDU. According to an embodiment, the HE-SIG-A field of the HE ER SU PPDU may be configured similarly. The function of each field included in HE-SIG-A will be described as follows.

The UL/DL field indicates a transmission direction of the corresponding PPDU. That is, the corresponding field indicates whether the corresponding PPDU is transmitted with uplink or is transmitted with downlink. The format field is used to differentiate an HE SU PPDU from an HE Trigger-based PPDU. The BSS color field consists of 6 bits and indicates an identifier of the BSS corresponding to a terminal that transmitted the corresponding PPDU. The spatial reuse field carries information such as signal to interference plus noise ratio (SINR), transmission power, etc., which can be referred to by terminals to perform spatial reuse transmission during the transmission of the corresponding PPDU.

The TXOP duration field indicates duration information for TXOP protection

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and NAV setting. The corresponding field sets the duration of the TXOP interval in which consecutive transmission is to be performed after the corresponding PPDU, so that the neighboring terminals set a NAV for the corresponding duration. The bandwidth field indicates the total bandwidth in which the corresponding PPDU is transmitted. 2 The 2

~~According to an embodiment, the~~ bandwidth field may consist of 2 bits and indicate one of 20 MHz, 40 MHz, 80 MH and 160 MHz (including 80+80 MHz). The MCS field indicates an MCS value applied to the data field of the corresponding PPDU. The CP+LTF size field indicates the duration of the cyclic prefix (CP) or guard interval (GI) and the size of the HE-LTF. More specifically, the corresponding field indicates the combination of the HE-LTF size used among 1x, 2x, and 4x HE-LTF, and the CP (or GI) value used in the data field among 0.8us, 1.6us, and 3.2us.

The coding field may indicate which coding scheme is used between binary convolutional code (BCC) and low density parity check (LDPC). In addition, the corresponding field may indicate whether an extra OFDM symbol for LDPC is present. The number of space time streams (NSTS) field indicates the number of space-time streams used for MIMO transmission. The space time block coding (STBC) field indicates whether space-time block coding is used. The transmit beamforming (TxBF) field indicates whether beamforming is applied to the transmission of the corresponding PPDU. The dual carrier modulation (DCM) field indicates whether dual carrier modulation is applied to the data field. The dual carrier modulation transmits the same information through two subcarriers in order to cope with narrowband interference. The packet extension field indicates which level of packet extension is applied to the PPDU. The beam change field indicates whether the part before the HE-STF of the corresponding PPDU is mapped spatially different from the HE-LTF. The CRC field and the tail field are used to determine the authenticity of the HE-SIG-A field

information and to initialize the BCC decoder, respectively.

Next, FIG. 12(b) illustrates a subfield configuration of the HE-SIG-A field of the HE MU PPDU. Among the subfields shown in FIG. 12(b), the same subfields as those shown in FIG. 12(a) will not be described.

The UL/DL field indicates the transmission direction of the corresponding PPDU. That is, the corresponding field indicates whether the corresponding PPDU is transmitted with uplink or is transmitted with downlink. The bandwidth field of the HE MU PPDU may indicate extra bandwidths in addition to the bandwidths of the HE SU PPDU. That is, the bandwidth field of the HE MU PPDU consists of 3 bits and indicates one of 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz), and predetermined non-contiguous bands. The specific embodiments of the predetermined non-contiguous bands will be described later.

The SIG-B MCS field indicates the MCS applied to the HE-SIG-B field. Depending on the amount of information that requires signaling, variable MCS between MSC0 and MSC5 can be applied to the HE-SIG-B. The CP+LTF size field indicates the duration of the CP or GI and the size of the HE-LTF. The corresponding field indicates the combination of the HE-LTF size used among 2x and 4x HE-LTF, and the CP (or GI) value used in the data field among 0.8us, 1.6us, and 3.2us.

The SIG-B compression field indicates whether to use a compression mode of the HE-SIG-B field. When the HE MU PPDU is transmitted using an MU-MIMO in the full bandwidth, the resource unit allocation information for each 20 MHz band becomes unnecessary. Therefore, in the full bandwidth MU-MIMO transmission, the SIG-B compression field indicates the compression mode of the HE-SIG-B field. In this case, the common field containing the resource unit allocation field is not present in the HE-SIG-B field. The SIG-B DCM field indicates whether the HE-SIG-B field is modulated

with the DCM for reliable transmission of the HE-SIG-B field. The number of HE-SIG-B symbols field indicates information on the number of OFDM symbols in the HE-SIG-B field.

On the other hand, when the HE MU PPDU is transmitted in a band of 40 MHz or more as described later, the HE-SIG-B may consist of two kinds of content channels in units of 20 MHz. The content channels are referred to as HE-SIG-B content channel 1 and HE-SIG-B content channel 2, respectively. 2 The 2

~~According to an embodiment of the present invention, the~~number of HE-SIG-B symbols in each channel can be kept similar by differentiating MCSs applied to the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2, respectively. The HE-SIG-A field of the HE MU PPDU may include a SIG-B dual MCS field. In this case, it is indicated through the corresponding field whether the MCSs applied to the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 are different with each other.

2 When 2

~~According to the embodiment of the present invention, when~~ the SIG-B compression field indicates the compression mode of the HE-SIG-B field (i.e., when the full bandwidth MU-MIMO transmission is indicated), a specific field of the HE-SIG-A may indicate information on the number of MU-MIMO users. For example, when the full bandwidth MU-MIMO transmission is performed, the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 do not need to distribute the amount of information through different MCSs. Therefore, when the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the SIG-B dual MCS field of the HE-SIG-A may indicate information on the number of MU-MIMO users. Likewise, when the full bandwidth MU-MIMO transmission is performed, information on the number of symbols in each HE-SIG-B content channel need not be delivered separately. Therefore, when the SIG-B compression field indicates the compression mode of the

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HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the information on the number of MU-MIMO users. As described above, in the compression mode in which the resource unit allocation field of the HE-SIG-B is omitted, information on the number of MU-MIMO users may be indicated through a specific subfield of the HE-SIG-A.

According to a further embodiment of the present invention, some of the subfields of the HE-SIG-A field of the HE MU PPDU may signal information different from the above teaching ~~embodiments~~ through a combination of a plurality of subfields. As described above, the HE MU PPDU may not only be used by the AP to perform a downlink transmission to a plurality of STAs, but may also be used by a single STA to perform an uplink transmission to the AP. Information ~~According to an embodiment of the present invention, information~~ based on the value indicated by the UL/DL field, the specific subfield of the HE-SIG-A field of the HE MU PPDU may be set differently from each other or indicate different information.

First, the bandwidth field may indicate different information based on the value indicated by the UL/DL field. When the UL/DL field indicates downlink transmission, the bandwidth field indicates any one of 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz), and predetermined non-contiguous bands. In a 3-bit bandwidth field, values of 0 to 3 indicate 20 MHz, 40 MHz, 80 MHz, and 160 MHz (including 80+80 MHz), respectively, and any one of values 4 to 7 indicates one of the predetermined non-contiguous bands. However, a PPDU with non-contiguous bandwidth may only be used for downlink transmission. Therefore, specific values of the bandwidth field (i.e., one or more values among 4 to 7) may indicate different information between when the UL/DL field indicates downlink transmission and when it indicates uplink transmission.

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For example, if the UL/DL field indicates an uplink transmission, the bandwidth field indicates any one of 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz), and a predetermined narrow bandwidths. That is, in the 3-bit bandwidth field, values of 0 to 3 indicate 20 MHz, 40 MHz, 80 MHz, and 160 MHz (including 80+80 MHz), respectively, and any one of values 4 to 7 may indicate one of the predetermined narrow bandwidths. The ~~According to an embodiment, the~~ predetermined narrow bandwidth may include a left-106-tone and a right-106-tone. In this case, among the 242-tone constituting a 20 MHz primary channel, the left-106-tone indicates the low-frequency 106-tone resource unit, and the right-106-tone indicates the high-frequency 106-tone resource unit. However, the present invention is not limited thereto, and the predetermined narrow bandwidth may include one or more of a 26-tone resource unit, a 52-tone resource unit, a 106-tone resource unit, or a combination thereof.

As described above, data transmission through a predetermined narrowband within the 20 MHz band may be performed when the UL MU PPDU is transmitted. The allocation information of the resource unit to be used for the narrowband transmission may be indicated through the resource unit allocation field and the user specific field of the HE-SIG-B. However, in this case, the signaling overhead may be large. Thus, ~~according to an embodiment of the present invention,~~ the uplink narrowband transmission may be indicated through the bandwidth field of the HE-SIG-A of the HE MU PPDU.

Next, the SIG-B compression field may be set differently based on the value indicated by the UL/DL field. The SIG-B compression field indicates whether to use the compression mode of the HE-SIG-B field. When the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the common field containing the resource unit allocation field is not present in the HE-SIG-B field. ~~According to the embodiment~~

The ~~of the present invention, the~~ SIG-B compression field may be set according to different rules between when the UL/DL field indicates downlink transmission and when it indicates uplink transmission.

More specifically, when the UL/DL field indicates downlink transmission, the SIG-B compression field indicates whether to perform the full bandwidth MU-MIMO transmission. That is, when the full-bandwidth MU-MIMO transmission is performed, the value of the SIG-B compression field is set to 1. Otherwise, the value of the SIG-B compression field is set to 0. However, the signaling of the resource unit allocation field may be unnecessary when a UL MU PPDU is transmitted by a single STA. Therefore, when the UL/DL field indicates uplink transmission, the value of the SIG-B compression field may be always set to 1. That is, when the UL/DL field indicates uplink transmission, the SIG-B compression field may always indicate that the common field is not present in the HE-SIG-B field. Although the full bandwidth MU-MIMO transmission is not performed, the compression mode of the HE-SIG-B field may be used to reduce the signaling overhead of the HE-SIG-B of the uplink transmission. Therefore, the common field may be omitted from the HE-SIG-B field of the UL MU PPDU.

According to the embodiments of the invention, ~~Next,~~ the number of HE-SIG-B symbols field indicates ~~may indicate~~ different information based at least in part on the value indicated by the UL/DL field. More specifically, the number of HE-SIG-B symbols field indicates ~~may indicate~~ different information based on the value indicated by the UL/DL field and the value of the SIG-B compression field.

The number of HE-SIG-B symbols field basically indicates the number of OFDM symbols in the HE-SIG-B field. However, as in the ~~embodiments~~ examples described above, when the UL/DL field indicates downlink transmission and the SIG-B

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compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A ⌜ indicates ⌟ ~~may indicate~~ the information on the number of MU-MIMO user. In this case, the user specific field of the HE-SIG-B field ⌜ consists ⌟ ~~may consist~~ of a user field for MU-MIMO allocation. Meanwhile, when the value of the SIG-B compression field in the UL MU PPDU is set to 1, it may be intended to omit the resource unit allocation field rather than to indicate the full bandwidth MU-MIMO transmission. Therefore, when the UL/DL field indicates uplink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A ⌜ indicates ⌟ ~~may indicate~~ the number of OFDM symbols in the HE-SIG-B field as in the basic definition. In this case, the user specific field of the HE-SIG-B field ⌜ consists ⌟ ~~may consist~~ of a user field for non-MU-MIMO allocation. ⌜ Since ⌟ ~~According to an embodiment, since~~ the UL MU PPDU is transmitted to a single AP, the user specific field of the HE-SIG-B field may include only one user field for the non-MU-MIMO allocation.

Next, FIG. 12(c) illustrates a subfield configuration of the HE-SIG-A field of the HE trigger-based PPDU. Among the subfields shown in FIG. 12(c), the same subfields as those shown in FIG. 12(a) or 12(b) will not be described.

The format field is used to differentiate an HE SU PPDU from an HE Trigger-based PPDU. Also, the HE Trigger-based PPDU includes the above-described BSS color field and TXOP duration field. The spatial reuse field of the HE Trigger-based PPDU consists of 16 bits and carries information for spatial reuse operation in units of 20 MHz or 40 MHz according to the total bandwidth. The bandwidth field consists of 2 bits and may indicate one of 20 MHz, 40 MHz, 80 MHz and 160 MHz (including 80+80 MHz).

FIG. 13 illustrates a configuration of an HE-SIG-B ⌜ field. ⌟ ~~field according to an~~

~~embodiment of the present invention.~~ The HE-SIG-B field is present in the HE MU PPDU and is transmitted in units of 20 MHz. In addition, the HE-SIG-B field indicates information necessary for receiving the HE MU PPDU. As illustrated in FIG. 13(a), the HE-SIG-B consists of a common field and a user specific field.

FIG. 13(b) illustrates ~~an embodiment of~~ a subfield configuration of the common field of the HE-SIG-B. First, the common field includes a resource unit allocation (RA) field. FIG. 13(c) illustrates an embodiment of the RA field.

Referring to FIG. 13(c), the RA field contains information on resource unit allocation of a specific bandwidth (e.g., 20 MHz) in the frequency domain. More specifically, the RA field consists in units of 8 bits, and indexes the size of the resource units constituting the specific bandwidth and their placement in the frequency domain. Further, the RA field may indicate the number of users in each resource unit. When the total bandwidth through which the PPDU is transmitted is greater than a predetermined bandwidth (e.g., 40 MHz), the RA field may be set to a multiple of 8 bits to carry information in units of the specific bandwidth.

Each partitioned resource unit is generally assigned to one user. However, resource units of a certain bandwidth (e.g., 106-tones) or more can be assigned to a plurality of users using MU-MIMO. In this case, the RA field may indicate the number of users in the corresponding resource unit. In addition, the RA field may indicate, through a predetermined index, a specific resource unit in which a user specific field is not transmitted, i.e., a specific resource unit (i.e., an empty RU) that is not assigned to the user. ~~According to an embodiment, the~~ The specific resource unit includes a resource unit (RU) having a bandwidth of a multiple of 20 MHz channels, i.e., 242-tone RU, 484-tone RU, 996-tone RU, and the like. In an empty RU indicated by the index value, data transmission is not performed. In this manner, the terminal may signal non-

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contiguous channel allocation information in units of 20 MHz through a predetermined index of the RA field of the HE-SIG-B.

When

~~According to an embodiment of the present invention, when~~ a PPDU is transmitted through a total bandwidth of 80 MHz or more, the common field further includes a field (hereinafter, referred to as C26 field) indicating whether a user is allocated to a center 26-tone RU of 80 MHz. The C26 field may consist of a 1-bit indicator before or after the RA field in the common field.

On the other hand, the user specific field consists of a plurality of user fields, and carries information for a designated STA to each allocated resource unit. The total number of user fields to be included in the user specific field may be determined based on the RA field and the C26 field. A plurality of user fields are transmitted in units of a user block field. The user block field is made up of an aggregation of two user fields, a CRC field and a tail field. Depending on the total number of user fields, the last user block field may contain information for one or two STAs. For example, if a total of three users (i.e., STA1, STA2, and STA3) are designated, information for STA1 and STA2 may be coded and transmitted along with the CRC/tail field in the first user block field, and information for STA3 may be coded and transmitted along with the CRC/tail field in the last user block field.

FIGS. 13(d)-1 and 13(d)-2 illustrate examples ~~embodiments~~ of the subfield configuration of the user field of the HE-SIG-B, respectively. FIG. 13(d)-1 illustrates a user field for an OFDMA transmission, and FIG. 13(d)-2 illustrates a user field for a MU-MIMO transmission. Each user field indicates a receiver AID of the corresponding resource unit. Exceptionally, when the HE MU PPDU is used for an uplink transmission, the user field may indicate a transmitter AID. When one user is allocated to one resource unit (i.e., non-MU-MIMO allocation), the user field includes a number of

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spatial streams (NSTS) field, a TxBF field, an MCS field, a DCM field and a coding field as illustrated in FIG. 13(d)-1. On the other hand, when a plurality of users are allocated to one resource unit (i.e., MU-MIMO allocation), the user field includes a spatial configuration field (SCF), an MCS field, a DCM field, and a coding field as illustrated in FIG. 13(d)-2. Each STA that receives a PPDU through an MU-MIMO allocation should identify the location and number of spatial streams for it in the corresponding resource unit. To this end, the user field for the MU-MIMO transmission includes a spatial configuration field (SCF).

FIG. 13(e) illustrates ~~an embodiment of~~ the SCF of the HE-SIG-B. The SCF indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation. Each STA identifies the OFDMA and/or MIMO allocation of the corresponding PPDU through the RA field and identifies whether the STA receives data through the MU-MIMO allocation according to the order indicated in the user specific field. When the STA receives data through the non-MU-MIMO allocation, the user field is interpreted according to the format of FIG. 13(d)-1. However, when the STA receives data through the MU-MIMO allocation, the user field is interpreted according to the format of FIG. 13(d)-2. On the other hand, when the SIG-B compression field indicates the full bandwidth MU-MIMO, the RA field is not present in the HE-SIG-B. In this case, since all the STAs signaled in the user specific field receive data through the MU-MIMO allocation, the STAs interpret the user field according to the format of FIG. 13(d)-2.

As described in the above 2 examples, 2 ~~embodiments,~~ when the SIG-B compression field indicates the full bandwidth MU-MIMO, the specific subfield of the HE-SIG-A may indicate the information on the number of MU-MIMO users. That is, when the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number

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of HE-SIG-B symbols field of the HE-SIG-A may indicate the information on the number of MU-MIMO users. 2 When 2

~~According to a further embodiment of the present invention, when~~ the SIG-B compression field indicates the full bandwidth MU-MIMO, the configuration of the user specific field of the HE-SIG-B may be identified based on the information on the number of MU-MIMO users indicated by the number of HE-SIG-B symbols field. For example, the type of the user field constituting the user specific field may be determined to be either a user field for MU-MIMO allocation or a user field for non-MU-MIMO allocation based on the information on the number of MU-MIMO users.

More specifically, when the SIG-B compression field indicates the full bandwidth MU-MIMO and the number of HE-SIG-B symbols field indicates two or more users, the user specific field of the HE-SIG-B consists of user fields for MU-MIMO allocation. 2 The 2

~~According to an embodiment, the~~ number of HE-SIG-B symbols field may be set to a value of 1 or more when it indicates two or more users. In this case, the receiving terminal of the corresponding PPDU may receive data through the MU-MIMO allocation.

However, when the SIG-B compression field indicates the full bandwidth MU-MIMO and the number of HE-SIG-B symbols field indicates a single user, the user specific field of the HE-SIG-B consists of one user field for non-MU-MIMO allocation. 2 The 2

~~According to an embodiment, the~~ number of HE-SIG-B symbols field may be set to 0 when it indicates a single user. In this case, the receiving terminal of the corresponding PPDU may receive data through non-MU-MIMO allocation. It is because the transmission is not interpreted as an MU-MIMO transmission when the SIG-B compression field indicates full bandwidth MU-MIMO but a single recipient is indicated. When only one user is allocated for MU-MIMO transmission, spatial stream

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information for the single user cannot be signaled through the SCF of the user field for MU-MIMO allocation shown in FIGS. 13(d) and 13(e). Thus, when the full bandwidth MU-MIMO is indicated with a single user, the user specific field of the HE-SIG-B may consist of a user field for non-MU-MIMO allocation. The configuration of the user specific field of the HE-SIG-B based on the information on the number of MU-MIMO users can be applied to both the uplink and downlink MU PPDUs.

In

~~According to a further embodiment of the present invention, in~~ the UL MU PPDU, the common field may not always be present in the HE-SIG-B field. Signaling of the C26 field and the RA field in the common field may be unnecessary when a single STA transmits a UL MU PPDU. Therefore, when the UL/DL field indicates uplink transmission, the common field is not present in the HE-SIG-B field. According to an embodiment, the value of the SIG-B compression field of the HE-SIG-A in the UL MU PPDU may be set to 1 to explicitly signal that the common field is not included in the HE-SIG-B. However, in this case, the full bandwidth MU-MIMO transmission is not performed, but the compression mode of the HE-SIG-B field may be used to reduce the signaling overhead of the HE-SIG-B in the uplink transmission.

In

~~According to another embodiment of the present invention, in~~ the UL MU PPDU, the compression mode of the HE-SIG-B field may be implicitly indicated regardless of the value of the SIG-B compression field, so that the common field is not present in the HE-SIG-B field.

Also, ~~according to the embodiment of the present invention,~~ the user specific field of the HE-SIG-B in the UL MU PPDU may consist of one user field for non-MU-MIMO allocation. That is, even if the value of the SIG-B compression field of the UL MU PPDU is set to 1 so that the compression mode of the HE-SIG-B field (or the full bandwidth MU-MIMO) is indicated, the user specific field of the HE-SIG-B may consist of a user field for non-MU-MIMO allocation. In this way, when a single STA

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performs uplink transmission to a single AP, a non-MU-MIMO-based (or OFDMA-based) user field is transmitted instead of a MU-MIMO-based user field so that information on the number of space-time streams to be received by the receiving terminal can be accurately transmitted.

A terminal ~~according to an embodiment of the present invention~~ may generate an HE MU PPDU including an HE-SIG-A field and an HE-SIG-B field configured according to the above-described methods, and transmit the generated HE MU PPDU. The terminal receiving the HE MU PPDU may decode the corresponding PPDU based on information obtained from the HE-SIG-A field of the received PPDU. In addition, the terminal may decode the HE-SIG-B field based on the information obtained from the HE-SIG-A field of the received HE MU PPDU. As described ~~in the~~ above, ~~above~~ ~~embodiments,~~ the configuration of the HE-SIG-B may be identified based on information obtained from at least one subfield of the HE-SIG-A. For example, the configuration of the HE-SIG-B may be identified based on at least one of the number of HE-SIG-B symbols field, the SIG-B compression field, and a combination thereof.

FIGS. 14 to 15 illustrate specific embodiments in which a single STA transmits an UL MU PPDU to an AP.

First, FIG. 14 illustrates an example ~~embodiment~~ in which the STA performs a UL MU PPDU transmission through a narrowband. Here, the narrowband may be a resource unit less than a 20 MHz bandwidth. As shown in FIG. 14(a), the STA can increase the transmission distance of data by concentrating the transmission power on a specific resource unit of a narrowband. FIGS. 14(b) to 14(d) illustrate various embodiments for signaling such narrowband transmission.

First, the narrowband transmission may be signaled through at least one subfield of the HE-SIG-A as shown in FIG. 14(b). When the HE MU PPDU is used for

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uplink transmission, the bandwidth field of the HE-SIG-A may indicate either 20 MHz, 40 MHz, 80 MHz, 160 MHz (including 80+80 MHz) or a predetermined narrow bandwidth. That is, in the 3-bit bandwidth field, values of 0 to 3 indicate 20 MHz, 40 MHz, 80 MHz, and 160 MHz (including 80+80 MHz), respectively, and any one of values 4 to 7 indicates one of the predetermined narrow bandwidths. 2 The 2 ~~According to an embodiment, the~~ predetermined narrow bandwidth may include a left-106-tone and a right-106-tone. In this case, among the 242-tone constituting a 20 MHz primary channel, the left-106-tone indicates the low-frequency 106-tone resource unit, and the right-106-tone indicates the high-frequency 106-tone resource unit. However, the present invention is not limited thereto, and the predetermined narrow bandwidth may include one or more of a 26-tone resource unit, a 52-tone resource unit, a 106-tone resource unit, or a combination thereof.

Next, the narrowband transmission may be signaled through a null STA ID contained in the user field of the HE-SIG-B as shown in FIG. 14(c). More specifically, the RA field of the HE-SIG-A may indicate information on the resource unit partition type in a particular channel. For example, if the bandwidth of 20 MHz is partitioned into two 106-tone resource units based on the OFDMA and the center 26-tone resource unit is not used, then the RA field may signal "0110zzzz" as shown in FIG. 14(c). In this case, an AID of the receiver or the transmitter may be inserted into the user field corresponding to the resource unit used for uplink data transmission between the partitioned two 106-tone resource units. On the other hand, a null STA ID may be inserted into the user fields corresponding to the remaining resource units through which data transmission is not performed. For example, if data is transmitted only through the second RU between two 106-tone resource units, a null STA ID may be inserted into the first user field.

As ~~According to another embodiment of the present invention, as~~ shown in FIG. 14(d), index values of the uplink resource unit allocation may be newly defined in the RA field of the HE-SIG-B for the narrowband transmission. More specifically, the RA field of the HE-SIG-B may index a specific 106-tone RU on which uplink transmission is performed. In this case, since only one user field corresponding to the resource unit indicated in the RA field is carried, the signaling overhead can be greatly reduced.

The ~~According to an embodiment, the~~ index values of the uplink resource unit allocation may be used among the unassigned (i.e., TBD) indices of the RA field configuration for DL-MU transmission. The ~~According to another embodiment, the~~ index values of the uplink resource unit allocation may be newly defined in the RA field.

FIG. 15 illustrates an example ~~embodiment~~ in which the STA performs UL MU PPDU transmission through a bandwidth of 20 MHz or more. As shown in FIG. 15(a), the uplink transmission using the HE MU PPDU may be performed not only through the narrowband but also through the full bandwidth of 20 MHz, 40 MHz, 80 MHz or 160 MHz (including 80+80 MHz). In this case, the bandwidth field of the HE-SIG-A indicates the total bandwidth of the PPDU. In addition, the SIG-B compression field may be always set to 1 as shown in FIG. 15(b) so that the common field is omitted from the HE-SIG-B field.

As described above, ~~in the above embodiments,~~ when the UL/DL field indicates downlink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field of the HE-SIG-A may indicate the information on the number of MU-MIMO users. In this case, the user specific field of the HE-SIG-B field may consist of user fields for MU-MIMO allocation. However, when the UL/DL field indicates uplink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field as in the

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embodiment of FIG. 15, the number of HE-SIG-B symbols field may indicate the number of OFDM symbols in the HE-SIG-B field as in the basic definition. In this case, the user specific field of the HE-SIG-B field may consist of a user field for non-MU-MIMO allocation.

FIG. 16 illustrates an encoding structure and a transmission method of the HE-SIG-B HE-SIG-B according to an embodiment of the present invention. FIG. 16(a) illustrates the encoding structure of the HE-SIG-B, and FIG. 16(b) illustrates the transmission method of the HE-SIG-B in a bandwidth of 40 MHz or more.

Referring to FIG. 16(a), the HE-SIG-B consists of a common field and a user specific field. The detailed configuration of the common field and the user specific field is as described in the embodiment of FIG. 13. Each user field of the user specific field is arranged in order of allocated users in the resource unit arrangement indicated by the RA field of the common field.

The user specific field consists of a plurality of user fields, and a plurality of user fields are transmitted in units of a user block field. As described above, the user block field is made up of an aggregation of two user fields, a CRC field, and a tail field. If the total number of user fields is odd, the last user block field may contain one user field. At the end of the HE-SIG-B, padding may be added along the OFDM symbol boundary.

Referring to FIG. 16(b), HE-SIG-B is separately encoded on each 20 MHz band. In this case, the HE-SIG-B may consist of a maximum of two contents in units of 20 MHz, that is, an HE-SIG-B content channel 1 and an HE-SIG-B content channel 2. In the embodiment of FIG. 16(b), each box represents a 20 MHz band, and "1" and "2" in the boxes represent the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2, respectively. Each HE-SIG-B content channel in the total band is arranged in

order of the physical frequency band. That is, the HE-SIG-B content channel 1 is transmitted in the lowest frequency band, and the HE-SIG-B content channel 2 is transmitted in the next higher frequency band. Such a content channel configuration is then duplicated through content duplication in the next higher frequency bands. For example, for the first to fourth channels with an increasing order of the frequency constituting the entire 80 MHz band, the HE-SIG-B content channel 1 is transmitted on the first channel and the third channel, and the HE-SIG-B content channel 2 is transmitted on the second channel and the fourth channel. Likewise, for the first to eighth channels with an increasing order of the frequency constituting the entire 160 MHz band, the HE-SIG-B content channel 1 is transmitted on the first channel, the third channel, the fifth channel and the seventh channel, and the HE-SIG-B content channel 2 is transmitted on the second channel, the fourth channel, the sixth channel and the eighth channel. When the terminal can decode the HE-SIG-B content channel 1 through at least one channel and decode the HE-SIG-B content channel 2 through the other at least one channel, information on the MU PPDU configuration of the total bandwidth can be obtained. On the other hand, when the total bandwidth is 20 MHz, only one SIG-B content channel is transmitted.

Non-contiguous channel allocation

Hereinafter, a non-contiguous channel allocation method and a signaling method thereof ~~according to an embodiment of the present invention~~ will be described with reference to FIGS. 17 to 21. 2 Non- 2

~~In the embodiment of the present invention, non-~~

contiguous channel allocation refers to channel allocation in which a band occupied by the transmitted packet (i.e., PPDU) includes at least one non-contiguous channel (or non-contiguous resource unit). However, a full bandwidth 80+80 MHz channel is regarded as a contiguous channel like a full bandwidth 160 MHz channel. Thus, a non-

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contiguous channel (or non-contiguous PPDU) in the embodiments of the present invention may refer to non-contiguous channels except for the full bandwidth 80+80 MHz channel.

In the following examples ~~embodiments~~ and drawings, the P20 channel indicates a 20 MHz primary channel, the S20 channel indicates a 20 MHz secondary channel, the S40 channel indicates a 40 MHz secondary channel, and the S80 channel indicates an 80 MHz secondary channel, respectively. Also, the S40A channel indicates the first 20MHz channel constituting the S40 channel, and the S40B channel indicates the second 20MHz channel constituting the S40 channel. Similarly, the S80A channel, the S80B channel, the S80C channel, and the S80D channel indicate the first 20MHz channel, the second 20MHz channel, the third 20MHz channel, and the fourth 20MHz channel constituting the S80 channel, respectively.

A ~~In the embodiment of the present invention, a~~ transmitter (e.g., an AP) signals non-contiguous channel allocation information through embodiments illustrated in each figure or combinations thereof. The transmitter may perform a CCA of multiple channels for a wideband packet transmission. In this case, the wideband may refer to a band having a total bandwidth of 40 MHz or more, but the present invention is not limited thereto. The transmitter transmits a packet through at least one channel which is idle based on the result of performing the CCA of multiple channels. In this case, when the packet is transmitted through a non-contiguous channel, the transmitter signals non-contiguous channel allocation information via a non-legacy preamble of the packet. As such, the transmitter transmits a wireless packet in which non-contiguous channel allocation information is signaled. A receiver (e.g., a STA) receives the wireless packet and obtains the non-contiguous channel allocation information from the received packet. The receiver decodes the received packet based on the obtained non-contiguous channel

allocation information. In this case, the received packet may be an HE MU PPDU, but the present invention is not limited thereto.

FIG. 17 illustrates a non-contiguous channel allocation method. ~~method according to an embodiment of the present invention.~~According to the example ~~embodiment~~ of FIG. 17, the location where at least one of the HE-SIG-B content channels is transmitted may be variable. In this case, the receiver should be able to variably set the decoding channel for receiving the HE-SIG-B content channel. In the example ~~embodiment~~ of FIG. 17, it is assumed that the HE-SIG-B content channel 1 is transmitted through the P20 channel and the channel through which the HE-SIG-B content channel 2 is transmitted may vary. However, depending on the physical frequency order of the P20 channel within the P40 channel, the HE-SIG-B content channel 2 may be transmitted through the P20 channel. In this case, the channel through which the HE-SIG-B content channel 1 is transmitted may vary depending on the channel configuration. The non-contiguous channel allocation information according to the embodiment of the present invention may support at least some configurations among the channel configurations listed in FIG. 17.

FIG. 17(a) illustrates a channel configuration in which only the P20 channel is allocated among the P80 (i.e., primary 80 MHz) band. In this case, the HE-SIG-B content channel 2 is not transmitted in the P80 band. FIG. 17(b) illustrates a channel configuration in which the P40 channel is basically allocated among the P80 band. In this case, both the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 may be transmitted through at least the P40 channel. A ~~According to the embodiment, a~~ non-contiguous channel in which any one among the two 20 MHz channels, that is, the S40A channel and the S40B channel of the S40 channel is allocated may be used. When both the S40A channel and the S40B channel are allocated, a contiguous channel of 80 MHz or 160 MHz bandwidth is configured.

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FIG. 17(c) illustrates a channel configuration in which only the P20 channel and the S40 channel are allocated among the P80 band. In this case, the HE-SIG-B content channel 1 may be transmitted through the P20 channel and the S40A channel, and the HE-SIG-B content channel 2 may be transmitted through the S40B channel. In the embodiments of FIG. 17(c), the HE-SIG-B content channel 1 and the HE-SIG-B content channel 2 may be transmitted based on the HE-SIG-B content channel transmission rule.

~~rule according to the embodiment of the present invention~~

Meanwhile, due to the limitation of the number of bits in the bandwidth field of the HE-SIG-A, the bandwidth field may indicate some configurations among the above channel configurations. When the bandwidth field consists of 3 bits, the bandwidth field may index four additional non-contiguous channel allocation information. The

~~According to the embodiment of the present invention, the~~ bandwidth field may indicate the total bandwidth information through which the PPDU is transmitted and some channel information to be punctured within the total bandwidth. In this case, the total bandwidth may be either 80 MHz bandwidth or 160 MHz (or 80+80 MHz) bandwidth. The

~~According to an embodiment of the present invention, the~~ bandwidth field may index puncturing of the S20 channel shown in FIG. 17(c), and puncturing of at least one of two 20 MHz channels in the S40 channel shown in FIG. 17(b), respectively.

In

~~According to the embodiment of the present invention, in~~ the channel configuration indicated by the bandwidth field of the HE-SIG-A, additional puncturing information may be indicated via the RA field of the HE-SIG-B. For example, when the bandwidth field indicates puncturing of one of two 20 MHz channels in the S40 channel at the total bandwidth of 80 MHz (e.g., the third and fifth channel configuration in FIG. 17(b)), the resource unit allocation field may indicate which 20 MHz channel in the S40 channel is punctured. Also, when the bandwidth field indicates puncturing of at least

one of two 20 MHz channels in the S40 channel at the total bandwidth of 160 MHz or 80+80 MHz (e.g., the second, fourth and sixth channel configurations in FIG. 17(b)), the resource unit allocation field may indicate which 20 MHz channel in the S40 channel is punctured. In addition, when the bandwidth field indicates puncturing of at least one of two 20 MHz channels in the S40 channel in a total bandwidth of 160 MHz or 80+80 MHz (e.g., the second, fourth and sixth channel configurations in FIG. 17(b)), the resource unit allocation field may indicate additional puncturing in the S80 channel. Further, when the bandwidth field indicates puncturing of the S20 channel in the total bandwidth of 160 MHz or 80+80 MHz (e.g., the second channel configuration in FIG. 17(c)), the resource unit allocation field may indicate additional puncturing in the S80 channel.

Channels in which puncturing is indicated as described above are not assigned to the user. A terminal receiving the non-contiguous PPDU may obtain the total bandwidth information through which the PPDU is transmitted and the channel information to be punctured within the total bandwidth via the bandwidth field of the HE-SIG-A of the corresponding PPDU. Further, the terminal may obtain additional channel puncturing information via the RA field of the HE-SIG-B of the corresponding PPDU. The terminal decodes the PPDU based on the obtained non-contiguous channel allocation information.

FIG. 18 illustrates a wideband acces z method. z ~~s method according to an embodiment of the present invention.~~ After the transmission of the previous PPDU is completed, the terminal having data to be transmitted performs a backoff procedure on the P20 channel. The backoff procedure may be started when the P20 channel is idle for an AIFS time. The terminal obtains a backoff counter within a range of a contention window (CW) for the backoff procedure. The terminal performs a CCA and decreases the backoff counter

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by one when the channel is idle. If the channel is busy, the terminal suspends the backoff procedure and resumes the backoff procedure an AIFS time after when the channel is idle again. When the backoff counter expires through the backoff procedure, the terminal may transmit data. In this case, the terminal performs a CCA for the secondary channels to transmit data for a PIFS time before the backoff counter expires.

~~The embodiment of~~ FIG. 18 shows a situation in which the S40A channel and the S80B channel are busy in the 160 MHz band in which the CCA is performed. If at least a part of the secondary channels on which the CCA is performed is busy, the PPDU transmission band of the terminal may be determined based on the physical layer CCA indication information. The physical layer CCA indication information may be represented by a PHY-CCA.indication primitive defined in the wireless LAN standard.

More specifically, the PHY-CCA.indication is a primitive for the PHY to represent the current state of a channel (or medium) to the local MAC entity, and includes a state indicator and a channel indicator. The state indicator indicates a busy state or an idle state. If it is determined that the channel cannot be used as a result of the channel assessment by the physical layer, the value of the state indicator is set to the busy state. Otherwise, the value of the state indicator is the idle state. The channel indicator indicates a channel set including channel(s) in the busy state. If the value of the state indicator for a particular channel set is idle, the corresponding channel indicator is not present in the PHY-CCA.indication primitive.

FIG. 18(a) illustrates a wideband access ㄹ ▛ method. The ▟ ㄹ ~~method according to the first embodiment of the present invention. According to the first embodiment of the present invention, the~~ physical layer CCA indication information may be represented by the PHY-CCA.indication primitive defined in the legacy wireless LAN system. That is, the channel indicator of the PHY-CCA.indication primitive may indicate only one of the

four values of primary, secondary, secondary40, and secondary80. Thus, the channel indicator of the PHY-CCA.indication primitive indicates the first channel set including channel(s) in the busy state along the channel set order of P20 channel, S20 channel, S40 channel and S80 channel. According to the example embodiment of FIG. 18(a), the channel indicator of the PHY-CCA.indication primitive indicates the S40 channel including the S40A channel in the busy state. That is, the physical layer may report the PHY-CCA.indication (BUSY, {secondary40}) to the MAC layer. The terminal may transmit the PPDU through the 40MHz band (i.e., P40 channel) combining the P20 channel and the S20 channel determined to be idle.

However, in order to transmit the MU PPDU through the non-contiguous channel allocation as described in FIG. 17, it is necessary to transmit more detailed physical layer CCA indication information. In order to solve the problem, FIG. 18(b) illustrates a wideband access method. ~~method according to the second embodiment of the present invention.~~ The ~~According to the second embodiment of the present invention, the~~ physical layer CCA indication information may be represented by the newly defined PHY-CCA.indication primitive. The ~~According to the second embodiment of the invention, the~~ units of the channel set for which the CCA result is reported may be subdivided into each 20 MHz channel. That is, the channel indicator of the PHY-CCA.indication primitive may indicate at least one of primary, secondary, secondary40A, secondary40B, secondary80A, secondary80B, secondary80C, secondary80D, or similar types of 20 MHz channels.

The ~~According to the embodiment of the present invention, the~~ channel indicator of the PHY-CCA.indication primitive reports all of the 20 MHz channel(s) determined to be busy, among eight 20 MHz channels constituting the 160 MHz band. According to the example ~~embodiment~~ of FIG. 18(b), the channel indicator of the PHY-CCA.indication

primitive indicates S40A channel and S80B channel which are in busy state. That is, the physical layer may report the PHY-CCA.indication (BUSY, {secondary40A, secondary80B}) to the MAC layer. The terminal transmits a PPDU using channels that are not busy. Referring to FIG. 18(b), the terminal may transmit a non-contiguous PPDU through channels (i.e., P20, S20, S40B, S80A, S80C, and S80D) other than the S40A channel and the S80B channel which are determined to be busy.

The

~~According to another embodiment of the present invention, the~~ CCA result per 20 MHz channel may be reported in a bitmap representation. That is, the channel indicator of the PHY-CCA.indication primitive may indicate the busy/idle state for each 20 MHz channel in a bitmap form. For example, the channel indicator of the PHY-CCA.indication primitive may consist of a bitmap having a length of 8 bits. Herein, each bit is set to 1 if the corresponding 20 MHz channel is busy and each bit is set to 0 if the corresponding 20 MHz channel is idle. In this case, the first to eighth bits of the bitmap indicate the busy/idle state of each of the eight 20 MHz channels in the order of the lowest frequency to the highest frequency within the 160 MHz (80+80 MHz) bandwidth.

The

~~According to a further embodiment of the present invention, the~~ physical layer may report the CCA results per 20 MHz channel only if the P20 channel is idle. That is, the channel indicator of the PHY-CCA.indication primitive indicates all of the 20 MHz secondary channel(s) determined to be busy among the eight 20 MHz channels constituting the 160 MHz band only when the P20 channel is idle. Also, if the CCA result per 20 MHz channel is reported in a bitmap representation, the bit corresponding to the P20 channel in the bitmap may be set to 0. If the P20 channel is busy, the channel indicator of the PHY-CCA.indication primitive does not indicate secondary channel information in units of 20 MHz. That is, the channel indicator of the PHY-

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CCA.indication primitive indicates only the first channel set including the busy channel(s) as in the legacy wireless LAN system.

FIG. 19 illustrates ~~an embodiment of~~ a method of exchanging and signaling BQRP and BQR for transmitting a non-contiguous PPDU. Referring to FIG. 19, an AP that intends to transmit a DL MU PPDU may perform a CCA in a physical layer and transmit the DL MU PPDU using channels determined to be idle based on the CCA result. 2 An 2

~~According to an embodiment, an~~ MU-RTS frame may be transmitted to one or more STAs before transmission of the DL MU PPDU, and sCTS frames may be transmitted from STAs that have received the MU-RTS frame. However, the MU-RTS may only be transmitted in the form of PPDUs based on contiguous channel allocation such as non-HT, non-HT duplicate or HE SU PPDU. Therefore, when the S40A channel and the S80B channel are busy as in the embodiment of FIG. 19, the MU-RTS may be transmitted only through the 40 MHz band (i.e., the P40 channel) including the P20 channel and the S20 channel. The AP can receive sCTS frames transmitted in response to the MU-RTS frame from the STAs, but cannot identify the available channel of each STA only by exchanging the MU-RTS frame and the sCTS frame.

Therefore, ~~according to the embodiment of the present invention,~~ the AP may transmit a bandwidth query report poll (BQRP) to help efficient resource allocation for MU PPDU transmission, and STAs may transmit a bandwidth query report (BQR) in response thereto . The BQR may include an available channel bitmap field representing available channel information of the corresponding STA. 2 The 2

~~According to an embodiment,~~

~~the~~ BQR may be carried via the control field of the MAC header. The STA may implicitly carry the BQR through the BQR control field of a frame transmitted to the AP, or may explicitly carry the BQR through a frame transmitted in response to the BQRP trigger frame of the AP. 2 The 2

~~According to the embodiment of the present invention, the~~

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BQR transmitted in response to a BQRP trigger frame may be referred to as a solicited BQR, and the BQR transmitted regardless of the reception of the BQRP trigger frame may be referred to as an unsolicited BQR.

The ~~According to an embodiment, the~~ AP may transmit a BQRP frame using an MU PPDU format capable of non-contiguous channel allocation-based transmission. The AP may determine whether each channel is available to the STA based on the BQR received from each STA. Through the BQRP/BQR transmission sequence, the AP may perform a non-contiguous channel allocation-based DL MU PPDU transmission by checking the available channel information of the STAs. Referring to the embodiment of FIG. 19, among the channels determined to be idle, the AP transmits the BQRP respectively to STA1 through the P40 channel, to STA2 through the S40B channel, to STA3 through the S80A channel, to STA4 through the S80C channel, and to STA 5 through the S80D channel. The BQRP transmitted to STA1, STA2, STA3, STA4 and STA5 can be carried via a non-contiguous MU PPDU. The AP receives BQR from STA1, STA3 and STA5 in response to BQRP. Thus, the AP can identify that the P40 channel is available to STA1, the S80A channel is available to STA3, and the S80D channel is available to STA5, respectively. However, the AP does not receive the BQR in response to BQRP from STA2 and STA4. Thus, the AP can identify that the S40B channel is not available to STA2, and the S80C channel is not available to STA4, respectively. The AP can perform DL MU PPDU transmission based on the collected available channel information of each STA.

FIG. 20 illustrates another example ~~embodiment~~ of a method of transmitting and signaling BQR for transmitting a non-contiguous PPDU. As described above, the STA may implicitly carry the BQR through the BQR control field of the frame transmitted to the AP. The AP can perform a non-contiguous channel allocation-based DL MU PPDU

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transmission by checking the available channel information of each STA through the unsolicited BQR received from the STAs at any time.

First, referring to FIG. 20(a), the BQR may be transmitted through a UL SU PPDU. The STA that intends to transmit a UL SU PPDU may perform a CCA in the physical layer and transmit the UL SU PPDU using channels determined to be idle based on the CCA result. However, the HE SU PPDU may only be transmitted on a contiguous channel allocation basis. Therefore, when the S40A channel and the S80B channel are busy as in the ƨ ▛example ▟ ƨ ~~embodiment~~ of FIG. 20(a), the UL SU PPDU may be transmitted through the 40 MHz band including the P20 channel and the S20 channel. In this case, the BQR may be carried via the BQR control field of the frame transmitted through the UL SU PPDU. The BQR may contain available channel information based on the CCA result detected by the corresponding STA.

Next, referring to FIG. 20(b), the BQR may be transmitted through an HE trigger-based (TB) PPDU. The STA that intends to transmit an HE-TB PPDU may perform a CCA in the physical layer and transmit the HE TB PPDU using channels determined to be idle based on the CCA result. In this case, the BQR may be carried via the BQR control field of the frame transmitted through the HE TB PPDU. The BQR may contain available channel information based on the CCA result detected by the corresponding STA.

As described above, the AP receiving the UL SU PPDU or the HE TB PPDU containing the BQR may check the available channel information of the corresponding STA and perform a DL PPDU transmission. Meanwhile, the BQR may indicate the available channel information according to various ƨ ▛examples. ▟ ƨ ~~embodiments~~ . A specific ƨ ▛exampe ▟ ƨ ~~embodiment~~ thereof will be described with reference to FIG. 21.

FIG. 21 illustrates a configuration of a ƨ ▛BQR. ▟ ƨ ~~BQR according to an embodiment of~~

~~the present invention.~~ The

~~According to an embodiment of the present invention, the~~ available channel information in the BQR may be represented by an available channel bitmap field. The

~~According to an embodiment, the~~ BQR includes a bandwidth indication field and an available channel bitmap field (or a bandwidth bitmap field). However, the bandwidth indication field may be omitted from the BQR according to an embodiment.

The bandwidth indication field may represent the total bandwidth through which the available channel information is carried. According to an embodiment, the bandwidth indication field may consist of 2 bits and may indicate either 20 MHz, 40 MHz, 80 MHz or 160 MHz (including 80+80 MHz). In addition, the available channel bitmap field may consist of 8 bits and may indicate availability (or busy/idle state) of each 20 MHz channel. When the BQR reports available channel information in a total bandwidth of 20 MHz, the bandwidth indication field indicates 20 MHz (or P20 channel). In addition, when the BQR reports available channel information in a total bandwidth of 40 MHz, the bandwidth indication field indicates 40 MHz (or P40 channel). In this case, the first bit and the second bit of the available channel bitmap field indicate availability of each of the two 20 MHz channels in the order of the low frequency to the high frequency within the 40 MHz bandwidth. Next, when the BQR reports available channel information in a total bandwidth of 80 MHz, the bandwidth indication field indicates 80 MHz (or P80 channel). In this case, the first to fourth bits of the available channel bitmap field indicate availability of each of the four 20MHz channels in the order from the lowest frequency to the highest frequency within the 80MHz bandwidth. Next, when the BQR reports available channel information in a total bandwidth of 160 MHz (80+80 MHz), the bandwidth indication field indicates 160 MHz (80+80 MHz) (or P160 channel). In this case, the first to eighth bits of the available channel bitmap field indicate availability of each of the eight 20MHz channels

in the order of the lowest frequency to the highest frequency within the 160MHz (80+80MHz) bandwidth.

Meanwhile, the BQR may include only the available channel bitmap field without the bandwidth indication field. In this case, the available channel bitmap field may consist of 8 bits, and may indicate availability (or busy/idle state) of each 20 MHz channel. When a 20 MHz channel in which the CCA is not performed according to the CCA performance capability of the STA is present, the value of the bit of the available channel bitmap field corresponding to the channel may be set to 1 (i.e., busy state).

The BQR may indicate the available channel information in various ways. The

~~According to the first embodiment of the present invention, the~~STA may explicitly signal, through the bandwidth indication field, bandwidth information through which the STA can perform the CCA before transmitting a PPDU including the BQR, and may indicate availability of each channel within the corresponding bandwidth through the available channel bitmap. For example, if the STA performed a CCA only for the corresponding 40 MHz bandwidth before transmitting the 40 MHz PPDU, the bandwidth indication field may indicate 40 MHz and the available channel bitmap field may carry only the CCA results of two 20 MHz channels. However, if the STA performs a CCA for a 160 MHz bandwidth that is wider than the bandwidth of the corresponding PPDU before transmitting the 40 MHz PPDU, the bandwidth indication field may indicate 160 MHz and the available channel bitmap field may carry the CCA result of eight 20 MHz channels. In such an embodiment, the STA may autonomously set the indicated bandwidth of the available channel bitmap field of the BQR based on its CCA performance capability.

Next, ~~according to the second embodiment of the present invention,~~ the STA may perform a CCA for the entire band through which the BQRP trigger frame is

received or the entire band through which the PPDU including the BQR is transmitted, and may indicate the availability of each channel within the corresponding bandwidth through the available channel bitmap. In this case, since the bandwidth information for which the available channel information is transmitted is obvious to the transmitter and the receiver, the bandwidth indication field may be omitted from the BQR. If there is a 20 MHz channel in which the CCA is not performed according to the CCA performance capability of the STA among the entire bandwidth in which the PPDU is transmitted, the STA may not perform the transmission of the unsolicited BQR. According to another embodiment, if there is a 20 MHz channel in which the CCA is not performed according to the CCA performance capability of the STA among the entire bands in which the PPDU is transmitted, the value of the bit of the available channel bitmap field corresponding to the channel may be set to 1 (i.e., busy state).

Next, ~~according to the third embodiment of the present invention,~~ the STA may perform a CCA for the total band operated by the BSS to which the corresponding STA is associated, and may indicate the availability of each channel within the corresponding bandwidth through the available channel bitmap. If the bandwidth that the STA can perform the CCA is smaller than the total bandwidth operated by the BSS according to the CCA performance capability of the STA, the availability of each channel within the bandwidth in which the STA can perform the CCA may be indicated through the available channel bitmap. That is, the STA may indicate the availability of each channel through the available channel bitmap based on a smaller value between the total bandwidth operated by the BSS and the bandwidth that the STA can perform the CCA, regardless of the entire band in which the BQRP trigger frame is received or the entire band in which the PPDU including the BQR is transmitted. In this case, since the bandwidth information for which the available channel information is transmitted is

obvious to the transmitter and the receiver, the bandwidth indication field may be omitted from the BQR. Therefore, the AP may transmit the DL MU PPDU based on the available channel information of the STA within the entire bandwidth regardless of the transmission bandwidth of the PPDU carrying the BQRP or BQR.

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 2 claims. ~~claims to be described below rather than the detailed description.~~

[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.

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Claims

1. 1. A wireless communication terminal (100), the terminal comprising:

a communication unit (120); and

a processor (110) configured to process signals transmitted and received through the communication unit (120),

wherein the processor (110) is configured to:

receive, through the communication unit (120), a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols subfield, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of OFDM symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

2. The wireless communication terminal (100) of claim 1,

wherein a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the Number of HE'-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

3. The wireless communication terminal (100) of claim 2,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is a single user.

4. The wireless communication terminal (100) of claim 3,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

5. The wireless communication terminal (100) of claim 3,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

6. The wireless communication terminal (100) of claim 1,

wherein the uplink/downlink subfield indicates whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the uplink/downlink subfield indicates uplink transmission or downlink transmission.

7. The wireless communication terminal (100) of claim 1,

wherein the SIG-B compression subfield indicates whether a common field is present in the HE-SIG-B.

8. The wireless communication terminal (100) of claim 7,

wherein the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users when the SIG-B compression subfield is set to a value indicating that the common field is not present, and

wherein the Number of HE-SIG-B Symbols field indicates the number of OFDM symbols in the HE-SIG-B when the SIG-B compression subfield is set to a value indicating that the common field is present.

9. A wireless communication method of a wireless communication terminal (100), the method comprising:

receiving a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols field, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield; and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

10. The wireless communication method of claim 9,

wherein a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

11. The wireless communication method of claim 10,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is a single user.

12. The wireless communication method of claim 11,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in

the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

13. The wireless communication method of claim 11,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

14. The wireless communication method of claim 9,

wherein the downlink/uplink subfield indicates whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the downlink/upilnk subfield indicates uplink transmission or downlink transmission.

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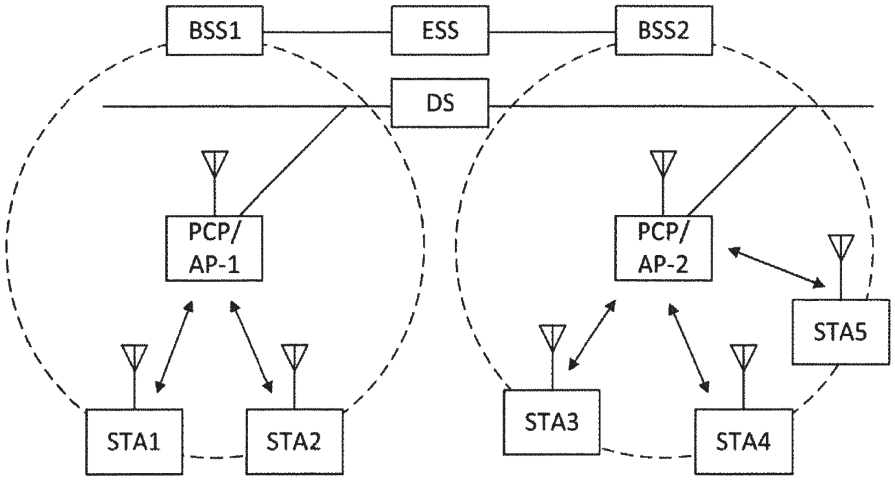


FIG. 1

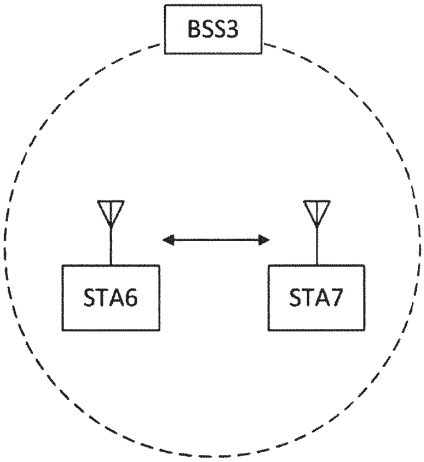


FIG. 2

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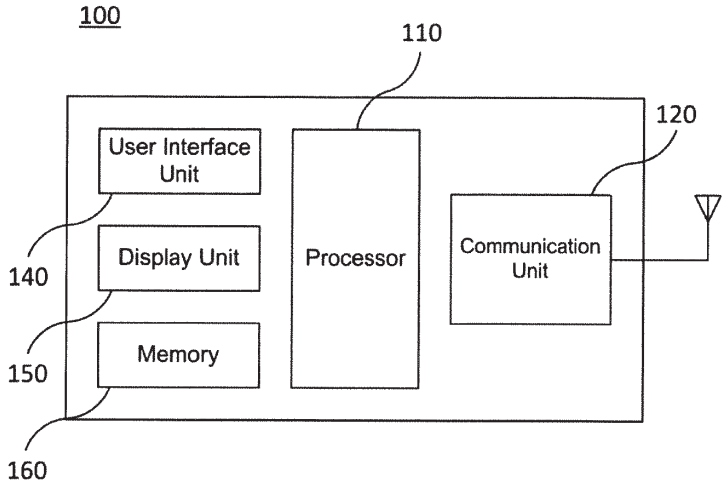


FIG. 3

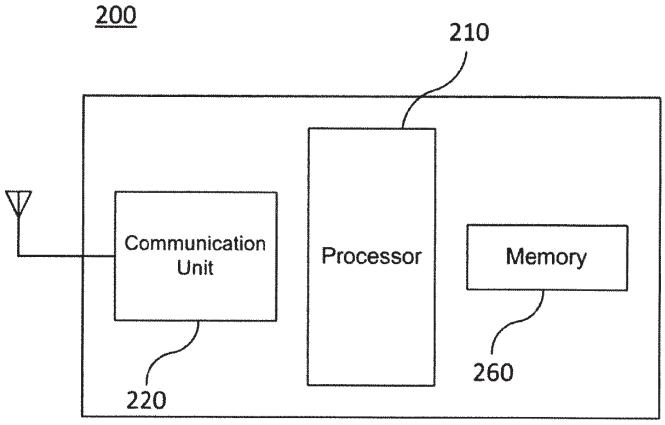


FIG. 4

M24159.0

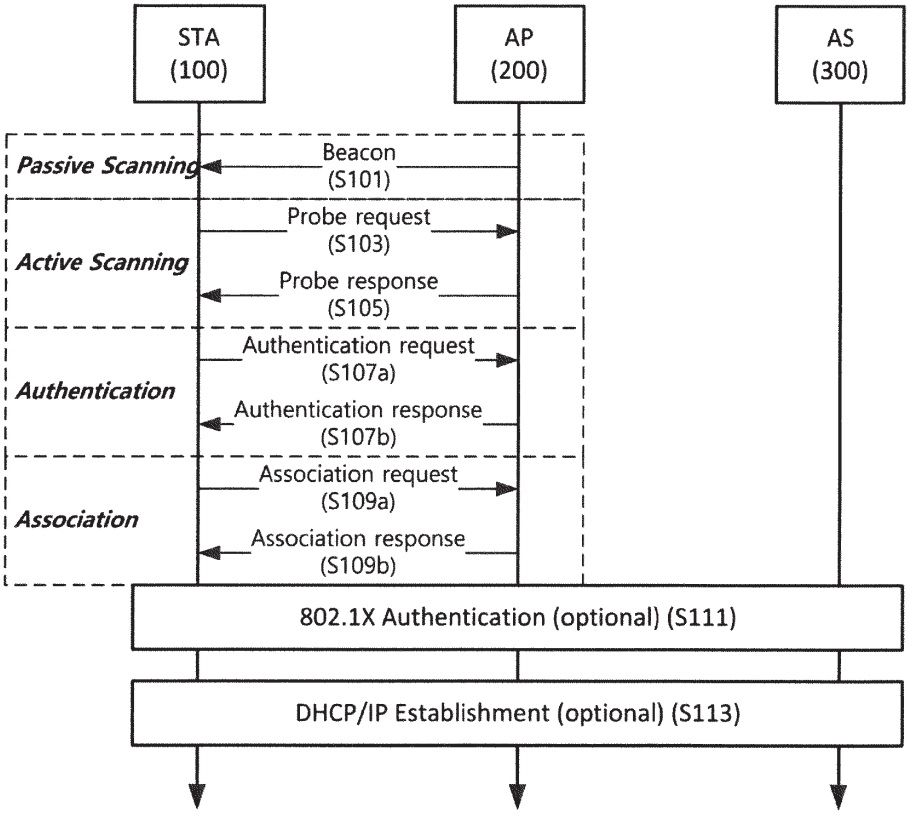


FIG. 5

M24159.0

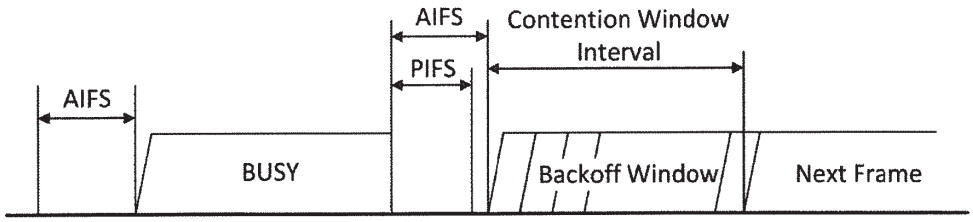


FIG. 6

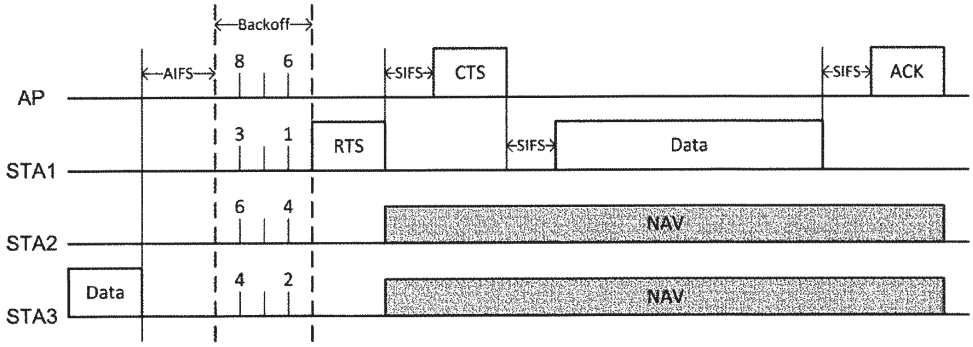


FIG. 7

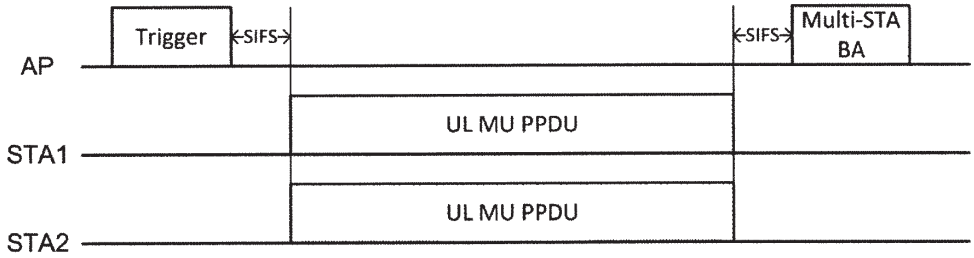


FIG. 8

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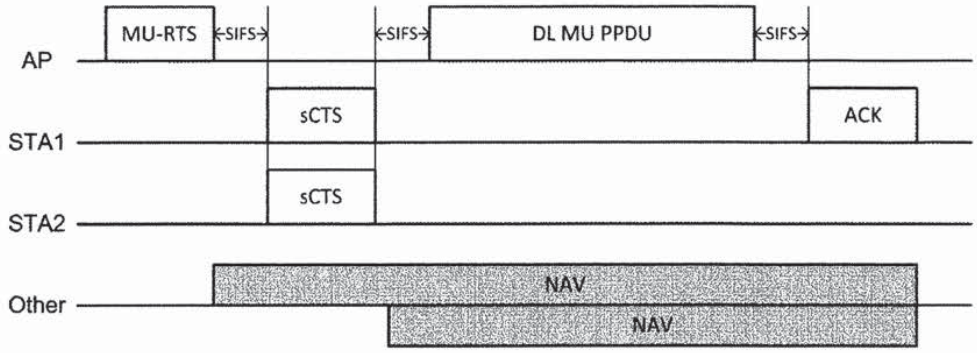


FIG. 9

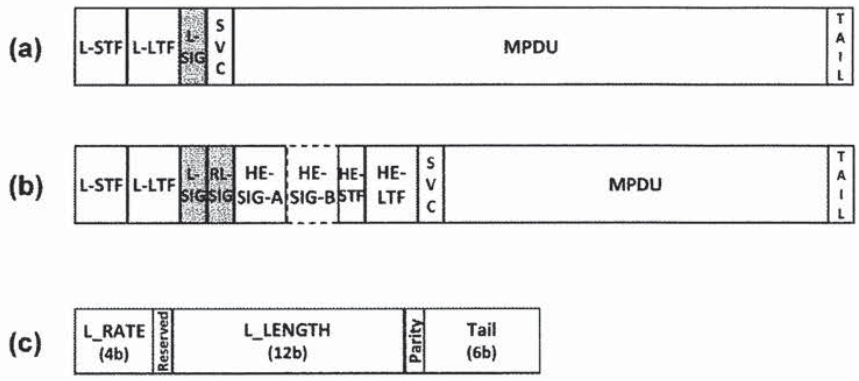


FIG. 10

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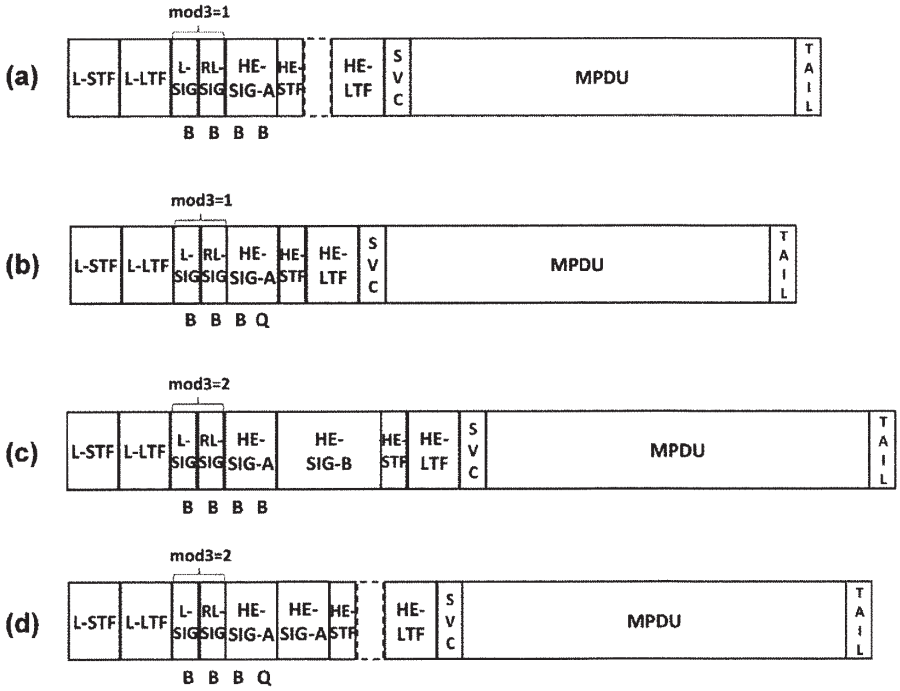
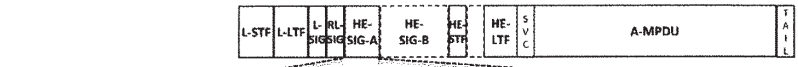


FIG. 11

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Field	Bit	Descriptions
Format	1	0: Trigger-based PPDU, 1: SU PPDU
Beam Change	1	
UL/DL	1	0:DL, 1:UL
MCS	4	
DCM	1	Dual carrier modulation
BSS Color	6	BSS Identification info
Reserved	1	
Spatial Reuse	4	TBD
Bandwidth	2	20/40/80/160(80+80)MHz
GI+LTF Size	3	1x_LTF+0.8us_GI 2x_LTF+0.8us_GI 2x_LTF+1.6us_GI 4x_LTF+3.2us_GI
NSTS	3	1~8 space time streams
TXOP Duration	7	
Coding	1	0:BCC, 1:LDPC
LDPC Extra Sym.	1	
STBC	1	Space Time Block Coding
TxBF	1	Beamforming
Pre-FEC Padding	2	Padding Length
Padding Disam.	1	Padding Disambiguity
Reserved	1	
Doppler	1	
CRC	4	
Tail	6	

(a)

Field	Bit	Descriptions
UL/DL	1	0:DL, 1:UL
SIGB MCS	3	MCS0~MCS5
SIGB DCM	1	Dual carrier modulation
BSS Color	6	BSS Identification info
Spatial Reuse	4	TBD
Bandwidth	3	(DL) 20/40/80/160(80+80), 80A, 80B, 160A, 160B (UL) 20/40/80/160(80+80), left-106tone, right-106tone, reserved
Num of SIG-B Sym	4	if SIG-B Compression is 1 (DL) Num of MU-MIMO Users (UL) Num of SIG-B Sym
SIG-B Compression	1	(DL) Set to 1 in Full BW MU-MIMO (UL) Always set to 1 to remove RU Allocation subfield
GI+LTF Size	3	2x_LTF+0.8us_GI 2x_LTF+1.6us_GI 4x_LTF+3.2us_GI
Doppler	1	
TXOP Duration	7	
Reserved	1	
Num of HE-LTF Sym	3	1, 2, 4, 6, 8
LDPC Extra Sym.	1	
STBC	1	Space Time Block Coding
Pre-FEC Padding	2	Padding Length
Padding Disam.	1	Padding Disambiguity
CRC	4	
Tail	6	

(b)

Field	Bit	Descriptions
Format	1	0: Trigger-based PPDU, 1: SU PPDU
BSS Color	6	BSS identification info
Spatial Reuse1	4	Spatial Reuse Parameter
Spatial Reuse2	4	Spatial Reuse Parameter
Spatial Reuse3	4	Spatial Reuse Parameter
Spatial Reuse4	4	Spatial Reuse Parameter
Reserved	1	
Bandwidth	2	20/40/80/160(80+80)MHz
TXOP Duration	7	
Reserved	9	
CRC	4	
Tail	6	

(c)

FIG. 12

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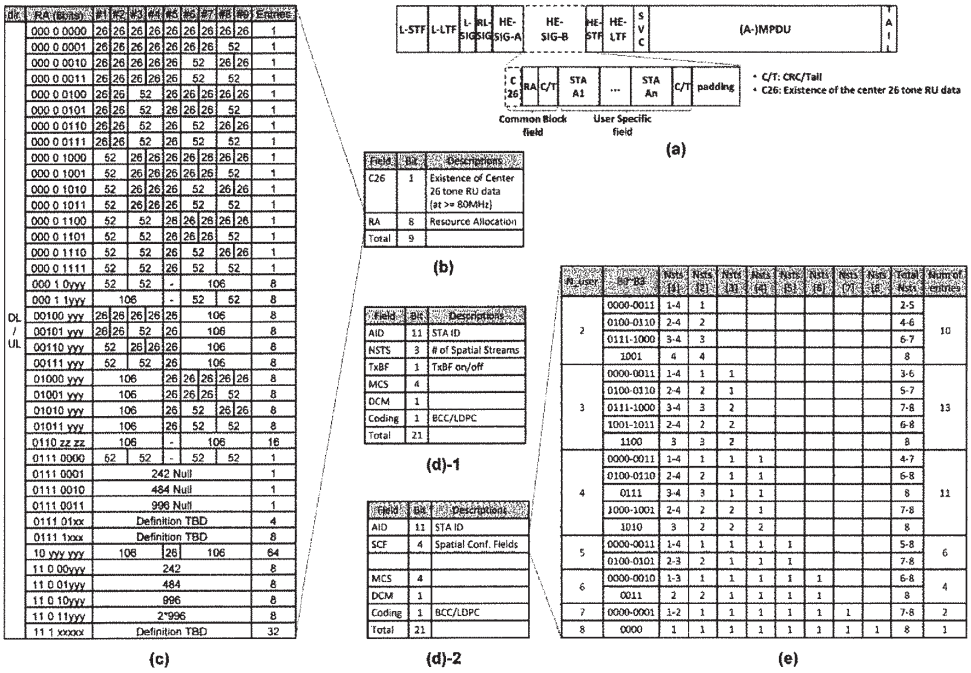
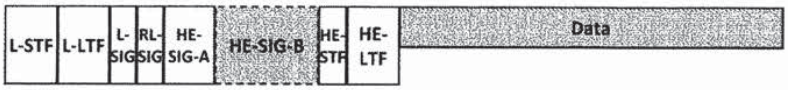


FIG. 13

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(a)



(b)

Field	Bit	Descriptions
BW	3	DL HE MU PPDU case - 20/40/80/160(80+80)MHz - 80A, 80B, 160A, 160B (Preamble Puncturing) UL HE MU PPDU case - 20/40/80/160(80+80)MHz - 20MHz-left 106 tone - 20MHz-right 106 tone



(OFDMA User Specific Info)

(c)

RA (8bits)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Entries
others	x	x	x	x	x	x	x	x	x	x
0110zzzz	106				-	106				16



(OFDMA User Specific Info)

(d)

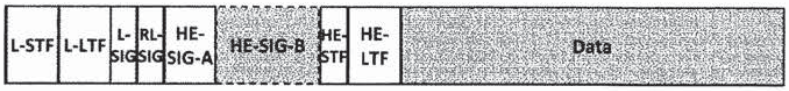
RA (8bits)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Entries
others	x	x	x	x	x	x	x	x	x	x
TBD	106				-					1
TBD	-				106					1



(OFDMA User Specific Info)

FIG. 14

(a)



(b)

Field	Bit	Descriptions
SIG-B Compression	1	DL HE MU PPDU case - "0" refer RA field in SIG-B - "1" MU-MIMO user specific info UL HE MU PPDU case - Always set to "1" - Use OFDMA user specific info

FIG. 15

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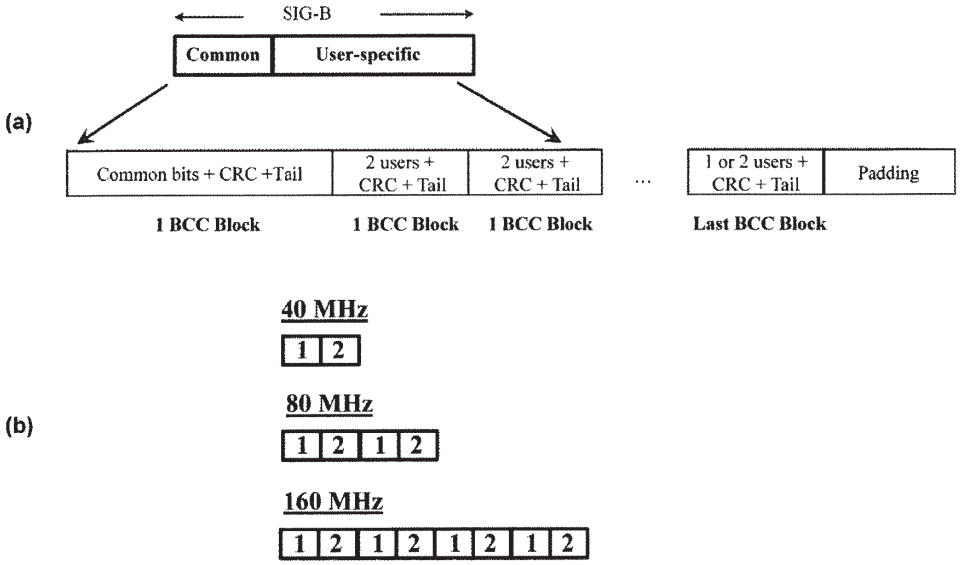


FIG. 16

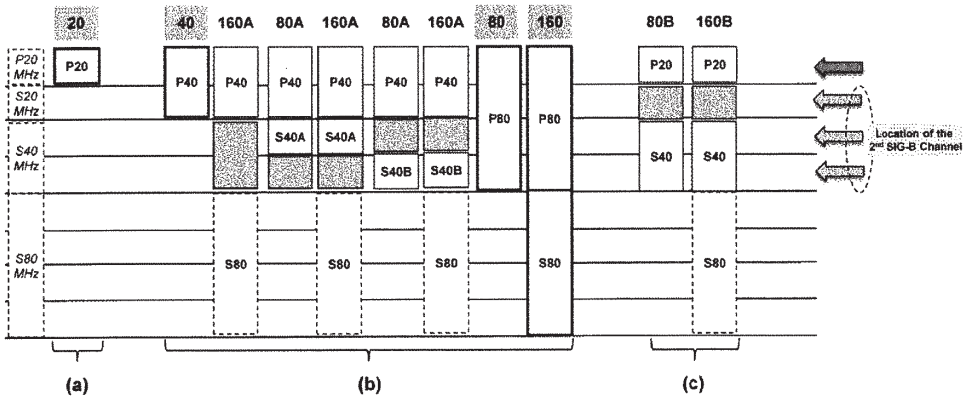


FIG. 17

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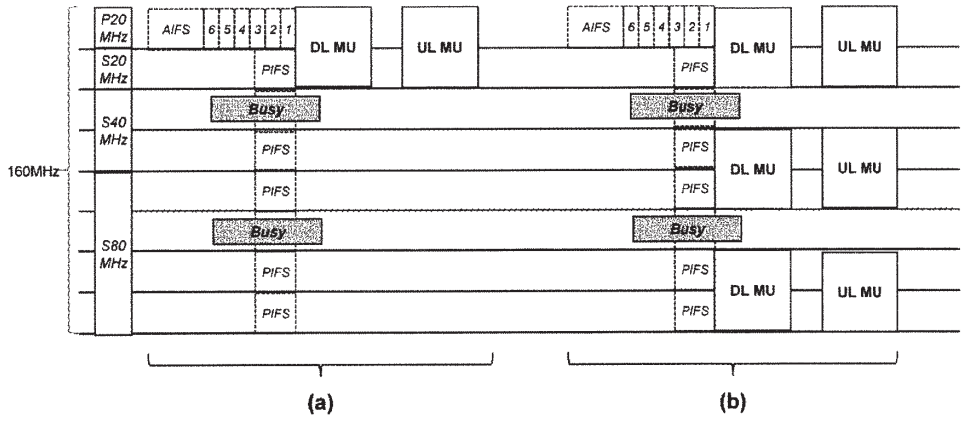


FIG. 18

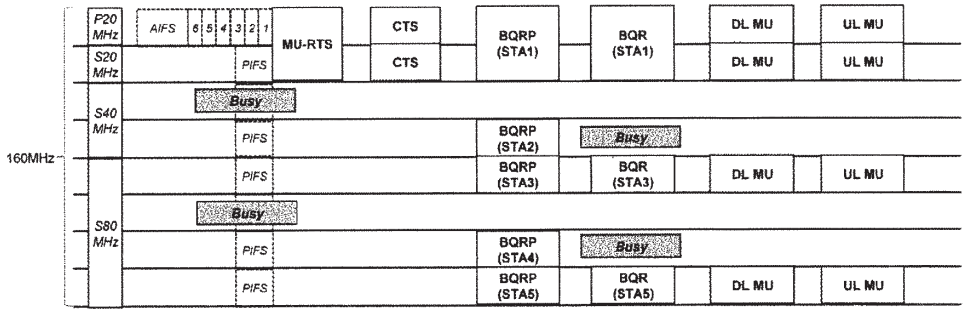


FIG. 19

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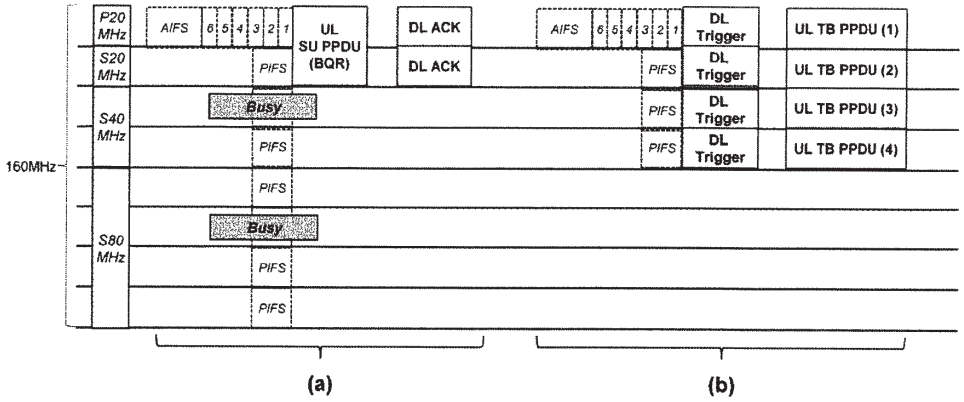
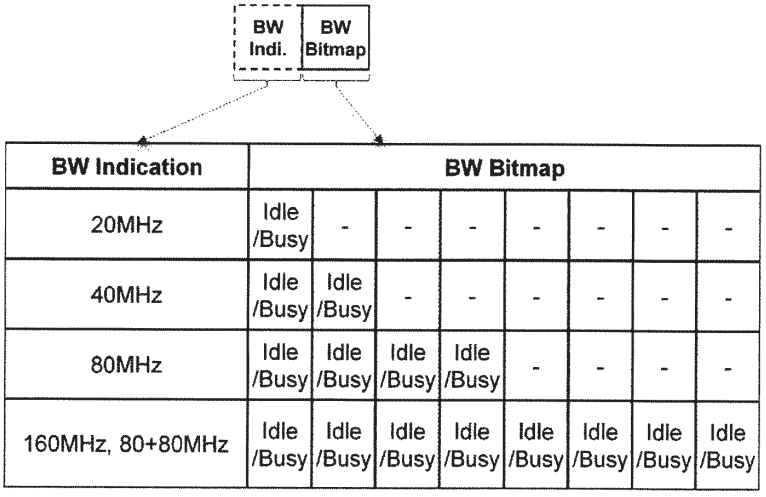


FIG. 20



BW Indication	BW Bitmap							
20MHz	Idle /Busy	-	-	-	-	-	-	-
40MHz	Idle /Busy	Idle /Busy	-	-	-	-	-	-
80MHz	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	-	-	-	-
160MHz, 80+80MHz	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy	Idle /Busy

FIG. 21

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Patentanwälte
European Patent Attorneys
European Trademark & Design Attorneys

Partnerschaft mbB

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22. März 2022

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Ihr Zeichen / Your Ref.	S2W2 Zeichen / S2W2 Ref.	Tag / Date

18 736 375.9 - 1215
Wilus Institute of Standards and Technology Inc., et al

In response to the Communication pursuant to Art. 94(3) EPC dated November 12, 2021:

Amendments:

No amendments have been made to the claims and the description.

Added Subject-Matter (Art. 123(2) EPC):

In section 2 of the Communication, the Examiner has raised added subject-matter objections for claim 1, particularly in respect of the following underlined features thereof:

> 1. A wireless communication terminal (100), the terminal comprising:
> a communication unit (120); and
> a processor (110) configured to process signals transmitted and received

through the communication unit (120),

wherein the processor (110) is configured to:

receive, through the communication unit (120), a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols subfield, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of OFDM symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

In particular, the Examiner is of the opinion that not specifying claim 1 with the two specific cases disclosed on page 34, line 18 to page 35, line 12, especially with the features relating to the UL/DL field and SIG-B compression field, which allegedly appear to be necessary for taking the decision of what is indicated in the user specific field, constitutes an inadmissible generalization and thus violates the requirements of Art. 123(2) EPC.

The applicant respectfully disagrees with the Examiner in that the features in question, i.e. "the number of HE-SIG-B symbols field indicates a number of MU-MIMO users or a number of OFDM symbols according to the value of the SIG-B compression field" and "a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of OFDM symbols", are disclosed in the following passages of the description as filed, not in conjunction with the features relating to the DL/UL field.

Page. 30, line 19 ~ Page. 31, line 3

"The SIG-B DCM field indicates whether the HE-SIG-B field is modulated with the DCM for reliable transmission of the HE-SIG-B field. ... The number of HE-SIG-B symbols field indicates information on the number of OFDM symbols in the HE-SIG-B field."

Page. 38, line 22 ~ Page. 39, line 9

"As described in the above embodiments, when the SIG-B compression field indicates the full bandwidth MU-MIMO, the specific subfield of the HE-SIG-A may indicate the information on the number of MU-MIMO users. That is, when the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field of the HE-SIG-A may indicate the information on the number of MU-MIMO users. According to a further embodiment of the present invention, when the SIG-B compression field indicates the full bandwidth MU-MIMO, the configuration of the user specific field of the HE-SIG-B may be identified based on the information on the number of MU-MIMO users indicated by the number of HE-SIG-B symbols field. For example, the type of the user field constituting the user specific field may be determined to be either a user field for MU-MIMO allocation or a user field for non-MU-MIMO allocation based on the information on the number of MU-MIMO users."

Page. 39, line 17 ~ Page. 40, line 6

"Thus, when the full bandwidth MU-MIMO is indicated with a single user, the user specific field of the HE-SIG-B may consist of a user field for non-MU-MIMO allocation. The configuration of the user specific field of the HE-SIG-B based on the information on the number of MU-MIMO users can be applied to both the uplink and downlink MU PPDUs." *(emphasis added)*

Based on the above passages of the description as filed, the skilled person would directly and unambiguously understand that the features in question in claim 1 are not inextricably linked to the features relating to the UL/DL field, as disclosed on page 34, line 18 to page 35, line 12, and that the overall disclosure justifies the generalizing isolation of the features in question and their introduction into claim 1. Thus, it does not constitute an inadmissible intermediate generalization and does not violate the requirements of Art.

123(2) EPC. The same holds true for the other independent claim 9.

Requests:

It is herewith respectfully requested that the Examining Division issue the communication under Rule 71 (3) EPC as the next step of the procedure.

If the Examiner still has objections to this application, he is kindly requested to put these objections in an official communication. If regarded appropriate, the Examiner is kindly invited to contact the representative of the applicant by telephone to discuss this case.

As a precautionary measure, oral proceedings are requested as an auxiliary request to be conducted as a video conference.

Respectfully submitted,

Axel Schmitt-Nilson
European Patent Attorney

The examination is being carried out on the **following application documents**

Description, Pages

1, 2, 4-59	filed with entry into the regional phase before the EPO			
3, 60, 533a	received on	01-03-2021	with letter of	01-03-2021

Claims, Numbers

1-14	filed in electronic form on	20-09-2021

Drawings, Sheets

1/12-12/12	filed with entry into the regional phase before the EPO

1 The application has been reconsidered in the light of the applicant's letter of reply dated 20 September 2021 (hereafter referred to as L2). Reference will also be made as may be required to the applicant's letter L1 (dated 1 March 2021), as well as to the European Search Opinion C1 and examining division's communication C2 (dated 11 May 2021).

2 The amendments filed with letter L2 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 123(2) EPC. The amendments concerned are the following:

Independent claims 1 and 9:

A wireless communication terminal, the terminal comprising:

a communication unit; and

a processor configured to process signals transmitted and received through the communication unit, wherein the processor is configured to:

receive, through the communication unit, a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/ downlink subfield, and a Number of HE-SIG-B Symbols subfield, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of OFDM symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

The applicant in L2 argues that the basis for this amendment is to be found in page 30, lines 2-4 and page 34, line 18 to page 35 line 12.

However, the description on page 34, line 18 to page 35 line 12 discloses two very specific cases:

1. When the UL/DL field indicates downlink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the information on the number of MU-MIMO user. In this case, the user specific field of the HE-SIG-B field may consist of a user field for MU-MIMO allocation.

2. When the UL/DL field indicates uplink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the number of OFDM symbols in the HE-SIG-B field as in the basic definition. In this case, the user specific field of the HE-SIG-B field may consist of a user field for non-MU-MIMO allocation.

Independent claim 1 does not include these specific limitations. First of all, independent claim 1 does not use the direction of the transmission (i.e. if the transmission is UL or DL) in order to separate the cases. According to the application as originally filed and taking into account particularly the paragraphs cited by the applicant in L2, both fields (UL/DL field and SIG-B compression field) are necessary for taking the decision of what is indicated in the user

specific field. Hence, these fields/features are inextricably linked, and isolated extraction of the SIG-B field into claim 1 thus violates the requirements of Article 123(2) EPC.

Moreover, not every possible combination of UL/DL fields and the indication of the HE-SIG-B symbols field is disclosed in the application. Only the 2 cases disclosed above are presented. Hence, the generalization of said cases as merely indicating that "wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field" instead of disclosing the two solely combinations presented in the description also confronts the skilled person with information which is not directly and unambiguously derivable from the original application as filed, thus violating the requirements of Article 123(2) EPC.

The same conclusion applies, to claim 9.

3 For the reasons given in section 2 above, the amended claims filed together with L2 are not allowable either. In view of the available prior art and of the applicant's arguments, it still does not appear that any part of the application could serve as a basis for a new allowable claim. Should the applicant nevertheless regard some particular matter as patentable, then

- the attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC);

- in order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made and indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III, 2.1);

- the applicant should indicate in the letter of reply the difference of the subject-matter of the new independent claim vis-à-vis the state of the art and the significance thereof; any argument supporting the presence of an inventive step should be given in the letter of reply;

- for reasons of conciseness (Article 84 EPC) and to reinforce unity of the invention (Article 82 EPC) a single independent claim per category should be filed (Rule 43 (2) EPC), with dependent claims as appropriate, Rule 43 (4) EPC;

- the independent claims should be drafted in two-part form (Rule 43 (1) EPC), delimited against D1;

- reference signs should be inserted in the claims (Rule 43 (7) EPC);

- the description should be amended 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 (GL F-IV, 4.3);

  - 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; and

  - 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 (Guidelines F-IV, 4.9).

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Primary Examiner
Name: Brezmes Alonso, Francisco
Tel: +31 70 340 - 4946

Schmitt-Nilson Schraud Waibel Wohlfrom
Patentanwälte Partnerschaft mbB
Pelkovenstraße 143
80992 München
ALLEMAGNE

Application No.	Ref.	Date
18 736 375.9 - 1215	M24159.0	12.11.2021
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).

Registered Letter

Brezmes Alonso, Francisco
Primary Examiner
For the Examining Division

Enclosure(s): 4 page/s reasons (EPO Form 2906)

Europäisches Patentamt
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Acknowledgement of receipt

We hereby acknowledge receipt of the following subsequently filed document(s):

Submission number	10209118
Application number	EP18736375.9
Date of receipt	20 September 2021
Receiving Office	European Patent Office, The Hague
Your reference	M24159.0
Applicant	All applicants as on file
Documents submitted	package-data.xml epf1038.pdf (1 p.) CLMS-HWA-1.pdf\210920_claims_amended.pdf (4 p.) ep-sfd-request.xml EXRE3-1.pdf\210920_Submission.pdf (4 p.) CLMS-1.pdf\210920_claims_clean.pdf (4 p.)
Submitted by	CN=Axel Schmitt-Nilson 38900
Method of submission	Online
Date and time receipt generated	20 September 2021, 13:58 (CEST)
Message Digest	5A:D8:54:91:3F:F1:AC:41:02:27:20:97:B0:9C:D6:84:A8:A4:23:4A

/European Patent Office/

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Claims

1. 1. A wireless communication terminal (100), the terminal comprising:

a communication unit (120); and

a processor (110) configured to process signals transmitted and received through the communication unit (120),

wherein the processor (110) is configured to:

receive, through the communication unit (120), a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a ~~specific subfield~~Number of HE-SIG-B Symbols subfield, and

wherein the ~~specific subfield~~Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of OFDM symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein ~~a configuration related to~~ a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field~~is identified by a combination of the SIG-B compression subfield and the specific subfield~~.

2. The wireless communication terminal (100) of claim 1,

wherein ~~the~~a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the ~~specific subfield~~Number of HE'-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

3. The wireless communication terminal (100) of claim 2,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the ~~specific subfield~~Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the ~~specific subfield~~Number of HE-SIG-B Symbols field is a single user.

4. The wireless communication terminal (100) of claim 3,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

5. The wireless communication terminal (100) of claim 3,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

6. The wireless communication terminal (100) of claim 1,

wherein the ~~HE-SIG-A field includes a UL/DL~~uplink/downlink subfield indicates~~ing~~ whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the ~~UL/DL~~uplink/downlink subfield indicates uplink transmission or downlink transmission.

7. The wireless communication terminal (100) of claim 1,

wherein the SIG-B compression subfield indicates whether a common field is present in the HE-SIG-B.

8. The wireless communication terminal (100) of claim 7,

wherein the ~~specific subfield~~Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users when the SIG-B compression subfield is set to a value indicating that the common field is not present, and

wherein the ~~specific subfield~~Number of HE-SIG-B Symbols field indicates the number of OFDM symbols in the HE-SIG-B when the SIG-B compression subfield is set to a value indicating that the common field is present.

9. A wireless communication method of a wireless communication terminal (100), the method comprising:

receiving a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a ~~specific subfield~~Number of HE-SIG-B Symbols field, and

wherein the ~~specific subfield~~Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield; and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein ~~a configuration related to~~ a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field~~is identified by a combination of the SIG-B compression subfield and the specific subfield~~.

10. The wireless communication method of claim 9,

wherein ~~the~~a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the ~~specific subfield~~Number of HE-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

11. The wireless communication method of claim 10,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the ~~specific subfield~~Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the ~~specific subfield~~Number of HE-SIG-B Symbols field is a single user.

12. The wireless communication method of claim 11,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

13. The wireless communication method of claim 11,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

14. The wireless communication method of claim 9,

wherein the ~~HE-SIG-A field includes a UL/DL~~downlink/uplink subfield indicates~~ing~~ whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the ~~UL/DL~~downlink/upilnk subfield indicates uplink transmission or downlink transmission.

M24159.0

Claims

1. 1. A wireless communication terminal (100), the terminal comprising:

a communication unit (120); and

a processor (110) configured to process signals transmitted and received through the communication unit (120),

wherein the processor (110) is configured to:

receive, through the communication unit (120), a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols subfield, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of OFDM symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

2. The wireless communication terminal (100) of claim 1,

wherein a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the Number of HE'-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

3. The wireless communication terminal (100) of claim 2,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is a single user.

4. The wireless communication terminal (100) of claim 3,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

5. The wireless communication terminal (100) of claim 3,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

6. The wireless communication terminal (100) of claim 1,

wherein the uplink/downlink subfield indicates whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the uplink/downlink subfield indicates uplink transmission or downlink transmission.

7. The wireless communication terminal (100) of claim 1,

wherein the SIG-B compression subfield indicates whether a common field is present in the HE-SIG-B.

8. The wireless communication terminal (100) of claim 7,

wherein the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users when the SIG-B compression subfield is set to a value indicating that the common field is not present, and

wherein the Number of HE-SIG-B Symbols field indicates the number of OFDM symbols in the HE-SIG-B when the SIG-B compression subfield is set to a value indicating that the common field is present.

9. A wireless communication method of a wireless communication terminal (100), the method comprising:

receiving a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols field, and

wherein the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO users or a number of symbols in the HE-SIG-B field according to a value of the SIG-B compression subfield; and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field.

10. The wireless communication method of claim 9,

wherein a configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

11. The wireless communication method of claim 10,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the Number of HE-SIG-B Symbols field is a single user.

12. The wireless communication method of claim 11,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in

the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

13. The wireless communication method of claim 11,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

14. The wireless communication method of claim 9,

wherein the downlink/uplink subfield indicates whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the downlink/upilnk subfield indicates uplink transmission or downlink transmission.

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Letter accompanying subsequently filed items

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The document(s) listed below is (are) subsequently filed documents pertaining to the following application:

Application number	18736375.9
Applicant's or representative's reference	M24159.0

	Description of document	Original file name	Assigned file name
1	Reply to examination report	210920_Submission.pdf	EXRE3-1.pdf
2	Amended claims with annotations	210920_claims_amended.pdf	CLMS-HWA-1.pdf
3	Amended claims (clean copy)	210920_claims_clean.pdf	CLMS-1.pdf

	Payment	
1	Method of payment	Not specified

Signatures

Place:	**Munich**
Date:	**20 September 2021**
Signed by:	**Axel Schmitt-Nilson 38900**
Association:	**Schmitt-Nilson Schraud Waibel Wohlfrom Patentanwälte**
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18 736 375.9	M24159.0 AS-cg	20/09/2021
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18 736 375.9 - 1215
Wilus Institute of Standards and Technology Inc., et al

In response to the Communication pursuant to Art. 94(3) EPC dated May 11, 2021:

New Documents:

The following documents are herewith filed:

- an amended set of claims 1 to 14, replacing the set of claims 1 to 14 previously on file. For convenience of the Examining Division, marked-up and clean copies are submitted;

All new documents submitted shall not limit the original disclosure of the application as originally filed and shall not be deemed as a waiver of any rights in this respect.

Amendments:

The subject matter of amended claims is originally disclosed in the documents as originally filed. Therefore, the amendments made are admissible under Art. 123 (2) EPC.

In new claim 1, it has been specified that the HE-SIG-A field includes a SIG-B compression subfield, an uplink/downlink subfield, and a Number of HE-SIG-B Symbols subfield. The amendment is originally disclosed in Fig. 12(b) and on page 30, lines 2-4 of the description as filed.

In new claim 1, it has been specified that the Number of HE-SIG-B Symbols field indicates a number of MU-MIMO or a number of OFDM symbols in the HE-SIG-B field users according to a value of the SIG-B compression subfield. The amendment is originally disclosed on page 34, line 18 - page 35, line 3 of the description as filed.

In new claim 1, it has been further specified that a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of symbols in the HE-SIG-B field. The amendment is originally disclosed on page 35, lines 3-12 of the description as filed, which will be discussed in detail below.

In new claims 1-3, 8, and 9-11, the term "specific subfield" has been replaced with "Number of HE-SIG-B Symbols field". The amendment is originally disclosed on page 35, lines 3-12 of the description as filed, which will also be discussed in detail below.

New claims 6 and 14 have been amended for clarity purpose only, i.e. to be in conformity with the amendments made in new claims 1 and 9, respectively.

New claims 4-5, 7, and 12-13 correspond to claims 4-5, 7, and 12-13 on file, respectively.

Added Subject-Matter (Art. 123(2) EPC):

It is respectfully submitted that the added subject-matter objections raised in section 2 of the Communication are overcome for the following reasons:

The Examiner is of the opinion that the feature "a configuration related to a user specific field included in the HE-SIG-B field is identified by a combination of the SIG-B compression subfield and the specific subfield", as recited in claims 1 and 9 as previously on file, involves an inadmissible intermediate generalization.

In order to address the intermediate generalization issue, in new claims 1 and 9, the feature in question has been replaced with the following features:

> "a user specific field included in the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of OFDM symbols in the HE-SIG-B field"

As stated above, the above features are originally disclosed in page 35, lines 3-12 of the description as filed. In particular, page 35, lines 1-4 of the description as filed states that in case the number of HE-SIG-B symbols filed indicates the information on the number of MU-MIMO user, the user specific field of the HE-SIG-B field may consist of a user field for MU-MIMO allocation. In addition, page 35, lines 8-12 of the description as filed states that in case the number of HE-SIG-B symbols field indicates the number of OFDM symbols in the HE-SIG-B field, the user specific field of the HE-SIG-B field may consist of a user field for non-MU-MIMO allocation. From this disclosure, the skilled person would directly and unambiguously understand that a user specific field of the HE-SIG-B field consists of a user field for MU-MIMO allocation or non-MU-MIMO allocation depending on whether the Number of HE-SIG-B Symbols field indicates the number of MU-MIMO users or the number of OFDM symbols in the HE-SIG-B field, as recited in new claims 1 and 9.

It is also respectfully submitted that the amendments made to new claims 1 and 9 are in line with the Examiner's arguments set out in the second paragraph of page 2 of the Communication other than the statement that the specific subfield should be the UL/DL

field. Applicant respectfully submits that the "specific subfield" is to be replaced with the "number of HE-SIG-B Symbols field" in that the latter indicates a number of MU-MIMO users or a number of OFDM symbols in the HE-SIG-B field, as disclosed not only in page 35, lines 3-12 of the description as filed, but also in new claims 1 and 9.

Novelty and Inventive Step (Art. 54, 56 EPC):

The subject-matter of new claims 1 and 14 is new and involves an inventive step with respect to the available prior art, at least on the basis of the Applicant's argumentation set out in sections II.2 and II.3 of the letter filed on March 1, 2021.

Requests:

It is herewith respectfully requested that the Examining Division issue the communication under Rule 71 (3) EPC as the next step of the procedure.

If the Examiner still has objections to this application, he is kindly requested to put these objections in an official communication. If regarded appropriate, the Examiner is kindly invited to contact the representative of the applicant by telephone to discuss this case.

As a precautionary measure, oral proceedings are requested as an auxiliary request to be conducted as a video conference.

Respectfully submitted,

Axel Schmitt-Nilson

Encls.:

- new claims 1 to 14 (marked-up and clean)

The examination is being carried out on the **following application documents**

Description, Pages

1, 2, 4-59	filed with entry into the regional phase before the EPO			
3, 60, 3a	received on	01-03-2021	with letter of	01-03-2021

Claims, Numbers

1-14	received on	01-03-2021	with letter of	01-03-2021

Drawings, Sheets

1/12-12/12	filed with entry into the regional phase before the EPO

1 The application has been reconsidered in the light of the applicant's letter of reply dated 1 March 2021 (hereafter referred to as L1). Reference will also be made as may be required to the European Search Opinion C1.

2 The amendment/s filed with letter L1 introduce subject-matter which extends beyond the content of the application as filed, contrary to Article 123(2) EPC. The amendments concerned are the following:

Independent claims 1 and 9:

wherein a configuration related to a user specific field included in the HE-SIG-B field is identified by a combination of the SIG-B compression subfield and the specific subfield.

The applicant in L1 argues that the basis for this amendment is to be found in paragraph spanning pages 34 and 35.

As claim 1 has been amended based on an intermediate generalisation of the above mentioned paragraph, the requirements of Guidelines H-V, 3.2.1 are to be considered. In particular, it is required that a feature taken from an embodiment is not related or inextricably linked to the other features of that embodiment.

However, the skilled reader will understand that in said paragraphs that that depending on the value of the UL/DL field (i.e. if it indicates uplink or downlink transmission) and the SIG-B compression field, the user-specific field of the HE-SIG-B may indicate different things (i.e. if it is for MU-MIMO allocation or non-MU-MIMO allocation). In fact, when considering the overall disclosure, the skilled person will understand that the specific subfield should be the UL/DL field and that the user specific field of the HE-SIG-B field may be only a user field for MU-MIMO or non-MU-MIMO allocation.

Hence, the features of the paragraph spanning pages 34 and 35 are inextricably linked, and their generalization as introduced in independent claim 1 thus violates the requirements of Article 123(2) EPC.

The same conclusion applies to claim 9.

3 Since it is not clear how exactly the applicant will amend the claims in order to remove the above objections with respect of added subject-matter (Article 123(2) EPC), the examiner is not presently in a position to efficiently carry out any further examination and give an opinion with respect of novelty and inventive step (Articles 52, 54 and 56 EPC).

4 For the reasons given in section 2 above, the amended claims filed together with L1 are not allowable either. In view of the available prior art and of the applicant's arguments, it still does not appear that any part of the application could serve as a basis for a new allowable claim. Should the applicant nevertheless regard some particular matter as patentable, then

- the attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC);

- in order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made and indicate the passages of the application as filed on which these amendments are based (see Guidelines H-

III, 2.1). The applicant is kindly reminded that support in the description for the combination of dependent claims with the newly amended independent claims is also a requirement of Rule 137(4) EPC;

- the applicant should indicate in the letter of reply the difference of the subject-matter of the new independent claim vis-à-vis the state of the art and the significance thereof; any argument supporting the presence of an inventive step should be given in the letter of reply;

- for reasons of conciseness (Article 84 EPC) and to reinforce unity of the invention (Article 82 EPC) a single independent claim per category should be filed (Rule 43 (2) EPC), with dependent claims as appropriate, Rule 43 (4) EPC;

- the independent claims should be drafted in two-part form (Rule 43 (1) EPC), delimited against D1;

- reference signs should be inserted in the claims (Rule 43 (7) EPC);

- the description should be amended 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 (GL F-IV, 4.3);

  - 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; and

  - 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 (Guidelines F-IV, 4.9).

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Application No.	Ref.	Date
18 736 375.9 - 1215	M24159.0	11.05.2021
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 insofar 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).

In case you withdraw the application within the above-mentioned period, the examination fee will be refunded at a rate of 50% (Art. 11 (b) RFees).

Failure to comply with this invitation in due time will result in the application being deemed to be withdrawn (Art. 94(4) EPC).

Registered letter
EPO Form 2001 11.16TRI

Brezmes Alonso, J
Primary Examiner
For the Examining Division

Enclosure(s): 3 page/s reasons (Form 2906)

Application No.: 18736375.9

Substantive examination has started on 29.04.21 (see Notice from the European Patent Office dated 29.01.2013, OJ EPO 2013, 153).

For the Examining Division

Amended Claims

1. A wireless communication terminal (100), the terminal comprising:

a communication unit (120); and

a processor (110) configured to process signals transmitted and received through the communication unit (120),

wherein the processor (110) is configured to:

receive, through the communication unit (120), a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield and a specific subfield, and

wherein the specific subfield indicates a number of MU-MIMO users according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration related to a user specific field included in the HE-SIG-B field is identified by a combination of the SIG-B compression subfield and the specific subfield.

2. The wireless communication terminal (100) of claim 1,

wherein the configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the specific subfield when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth

MU-MIMO transmission.

3. The wireless communication terminal (100) of claim 2,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is a single user.

4. The wireless communication terminal (100) of claim 3,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

5. The wireless communication terminal (100) of claim 3,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

6. The wireless communication terminal (100) of claim 1,

wherein the HE-SIG-A field includes a UL/DL subfield indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the UL/DL subfield indicates uplink transmission or downlink transmission.

7. The wireless communication terminal (100) of claim 1,

wherein the SIG-B compression subfield indicates whether a common field is present in the HE-SIG-B.

8. The wireless communication terminal (100) of claim 7,

wherein the specific subfield indicates the number of MU-MIMO users when the SIG-B compression subfield is set to a value indicating that the common field is not present, and

wherein the specific subfield indicates the number of OFDM symbols in the HE-SIG-B when the SIG-B compression subfield is set to a value indicating that the common field is present.

9. A wireless communication method of a wireless communication terminal (100), the method comprising:

receiving a high efficiency multi-user PHY protocol data unit, HE MU PPDU,

wherein a preamble of the HE MU PPDU includes high efficiency signal A, HE-SIG-A, field and high efficiency signal B, HE-SIG-B, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield and a specific subfield, and

wherein the specific subfield indicates a number of MU-MIMO users according to a value of the SIG-B compression subfield; and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration related to a user specific field included in the HE-SIG-B field is identified by a combination of the SIG-B compression subfield and the specific subfield.

10. The wireless communication method of claim 9,

wherein the configuration of the user specific field of the HE-SIG-B field is identified based on the number of MU-MIMO users indicated by the specific subfield when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission.

11. The wireless communication method of claim 10,

wherein the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is two or more users, and

wherein the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is a single user.

12. The wireless communication method of claim 11,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, NSTS, field.

13. The wireless communication method of claim 11,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, OFDMA, allocation.

14. The wireless communication method of claim 9,

wherein the HE-SIG-A field includes a UL/DL subfield indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield included in the HE-SIG-A field of the PPDU indicates different information based on whether the UL/DL subfield indicates uplink transmission or downlink transmission.

Amended Claims

1. A wireless communication terminal (100), the terminal comprising:

a communication unit (120); and

a processor (110) configured to process signals transmitted and received through the communication unit (120),

wherein the processor (110) is configured to:

receive, through the communication unit (120), a high efficiency multi-user PHY protocol data unit, ~~(~~HE MU PPDU~~)~~,

wherein a preamble of the HE MU PPDU includes high efficiency signal A ~~field~~, ~~(~~HE-SIG-A~~)~~, field and high efficiency signal B ~~field~~, ~~(~~HE-SIG-B~~)~~, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield and a specific subfield, and

wherein the specific subfield indicates a number of MU-MIMO users according to a value of the SIG-B compression subfield, and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration ~~of~~ related to a user specific field included in the HE-SIG-B field ~~the HE-SIG-B~~ is identified by a combination of the SIG-B compression subfield and the specific subfield~~based on information obtained from at least one subfield of the HE-SIG-A~~.

~~2. The wireless communication terminal of claim 1, wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific~~

~~field of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.~~

~~3~~2. The wireless communication terminal (100) of claim ~~2~~1,

wherein ~~when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission,~~ the configuration of the user specific field of the HE-SIG-B field is identified based on ~~information on~~ the number of MU-MIMO users indicated by the specific subfield when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission~~the HE-SIG-A~~.

4~~3~~. The wireless communication terminal (100) of claim ~~3~~2,

wherein ~~when the information on the number of MU-MIMO users indicates two or more users,~~ the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is two or more users, and

wherein ~~when the information on the number of MU-MIMO users indicates a single user,~~ the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is a single user.

~~5~~4. The wireless communication terminal (100) of claim 4~~3~~,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in ~~an~~ the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, ~~(~~NSTS~~)~~, field.

~~6~~5. The wireless communication terminal (100) of claim 4~~3~~,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, ~~(~~OFDMA~~)~~, allocation.

~~7. The wireless communication terminal of claim 3, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.~~

~~8~~6. The wireless communication terminal (100) of claim 1,

wherein the HE-SIG-A field includes a UL/DL subfield indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield ~~of~~ included in the HE-SIG-A field of the PPDU indicates different information ~~or is set differently~~ based on whether the UL/DL subfield indicates uplink transmission or downlink transmission~~a value indicated by the UL/DL field~~.

7. The wireless communication terminal (100) of claim 1,

wherein the SIG-B compression subfield indicates whether a common field is present in the HE-SIG-B.

8. The wireless communication terminal (100) of claim 7,

wherein the specific subfield indicates the number of MU-MIMO users when the SIG-B compression subfield is set to a value indicating that the common field is not present, and

wherein the specific subfield indicates the number of OFDM symbols in the HE-SIG-B when the SIG-B compression subfield is set to a value indicating that the common field is present.

9. A wireless communication method of a wireless communication terminal (100), the method comprising:

receiving a high efficiency multi-user PHY protocol data unit, ~~(~~HE MU PPDU~~,)~~,

wherein a preamble of the HE MU PPDU includes high efficiency signal A ~~field,~~ ~~(~~HE-SIG-A~~)~~, field and high efficiency signal B ~~field,~~ ~~(~~HE-SIG-B~~)~~, field,

wherein the HE-SIG-A field includes a SIG-B compression subfield and a specific subfield, and

wherein the specific subfield indicates a number of MU-MIMO users according to a value of the SIG-B compression subfield; and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration ~~of~~ related to a user specific field included in the HE-SIG-B field ~~the HE-SIG-B~~ is identified by a combination of the SIG-B compression subfield and the specific subfield~~based on information obtained from at least one subfield of the HE-SIG-A~~.

~~10. The wireless communication method of claim 9, wherein when a SIG-B~~

~~compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific field of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.~~

~~11~~10. The wireless communication method of claim ~~10~~9,

wherein ~~when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission,~~ the configuration of the user specific field of the HE-SIG-B field is identified based on ~~information on~~ the number of MU-MIMO users indicated by the specific subfield when the SIG-B compression subfield of the HE-SIG-A field indicates full bandwidth MU-MIMO transmission~~the HE-SIG-A~~.

~~12~~11. The wireless communication method of claim ~~11~~10,

wherein ~~when the information on the number of MU-MIMO users indicates two or more users,~~ the user specific field of the HE-SIG-B field includes a plurality of user fields for MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is two or more users, and

wherein ~~when the information on the number of MU-MIMO users indicates a single user,~~ the user specific field of the HE-SIG-B field includes one user field for non-MU-MIMO allocation when the number of MU-MIMO users indicated by the specific subfield is a single user.

~~13~~12. The wireless communication method of claim ~~12~~11,

wherein each of the plurality of user fields for the MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in ~~an~~

the MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the one user field for the non-MU-MIMO allocation includes a number of space time streams, ~~(~~NSTS~~)~~, field.

~~14~~13. The wireless communication method of claim ~~12~~11,

wherein the one user field for the non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access, ~~(~~OFDMA~~)~~, allocation.

~~15. The wireless communication method of claim 11, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.~~

~~16~~14. The wireless communication method of claim 9,

wherein the HE-SIG-A field includes a UL/DL subfield indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield ~~of~~ included in the HE-SIG-A field of the PPDU indicates different information ~~or is set differently~~ based on whether the UL/DL subfield indicates uplink transmission or downlink transmission~~a value indicated by the UL/DL field~~.

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.

"High Efficiency (HE) PHY specification", IEEE DRAFT; TGAX_CL_26, IEEE-SA, PISCATAWAY, NJ USA, vol. 802.11ax drafts, no D0.5 1 October 2016 (2016-10-01), pages 1-207 discloses in section 26.3.3.7.4 that an AP that transmits an HE MU PPDU shall set the UL/DL field in the HE-SIG-A field to 0. A fully bandwidth MU MIMO transmission using HE MU PPDU format has a value of 1 for the SIGB Compression field in HE-SIG-A and the SIGB Common field is not present. If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and

the number of STAs on each RU for SU/MU-MIMO transmission. The number of users in RU r for MU-MIMO transmission is indicated together with the RU allocation as defined in RU allocation signaling.

[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.

[Technical Solution]

Embodiments of the invention include a wireless communication terminal in accordance with claim 1 and a wireless communication method of a wireless communication terminal in accordance with claim 9. Further embodiments are given in the dependent claims.

In order to achieve the objects, the present invention provides a wireless communication method and a wireless communication terminal as below.

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.

[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.

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.

"High Efficiency (HE) PHY specification", IEEE DRAFT; TGAX_CL_26, IEEE-SA, PISCATAWAY, NJ USA, vol. 802.11ax drafts, no D0.5 1 October 2016 (2016-10-01), pages 1-207 discloses in section 26.3.3.7.4 that an AP that transmits an HE MU PPDU shall set the UL/DL field in the HE-SIG-A field to 0. A fully bandwidth MU MIMO transmission using HE MU PPDU format has a value of 1 for the SIGB Compression field in HE-SIG-A and the SIGB Common field is not present. If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and

the number of STAs on each RU for SU/MU-MIMO transmission. The number of users in RU r for MU-MIMO transmission is indicated together with the RU allocation as defined in RU allocation signaling.

[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.

[Technical Solution]

Embodiments of the invention include a wireless communication terminal in accordance with claim 1 and a wireless communication method of a wireless communication terminal in accordance with claim 9. Further embodiments are given in the dependent claims.

In order to achieve the objects, the present invention provides a wireless communication method and a wireless communication terminal as below.

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.

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Wilus Institute of Standards and Technology Inc. et al.

This submission is in response to the Communication pursuant to Rules 70(2) and 70a(2) EPC, dated August 18, 2020.

I. Indication to proceed further

The applicant herewith indicates their desire to proceed further with the present application.

II. Response to the EESR

II.1. Amended application documents, original disclosure, clarity

Enclosed herewith, an amended set of claims 1-14 is filed for the further prosecution of the present application.

Amended claim 1 is based on previously pending claim 1 and contains the following amendments. It has been specified that "the HE-SIG-A field includes a SIG-B compression subfield and a specific subfield" and that "the specific subfield indicates a number of MU-MIMO users according to a value of the SIG-B compression subfield". Further, the feature "wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A" has been specified to "wherein a configuration related to a user specific field included in the HE-SIG-B field is identified by a combination of the SIG-B compression subfield and the specific subfield". Original disclosure for these amendments is given - inter alia - in the following passages of the description:

page 30, paragraph 2: "FIG. 12(b) illustrates a subfield configuration of the HE-SIG-A field of the HE MU PPDU. Among the subfields shown in FIG. 12(b) , the same subfields as those shown in FIG. 12(a) will not be described."

page 30, paragraph 5: "The SIG-B compression field indicates whether to use a compression mode of the HE-SIG-B field."

paragraph spanning pages 31 / 32, first sentence: "According to the embodiment of the present invention, when the SIG-B compression field indicates the compression mode of the HE-SIG-B field (i.e., when the full bandwidth MU-MIMO transmission is indicated), a specific field of the HE-SIG-A may indicate information on the number of MU-MIMO users."

paragraph spanning pages 31 / 32, last sentence: "information on the number of MU-MIMO users may be indicated through a specific subfield of the HE-SIG-A"

page 32, paragraph 2: "According to a further embodiment of the present invention, some of the subfields of the HE-SIG-A field of the HE MU PPDU may signal information different from the above embodiments through a combination of a plurality of subfields."

paragraph spanning pages 34 / 35: "The number of HE-SIG-B symbols field basically indicates the number of OFDM symbols in the HE-SIG-B field. However, as in the embodiments described above, when the UL/DL field indicates downlink transmission and

the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the information on the number of MU-MIMO user. In this case, the **user specific field of the HE-SIG-B field** may consist of a user field for MU-MIMO allocation. Meanwhile, when the value of the SIG-B compression field in the UL MU PPDU is set to 1, it may be intended to omit the resource unit allocation field rather than to indicate the full bandwidth MU-MIMO transmission. Therefore, when the UL/DL field indicates uplink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the number of OFDM symbols in the HE-SIG-B field as in the basic definition. In this case, **the user specific field of the HE-SIG-B field** may consist of a user field for non-MU-MIMO allocation. According to an embodiment, since the UL MU PPDU is transmitted to a single AP, the user specific field of the HE-SIG-B field may include only one user field for the non-MU-MIMO allocation."

From the latter paragraph, it is clearly and unambiguously derivable to the skilled person that "a configuration related to a user specific field included in the HE-SIG-B field is identified by a combination of the SIG-B compression subfield and the specific subfield".

It is respectfully requested not to insist on the two-part form for amended claim 1, because it is not suitable in the present case. Dissecting the features of amended claim 1 into known features and unknown features would lead to a highly artificial claim language and would greatly diminish readability of claim 1. Further, D1 has been acknowledged in the amended description, and the contribution over the prior art is also apparent from the comparison between claim 1 and the cited art. The two-part form should not be insisted upon.

Claims 2-6 of the amended set of claims are based on claims 3-6 and 8, as previously on file. Amended claims 2 and 3 have been re-arranged for easier readability, have been slightly amended for clarity ("a plurality of user fields" vs. "one user field") and have been adapted to amended claim 1 for consistency. Amended claims 4 and 5 have been amended for consistency with amended claim 3. Claim 6 has been slightly re-worded for clarity and consistency with the preceding claims.

Claims 7-8 of the amended set of claims have been newly introduced.

Original disclosure for the additional claims is given - inter alia - in the following passages of the description:

page 30, paragraph 2: "FIG. 12(b) illustrates a subfield configuration of the HE-SIG-A field of the HE MU PPDU. Among the subfields shown in FIG. 12(b) , the same subfields as those shown in FIG. 12(a) will not be described."

paragraph spanning pages 30 / 31: "Therefore, in the full bandwidth MU-MIMO transmission, the SIG-B compression field indicates the compression mode of the HE-SIG-B field. In this case, the common field containing the resource unit allocation field is not present in the HE-SIG-B field."

paragraph spanning pages 33 / 34: "The SIG-B compression field indicates whether to use the compression mode of the HE-SIG-B field. When the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the common field containing the resource unit allocation field is not present in the HE-SIG-B field."

page 34, paragraph 2: "That is, when the UL/DL field indicates uplink transmission, the SIG-B compression field may always indicate that the common field is not present in the HE-SIG-B field."

paragraph spanning pages 34 / 35: "The number of HE-SIG-B symbols field basically indicates the number of OFDM symbols in the HE-SIG-B field. However, as in the embodiments described above, when the UL/DL field indicates downlink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the information on the number of MU-MIMO user. In this case, the user specific field of the HE-SIG-B field may consist of a user field for MU-MIMO allocation. Meanwhile, when the value of the SIG-B compression field in the UL MU PPDU is set to 1, it may be intended to omit the resource unit allocation field rather than to indicate the full bandwidth MU-MIMO transmission. Therefore, when the UL/DL field indicates uplink transmission and the SIG-B compression field indicates the compression mode of the HE-SIG-B field, the number of HE-SIG-B symbols field in the HE-SIG-A may indicate the number of OFDM symbols in the HE-SIG-

B field as in the basic definition. In this case, the user specific field of the HE-SIG-B field may consist of a user field for non-MU-MIMO allocation. According to an embodiment, since the UL MU PPDU is transmitted to a single AP, the user specific field of the HE-SIG-B field may include only one user field for the non-MU-MIMO allocation."

Amended independent claim 9 is based on previously pending claim 1 and has been amended in a manner analogous to claim 1. Amended claim 9 has been left in the one-part form for the reasons laid out above with respect to claim 1.

Claims 10-14 of the amended set of claims are based on claims 11-14 and 16, as previously on file. They have been amended in a manner analogous to corresponding device claims 2-6.

As compared to the previously pending set of claims, claims 2, 7, 10, and 15 have been cancelled. It is stressed, that the cancelling of those claims does not constitute any waiver of any rights. The applicant reserves the right to revert to the subject matter of previously pending claims 2, 7, 10, and 15 at a later point in time, e.g. via a divisional application.

Reference numerals have been placed in parentheses throughout the claims.

In order to overcome the clarity objection of section 2 of the EESR, the parentheses have been removed and the acronyms in question have been placed between commas.

Also enclosed herewith, amended description pages 3, 3a and 60 are filed, both in a marked-up version and a clean version. Therein, the description has been brought in conformity with the amended set of claims and cited document D1 has been acknowledged and its relevant contents indicated. Further, the objection regarding page 60 of the description has been addressed.

II.2. Novelty

The subject matter of amended independent claims 1 and 9 is new with respect to the cited documents.

D1 at least fails to disclose the features that the "the HE-SIG-A field includes a SIG-B compression subfield and a specific subfield, [...] wherein the specific subfield indicates a number of MU-MIMO users **according to** a value of the SIG-B compression subfield" and that "a configuration related to a user specific field included in the HE-SIG-B field is identified **by a combination** of the SIG-B compression subfield and the specific subfield".

D1 simply discloses whether the common field of HE-SIG-B is included according to the value of the compression field of HE-SIG-A and that the SIGB Number of Symbols / Number of MU-MIMO users field indicates the number of STAs. However, D1 does not disclose a method of identifying the configuration of user specific fields of HE-SIG-B based on the combination of subfields and how the value indicated by the SIGB Number of Symbols / Number of MU-MIMO users field varies depending on the value of the compression field.

Specifically, D1 simply discloses a method of indicating whether a specific field is included in HE-SIG-B based on the value of a single field of HE-SIG-A, but does not disclose a method for recognizing the field configuration of HE-SIG-B by the combination of the values of the fields included in HE-SIG-A.

In addition, D1 simply states that the SIGB Number of Symbols / Number of MU-MIMO users field represents the number of STAs in the MU-MIMO group, regardless of the value of the compression field. Rather, Section 26.3.3.7.4 of D1 states that:

An AP that transmits an HE MU PPDU shall set the UL/DL field in the HE-SIG-A field to 0.(#1862) A full bandwidth MU MIMO transmission using HE MU PPDU format has a value of 1 for the SIGB Compression field in HE-SIG-A and the SIGB Common field is not present.(#2126) If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and the number of STAs on each RU for SU/MU-MIMO(#1507) transmission. The number of users in RU r for MU-MIMO transmission, $N_{user,r}$ is indicated together with the RU allocation as defined in RU allocation signaling: arrangement and number of MU-MIMO al. If the value of the SIGB Compression field in HE-SIG-A is 1, there is no RU allocation signaling in HE-SIG-B Common field and HE-SIG-B contains only User specific fields. The number of STAs in the MU-MIMO(#1507) group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field(#853) in HE-SIG-A. For bandwidths larger than 20 MHz, the User block fields are split equitably between two SIG-B channels, i.e., for a k user MU-MIMO PPDU, 1, ..., ceil(k/2) User fblock fields are carried in HE-SIG-B content channel 1 and ceil(k/2) + 1, ..., k User block fields in HE-SIG-B

In contrast thereto, amended claim 1 of the present application discloses a method of identifying the configuration of subfields included in HE-SIG-B based on a combination of a SIG-B compression subfield and a specific field included in HE-SIG-A. Also, amended claim 1 discloses how a specific field indicates or does not indicate the number of MU-MIMO users depending on the value of the SIG-B compression subfield.

That is, amended claim 1 of the present application discloses a method of identifying the configuration of at least one subfield of HE-SIG-B by a combination of a SIG-B compression field and a specific subfield that indicates or does not indicate the number of MU-MIMO users by the value of the SIG-B compression field.

Consequently, the subject matter of amended claim 1 is new with respect to D1.

Further, none of the additionally cited references D2 to D4 discloses the newly introduced features of amended claim 1. Consequently, the subject matter of amended claim 1 is also new with respect to D2, D3, and D4.

The subject matter of independent method claim 9 is also new, at least for analogous reasons.

II.3. Inventive step

The subject matter of amended claims 1 and 9 also involves an inventive step with respect to the cited documents.

The subject matter of amended claim 1 was not obvious from the cited documents.

D1 is considered the closest prior art.

The subject matter of amended claim 1 differs from the disclosure of D1 at least in the following features:

- "wherein the HE-SIG-A field includes a SIG-B compression subfield and a specific subfield, and wherein the specific subfield indicates a number of MU-MIMO users according to a value of the SIG-B compression subfield"; and

- "wherein a configuration related to a user specific field included in the HE-SIG-B field is identified by a combination of the SIG-B compression subfield and the specific subfield".

The differing features have the technical effect of providing a more efficient communication. By creating and exploiting interdependencies between the SIG-B compression subfield and the specific subfield of the HE-SIG-A field, a larger signalling content can be embedded into these subfields and a more efficient identification of the configuration of the HE-SIG-B field may be achieved.

Accordingly, the objective technical problem is to improve communication efficiency.

The solution to the objective technical problem was not obvious to the skilled person.

D1 does not contain any hint in the direction of the differing features nor in the direction of the technical effect that may be achieved therewith. In particular, D1 does not contain any hint in the direction of indicating a number of MU-MIMO users via a specific subfield of the HE-SIG-A field according to a value of the SIG-B compression subfield nor in the direction of "a configuration related to a user specific field included in the HE-SIG-B field [being] identified by a combination of the SIG-B compression subfield and the specific subfield".

Further, D2, D3, and D4 also do not contain any hint in the direction of the differing features nor in the direction of the technical effect that may be achieved therewith.

The subject matter of amended claim 1 was neither obvious from D1 nor obvious from D1 in combination with any of D2, D3, and D4.

Consequently, the subject matter of claim 1 involves an inventive step.

The subject matter of method claim 9 also involves an inventive step, at least for analogous reasons.

II.4. Requests

On the basis of the amended application documents, it is requested to issue a Communication pursuant to Rule 71 (3) EPC. Should the Examining Division unexpectedly have concerns regarding the grant of a patent, it is requested to issue a Communication pursuant to Art. 94 (3) EPC. If the concerns are minor in nature, the Examining Division is also invited to contact the undersigned attorney by telephone.

Just as a precaution, Oral Proceedings are already requested at this stage of the proceedings as an auxiliary request.

Respectfully submitted,

Axel Schmitt-Nilson

Encl.:
amended claims 1-14 (marked-up and clean versions)
amended description pages 3, 3a, and 60 (marked-up and clean versions)

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Date
18.08.20

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 / 3567911 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Communication pursuant to Rules 70(2) and 70a(2) EPC

A supplementary European search report has been drawn up concerning the above-identified European patent application (publication number: 3567911).

Since the request for examination has been filed (R. 70(1), 159(1)(f), Art. 94(1) EPC) prior to the transmission of the supplementary European search report, you are hereby invited to indicate within

six months

of notification of this communication whether you wish to proceed further with the European patent application.

If you do not indicate in due time that you wish to proceed further with the European patent application, it **will be deemed to be withdrawn** (R. 70(3) EPC).

You are invited, within the above-mentioned six-month period, to comment on the objections raised in the opinion accompanying the European search report and/or to file any amendments to the description, claims and drawings correcting any deficiencies noted in the opinion (R. 70a(2), R. 137(2) EPC; Guidelines for Examination in the EPO, B-XI, 8).

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).

Should the reply to the invitation pursuant to Rule 70a(2) EPC be filed in an admissible non-EPO language, a translation is to be submitted within one month of its filing (R. 6(2) EPC).

Should you not comply with this invitation within the time limit, the application **will be deemed to be withdrawn** in accordance with Rule 70a(3) EPC.

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Date
31.07.20

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 / 3567911 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Communication

The extended European search report is enclosed.

The extended European search report includes, pursuant to Rule 62 EPC, the supplementary European search report (Art. 153(7) EPC) and the European search opinion.

Copies of documents cited in the European search report are attached.

☑ 0 additional set(s) of copies of such documents is (are) enclosed as well.

Refund of the search fee
If applicable under Article 9 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

Should you wish to further prosecute this application in the examination phase, your attention is drawn to the provisions of Rule 70a EPC. An invitation to respond to the extended European search report will be issued shortly (R. 70(2) EPC).

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EPO Machine Translation XML

SUBJECT OF THE INVENTION
TRANSMISSION METHOD FOR MULTI USER IN WIRELESS LOCAL AREA NETWORK}

[**0001**] The present invention relates to WLAN technology, and more particularly, to multi-user transmission.

[**0002**] With the development of information and communication technology, various wireless communication technologies are being developed. Wireless local area network (WLAN) is based on radio frequency technology, personal digital assistant (PDA), laptop computer, portable multimedia player (PMP), smart It is a technology for wirelessly accessing the Internet in a home, business, or a specific service providing area by using a portable terminal such as a smart phone or a tablet PC.

[**0003**] The standard for WLAN technology is being developed as an Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard. As the spread of WLAN is activated and applications using the same are diversified, there is an increasing need for new WLAN technologies that support higher throughput than existing WLAN technologies. Very high throughput (VHT) WLAN technology is proposed to support data processing speed of 1Gbps or more. Among them, the WLAN technology according to the IEEE 802.11ac standard is a technology for providing an ultra high throughput in the band below 6GHz, and the WLAN technology according to the IEEE 802.11ad standard is a technology for providing an ultra high throughput in the 60GHz band.

[**0004**] In addition, standards for various WLAN technologies have been defined and technology development is in progress. Typically, the WLAN technology according to the IEEE 802.11af standard is a technology defined for the operation of the WLAN in the TV white space (white space), and the WLAN technology according to the IEEE 802.11ah standard operates at a low power in the band below 1GHz The technology is defined to support a large number of terminals, and the WLAN technology according to the IEEE 802.11ai standard is a technology defined for fast initial link setup (FILS) in a WLAN system. Recently, IEEE 802.11ax standardization for the purpose of improving frequency efficiency in a dense environment in which a plurality of base stations and terminals exist.

[**0005**] In a system based on the WLAN technology, multi-user (MU) transmission may be performed. Multi-user transmission may include uplink and downlink transmission based on orthogonal

frequency division multiple access (OFDMA), uplink and downlink transmission based on multi-user-multiple input multiple output (MU-MIMO), and the like. When multi-user transmission is performed between stations, information necessary for multi-user transmission may be signaled to the corresponding station.

[**0006**] An object of the present invention for solving the above problems is to provide a method for operating a station supporting multi-user transmission in a WLAN.

[**0007**] A method of operating a first station in a WLAN according to an embodiment of the present invention for achieving the above object includes generating a PPDU including a legacy preamble, a HE preamble, and a payload, and transmitting the PPDU. The HE preamble includes an HE-SIG-A field, an HE-SIG-B field, an HE-STF, and an HE-LTF, and the HE-SIG-A field includes the number of symbols in the HE-SIG-B field. It contains information indicating.

[**0008**] Here, the number of symbols in the HE-SIG-B field may be indicated based on transmission bandwidth information of the PPDU included in the HE-SIG-A field.

[**0009**] Here, the number of symbols in the HE-SIG-B field may be indicated based on transmission bandwidth information of the PPDU included in the HE-SIG-A field and resource size information allocated to a station receiving the PPDU.

[**0010**] Here, the number of symbols in the HE-SIG-B field may be indicated based on the number information of stations that receive the PPDU included in the HE-SIG-A field.

[**0011**] Here, the HE-SIG-A field may further include information indicating MCS of the HE-SIG-B field.

[**0012**] Here, the HE-SIG-B field may be repeated on the time axis.

[**0013**] Here, the HE-SIG-B field may include resource allocation information of a station that receives the PPDU.

[**0014**] According to another aspect of the present invention, there is provided a method for operating a first station in a WLAN, the method comprising: acquiring a legacy preamble included in a PPDU received from a second station, a HE preamble included in the PPDU; Acquiring a payload included in the PPDU based on information included in the HE preamble, wherein the HE preamble includes an HE-SIG-A field, an HE-SIG-B field, and an HE- It includes the STF and HE-LTF, the HE-SIG-A field includes information indicating the number of symbols of the HE-SIG-B field.

[0015] Here, the number of symbols in the HE-SIG-B field may be indicated based on transmission bandwidth information of the PPDU included in the HE-SIG-A field.

[0016] Here, the number of symbols in the HE-SIG-B field may be indicated based on transmission bandwidth information of the PPDU included in the HE-SIG-A field and resource size information allocated to a station receiving the PPDU.

[0017] Here, the number of symbols in the HE-SIG-B field may be indicated based on the number information of stations that receive the PPDU included in the HE-SIG-A field.

[0018] Here, the HE-SIG-A field may further include information indicating MCS of the HE-SIG-B field.

[0019] Here, the HE-SIG-B field may be repeated on the time axis.

[0020] Here, the HE-SIG-B field may include resource allocation information of a station that receives the PPDU.

[0021] According to the present invention, when multi-user transmission is performed, resource allocation information may be included in the HE-SIG field (eg, the HE-SIG-A field, the HE-SIG-B field, etc.) of the PPDU. Based on the allocation information, it is possible to identify resources allocated to itself and to decode a signal received through the identified resources. Among the information required for multi-user transmission (eg, resource allocation information, etc.), common information may be transmitted through the entire frequency band, and user-specific information may be assigned to the frequency band (or , Spatial stream). Information required for transmission may vary according to a transmission method (eg, OFDM, OFDMA, SU-MIMO, MU-MIMO, etc.) of the PPDU, and thus, the structure of the preamble included in the PPDU may also be changed. Through this, the performance of the WLAN can be improved.

[0022] 1 is a block diagram showing the structure of a WLAN device. 2 is a schematic block diagram illustrating a transmission signal processor in a WLAN. 3 is a schematic block diagram illustrating a reception signal processor in a WLAN. 4 is a diagram illustrating an interframe space relationship. FIG. 5 is a conceptual diagram illustrating a frame transmission procedure according to a CSMA / CA scheme for avoiding collision between frames in a channel. 6 is a conceptual diagram illustrating an embodiment of a topology of a WLAN. 7 is a flowchart illustrating an embodiment of downlink transmission in a WLAN. 8 is a block diagram illustrating a first embodiment of a PPDU. 9 is a block diagram illustrating a second embodiment and a third embodiment of a PPDU. 10 is a block diagram illustrating a fourth embodiment of a PPDU. 11 is a flowchart illustrating an

embodiment of uplink transmission in a WLAN. 12 is a block diagram illustrating a fifth embodiment of a PPDU.

[**0023**] DETAILED DESCRIPTION Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings so that those skilled in the art may easily implement the present invention. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. In the drawings, parts irrelevant to the description are omitted for simplicity of explanation, and like reference numerals designate like parts throughout the specification.

[**0024**] In a wireless local area network (WLAN) (hereinafter referred to as "wireless LAN"), a basic service set (BSS) includes a plurality of WLAN devices. The WLAN device may include a medium access control (MAC) layer and a physical (PHY) layer according to the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standard. At least one of the plurality of WLAN devices may be an access point (AP), and the other WLAN device may be a non-AP station (non-AP station, non-AP STA). Or in ad hoc networking, the plurality of WLAN devices may all be non-AP stations. In general, a station (STA) is also used as a case of collectively an access point (AP) and a non-AP station, but for convenience, a non-AP station may be referred to as a station (STA).

[**0025**] 1 is a block diagram showing the structure of a WLAN device.

[**0026**] Referring to FIG. 1, the WLAN device 1 includes a baseband processor 10, a radio frequency (RF) transceiver 20, an antenna unit 30, a memory 40, and an input interface unit 50. , An output interface unit 60 and a bus 70. The baseband processor 10 performs baseband related signal processing described herein, and may include a MAC processor 11 and a PHY processor 15.

[**0027**] In one embodiment, the MAC processor 11 may include a MAC software processor 12 and a MAC hardware processor 13. In this case, the memory 40 includes software including some functions of the MAC layer (hereinafter referred to as 'MAC software'), and the MAC software processor 12 drives the MAC software to implement some functions of the MAC. The MAC hardware processor 13 may implement the remaining functions of the MAC layer as hardware (MAC hardware), but is not limited thereto. The PHY processor 15 may include a transmit signal processor 100 and a receive signal processor 200.

[**0028**] The baseband processor 10, the memory 40, the input interface unit 50 and the output interface unit 60 may communicate with each other via the bus 70. The RF transceiver 20 may include an RF transmitter 21 and an RF receiver 22. The memory 40 may store an operating system, an application, and the like in addition to the MAC software, and the input interface unit 50 obtains

information from the user, and the output interface unit 60 receives information from the user. Output

[**0029**] The antenna unit 30 may include one or more antennas. When using a multiple-input multiple-output (MIMO) or a multi-user MIMO (MU-MIMO), the antenna unit 30 may include a plurality of antennas.

[**0030**] 2 is a schematic block diagram illustrating a transmission signal processor in a WLAN.

[**0031**] Referring to FIG. 2, the transmission signal processing unit 100 includes an encoder 110, an interleaver 120, a mapper 130, an inverse Fourier transformer 140, and a guard interval (GI) inserter 150. can do.

[**0032**] The encoder 110 encodes input data and may be, for example, a forward error correction (FEC) encoder. The FEC encoder may include a binary convolutional code (BCC) encoder, in which case a puncturing device may be included therein. Alternatively, the FEC encoder may include a low-density parity-check (LDPC) encoder.

[**0033**] The transmission signal processing unit 100 may further include a scrambler that scrambles before encoding the input data in order to reduce the probability of generating the same long sequence of zeros or ones. When a plurality of BCC encoders are used as the encoder 110, the transmission signal processing unit 100 may further include an encoder parser for demultiplexing the scrambled bits into the plurality of BCC encoders. When the LDPC encoder is used as the encoder 110, the transmission signal processing unit 100 may not use the encoder parser.

[**0034**] The interleaver 120 changes the order by interleaving the bits of the stream output from the encoder 110. Interleaving may be applied only when a BCC encoder is used as the encoder 110. The mapper 130 maps the bit string output from the interleaver 120 to constellation points. When the LDPC encoder is used as the encoder 110, the mapper 130 may further perform LDPC tone mapping in addition to constellation point mapping.

[**0035**] When using MIMO or MU-MIMO, the transmission signal processing unit 100 may use the plurality of interleavers 120 and the plurality of mappers 130 corresponding to the number NSS of the spatial streams. In this case, the transmission signal processing unit 100 may further include a stream parser that divides the outputs of the plurality of BCC encoders or LDPC encoders into a plurality of blocks to be provided to different interleavers 120 or mappers 130. In addition, the transmission signal processing unit 100 transmits a space-time block code (STBC) encoder and a space-time stream that spread constellation points from NSS spatial streams to NSTS space-time

streams. It may further include a spatial mapper that maps to chains). The spatial mapper may use methods such as direct mapping, spatial expansion, beamforming, and the like.

[**0036**] The inverse Fourier transformer 140 uses an inverse discrete Fourier transform (IDFT) or an inverse fast Fourier transform (IFFT) to time the constellation block output from the mapper 130 or the spatial mapper. Convert to an area block, that is, a symbol. In case of using STBC encoder and spatial mapper, inverse Fourier transformer 140 may be provided per transmission chain.

[**0037**] When using MIMO or MU-MIMO, the transmission signal processing unit 100 may insert cyclic shift diversity (CSD) before or after inverse Fourier transform in order to prevent unintended beamforming. CSD may be specified per transport chain or per space-time stream. Or the CSD may be applied as part of the space mapper. In addition, when using MU-MIMO, some blocks before the space mapper may be provided for each user.

[**0038**] The GI inserter 150 inserts the GI in front of the symbol. The transmission signal processing unit 100 may smoothly window the edge of the symbol after inserting the GI. The RF transmitter 21 converts a symbol into an RF signal and transmits it through an antenna. When using MIMO or MU-MIMO, the GI inserter 150 and the RF transmitter 21 may be provided for each transmission chain.

[**0039**] 3 is a schematic block diagram illustrating a reception signal processor in a WLAN.

[**0040**] Referring to FIG. 3, the received signal processor 200 may include a GI remover 220, a Fourier transformer 230, a demapper 240, a deinterleaver 250, and a decoder 260. The RF receiver 22 receives an RF signal through an antenna and converts the RF signal into a symbol, and the GI remover 220 removes the GI from the symbol. When using MIMO or MU-MIMO, RF receiver 22 and GI canceller 220 may be provided per receive chain.

[**0041**] The Fourier transformer 230 converts a symbol, that is, a time domain block, to a constellation point in the frequency domain using a Discrete Fourier transform (DFT) or fast Fourier transform (FFT). The Fourier transformer 230 may be provided for each reception chain. If you use MIMO or MU-MIMO, you can include a spatial demapper that transforms Fourier transformed receive chains into constellation points in the space-time stream, and STBC decoders that despread the constellation points from the space-time stream to the spatial stream. have.

[**0042**] The demapper 240 demaps the constellation block output from the Fourier transformer 230 or the STBC decoder into a bit stream. When the received signal is LDPC encoded, the demapper 240 may further perform LDPC tone demapping before constellation point demapping.

The deinterleaver 250 deinterleaves the bits of the stream output from the demapper 240. Deinterleaving can be applied only when the received signal is BCC encoded.

[**0043**] When using MIMO or MU-MIMO, the reception signal processing unit 200 may use a plurality of demappers 240 and a plurality of deinterleavers 250 corresponding to the number of spatial streams. In this case, the reception signal processing unit 200 may further include a stream deparser for combining the streams output from the plurality of deinterleavers 250.

[**0044**] The decoder 260 decodes the stream output from the deinterleaver 250 or the stream parser, and may be, for example, an FEC decoder. The FEC decoder may include a BCC decoder or an LDPC decoder. The received signal processor 200 may further include a descrambler that descrambles the data decoded by the decoder 260. When a plurality of BCC decoders are used as the decoder 260, the reception signal processing unit 200 may further include an encoder deparser for multiplexing the decoded data. When the LDPC decoder is used as the decoder 260, the reception signal processor 200 may not use the encoder parser.

[**0045**] 4 is a diagram illustrating an interframe space (IFS) relationship.

[**0046**] Referring to FIG. 4, a data frame, a control frame, and a management frame may be exchanged between WLAN devices. The data frame is a frame used for transmission of data forwarded to a higher layer. The data frame is transmitted after a backoff is performed after a distributed coordination function (IFS) has elapsed from when the medium is idle.

[**0047**] The management frame is a frame used for exchanging management information that is not forwarded to a higher layer. The management frame is transmitted after a backoff is performed after an IFS such as DIFS or point coordination function IFS (PIFS). Subtype frame of management frame includes Beacon, Association request / response, probe request / response, authentication request / response. A control frame is a frame used to control access to a medium. Subtype frames of control frames include RTS, CTS, and ACK. If the control frame is not a response frame of another frame, the control frame is transmitted after the backoff is performed after the elapse of DIFS. If the control frame is a response frame of another frame, the control frame is transmitted without the backoff after the short IFS (SIFS). The type and subtype of the frame may be identified by a type field and a subtype field in the frame control field.

[**0048**] On the other hand, a Quality of Service (QoS) STA may transmit a frame after performing the backoff after passing the arbitration IFS (AIFS), ie, AIFS [AC], for the access category (AC) to which the frame belongs. In this case, the frame in which AIFS [AC] may be used may be a control frame rather than a data frame, a management frame, and a response frame.

[**0049**] 5 is a conceptual diagram illustrating a frame transmission procedure according to a carrier sense multiple access (CSMA) / collision avoidance (CA) scheme for avoiding collision between frames in a channel.

[**0050**] Referring to FIG. 5, a first station STA1 means a transmitting station to which data is to be transmitted, and a second station STA2 means a receiving station which receives data transmitted from the first station STA1. The third station STA3 may be located in an area capable of receiving a frame transmitted from the first station STA1 and / or a frame transmitted from the second station STA2.

[**0051**] The first station STA1 may determine whether a channel is used through carrier sensing. The first station STA1 may determine the occupancy state of the channel based on the amount of energy present in the channel or the correlation of the signal, or may use a network allocation vector (NAV) timer to The occupancy state can be determined.

[**0052**] The first station STA1 transmits a request to send (RTS) frame after performing a backoff when it is determined that the channel is not used by another station during DIFS (that is, when the channel is in an idle state). Can be sent to (STA2). When the second station STA2 receives the RTS frame, the second station STA2 may transmit a clear to send (CTS) frame, which is a response to the RTS frame, to the first station STA1 after SIFS.

[**0053**] Meanwhile, when receiving the RTS frame, the third station STA3 uses the duration information included in the RTS frame to transmit frame frames continuously transmitted (for example, SIFS + CTS frame + SIFS + data). Frame + SIFS + ACK frame). Alternatively, when the third station STA3 receives the CTS frame, the third station STA3 uses the duration information included in the CTS frame in a subsequent frame transmission period (eg, SIFS + data frame + SIFS + ACK frame). You can set the NAV timer for. If the third station STA3 receives a new frame before the NAV timer expires, the third station STA3 may update the NAV timer using duration information included in the new frame. The third station STA3 does not attempt channel access until the NAV timer expires.

[**0054**] When the first station STA1 receives the CTS frame from the second station STA2, the first station STA1 may transmit the data frame to the second station STA2 after SIFS from the time when the reception of the CTS frame is completed. When the second station STA2 successfully receives the data frame, the second station STA2 may transmit an ACK frame, which is a response to the data frame, to the first station STA1 after SIFS.

[**0055**] When the NAV timer expires, the third station STA3 may determine whether the channel is used through carrier sensing. When it is determined that the channel is not used by another station

during the DIFS from the expiration of the NAV timer, the third station STA3 may try to access the channel after the contention window CW due to the random backoff has passed.

[**0056**] 6 is a conceptual diagram illustrating an embodiment of a topology of a WLAN.

[**0057**] Referring to FIG. 6, the first station 610, the second station 620, the third station 630, and the fourth station 640 may be located within cell coverage of the access point 600. And may be associated with the access point 600. The access point 600 and stations 610, 620, 630, and 640 may perform single user (SU) transmission or multi user (MU) transmission. Single user transmission includes uplink / downlink transmission based on orthogonal frequency division multiplexing (OFDM), uplink / downlink transmission based on & quot; multi-input multiple output (SU-MIMO) and OFDM & quot; can do. Multi-user transmission includes uplink / downlink transmission based on orthogonal frequency division multiple access (OFDMA), uplink / downlink transmission based on “SU-MIMO and OFDMA”, and uplink / downlink based on “MU-MIMO and OFDM” It may include a link transmission, uplink / downlink transmission based on "MU-MIMO and OFDMA".

[**0058**] The access point 600 and the stations 610, 620, 630, and 640 may perform single user transmission or multi-user transmission in units of 20 MHz bandwidth (eg, 20 MHz, 40 MHz, 80 MHz, 160 MHz, etc.) of bandwidth. Alternatively, single user transmission or multi-user transmission may be performed in a unit having a bandwidth less than 20 MHz (eg, a bandwidth of 10 MHz, 5 MHz, 2.5 MHz, etc.). If the subcarrier spacing is 312.5 kHz, 156.25 kHz, or 78.125 kHz, a frequency band of 20 MHz bandwidth can include 64, 128, or 256 subcarriers, respectively, and multiple bandwidths in 10 MHz, 5 MHz, or 2.5 MHz units. User transmission may be performed.

[**0059**] Next, an OFDM based downlink transmission method, a "SU-MIMO and OFDM" based downlink transmission method, and a "MU-MIMO and OFDM" based downlink transmission method will be described.

[**0060**] 7 is a flowchart illustrating an embodiment of downlink transmission in a WLAN.

[**0061**] Referring to FIG. 7, the access point AP may be the access point 600 described with reference to FIG. 6, and the stations STAs may include the stations 610, 620, 630, described with reference to FIG. 6. 640). Access points (APs) and stations (STAs) may configure the WLAN topology described with reference to FIG. 6. The AP may perform OFDM-based downlink transmission, “SU-MIMO and OFDM” -based downlink transmission, “MU-MIMO and OFDM” -based downlink transmission, and stations (STAs). May perform an operation corresponding to the operation of the access point (AP). The AP may generate a PPDU (Physical Layer Convergence Procedure)

protocol data unit (PPDU) (S700). The PPDU may have a structure as follows. The structure of the PPDU is not limited to the following description, and the PPDU may have various structures.

[**0062**] 8 is a block diagram illustrating a first embodiment of a PPDU.

[**0063**] Referring to FIG. 8, the PPDU 800 may include a legacy preamble, a high efficiency (HE) preamble, and a payload. The legacy preamble may include a legacy-short training field (L-STF), a long training field (L-LTF), and an L-SIG (signal) field. When the transmission bandwidth of the PPDU 800 is 80 MHz, the fields included in the legacy preamble may be duplicated in units of 20 MHz bandwidth. The HE preamble may include a HE-SIG-A field, a HE-STF, HE-LTF, and a HE-SIG-B field. When the transmission bandwidth of the PPDU 800 is 80 MHz, the HE-SIG-A field may be duplicated in units of 20 MHz bandwidth, and the HE-STF, HE-LTF, and HE-SIG-B fields may be transmitted through the 80 MHz bandwidth. have. The HE-SIG-A field may include at least one of information elements described in Table 1 below.

[**0064**] [pat00001.jpg]

[**0065**] The bandwidth indicator may indicate the transmission bandwidth (eg, 20 MHz, 40 MHz, 80 MHz, 160 MHz, etc.) of the PPDU 800. The bandwidth indicator included in the HE-SIG-A field of the PPDU 800 may indicate a bandwidth of 80 MHz. For example, if the bandwidth indicator is set to binary "00", "01", "10" or "11", it may indicate the bandwidth 20MHz, 40MHz, 80MHz or 160MHz, respectively. If the frequency band over which the PPDU 800 is transmitted is non-continuous, the bandwidth indicator may indicate the bandwidth of the non-continuous frequency band. The UL / DL indicator may indicate that transmission of the PPDU 800 is uplink (UL) transmission or downlink (DL) transmission. The UL / DL indicator included in the HE-SIG-A field of the PPDU 800 may indicate downlink transmission. For example, when the UL / DL indicator is set to binary "0" or "1", this may indicate uplink transmission or downlink transmission, respectively.

[**0066**] The OFDM / OFDMA indicator may indicate that the transmission of the PPDU 800 is an OFDM based transmission or an OFDMA based transmission. The OFDM / OFDMA indicator included in the HE-SIG-A field of the PPDU 800 may indicate OFDM based transmission. For example, if the OFDM / OFDMA indicator is set to binary "0" or "1", this may indicate OFDM based transmission or OFDMA based transmission, respectively. When OFDM-based transmission is indicated by the OFDM / OFDMA indicator, the HE-SIG field consecutive to the HE-SIG-A field in the PPDU 800 (eg, between the HE-SIG-A field and the HE-STF). HE-SIG field located at) may not exist. That is, since OFDM-based transmission does not require resource allocation information, the resource allocation information or the HE-SIG field including the same may not exist in the PPDU 800. The SU / MU indicator may indicate that the transmission of the PPDU 800 is a single user transmission or a multi-user transmission. If the PPDU 800 is transmitted based on OFDM or "SU-

MIMO and OFDM", the SU / MU indicator may indicate single user transmission. If the PPDU 800 is transmitted based on "MU-MIMO and OFDM", the SU / MU indicator may indicate multi-user transmission. For example, if the SU / MU indicator is set to binary "0" or "1", this may indicate either single user transmission or multiple user transmission, respectively. Also, if the SU / MU indicator is set to binary & quot; 1 & quot ;, this may indicate that MU-MIMO is applied to the full bandwidth of the PPDU 800. The SU / MU indicator may be present in the HE-SIG-A field of the PPDU 800 when the OFDM / OFDMA indicator indicates OFDM-based transmission, and the PPDU 800 when the OFDM / OFDMA indicator indicates OFDMA-based transmission.) May not be present in the HE-SIG-A field.

[**0067**] The STA identifier may indicate at least one station that receives the PPDU 800. When the PPDU 800 is transmitted based on OFDM or “SU-MIMO and OFDM,” an association identifier (AID) or a partial AID (PAID) may be used as the STA identifier. When the PPDU 800 is transmitted based on "MU-MIMO and OFDM", a group ID may be used as the STA identifier. The group ID may indicate a group including a plurality of stations. The STA identifier is not limited to the above description and may be variously set. For example, the STA identifier may be joint encoded with information included in the HE preamble (eg, the HE-SIG-A field or the HE-SIG-B field).

[**0068**] The BSS identifier may indicate a BSS to which the access point (AP) that transmitted the PPDU 800 belongs. Alternatively, the BSS identifier may be used by the station that receives the PPDU 800 to distinguish whether the BSS to which the access point (AP) to which the PPDU 800 belongs is a BSS to which it belongs, or an overlapping BSS. For example, the BSS identifier may be a BSSID (BSSID) or a BSS color.

[**0069**] Here, the BSS color may include a value indicating a BSS to which the access point (AP) that transmitted the PPDU 800 belongs. A communication entity (eg, an access point or a station) may set one value as a value of a BSS color representing a BSS to which it belongs. For example, when the BSS color is represented by three bits, eight BSSs can be distinguished by the BSS color. The value of the BSS color may be set to one of 0 to 7 through negotiation between access points (APs) belonging to the BSS, and the value of the set BSS color may be maintained while the corresponding BSS is present. Communication entities (eg, access points, stations) belonging to the same BSS may have values of the same BSS color. That is, the value of the BSS color included in the HE-SIG-A field of the PPDU generated by the communication entity belonging to the same BSS may be set identically.

[**0070**] For example, a station receiving the PPDU 800 may obtain a BSS color from the HE-SIG-A field of the PPDU 800, and may obtain a value of the obtained BSS color (for example, 1) and its BSS color. If the color values (eg, 1) are the same, it may be determined that the BSS to which the access point (AP) that has transmitted the PPDU 800 belongs is the same as the BSS to which it

belongs. On the other hand, if the station has a different BSS color value (for example, 2) and its BSS color value (for example, 1), then the BSS to which the access point (AP) to which the PPDU 800 transmits belongs is determined. It can be determined that it is different from the BSS to which it belongs (ie, OBSS). In this case, the station can operate in the doze mode without decoding subsequent fields (eg, fields after the HE-SIG-A field or fields after the HE preamble), and the PPDU 800 Transition from the doze mode to the awake mode at the end of. The BSS color is not limited to the above description and may be variously set.

[**0071**] The NSTS may indicate the number of space-time streams. Space-time block coding (STBC) may indicate the dimensionality of the STBC. That is, the number of spatial streams allocated to the station receiving the PPDU 800 may be indicated by NSTS and STBC. When the PPDU 800 is transmitted based on OFDM, each of the NSTS and STBC may be set to 0, or the NSTS and STBC may not be present in the HE-SIG-A field of the PPDU 800. When the PPDU 800 is transmitted based on "SU-MIMO and OFDM" or "MU-MIMO and OFDM", each of the NSTS and STBC may be set to a non-zero value. When the PPDU 800 is transmitted based on "MU-MIMO and OFDM", NSTS and STBC may be set per station.

[**0072**] The HE-SIG-B field may include MCS information of the payload, length information of the payload, and the like. The payload may include at least one data unit. Meanwhile, PPDUs used for OFDM-based uplink transmission, “SU-MIMO and OFDM” -based uplink transmission, and “MU-MIMO and OFDM” -based uplink transmission, respectively, may be described as PPDU (see FIG. 8). 800 and the same or similar structure.

[**0073**] Referring back to FIG. 7, the AP may transmit the PPDU 800 (S710). In the case of OFDM-based downlink transmission or “SU-MIMO and OFDM” -based downlink transmission, the AP may transmit the PPDU 800 to one station (STA). In the case of "MU-MIMO and OFDM" based downlink transmission, the access point (AP) may transmit the PPDU 800 to a plurality of stations (STAs).

[**0074**] The station STA may acquire a legacy preamble included in the PPDU 800 received from the access point AP (S720), and obtain a HE preamble included in the PPDU 800 (S730). The station (STA) may know the transmission bandwidth of the PPDU 800 based on the bandwidth indicator included in the HE-SIG-A field of the PPDU 800, and may indicate the UL / DL indicator included in the HE-SIG-A field. On the basis of this, it can be confirmed that the transmission of the PPDU 800 is a downlink transmission, and it can be confirmed that the transmission of the PPDU 800 is OFDM based transmission based on the OFDM / OFDMA indicator included in the HE-SIG-A field. . The station STA may confirm that the transmission of the PPDU 800 is a single user transmission or a multi-user transmission based on the SU / MU indicator included in the HE-SIG-A field of the PPDU 800. On the basis of the STA identifier included in the A field, it is possible

to determine whether it corresponds to a station to receive the PPDU 800, and the access point which transmitted the PPDU 800 based on the BSS identifier included in the HE-SIG-A field. You can check the BSS to which the (AP) belongs. The station STA may identify the spatial stream allocated to it based on the NSTS and the STBC included in the HE-SIG-A field of the PPDU 800.

[**0075**] In addition, the station (STA) may check the MCS of the payload based on the MCS information included in the HE-SIG-B field of the PPDU 800, and the pay station is based on the length information included in the HE-SIG-B field. You can check the length of the rod. The station STA may acquire the payload of the PPDU 800 based on the information included in the HE preamble (S740). The station STA may transmit an ACK frame, which is a response to the PPDU 800, to the access point AP when the PPDU 800 is successfully received.

[**0076**] Next, the OFDMA based downlink transmission method, the "SU-MIMO and OFDMA" based downlink transmission method, and the "MU-MIMO and OFDMA" based downlink transmission method will be described.

[**0077**] Referring back to FIG. 7, the AP may perform OFDMA based downlink transmission, “SU-MIMO and OFDMA” based downlink transmission, and “MU-MIMO and OFDMA” based downlink transmission. The stations STAs may perform operations corresponding to those of the access point AP. The access point AP may generate a PPDU (S700). The PPDU may have a structure as follows. The structure of the PPDU is not limited to the following description, and the PPDU may have various structures.

[**0078**] 9 is a block diagram illustrating a second embodiment and a third embodiment of a PPDU.

[**0079**] 9, the PPDUs 910 and 920 may include a legacy preamble, an HE preamble, and a payload. The legacy preamble may include L-STF, L-LTF, and L-SIG fields. When the transmission bandwidth of the PPDUs 910 and 920 is 80 MHz, the fields included in the legacy preamble may be copied in units of 20 MHz bandwidth. The HE preamble may include an HE-SIG-A field, an HE-SIG-B field, an HE-STF, an HE-LTF, and an HE-SIG-C field. The field included in the HE preamble is not limited thereto, and the HE preamble may be configured in various ways. For example, the HE preamble may consist of a HE-SIG-A field, a HE-SIG-B field, a HE-STF, and a HE-LTF.

[**0080**] When the transmission bandwidth of the PPDU 910 is 80 MHz, the HE-SIG-A field and the HE-SIG-B field may be duplicated in units of 20 MHz bandwidth, and the HE-STF and HE-LTF may be transmitted through the 80 MHz bandwidth. have. When the transmission bandwidth of the PPDU 920 is 80 MHz, the HE-SIG-A field may be replicated in units of 20 MHz bandwidth, and the HE-SIG-B field, HE-STF, and HE-LTF may be transmitted through a bandwidth of 80 MHz. have. Here, the HE-SIG-B field may be repeated at least once on the time axis, and in this case, a signal to

noise ratio (SNR) of the HE-SIG-B field may be increased at the receiving end. If the HE-SIG-B field is repeated, this may be indicated by a repetition indicator included in the HE-SIG-A field. The HE-SIG-A field may include at least one of the information elements described in Table 2 below.

[**0081**] [pat00002.jpg]

[**0082**] Each of the bandwidth indicator, the UL / DL indicator, the OFDM / OFDMA indicator, the STA identifier, and the BSS identifier may be the same as the corresponding information element described with reference to Table 1. Here, the bandwidth indicator may indicate a bandwidth of 80MHz, the UL / DL indicator may indicate downlink transmission, the OFDM / OFDMA indicator may indicate OFDMA transmission, and a group ID may be used as the STA identifier.

[**0083**] In addition, the HE-SIG-A field may further include a repeating indicator indicating whether to repeat the HE-SIG-B field continuous with the HE-SIG-A field. For example, the repetition indicator may be set to binary "0" or "1", which may indicate that the HE-SIG-B field is not repeated or that the HE-SIG-B field is repeated, respectively.

[**0084**] The resource allocation structure indicator may indicate the size of resources (eg, time resource, frequency resource, spatial stream, etc.) allocated to the station receiving the PPDUs 910 and 920. For example, the resource allocation structure indicator may indicate the minimum size of resources allocated to the station. The number indicator of the STA may indicate the number of stations that receive the PPDUs 910 and 920 (that is, the number of stations participating in the multi-user transmission). The symbol indicator may explicitly indicate the number of symbols (eg, the size of the HE-SIG-B field) of the HE-SIG-B field consecutive to the HE-SIG-A field.

[**0085**] Meanwhile, the HE-SIG-B field may include resource allocation information, and the resource allocation information may include at least one of time resource allocation information, frequency resource allocation information, and spatial stream allocation information for each station. The number of symbols in the HE-SIG-B field may vary depending on the amount of information (eg, resource allocation information, etc.) included in the HE-SIG-B field. In this case, the number of symbols in the HE-SIG-B field may be indicated by at least one of a bandwidth indicator, a resource allocation structure indicator, a number indicator of a STA, and a symbol indicator.
In a first method, the number of symbols in the HE-SIG-B field may be preset according to the transmission bandwidth of the PPDUs 910 and 920, and the station receiving the PPDUs 910 and 920 may receive the PPDUs 910 and 920. The number of symbols in the HE-SIG-B field may be checked based on the bandwidth indicator included in the HE-SIG-A field. For example, the number of symbols in the HE-SIG-B field may be proportional to the size of the transmission bandwidth of the PPDUs 910 and 920.

[**0086**] In the second method, the number of symbols in the HE-SIG-B field may be preset according to the "size of transmission bandwidth and resource allocation structure of the PPDUs 910 and 920", and the station receiving the PPDUs 910 and 920 may be preset. Can identify the number of symbols in the HE-SIG-B field based on the "size of transmission bandwidth and resource allocation structure of PPDUs 910 and 920". For example, when the transmission bandwidth of the PPDUs 910 and 920 is relatively large and a lot of resources are allocated to one station, the resource allocation information to be included in the HE-SIG-B field may be small. In this case, the number of symbols in the HE-SIG-B field may be accurately indicated by considering the resource allocation structure as well as the size of the transmission bandwidth of the PPDUs 910 and 920.

[**0087**] In a third method, the number of symbols in the HE-SIG-B field may be preset according to the number of stations receiving the PPDUs 910 and 920, and the station receiving the PPDUs 910 and 920 may be a number indicator of the STA. Based on the number of symbols in the HE-SIG-B field can be confirmed. For example, the number of symbols in the HE-SIG-B field may be proportional to the number of stations indicated by the number indicator of the STA. Alternatively, the number of stations receiving the PPDUs 910 and 920 may be estimated based on the "size and resource allocation structure of the transmission bandwidth of the PPDUs 910 and 920" instead of the number indicator of the STA. In a fourth method, the number of symbols in the HE-SIG-B field may be explicitly indicated by the symbol indicator. The station receiving the PPDUs 910 and 920 may check the number of symbols in the HE-SIG-B field based on the symbol indicator. The method of indicating the number of symbols in the HE-SIG-B field is not limited to the above-described method, and the number of symbols in the HE-SIG-B field may be indicated in various ways.

[**0088**] Meanwhile, the MCS of the HE-SIG-B field may vary according to the amount of information (for example, resource allocation information, etc.) included in the HE-SIG-B field, and the HE-SIG-B field (or HE The MCS indicator indicating the MCS of the fields after the -SIG-A field may be included in the HE-SIG-A field. The MCS indicator may indicate MCS using 1 bit. The MCS of the HE-SIG-A field (eg, MCS 0) may be different from the MCS of the HE-SIG-B field (eg, MCS 1). For example, if the MCS indicator is set to binary "0" or "1", this may indicate MCS 0 or MCS 1, respectively. Alternatively, the MCS indicator may indicate MCS using 3 bits. For example, if the MCS indicator is set to binary "000", "001", "010", "011", "100", "101", "110", or "111", this is MCS 0, MCS 1 respectively. , MCS 2, MCS 3, MCS 4, MCS 5, MCS 6 or MCS 7 may be indicated. Here, the MCS of the HE-SIG-B field may be set based on the link having the lowest quality among the links of each of the AP and the STAs. The method of indicating the MCS of the HE-SIG-B field is not limited to the above-described method, and the MCS of the HE-SIG-B field may be indicated in various ways.

[**0089**] The HE-SIG-B field may include resource allocation information, subband information, a cyclic prefix length indicator, a subcarrier spacing indicator, an FFT / IFFT structure indicator, and the like. The resource allocation information may include at least one of time resource allocation information, frequency resource allocation information, and spatial stream allocation information. Resource allocation information may be set for each station or subband (for example, a frequency band having a bandwidth of 20 MHz). The time resource allocation information may include time resource information allocated to the group indicated by the STA identifier (ie, group ID) of the HE-SIG-A field, and time resource information allocated to each of the stations belonging to the group. The frequency resource allocation information may include frequency resource information allocated to the group indicated by the STA identifier (ie, group ID) of the HE-SIG-A field, and frequency resource information allocated to each of the stations belonging to the group. The frequency resource may be allocated to the station in units of a bandwidth of 20 MHz, and may be allocated to the station in units of less than 20 MHz of bandwidth (eg, 10 MHz, 5 MHz, 2.5 MHz, etc.). The spatial stream allocation information may include spatial stream information allocated to the group indicated by the STA identifier (ie, group ID) of the HE-SIG-A field, and spatial stream information allocated to each of the stations belonging to the group. Here, the spatial stream may be indicated by STBC and NSTS. Thus, the spatial stream information may include STBC and NSTS per station (or group).

[**0090**] The subband information may include common information (eg, restrictions) for each subband (for example, a frequency band having a bandwidth of 20 MHz). For example, common resource allocation information for each subband may exist in the resource allocation information, and such information may be combined into one subband information. If the number of spatial streams allocated to each of the subbands is equal to two, the subband information may indicate that the number of spatial streams allocated to each of the subbands is two.

[**0091**] The CP length indicator may indicate a CP length of fields (eg, HE-STF, HE-LTF, HE-SIG-C field, payload, etc.) that are continuous with the HE-SIG-B field. CP length may be 0.4 μs, 0.8 μs, 1.6 μs, 3.2 μs and the like. The CP length indicator may explicitly indicate the CP length. Alternatively, the CP length indicator may indicate the CP length using 2 bits. For example, a CP length indicator set to binary "00", "01", "10" or "11" may indicate a CP having a length of 0.4 ms, 0.8 ms, 1.6 ms or 3.2 ms.

[**0092**] The subcarrier spacing indicator may indicate the subcarrier spacing of the HE-SIG-B field and the consecutive fields (eg, the HE-STF, the HE-LTF, the HE-SIG-C field, the payload, etc.). The subcarrier spacing may be 312.5 kHz, 156.25 kHz, 78.125 kHz, or the like. The subcarrier spacing indicator may explicitly indicate the subcarrier spacing. Alternatively, the subcarrier spacing indicator may indicate the subcarrier spacing using 2 bits. For example, the subcarrier spacing

indicator set to binary "00", "01", or "10" may indicate that the subcarrier spacing is 312.5 kHz, 156.25 kHz, or 78.125 kHz.

[**0093**] The FFT / IFFT structure indicator is the size of the FFT / IFFT used for the HE-SIG-B field and subsequent fields (e.g., HE-STF, HE-LTF, HE-SIG-C field, payload, etc.). Can be indicated. The size of the FFT / IFFT may be 32-point, 62-point, 128-point, 256-point, or the like. The FFT / IFFT structure indicator may explicitly indicate the size of the FFT / IFFT. Alternatively, the FFT / IFFT structure indicator may indicate the size of the FFT / IFFT using 2 bits. For example, an FFT / IFFT structure indicator set to binary "00", "01", "10", or "11", respectively, is a FFT / IFFT having a size of 32-point, 62-point, 128-point, or 256-point. IFFT can be indicated.

[**0094**] The HE-SIG-C field may include MCS information of payload, length information of payload, and the like. The payload may comprise a data unit. The HE-SIG-C field and payload may be set to a bandwidth unit (eg, 20 MHz, 10 MHz, 5 MHz, 2.5 MHz, etc.) indicated by resource allocation information included in the HE-SIG-B field. Meanwhile, the PPDU based on "MIMO and OFDMA" is as follows.

[**0095**] 10 is a block diagram illustrating a fourth embodiment of a PPDU.

[**0096**] Referring to FIG. 10, the PPDU-1 1000-1 transmitted through the first frequency band having a bandwidth of 20 HMz may be transmitted based on “SU-MIMO and OFDMA”. For example, L-STF, L-LTF, L-SIG field, HE-SIG-A field, HE-SIG-B field, HE-STF and HE-LTF of PPDU-1 (1000-1) May be transmitted over spatial streams. The HE-SIG-C field and payload allocated to the upper bandwidth 10 MHz of the first frequency band may be transmitted to the first station 610 through two spatial streams, and then the HE-SIG- allocated to the bandwidth 5 MHz The C field and payload can be sent to the second station 620 via one spatial stream, and then the HE-SIG-C field and payload allocated to the bandwidth 5 MHz is transmitted via the third spatial stream to the third station. 630 may be sent.

[**0097**] The PPDU-2 1000-2 transmitted on the second frequency band having a bandwidth of 20 HMz may be transmitted based on “MU-MIMO and OFDMA”. For example, the L-STF, L-LTF, L-SIG field, HE-SIG-A field, HE-SIG-B field, HE-STF, and HE-LTF of PPDU-2 (1000-2) have four May be transmitted over spatial streams. The HE-SIG-C field and payload for the first station 610 may be transmitted over two spatial streams, and the HE-SIG-C field and payload for the second station 620 may be one space Can be transmitted on a stream, the HE-SIG-C field and payload for the third station 630 can be transmitted on one spatial stream

[**0098**] Referring to FIG. 7 again, the AP may transmit PPDUs 910 and 920 (or PPDUs 1000-1 and 1000-2) (S710). The station STA may obtain a legacy preamble included in the PPDUs 910 and

920 received from the access point AP (S720), and may acquire a HE preamble included in the PPDUs 910 and 920 (S720). S730). The stations STA may know the transmission bandwidth of the PPDUs 910 and 920 based on the bandwidth indicator included in the HE-SIG-A field of the PPDUs 910 and 920 and are included in the HE-SIG-A field. It may be confirmed that the transmission of the PPDUs 910 and 920 is downlink transmission based on the UL / DL indicator, and the transmission of the PPDUs 910 and 920 is based on the OFDM / OFDMA indicator included in the HE-SIG-A field. It can be confirmed that the transmission is based on OFDMA.

[**0099**] The station STA may determine whether the station corresponds to a station to receive the PPDUs 910 and 920 based on the STA identifier (ie, the group ID) included in the HE-SIG-A field of the PPDUs 910 and 920. Based on the BSS identifier included in the HE-SIG-A field, the BSS to which the access point (AP) that has transmitted the PPDUs 910 and 920 may be identified. The station (STA) is contiguous with the HE-SIG-A field through at least one of a bandwidth indicator, a resource allocation structure indicator, a number indicator of a STA, and a symbol indicator included in the HE-SIG-A field of the PPDUs 910 and 920. The number of symbols in the HE-SIG-B field may be checked. The station (STA) is a HE-SIG-B field (or HE-SIG-A field) contiguous with the HE-SIG-A field based on the MCS indicator included in the HE-SIG-A field of the PPDUs 910 and 920. MCS of the following fields) can be checked, and it can be checked whether the HE-SIG-B field and the continuous HE-SIG-B field are repeated based on the repetition indicator included in the HE-SIG-A field.

[**0100**] The station STA may obtain the HE-SIG-B field based on information included in the HE-SIG-A field of the PPDUs 910 and 920. The station STA may identify time resources, frequency resources, spatial streams, etc. allocated to itself based on resource allocation information included in the HE-SIG-B field of the PPDUs 910 and 920, and the HE-SIG-B Based on the CP length indicator included in the field, the CP length of the HE-SIG-B field and the consecutive fields (HE-STF, HE-LTF, HE-SIG-C field, payload, etc.) may be checked. Based on the subcarrier spacing indicator included in the SIG-B field, the subcarrier spacing of the fields consecutive to the HE-SIG-B field (HE-STF, HE-LTF, HE-SIG-C field, payload, etc.) is checked. And successive fields (HE-STF, HE-LTF, HE-SIG-C field, payload, etc.) based on the FFT / IFFT structure indicator included in the HE-SIG-B field. You can check the FFT / IFFT size.

[**0101**] The station STA may acquire the HE-STF, HE-LTF, and HE-SIG-C fields based on the information included in the HE-SIG-B fields of the PPDUs 910 and 920. The station STA may identify the MCS applied to the payload based on the MCS information included in the HE-SIG-C fields of the PPDUs 910 and 920 and based on the length information included in the HE-SIG-C field. You can check the payload length. The station STA may acquire a payload based on information included in the HE-SIG-A field, the HE-SIG-B field, the HE-SIG-C field, and the like (S740). The station STA

may transmit an ACK frame, which is a response to the PPDUs 910 and 920, to the access point when the PPDUs 910 and 920 are successfully received.

[**0102**] Next, an OFDMA-based uplink transmission method will be described.

[**0103**] 11 is a flowchart illustrating an embodiment of uplink transmission in a WLAN.

[**0104**] Referring to FIG. 11, the access point AP may be the access point 600 described with reference to FIG. 6, and the stations STAs may include the stations 610, 620, 630, described with reference to FIG. 6. 640). Access points (APs) and stations (STAs) may configure the WLAN topology described with reference to FIG. 6. The access point (AP) may generate a trigger frame for triggering (triggering) the OFDMA-based uplink transmission (S1100). The trigger frame includes information (eg, resource allocation information, subband information, CP length indicator) included in the HE-SIG-A field, the HE-SIG-B field, and the HE-SIG-C field described with reference to FIG. 9. , Subcarrier spacing indicator, FFT / IFFT structure indicator), and the like. The access point AP may transmit a trigger frame in operation S1110.

[**0105**] The station STA may receive a trigger frame from the access point AP, and may determine whether the station STA participates in OFDMA-based uplink transmission based on information included in the trigger frame. When it is determined that the station STA participates in the OFDMA-based uplink transmission, the station STA may identify resources allocated to the base station based on the information included in the trigger frame. The station STA may generate a PPDU based on the allocated resource (S1120). The first station 610, the second station 620, and the third station 630 participate in OFDMA-based uplink transmission, and sequentially each of the stations 610, 620, and 630 participating in the uplink transmission. When bandwidths of 40 MHz, 20 MHz, and 20 MHz are allocated, the stations 610, 620, and 630 participating in uplink transmission may generate the following PPDU.

[**0106**] 12 is a block diagram illustrating a fifth embodiment of a PPDU.

[**0107**] Referring to FIG. 12, each of the PPDU-1 1200-1, the PPDU-2 1200-2, and the PPDU-3 1200-3 is a first station 610, a second station 620, and a third station. May be generated by the station 630. The PPDUs 1200-1, 1200-2, and 1200-3 may be transmitted through the same frequency band having a bandwidth of 80 MHz. Each of the PPDUs 1200-1, 1200-2, and 1200-3 may include a legacy preamble, an HE preamble, and a payload. The legacy preamble may include L-STF, L-LTF, and L-SIG fields, and the fields included in the legacy preamble may be copied in units of bandwidth 20 MHz. The HE preamble may include a HE-SIG-A field, a HE-STF, HE-LTF, and a HE-SIG-B field. The HE-SIG-A field may include information elements described with reference to

Table 1, and the HE-SIG-B field may include information included in the HE-SIG-B described with reference to FIG. 8 (eg, Payload MCS, payload length information, etc.).

[**0108**] Legacy preamble and HE-SIG-A fields may be transmitted over a full bandwidth of 80 MHz, with the HE-STF, HE-LTF, HE-SIG-B fields and payload assigned to each station 610, 620, 630 It can be transmitted over bandwidth. For example, the first station 610 may transmit the HE-STF, HE-LTF, HE-SIG-B field and payload over a bandwidth of 40 MHz, and the second station 620 may transmit the HE-STF, HE- LTF, HE-SIG-B field and payload may be transmitted over a bandwidth of 20 MHz, and the third station 630 may transmit HE-STF, HE-LTF, HE-SIG-B field and payload over a bandwidth of 20 MHz Can be.

[**0109**] Referring back to FIG. 11, the station STA may transmit PPDUs 1200-1, 1200-2, and 1200-3 to the access point AP (S1130). The access point AP may receive PPDUs 1200-1, 1200-2, 1200-3 from stations STAs, and may include payloads included in the PPDUs 1200-1, 1200-2, 1200-3. Obtain a load. The AP may transmit an ACK frame that is a response to the PPDU 1200-1, 1200-2, or 1200-3 when the APDUs 1200-1, 1200-2, or 1200-3 are successfully received. STAs) may be transmitted to each of the STAs.

[**0110**] Although described with reference to the embodiments above, those skilled in the art will understand that the present invention can be variously modified and changed without departing from the spirit and scope of the invention as set forth in the claims below. Could be.

1. A method of operating a first station in a wireless local area network, comprising: a physical layer convergence procedure (PPDU) including a legacy preamble, a high efficiency (HE) preamble, and a payload generating a protocol data unit); And transmitting the PPDU, wherein the HE preamble includes a HE-SIG (signal) -A field, an HE-SIG-B field, a HE-STF (short training field), and a HE-LTF (long training field). And the HE-SIG-A field includes information indicating the number of symbols of the HE-SIG-B field.
2. The method of claim 1, wherein the number of symbols in the HE-SIG-B field is indicated based on transmission bandwidth information of the PPDU included in the HE-SIG-A field.
3. The method according to claim 1, The number of symbols in the HE-SIG-B field is indicated based on the transmission bandwidth information of the PPDU included in the HE-SIG-A field and resource size information allocated to the station receiving the PPDU , Operating method of the first station.
4. The method according to claim 1, wherein the number of symbols in the HE-SIG-B field is indicated based on information on the number of stations that receive the PPDU included in the HE-SIG-A field.
5. The method of claim 1, wherein the HE-SIG-A field further includes information indicating a modulation and coding scheme (MCS) of the HE-SIG-B field.
6. The method of claim 1, wherein the HE-SIG-B field is repeated on a time axis.

7. The method of claim 1, wherein the HE-SIG-B field includes resource allocation information of a station that receives the PPDU.
8. A method of operating a first station in a wireless local area network, the method comprising: obtaining a legacy preamble included in a physical layer convergence procedure (PPDU) protocol data unit (PPDU) received from a second station Obtaining a high efficiency (HE) preamble included in the PPDU; And obtaining a payload included in the PPDU based on the information included in the HE preamble, wherein the HE preamble includes a HE-SIG (signal) -A field, a HE-SIG-B field, And a short training field (HE-STF) and a long training field (HE-LTF), wherein the HE-SIG-A field includes information indicating the number of symbols of the HE-SIG-B field. Method of operation of the first station.
9. The method of claim 8, wherein the number of symbols in the HE-SIG-B field is indicated based on transmission bandwidth information of the PPDU included in the HE-SIG-A field.
10. The method according to claim 8, wherein the number of symbols in the HE-SIG-B field is indicated based on transmission bandwidth information of the PPDU included in the HE-SIG-A field and resource size information allocated to a station receiving the PPDU. , Operating method of the first station.
11. The method according to claim 8, wherein the number of symbols in the HE-SIG-B field is indicated based on the number information of stations that receive the PPDU included in the HE-SIG-A field.
12. The method of claim 8, wherein the HE-SIG-A field further includes information indicating a modulation and coding scheme (MCS) of the HE-SIG-B field.
13. The method of claim 8, wherein the HE-SIG-B field is repeated on a time axis.
14. The method of claim 8, wherein the HE-SIG-B field includes resource allocation information of a station receiving the PPDU.

The examination is being carried out on the **following application documents**

Description, Pages

1-60	filed with entry into the regional phase before the EPO

Claims, Numbers

1-16	received on	04-02-2020	with letter of	04-02-2020

Drawings, Sheets

1/12-12/12	filed with entry into the regional phase before the EPO

1 The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1 "High Efficiency (HE) PHY specification",
IEEE DRAFT; TGAX_CL_26, IEEE-SA, PISCATAWAY, NJ USA
,
vol. 802.11ax drafts, no. D0.5 1 October 2016 (2016-10-01), pages 1-207, XP068137445,
Retrieved from the Internet:
URL:www.ieee802.org/11/private/Draft_Standards/11ax/TGax_CI_26.rtf
[retrieved on 2016-10-01]

D2 WO 2016/087917 A1 (NEWRACOM INC [US]) 9 June 2016 (2016-06-09); -& EP 3 226 641 A1 (NEWRACOM INC [US]) 4 October 2017 (2017-10-04)

D3 US 2016/330300 A1 (JOSIAM KAUSHIK M [US] ET AL) 10 November 2016 (2016-11-10)

D4 KR 2016 0063282 A (NEWRACOM INC [US]) 3 June 2016 (2016-06-03)

2 The application does not meet the requirements of Article 84 EPC, because claims 1, 5, 6, 8, 13 and 14 are not clear.

2.1 Claims 1, 5, 6, 8, 13 and 14 contain features set in brackets () thus leaving unclear whether these form part of the definition of the claim or not (Article 84 EPC).

3 The present application does not meet the requirements of Article 52(1) EPC, because the subject-matter of independent claims 1 and 9 is not new in the sense of Article 54(1) and (2) EPC.

3.1 Document D1 discloses (the references in parentheses applying to this document):

> A wireless communication terminal, the terminal comprising:
>
> a communication unit; and
>
> a processor configured to process signals transmitted and received through the communication unit, wherein the processor is configured to:
>
> receive, through the communication unit, a high efficiency multi-user PHY protocol data unit, HE MU PPDU, wherein a preamble of the HE MU PPDU includes high efficiency signal A field, HE-SIG-A, and high efficiency signal B field, HE-SIG-B (see section 26.3.3.7.4), and
>
> decode the received HE MU PPDU based on information obtained from the HE-SIG-A (see section 26.3.3.7.4),
>
> wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A (see section 26.3.3.7.4 "f the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and the number of STAs on each RU for SU/MU-MIMO").

The subject-matter of independent claim 1 is therefore not new (Article 54(1) and (2) EPC).

3.2 The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claim 9, which is therefore also considered not new (Article 54(1) and (2) EPC) and, hence, said claim is not allowable.

3.3 Furthermore the applicant is also made aware that, having regard to the disclosure of documents D2-D4 (see references in the search report), the subject-matter of independent claims 1 and 9 is not new (Article 54(1) and (2) EPC).

4 Furthermore, dependent claims 2-8 and 10-16, insofar as they can be understood, do not contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the EPC in respect of novelty (Article 54(1) and (2) EPC) and/or inventive step (Article 56 EPC), for the following reasons:

- Claims 2-5, 7, 8, 10-13, 15, 16 : not new, see document D1, see section 26.3.3.7.4;

- Claims 6, 14 : not new, see document D1, see section 26.3.2.1;

5 The applicant is invited to file amendments.

It is however not at present apparent which part of the application could serve as a basis for a new, allowable claim. Should the applicant nevertheless regard some particular matter as patentable, then

- the attention of the applicant is drawn to the fact that the application may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed (Article 123(2) EPC);

- in order to comply with the requirements of Rule 137(4) EPC, the applicant should clearly identify the amendments made and indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III, 2.1);

- when filing amended claims the applicant should at the same time bring the description into conformity with the amended claims (Rule 42 (1) (c) EPC);

- the applicant should indicate in the letter of reply the difference of the subject-matter of the new independent claim vis-à-vis the state of the art and the significance thereof; any argument supporting the presence of an inventive step should be given in the letter of reply;

- for reasons of conciseness (Article 84 EPC) and to reinforce unity of the invention (Article 82 EPC) a single independent claim per category should be filed (Rule 43 (2) EPC), with dependent claims as appropriate, Rule 43 (4) EPC;

- the independent claims should be drafted in two-part form (Rule 43 (1) EPC), delimited against D1;

- reference signs should be inserted in the claims (Rule 43 (7) EPC);

- possible use of the word "embodiment" in the description should be reserved to indicate a particular realisation of the invention as defined in dependent claims, R. 43(3) EPC. Possible use of the word "preferable" or "option", "optional" must be avoided for essential features of the claims. Inappropriate use of said formulations in the description should therefore be avoided or brought into conformity to avoid lack of clarity in the definition of the invention given by the claims;

- the statement in the description page 60 lines 11-14 which implies that the extent of protection may be expanded in some vague and not precisely defined way should be deleted in order to comply with the requirements of Article 84 EPC (see Guidelines F-IV, 4.4); and

- the prior art documents cited in this communication should be acknowledged in the description (Rule 42 (1)(b) EPC).

Information on Search Strategy - Pilot phase (see OJ 2015, A86)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
EP 18 73 6375

TITLE: WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET

APPLICANT: Wilus Institute of Standards and Technology Inc.

IPC CLASSIFICATION: H04W28/06, H04W74/08, H04W84/12, H04W72/04, H04B7/0452, H04L27/00

EXAMINER: Brezmes Alonso, J

CONSULTED DATABASES: DOSYS, INET, WPI, XP3GPP, NPL

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: H04B7/0452, H04L27/00

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
high efficiency multi-user PHY protocol data unit (HE MU PPDU)
HE SIG-A and HE SIG-B
MU MIMO

EPO FORM P04A42

Europäisches Patentamt
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Office européen des brevets

SUPPLEMENTARY EUROPEAN SEARCH REPORT

Application Number
EP 18 73 6375

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	"High Efficiency (HE) PHY specification", IEEE DRAFT; TGAX_CL_26, IEEE-SA, PISCATAWAY, NJ USA , vol. 802.11ax drafts, no. D0.5 1 October 2016 (2016-10-01), pages 1-207, XP068137445, Retrieved from the Internet: URL:www.ieee802.org/11/private/Draft_Standards/11ax/TGax_Cl_26.rtf [retrieved on 2016-10-01] * section 26.3.2.1 section 26.3.3.7.4 *	1-16	INV. H04W28/06 H04W74/08 H04W84/12 H04W72/04 H04B7/0452 H04L27/00
X	WO 2016/087917 A1 (NEWRACOM INC [US]) 9 June 2016 (2016-06-09) * the whole document * -& EP 3 226 641 A1 (NEWRACOM INC [US]) 4 October 2017 (2017-10-04) * paragraph [0080] - paragraph [0092] * * paragraph [0126] - paragraph [0161] *	1-16	
X	US 2016/330300 A1 (JOSIAM KAUSHIK M [US] ET AL) 10 November 2016 (2016-11-10) * paragraph [0094] - paragraph [0111] *	1-16	TECHNICAL FIELDS SEARCHED (IPC) H04B H04L
X	KR 2016 0063282 A (NEWRACOM INC [US]) 3 June 2016 (2016-06-03) * paragraph [0005] - paragraph [0014] * * paragraph [0066] - paragraph [0082] *	1-16	

The supplementary search report has been based on the last set of claims valid and available at the start of the search.

Place of search	Date of completion of the search	Examiner
The Hague	16 July 2020	Brezmes Alonso, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C04)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 73 6375

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

16-07-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016087917 A1	09-06-2016	EP 3226641 A1	04-10-2017
		US 2017289987 A1	05-10-2017
		WO 2016087917 A1	09-06-2016
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		EP 3293932 A1	14-03-2018
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		US 2016330300 A1	10-11-2016
KR 20160063282 A	03-06-2016	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

Europäisches Patentamt
European Patent Office
Office européen des brevets

Application No.: 18736375.9

The search has started on 16.07.20 (see Notice from the European Patent Office dated 03/2013, OJ EPO 2013, 153).

Receiving Section

Amendments to the Claims

1. A wireless communication terminal, the terminal comprising:

a communication unit; and

a processor configured to process signals transmitted and received through the communication unit,

wherein the processor is configured to:

receive, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

2. The wireless communication terminal of claim 1, wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific field of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

3. The wireless communication terminal of claim 2, wherein when the SIG-B

compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the configuration of the user specific field of the HE-SIG-B is identified based on information on the number of MU-MIMO users indicated by the HE-SIG-A.

4. The wireless communication terminal of claim 3,

wherein when the information on the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and

wherein when the information on the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.

5. The wireless communication terminal of claim 4,

wherein the user field for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.

6. The wireless communication terminal of claim 4, wherein the user field for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

7. The wireless communication terminal of claim 3, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

8. The wireless communication terminal of claim 1,

wherein the HE-SIG-A includes a UL/DL field indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield of the HE-SIG-A of the PPDU indicates different information or is set differently based on a value indicated by the UL/DL field.

9. A wireless communication method of a wireless communication terminal, the method comprising:

receiving a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B); and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

10. The wireless communication method of claim 9, wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific

field of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

11. The wireless communication method of claim 10, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the configuration of the user specific field of the HE-SIG-B is identified based on information on the number of MU-MIMO users indicated by the HE-SIG-A.

12. The wireless communication method of claim 11,

wherein when the information on the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and

wherein when the information on the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.

13. The wireless communication method of claim 12,

wherein the user field for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.

14. The wireless communication method of claim 12, wherein the user field for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

15. The wireless communication method of claim 11, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

16. The wireless communication method of claim 9,

wherein the HE-SIG-A includes a UL/DL field indicating whether the PPDU is transmitted on an uplink or transmitted on downlink, and

wherein at least one subfield of the HE-SIG-A of the PPDU indicates different information or is set differently based on a value indicated by the UL/DL field.

Amendments to the Claims

1. A wireless communication terminal, the terminal comprising:

a communication unit; and

a processor configured to process signals transmitted and received through the communication unit,

wherein the processor is configured to:

receive, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

2. The wireless communication terminal of claim 1, wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific field of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

3. The wireless communication terminal of claim 2, wherein when the SIG-B

compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the configuration of the user specific field of the HE-SIG-B is identified based on information on the number of MU-MIMO users indicated by the HE-SIG-A.

4. The wireless communication terminal of claim 3,

~~wherein a type of a user field constituting the user specific field of the HE-SIG-B includes a user field for MU-MIMO allocation and a user field for non-MU-MIMO allocation,~~

wherein when the information on the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B ~~consists of~~includes user fields for MU-MIMO allocation, and

wherein when the information on the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B ~~consists of~~includes one user field for non-MU-MIMO allocation.

5. The wireless communication terminal of claim 4,

wherein the user field for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the user field for non-MU-MIMO allocation includes a number of ~~spatial~~space time streams (NSTS) field.

6. The wireless communication terminal of claim 4, wherein the user field for

non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

7. The wireless communication terminal of claim 3, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

8. The wireless communication terminal of claim 1,

wherein the HE-SIG-A includes a UL/DL field indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield of the HE-SIG-A of the PPDU indicates different information or is set differently based on a value indicated by the UL/DL field.

~~9. The wireless communication terminal of claim 8,~~

~~wherein when the UL/DL field indicates a downlink transmission, a specific value of a bandwidth field of the HE-SIG-A indicates a predetermined non-contiguous band, and~~

~~wherein when the UL/DL field indicates an uplink transmission, the specific value of the bandwidth field of the HE-SIG-A indicates a predetermined narrow band.~~

~~10. The wireless communication terminal of claim 9, wherein the predetermined narrow band includes at least one of a left 106-tone and a right 106-tone.~~

~~11. The wireless communication terminal of claim 8,~~

~~wherein when the UL/DL field indicates a downlink transmission, a SIG-B compression field of the HE-SIG-A indicates whether to perform a full bandwidth MU-MIMO transmission in which a common field is not present in an HE-SIG-B field, and~~

~~wherein when the UL/DL field indicates an uplink transmission, the SIG-B compression field of the HE-SIG-A always indicates that the common field is not present in the HE-SIG-B field.~~

~~12. The wireless communication terminal of claim 8, wherein when a SIG-B compression field of the HE-SIG-A indicates a compression mode of an HE-SIG-B field,~~

~~a number of HE-SIG-B symbols field in the HE-SIG-A indicates information on the number of MU-MIMO users if the UL/DL field indicates a downlink transmission, and~~

~~the number of HE-SIG-B symbols field in the HE-SIG-A indicates information on the number of OFDM symbols in the HE-SIG-B field.~~

~~13~~9. A wireless communication method of a wireless communication terminal, the method comprising:

receiving a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B); and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

~~14~~10. The wireless communication method of claim ~~13~~9, wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific field of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

~~15~~11. The wireless communication method of claim ~~14~~10, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the configuration of the user specific field of the HE-SIG-B is identified based on information on the number of MU-MIMO users indicated by the HE-SIG-A.

~~16~~12. The wireless communication method of claim ~~15~~11,

~~wherein a type of a user field constituting the user specific field of the HE-SIG-B includes a user field for MU-MIMO allocation and a user field for non-MU-MIMO allocation,~~

wherein when the information on the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B ~~consists of~~includes user fields for MU-MIMO allocation, and

wherein when the information on the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B ~~consists of~~includes one user field for non-MU-MIMO allocation.

~~17~~13. The wireless communication method of claim ~~16~~12,

wherein the user field for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the user field for non-MU-MIMO allocation includes a number of ~~spatial~~space time streams (NSTS) field.

~~18~~14. The wireless communication method of claim ~~16~~12, wherein the user field for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

~~19~~15. The wireless communication method of claim ~~15~~11, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

~~20~~16. The wireless communication method of claim ~~13~~9,

wherein the HE-SIG-A includes a UL/DL field indicating whether the PPDU is transmitted on an uplink or transmitted on downlink, and

wherein at least one subfield of the HE-SIG-A of the PPDU indicates different information or is set differently based on a value indicated by the UL/DL field.

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WOHLFROM

Patentanwälte
European Patent Attorneys
European Trademark & Design Attorneys

Partnerschaft mbB

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An das
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* Stanford ** American Univ., DC

18 736 375.9	M24159.0	03/02/2020
Ihr Zeichen / Your Ref.	Unser Zeichen / Our Ref.	Tag / Date

18 736 375.9
Wilus Institute of Standards and Technology Inc., et al

This submission is in response to the Communication pursuant to Rules 161 (2) and 162 EPC, dated August 23, 2019.

Enclosed herewith, an amended set of claims 1 to 16 is filed, serving as the basis for the further prosecution of the present application. The amended set of claims is filed both in a marked-up version and a clean version.

The additional claim fee for claim 16 has been paid online. A copy of the online payment receipt is enclosed herewith.

The subject matter of amended claims 1-16 is originally disclosed, as will be laid out below.

1) Original disclosure for amended claims 4 and 12

Claims 4 and 12 have been amended to delete the duplicate elements in the claims. No new matter has been added.

2) Original disclosure for amended claims 5 and 13

The amendments to claims 5 and 13 are originally disclosed on page 29, lines 15-16 of the description:

"The number of space time streams (NSTS) field indicates the number of space-time streams used for MIMO transmission." (page 29, lines 15-16)

As compared to the original set of claims, original claims 9-12 have been cancelled. It is stressed, that the cancelling of those claims does not constitute any waiver of any rights. The applicant reserves the right to revert to the subject matter of original claims 9-12 at a later point in time, e.g. via a divisional application.

Respectfully submitted,

Axel Schmitt-Nilson

Encl.:
amended set of claims 1-16 (marked-up and clean copies)
copy of online payment confirmation

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Online-Gebührenzahlung - **Abbuchungsauftrag**

Vielen Dank für Ihren Auftrag vom 04.02.2020 11:16 GMT+01

Auf der Grundlage dieses Abbuchungsauftrags wird das laufende Konto Nr. 28003100 zur Zahlung der nachstehenden Gebühren für die Anmeldenummer 187363759 mit Wirkung vom **04.02.2020** mit dem Betrag von EUR 235,00 belastet, sofern ausreichende Mittel auf diesem Konto vorhanden sind.

Nr. des laufenden Kontos:	28003100
Kontoinhaber:	Schmitt-Nilson Schraud Waibel Wohlf
Bezahlt durch:	Susanne Sommerfeld
Anmeldenummer:	187363759
Name des Anmelders:	Wilus Institute et. al.
Referenz:	M24159.0
Gesamtzahl der ausgewählten Gebühren:	1
Gesamtbetrag in EUR:	**235,00 +**

Gebührencode	Beschreibung	Betrag EUR
015	Anspruchsgebühr - für den 16. und jeden weiteren Anspruch bis zu einer Obergrenze von 50	235,00 +

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Patentanwälte Partnerschaft mbB
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80992 München
ALLEMAGNE

Date
16.10.19

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 / 3567911 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Notification of European publication number and information on the application of Article 67(3) EPC

You are hereby informed that the technical preparations for the publication of the translation of the above-mentioned international application as supplied to the EPO pursuant to Article 153(4) EPC have been completed.

The translation will be published on 13.11.19.
The publication number is: 3567911.
The publication in accordance with Article 153(4) EPC will be mentioned in European Patent Bulletin number 2019/46 (**http://www.european-patent-office.org/e_pub/bulletin/index.htm**).

The title of the invention in the three official languages of the European Patent Office is worded as follows:

DRAHTLOSKOMMUNIKATIONSVERFAHREN UND DRAHTLOSKOMMUNIKATIONSENDGERÄT ZUR SIGNALISIERUNG VON MEHRBENUTZERPAKETEN
WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET
PROCÉDÉ DE COMMUNICATION SANS FIL ET TERMINAL DE COMMUNICATION SANS FIL POUR SIGNALISATION DE PAQUETS MULTI-UTILISATEURS

Provisional protection under Article 67(1) and (2) EPC in the individual contracting states becomes effective when the conditions referred to in Article 67(3) EPC have been fulfilled. Provisional protection in the individual extension and validation states is governed by the national laws of the countries concerned. For more details, see Chapter III of the EPO brochure "National Law relating to the EPC" (**www.epo.org/law-practice/legal-texts/national-law.html**), which also contains information about the extension and validation system. Further information can also be found in the Official Journal of the European Patent Office.

In all future communications to the EPO, please quote the application number as indicated above, i.e. including the final four figures (which identify the Directorate responsible for the subsequent procedure).

Remark
For European patent applications with a date of publication after 01.04.05, no paper copies will be forwarded to the applicant any longer. The publication can be downloaded, free of charge, from the EPO publication server **https://data.epo.org/publication-server/** or can be ordered from the Vienna sub-office upon payment of a fee (see Decision of the President of the EPO dated 12 July 2007 concerning the form of publication of European patent applications, European search reports and European patent specifications, Special edition No. 3, OJ EPO 2007, 97).

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Date
27.09.19

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Communication pursuant to Rule 19(1) EPC

The communication issued pursuant to Rule 19(3) EPC, sent to the inventor designated below, has been returned by the postal services.
You are requested to indicate the correct address of the inventor (R. 19(1) EPC).

Inventor : KO, Geonjung
301-606 36 Dongtanwoncheon-ro 915beon-gil Yeongtong-gu
KR / Suwon-si Gyeonggi-do 16547

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REPUBLIQUE DE COREE

Date
21.08.19

Reference	Application No./Patent No.
	18736375.9 - 1215 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Notification of the data mentioned in Rule 19(3) EPC

In the above-identified patent application you are designated as inventor/co-inventor.
Pursuant to Rule 19(3) EPC the following data are notified herewith:

DATE OF FILING	: 09.01.18
PRIORITY	: KR/09.01.17/ KRA 20170003147 : KR/18.01.17/ KRA 20170008927
TITLE	: WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET
DESIGNATED STATES	: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

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ALLEMAGNE

Date
23.08.19

Reference	Application No./Patent No.
M24159.0	18736375.9 - 1215 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Communication pursuant to Rules 161(2) and 162 EPC

1. Amendment of the application (R. 161(2) EPC)

The above-mentioned international (Euro-PCT) application has entered the European phase.

Under Articles 28, 41 PCT and Rules 52, 78 PCT the application may be amended before a designated or elected Office.

In accordance with Rule 161(2) EPC, you may amend your application once within a **non-extendable period of six months** after notification of the present communication.

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).

The claims applicable on expiry of this period, i.e. those filed on entry into the European phase or in response to the present communication, will form the basis for the calculation of any claims fee to be paid (see page 2).

2 Claims fees under Rule 162 EPC

If the application documents on which the European grant procedure is to be based comprise more than fifteen claims, a claims fee shall be payable for the sixteenth and each subsequent claim within the period provided for in Rule 159(1) EPC.

☐ Based on the application documents currently on file, all necessary claims fees have already been paid (or the documents do not comprise more than 15 claims).

☐ All necessary fees will be debited automatically according to the automatic debit order.

☑ The claims fees due for the claims 16 to 20 were not paid within the above-mentioned period.

Any outstanding claims fee, either based on the current set of claims or on any amended claims to be filed pursuant to Rule 161 EPC (see page 1), may still be validly paid within a **non-extendable period of six months** after notification of this communication (R. 162(2) EPC).

If a payment is made for only some of the claims, you must indicate for which claims it is intended. If a claims fee is not paid in due time, the claim concerned is deemed to be abandoned (R. 162(4) EPC).

If claims fees have already been paid, but on expiry of the above-mentioned period there is a new set of claims containing fewer fee-incurring claims than before, the claims fees in excess of those due under Rule 162(2), second sentence EPC will be refunded (R. 162(3) EPC).

You are reminded that the supplementary search carried out according to Article 153(7) EPC will relate only to the last set of claims applicable on expiry of the above period AND will be confined to those fee-incurring claims for which fees have been paid in due time.

The claims fee is currently

EUR 235 for the 16th and each subsequent claim up to the limit of 50
EUR 585 for the 51st and each subsequent claim

Making payments
For payments made via deposit account, please note that as from 1 December 2017 debit orders will only be carried out if filed in an electronically processable format (xml), using an accepted means of filing as laid down in the Arrangements for deposit accounts (ADA), published in the Supplementary publication in the Official Journal.

All relevant information related to the modes of payment of fees to the EPO can be retrieved from the EPO website at "**Making Payments**".

Information concerning fee amounts
Procedural fees are usually adjusted every two years, on even years, with effect from 1 April. Therefore, before making a payment, parties should verify the amounts actually due on the date of payment using the applicable version of the Schedule of fees and expenses, published as a Supplement to the Official Journal of the EPO, available on the EPO website (**www.epo.org**) at **www.epo.org/schedule-of-fees**. The "Schedule of fees" table allows the viewing, downloading and searching of individual fee amounts, both current and previous.

Important note to users of the automatic debiting procedure
Unless the EPO receives prior instructions to the contrary, the fees for all claims incurring fees will be debited on the last day of the period for payment.

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Date
21.08.19

Reference	Application No./Patent No.
	18736375.9 - 1215 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Notification of the data mentioned in Rule 19(3) EPC

In the above-identified patent application you are designated as inventor/co-inventor.
Pursuant to Rule 19(3) EPC the following data are notified herewith:

DATE OF FILING	: 09.01.18
PRIORITY	: KR/09.01.17/ KRA 20170003147 : KR/18.01.17/ KRA 20170008927
TITLE	: WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET
DESIGNATED STATES	: AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

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Date
21.08.19

Reference	Application No./Patent No.
	18736375.9 - 1215 PCT/KR2018000443
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Date
21.08.19

Reference	Application No./Patent No.
	18736375.9 - 1215 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Notification of the data mentioned in Rule 19(3) EPC

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Pursuant to Rule 19(3) EPC the following data are notified herewith:

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PRIORITY	: KR/09.01.17/ KRA 20170003147 : KR/18.01.17/ KRA 20170008927
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Date
21.08.19

Reference	Application No./Patent No.
	18736375.9 - 1215 PCT/KR2018000443
Applicant/Proprietor	
Wilus Institute of Standards and Technology Inc., et al	

Notification of the data mentioned in Rule 19(3) EPC

In the above-identified patent application you are designated as inventor/co-inventor.
Pursuant to Rule 19(3) EPC the following data are notified herewith:

DATE OF FILING	: 09.01.18
PRIORITY	: KR/09.01.17/ KRA 20170003147 : KR/18.01.17/ KRA 20170008927
TITLE	: WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET
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Acknowledgement of receipt

We hereby acknowledge receipt of the form for entry into the European phase (EPO as designated or elected Office) as follows:

Submission number	7741288
PCT application number	PCT/KR2018/000443
EP application number	18736375.9
Date of receipt	06 August 2019
Receiving Office	European Patent Office, The Hague
Your reference	M24159.0
Applicant	
Country	
Documents submitted	package-data.xml application-body.xml SPECTRANEPO-1.pdf\190805_documents.pdf (79 p.) ep-euro-pct.xml epf1200.pdf (5 p.)
Submitted by	CN=Axel Schmitt-Nilson 38900
Method of submission	Online
Date and time receipt generated	06 August 2019, 15:15 (CEST)
Message Digest	AC:F3:54:E0:6D:70:63:64:D8:BB:7F:F0:5F:F5:B7:00:4D:93:67:69

Correction by the EPO of errors in debit instructions filed by eOLF
Errors in debit instructions filed by eOLF that are caused by the editing of Form 1038E entries or the continued use of outdated software (all forms) may be corrected automatically by the EPO, leaving the payment date unchanged (see decision T 152/82,

OJ EPO 1984, 301 and point 6.3 ff ADA, Supplement to OJ EPO 10/2007).

/European Patent Office/

[ABSTRACT]

The present invention relates to a wireless communication method and a wireless communication terminal for signaling a multi-user packet.

More specifically, provided are a wireless communication terminal including a communication unit; and a processor configured to process signals transmitted and received through the communication unit, wherein the processor receives, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and decodes the received HE MU PPDU based on information obtained from the HE-SIG-A, wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A and a wireless communication method using the same.

[CLAIMS]

1. A wireless communication terminal, the terminal comprising:

a communication unit; and

a processor configured to process signals transmitted and received through the communication unit,

wherein the processor is configured to:

receive, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and

decode the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

2. The wireless communication terminal of claim 1, wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific field of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

3. The wireless communication terminal of claim 2, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the configuration of the user specific field of the HE-SIG-B is identified based on information on the number of MU-MIMO users indicated by the HE-SIG-A.

4. The wireless communication terminal of claim 3,

wherein a type of a user field constituting the user specific field of the HE-SIG-B includes a user field for MU-MIMO allocation and a user field for non-MU-MIMO allocation,

wherein when the information on the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B consists of user fields for MU-MIMO allocation, and

wherein when the information on the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B consists of one user field for non-MU-MIMO allocation.

5. The wireless communication terminal of claim 4,

wherein the user field for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the user field for non-MU-MIMO allocation includes a number of spatial streams (NSTS) field.

6. The wireless communication terminal of claim 4, wherein the user field for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

7. The wireless communication terminal of claim 3, wherein when the SIG-B

compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

8. The wireless communication terminal of claim 1,

wherein the HE-SIG-A includes a UL/DL field indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink, and

wherein at least one subfield of the HE-SIG-A of the PPDU indicates different information or is set differently based on a value indicated by the UL/DL field.

9. The wireless communication terminal of claim 8,

wherein when the UL/DL field indicates a downlink transmission, a specific value of a bandwidth field of the HE-SIG-A indicates a predetermined non-contiguous band, and

wherein when the UL/DL field indicates an uplink transmission, the specific value of the bandwidth field of the HE-SIG-A indicates a predetermined narrow band.

10. The wireless communication terminal of claim 9, wherein the predetermined narrow band includes at least one of a left-106-tone and a right-106-tone.

11. The wireless communication terminal of claim 8,

wherein when the UL/DL field indicates a downlink transmission, a SIG-B compression field of the HE-SIG-A indicates whether to perform a full bandwidth MU-MIMO transmission in which a common field is not present in an HE-SIG-B field, and

wherein when the UL/DL field indicates an uplink transmission, the SIG-B

compression field of the HE-SIG-A always indicates that the common field is not present in the HE-SIG-B field.

12. The wireless communication terminal of claim 8, wherein when a SIG-B compression field of the HE-SIG-A indicates a compression mode of an HE-SIG-B field,

a number of HE-SIG-B symbols field in the HE-SIG-A indicates information on the number of MU-MIMO users if the UL/DL field indicates a downlink transmission, and

the number of HE-SIG-B symbols field in the HE-SIG-A indicates information on the number of OFDM symbols in the HE-SIG-B field.

13. A wireless communication method of a wireless communication terminal, the method comprising:

receiving a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B); and

decoding the received HE MU PPDU based on information obtained from the HE-SIG-A,

wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

14. The wireless communication method of claim 13, wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific field of the HE-SIG-B is identified based on information obtained from at least one

subfield of the HE-SIG-A.

15. The wireless communication method of claim 14, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the configuration of the user specific field of the HE-SIG-B is identified based on information on the number of MU-MIMO users indicated by the HE-SIG-A.

16. The wireless communication method of claim 15,

wherein a type of a user field constituting the user specific field of the HE-SIG-B includes a user field for MU-MIMO allocation and a user field for non-MU-MIMO allocation,

wherein when the information on the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B consists of user fields for MU-MIMO allocation, and

wherein when the information on the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B consists of one user field for non-MU-MIMO allocation.

17. The wireless communication method of claim 16,

wherein the user field for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

wherein the user field for non-MU-MIMO allocation includes a number of spatial streams (NSTS) field.

18. The wireless communication method of claim 16, wherein the user field for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

19. The wireless communication method of claim 15, wherein when the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

20. The wireless communication method of claim 13,

wherein the HE-SIG-A includes a UL/DL field indicating whether the PPDU is transmitted on an uplink or transmitted on downlink, and

wherein at least one subfield of the HE-SIG-A of the PPDU indicates different information or is set differently based on a value indicated by the UL/DL field.

[DESCRIPTION]

[Invention Title]

WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET

[Technical Field]

The present invention relates to a wireless communication method and a wireless communication terminal for signaling a multi-user packet.

[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.

[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, the terminal including a communication unit; and a processor configured to process signals transmitted and received through the communication unit, wherein the processor receives, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and decodes the received HE MU PPDU based on information obtained from the HE-SIG-A, wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

In addition, an exemplary embodiment of the present invention provides a wireless communication method of a wireless communication terminal, the method including: receiving a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B); and decoding the received HE MU PPDU based on information obtained from the HE-SIG-A, wherein a configuration of the HE-SIG-B is identified based on information obtained from at least one subfield of the HE-SIG-A.

When a SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission so that a common field is not present in the HE-SIG-B, a configuration of a user specific field of the HE-SIG-B may be identified based on information obtained from at least one subfield of the HE-SIG-A.

When the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the configuration of the user specific field of the HE-SIG-B may be identified based on information on the number of MU-MIMO users indicated by the HE-SIG-A.

A type of a user field constituting the user specific field of the HE-SIG-B may include a user field for MU-MIMO allocation and a user field for non-MU-MIMO allocation. The user specific field of the HE-SIG-B may consist of user fields for MU-MIMO allocation when the information on the number of MU-MIMO users indicates two or more users. The user specific field of the HE-SIG-B may consist of one user field for non-MU-MIMO allocation when the information on the number of MU-MIMO users indicates a single user.

The user field for MU-MIMO allocation may include a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and the user field for non-MU-MIMO allocation may include a number of spatial streams (NSTS) field.

The user field for non-MU-MIMO allocation may be a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

When the SIG-B compression field of the HE-SIG-A indicates full bandwidth MU-MIMO transmission, the information on the number of MU-MIMO users may be indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

The HE-SIG-A may include a UL/DL field indicating whether the PPDU is transmitted on an uplink or transmitted on a downlink. At least one subfield of the HE-SIG-A of the PPDU may indicate different information or may be set differently based on a value indicated by the UL/DL field.

A specific value of a bandwidth field of the HE-SIG-A may indicate a predetermined non-contiguous band when the UL/DL field indicates a downlink transmission. The specific value of the bandwidth field of the HE-SIG-A may indicate a predetermined narrow band when the UL/DL field indicates an uplink transmission.

The predetermined narrow band may include at least one of a left-106-tone and a right-106-tone.

A SIG-B compression field of the HE-SIG-A may indicate whether to perform a full bandwidth MU-MIMO transmission in which a common field is not present in an HE-SIG-B field when the UL/DL field indicates a downlink transmission. The SIG-B compression field of the HE-SIG-A may always indicate that the common field is not present in the HE-SIG-B field when the UL/DL field indicates an uplink transmission.

When a SIG-B compression field of the HE-SIG-A indicates a compression mode of an HE-SIG-B field, a number of HE-SIG-B symbols field in the HE-SIG-A may indicate information on the number of MU-MIMO users if the UL/DL field indicates a downlink transmission, and the number of HE-SIG-B symbols field in the HE-SIG-A may indicate information on the number of OFDM symbols in the HE-SIG-B field.

[Advantageous Effects]

According to an embodiment of the present invention, a header field of a physical layer of a wireless LAN packet supporting simultaneous multi-user transmission in an indoor/outdoor environment can be efficiently configured.

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 a carrier sense multiple access (CSMA)/collision avoidance (CA) method used in wireless LAN communication.

FIG. 7 illustrates a method for performing a distributed coordination function (DCF) using a request to send (RTS) frame and a clear to send (CTS) frame.

FIGS. 8 and 9 illustrate multi-user transmission methods according to an embodiment of the present invention.

FIG. 10 illustrates an embodiment of a legacy PPDU format and a non-legacy PPDU format.

FIG. 11 illustrates various HE PPDU formats and an indication method thereof according to an embodiment of the present invention.

FIG. 12 illustrates an embodiment of a configuration of an HE-SIG-A field according to the HE PPDU format.

FIG. 13 illustrates a configuration of an HE-SIG-B field according to an embodiment of the present invention.

FIGS. 14 to 15 illustrate specific embodiments in which a single STA transmits an UL MU PPDU to an AP.

FIG. 16 illustrates an encoding structure and a transmission method of the HE-SIG-B according to an embodiment of the present invention.

FIG. 17 illustrates a non-contiguous channel allocation method according to

an embodiment of the present invention.

FIG. 18 illustrates a wideband access method according an embodiment of the present invention.

FIG. 19 illustrates an embodiment of a method of exchanging and signaling BQRP and BQR for transmitting a non-contiguous PPDU.

FIG. 20 illustrates another embodiment of a method of transmitting and signaling BQR for transmitting a non-contiguous PPDU.

FIG. 21 illustrates a configuration of a BQR according to an embodiment of the present invention.

[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. 10-2017-0003147 and 10-2017-0008927 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.

FIG. 6 is a diagram illustrating a carrier sense multiple access (CSMA)/collision avoidance (CA) method used in wireless LAN communication.

A terminal that performs a wireless LAN communication checks whether a channel is busy by performing carrier sensing before transmitting data. When a wireless signal having a predetermined strength or more is sensed, it is determined that the corresponding channel is busy and the terminal delays the access to the corresponding channel. Such a process is referred to as clear channel assessment (CCA) and a level to decide whether the corresponding signal is sensed is referred to as a CCA threshold. When a wireless signal having the CCA threshold or more, which is received by the terminal, indicates the corresponding terminal as a receiver, the terminal processes the received wireless signal. Meanwhile, when a wireless signal is not sensed in the corresponding channel or a wireless signal having a strength smaller than the CCA threshold is sensed, it is determined that the channel is idle.

When it is determined that the channel is idle, each terminal having data to be transmitted performs a backoff procedure after an inter frame space (IFS) time depending on a situation of each terminal, for instance, an arbitration IFS (AIFS), a PCF IFS (PIFS), or the like elapses. According to the embodiment, the AIFS may be used as a component which substitutes for the existing DCF IFS (DIFS). Each terminal stands by while decreasing slot time(s) as long as a random number determined by the corresponding terminal during an interval of an idle state of the channel and a terminal that completely exhausts the slot time(s) attempts to access the corresponding channel. As such, an interval in which each terminal performs the backoff procedure is referred to as a contention window interval.

When a specific terminal successfully accesses the channel, the corresponding