PTO-1390 (06-13)
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TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A SUBMISSION UNDER 35 U.S.C. 371

Attorney Docket No.	
811.0053	
U.S. Application No. (if known, see 37 CFR 1.5)	

International Application No.	International Filing Date	Priority Date Claimed
PCT/KR2014/008765	September 22, 2014	September 27, 2013

Title of Invention
METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

First Named Inventor
PARK, Kyujin

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.

1. ☑ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). NOTE: The express request under 35 U.S.C. 371(f) will not be effective unless the requirements under 35 U.S.C. 371(c)(1), (2), and (4) for payment of the basic national fee, copy of the International Application and English translation thereof (if required), and the oath or declaration of the inventor(s) have been received.
2. ☑ A copy of the International Application (35 U.S.C. 371(c)(2)) is attached hereto (not required if the International Application was previously communicated by the International Bureau or was filed in the United States Receiving Office (RO/US)).
3. An English language translation of the International Application (35 U.S.C. 371(c)(2))
   a. ☑ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
4. An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4))
   a. ☑ is attached.
   b. ☐ was previously filed in the international phase under PCT Rule 4.17(iv).

Items 5 to 8 below concern amendments made in the international phase.

PCT Article 19 and 34 amendments

5. ☐ Amendments to the claims under PCT Article 19 are attached (not required if communicated by the International Bureau) (35 U.S.C. 371(c)(3)).
6. ☐ English translation of the PCT Article 19 amendment is attached (35 U.S.C. 371(c)(3)).
7. ☐ English translation of annexes (Article 19 and/or 34 amendments only) of the International Preliminary Examination Report is attached (35 U.S.C. 371(c)(5)).

Cancellation of amendments made in the international phase

8a. ☐ Do not enter the amendment made in the international phase under PCT Article 19.

8b. ☐ Do not enter the amendment made in the international phase under PCT Article 34.

NOTE: A proper amendment made in English under Article 19 or 34 will be entered in the U.S. national phase application absent a clear instruction from applicant not to enter the amendment(s).

The following items 9 to 17 concern a document(s) or information included.

9. ☑ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
10. ☑ A preliminary amendment.
11. ☑ An Application Data Sheet under 37 CFR 1.76.
12. ☐ A substitute specification. NOTE: A substitute specification cannot include claims. See 37 CFR 1.125(b).
13. ☑ A power of attorney and/or change of address letter.
14. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821-1.825.
15. ☐ Assignment papers *(cover sheet and document(s))*. Name of Assignee: _____
16. ☐ 37 CFR 3.73(c) Statement *(when there is an Assignee)*.

This collection of information is required by 37 CFR 1.414 and 1.491-1.492. The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 15 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

U.S. APPLN. No. (if known – see 37 CFR 1.5)	INTERNATIONAL APPLICATION No.	ATTORNEY DOCKET No.
	PCT/KR2014/008765	811.0053

17. ☐ Other items or information:

The following fees have been submitted.	CALCULATIONS	PTO USE ONLY
18. ☑ Basic national fee (37 CFR 1.492(a)) **$280**	$ 280	
19. ☑ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) ..... **$0** All other situations **$720**	$ 720	
20. ☑ Search fee (37 CFR 1.492(b)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4) ..... **$0** Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority .....**$120** International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB .....**$480** All other situations **$600**	480 $	
TOTAL OF 18, 19, and 20 =	$ 1,480	
☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) in an electronic medium or computer program listing in an electronic medium) (37 CFR 1.492(j)). Fee for each additional 50 sheets of paper or fraction thereof **$400**		

Total Sheets	Extra Sheets	Number of each addition 50 or fraction thereof (round **up** to a whole number)	RATE	
- 100 =	/ 50 =		x **$400**	$
Surcharge of **$140.00** for furnishing any of the search fee, examination fee, or the oath or declaration after the date of commencement of the national stage (37 CFR 1.492(h)).				$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	
Total claims	19 - 20 =		x **$80**	$ 0
Independent claims	4 - 3 =	1	x **$420**	$ 420
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			**+ $780**	$
Processing fee of **$140.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). **+**				$
TOTAL OF ABOVE CALCULATIONS =				$ 1,900
☐ **Applicant asserts small entity status.** See 37 CFR 1.27. Fees above are reduced by ½.				
☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Fees above are reduced by ¾. Applicant must attach form PTO/SB/15A or B or equivalent.				
TOTAL NATIONAL FEE =				$ 1,900
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property. **+**				$
TOTAL FEES ENCLOSED =				$ 1,900
			Amount to be refunded:	$
			Amount to be charged:	$

a. ☐ A check in the amount of $_____ to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees.

c. ☑ The Director is hereby authorized to charge additional fees which may be required, or credit any overpayment, to Deposit Account No. 505881 as follows:

i. ☑ any required fee.

ii. ☐ any required fee except for excess claims fees required under 37 CFR 1.492(d) and (e) and multiple dependent claim fee required under 37 CFR 1.492(f).

d. ☑ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038. The PTO-2038 should only be mailed or faxed to the USPTO. However, when paying the basic national fee, the PTO-2038 may NOT be faxed to the USPTO.

ADVISORY: If filing by EFS-Web, do **NOT** attach the PTO-2038 form as a PDF along with your EFS-Web submission. Please be advised that this is **not** recommended and by doing so your **credit card information may be displayed via PAIR**. To protect your information, it is recommended to pay fees online by using the electronic payment method.

NOTE: Where an appropriate time limit under 37 CFR 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the International Application to pending status.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File)Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013, and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE 1: By providing this statement under 37 CFR 1.55 or 1.78, **this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA**.

NOTE 2: A U.S. national stage application may not claim priority to the international application of which it is the national phase. The filing date of a U.S. national stage application is the international filing date. See 35 U.S.C. 363.

Correspondence Address

☑ The address associated with Customer Number: 76277 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone			
Email					

Signature	/Ian M. Hughes/	Date	03/25/2016
Name (Print/Type)	Ian M. Hughes, Esq.	Registration No. (Attorney/Agent)	41,083

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	811.0053
	Application Number	
Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kyujin		PARK	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Seoul	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	(Korea Telecom Research Center, Umyeon-dong) 151
Address 2	Taebong-ro, Seocho-gu

City	Seoul	State/Province	
Postal Code	137-140	**Country** [i]	KR

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Woo-jin		CHOI	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Seoul	Country of Residence [i]	KR

Mailing Address of Inventor:

Address 1	(Korea Telecom Research Center, Umyeon-dong) 151
Address 2	Taebong-ro, Seocho-gu

City	Seoul	State/Province	
Postal Code	137-140	**Country** [i]	KR

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	811.0053
	Application Number	
Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF	

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	76277		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF		
Attorney Docket Number	811.0053	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	76277		

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	811.0053
	Application Number	
Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	a 371 of international	PCT/KR2014/008765	2014-09-22

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
10-2013-0115367	KR	2013-09-27	

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
10-2014-0057938	KR	2014-05-14	

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

IPR2025-00138
Petitioner's Exhibit 1002
Page 000007

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	811.0053
	Application Number	
Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	811.0053
	Application Number	
Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	KT CORPORATION		
Mailing Address Information For Applicant:			
Address 1	(206, Jeongja-dong) 90, Buljeong-ro, Bundang-gu		
Address 2	Seongnam-si		
City	Gyeonggi-do	**State/Province**	
Country	KR	Postal Code	463-711
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	811.0053
	Application Number	
Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	KT CORPORATION

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	(206, Jeongja-dong) 90, Buljeong-ro, Bundang-gu		
Address 2	Seongnam-si		
City	Gyeonggi-do	**State/Province**	
Country i	KR	Postal Code	463-711
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Ian M. Hughes/			Date (YYYY-MM-DD)	2016-03-25
First Name	Ian	Last Name	Hughes	Registration Number	41083

Additional Signature may be generated within this form by selecting the Add button. Add

IPR2025-00138
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	811.0053
	Application Number	
Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF	

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREFOR

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] The attached application, or
- [x] United States application or PCT international application number PCT/KR2014/008765 filed on September 22, 2014

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: PARK, Kyujin Date (Optional):

Signature:

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

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- [x] The attached application, or
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I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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LEGAL NAME OF INVENTOR

Inventor: CHOI, Woo-jin Date (Optional): March 7, 2014

Signature: [signature]

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 form for each additional inventor.

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Customer No.: 76277 *PATENT*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Kyujin PARK et al. Re: Attorney Docket No.: 811.0053

Serial No.: Group Art Unit:
Filed: 03/25/2016 Examiner:
Matter No.: 811.0053 Conf. No.:

For: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Prior to examination on the merits, please amend the above-identified application as follows.

Amendments to the Specification begin on page 2.

Remarks begin on page 3.

AMENDMENTS TO THE SPECIFICATION

In the Specification

Please **INSERT** the following paragraph under the title of the invention on page 1 as follows.

-- CROSS REFERENCE TO RELATED APPLICATIONS

This application is a National Stage Patent Application of PCT International Patent Application No. PCT/KR2014/008765 (filed on September 22, 2014) under 35 U.S.C. §371, which claims priority to Korean Patent Application Nos. 10-2013-0115367 (filed on September 27, 2013) and 10-2014-0057938 (filed on May 14, 2014), the teachings of which are incorporated herein in their entireties by reference.--

Please **AMEND** the paragraph [130] ~ [132] as follows.

~~[130]~~

~~[131] **CROSS-REFERENCE TO RELATED APPLICATIONS**~~

~~[132] This application claims priority under 35 U.S.C. §119(a) on Patent Applications No. 10-2013-0115367 filed in Korea on September 27, 2013, and No. 10-2014-0057938 filed in Korea on May 14, 2014 , the entire contents of which are hereby incorporated by reference. In addition, this application claims priority in countries, other than the U.S., with the same reason based on the Korean Patent Application, the entire contents of which are hereby incorporated by reference.~~

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REMARKS

By this amendment, the specification is amended to claim priority. No new matter has been added.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided. Prompt and favorable consideration of this Amendment is respectfully requested.

Respectfully submitted,

Date: 25 March 2016
Customer No. 76277
IP Legal Services, LLC
P.O. Box 651325
Sterling, VA 20165

/Ian M. Hughes/
Ian M. Hughes, Reg. No. 41,083
Kyung Hee Kim, Reg. No. 69,183
Attorney/Agent for Applicant
(571) 267-7183 (phone)

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METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

Technical Field

[1] The present disclosure relates to a method and an apparatus for allocating resources of an uplink control channel for uplink Hybrid Automatic Repeat Request (HARQ) ACK/NACK feedback of an Machine Type Communication (MTC) terminal in a wireless communication system.

Background Art

[2] Machine type communication (hereinafter, referred to as "MTC") is a type of data communication in which one or more machines or objects communicate with each other (e.g., machine to machine) without human interaction. The MTC communication does not require human interaction. The MTC refers to all communication systems that perform communication without a human's intervention.

[3] The MTC terminals may be installed in an area where a radio wave environment is not good compared to general terminals. In order for the MTC terminal to operate in such an area where the radio wave environment is not good compared to the general terminal, control information and/or data of each physical channel, which is transmitted in a single frame unit, may be required to be repeatedly transmitted in a plurality of subframes.

[4] Meanwhile, a resource of an uplink control channel, in which response information of downlink data is transmitted, may be determined by a function of a resource of a downlink control channel for scheduling downlink data. However, when control information is repeatedly transmitted in order to improve control information reception performance of a MTC terminal as described above, i) how to determine resources of an uplink control channel for the MTC terminal may be uncertain, and ii) the resources of the uplink control channel for the MTC terminal may conflict with resources of an uplink control channel for a typical terminal.

Detailed Description of the Invention

Technical Problem

[5] In order to overcome the problems above, in accordance with at least one embodiment of the present disclosure, a method and an apparatus may be provided

for allocating resources of an uplink control channel for a MTC terminal.

Technical Solution

[6] In accordance with at least one embodiment of the present disclosure, a method may be provided for transmitting response information of downlink data of a Machine Type Communication (MTC) terminal. The method may include: receiving structural information that contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) offset information of the resource allocated to the uplink control channel; receiving downlink control information for scheduling the downlink data; receiving the downlink data; and transmitting the response information on the downlink data by using the resource of the uplink control channel. The resource of the uplink control channel is determined based on at least one piece of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the offset information on the resource allocated to the uplink control channel.

[7] In accordance with another embodiment of the present disclosure, a method may be provided for configuring a resource of response information of downlink data of a Machine Type Communication (MTC) terminal in the base station. The method may include transmitting structural information that contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) offset information of the resource allocated to the uplink control channel; transmitting downlink control information for scheduling the downlink data; and transmitting the downlink data, wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of i) information on the resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to which the uplink control channel, and iii) the offset information of the resource allocated to the uplink control channel.

[8] In accordance with still another embodiment of the present disclosure, a terminal may be provided for transmitting response information of downlink data to a base station. The terminal may include: a receiving unit, a controller, and a transmitting unit. that the receiving unit is configured to receive structural information, downlink control information for scheduling the downlink data, and the downlink data. The structure information contains at least one piece of i)

information on the resource allocated to an uplink control channel for transmitting the response information and ii) offset information on the resource allocated to the uplink control channel. The controller is configured to determine a resource of the uplink control channel for transmitting the response information of the downlink data based on at least one piece of i) information on the resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the offset information of the resource allocated to the uplink control channel. The transmitting unit is configured to transmit the response information on the downlink data by using the determined resource of the uplink control channel.

[9] In accordance with yet another embodiment of the present disclosure, a base station may be provided for configuring a resource of transmitting response information of downlink data for a Machine Type Communication (MTC) terminal. The base station may include a transmitting unit configured to transmit structural information, downlink control information for scheduling the downlink data, and the downlink data. The structure information contains at least one piece of i) information on the resource allocated to an uplink control channel for transmitting the response information and ii) offset information of the resource allocated to the uplink control channel. The resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the offset information on the resource allocated to which the uplink control channel.

Advantageous Effects

[10] According to the present disclosure as described above, a method and an apparatus may be provided for allocating resources of an uplink control channel for a MTC terminal.

Brief Description of the Drawings

[11] FIG. 1 illustrates an example of a wireless communication system to which an embodiment of the present disclosure is applied.

[12] FIG. 2 is a flowchart illustrating an exemplary method according to a first embodiment of the present disclosure.

[13] FIG. 3 is a flowchart illustrating another exemplary method according to the first embodiment of the present disclosure.

[14] FIG. 4 is a diagram showing that a PDCCH is repeatedly transmitted through a plurality of downlink subframes according to an embodiment of the present disclosure.

[15] FIG. 5 is a flowchart illustrating a method according to a second embodiment of the present disclosure.

[16] FIG. 6 is a flowchart illustrating a method according to a third embodiment of the present disclosure.

[17] FIG. 7 is a flowchart illustrating a PUCCH transmission method of a terminal, according to an embodiment of the present disclosure.

[18] FIG. 8 is a flowchart illustrating a PUCCH configuration method of a base station, according to an embodiment of the present disclosure.

[19] FIG. 9 is a block diagram showing a configuration of a terminal, according to an embodiment of the present disclosure.

[20] FIG. 10 is a block diagram showing a configuration of a base station, according to an embodiment of the present disclosure.

Mode for Carrying Out the Invention

[21] Hereinafter, some embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. It should be noted that the same reference numerals denote the same elements even in different drawings. In addition, the description of the related well-known elements or functions, which may obscure the subject matter of the present disclosure, will be omitted in the present specification.

[22] In the present specification, a MTC terminal may refer to a terminal that supports a low cost (or low complexity), or a terminal that supports coverage enhancement. Alternatively, in the present specification, the MTC terminal may refer to a terminal that is defined as a specific category to support a low cost (or low complexity) and/or coverage enhancement.

[23] In other words, the MTC terminal may refer to the 3GPP Release-13 low cost (or low complexity) UE Category/type of device that is newly defined to perform LTE-based and MTC-related operations. Alternatively, in the present specification, the MTC terminal may refer to: a terminal that supports the improved coverage compared to the conventional LTE coverage; the UE category/type of

device that is defined in the conventional 3GPP Release-12 or less, which supports low power consumption; or the 3GPP Release-13 low cost (or low complexity) UE Category/type of device that is newly defined.

[24] FIG. 1 illustrates a wireless communication system to which an embodiment of the present disclosure is applied.

[25] In accordance with at least one embodiment, the wireless communication system may be widely deployed to provide various types of communication services, such as voice calls, packet data, or the like. The wireless communication system includes a user equipment (UE) 10 and a base station (BS or eNB) 20. The user equipment in the present specification has a wide concept that refers to a terminal in the wireless communication and shall be interpreted as a concept containing an Mobile Station (MS), a User Terminal (UT), an Subscriber Station (SS), or wireless devices in the global systems for mobile communication (GSM), as well as the User Equipment (UE) in the wideband code division multiple access (WCDMA), long term evolution (LTE), or high speed packet access (HSPA).

[26] The base station 20 or a cell generally denotes a station that communicates with the user equipment 10, and may be referred to as a Node-B, an eNB (evolved Node-B), a sector, a site, a BTS (Base Transceiver System), an AP, a relay node, an RRH (Remote Radio Head), an RU (Radio Unit), or a small cell as well.

[27] That is, the base station or the cell in the present disclosure should be interpreted as having a broad meaning that represents a partial area or function, which is covered by a Base Station Controller (BSC) in the CDMA, the Node B in the WCDMA, or the eNB or sector in the LTE, and may encompass various coverage areas, such as a mega cell, a macro cell, a micro cell, a pico cell, a femto cell, a relay node, the remote radio head (RRH), the radio unit (RU), or the small cell communication range.

[28] The base stations are provided to control the various cells described above, and the base station may be interpreted as two meanings that contain:

i) devices that provide the mega cell, the macro cell, the microcell, the pico cell, the femto cell, or the small cell in relation to the wireless area; or

ii) the wireless area itself.

With regard to i), the devices that provide a specific wireless area and are controlled by the same object, or all devices that cooperate with each other to form the wireless area, may be referred to as the base station. The eNB, the RRH, antennas, the RU, LPN, points, transmission/reception points, transmission points,

or reception points may be an example of the base station depending on the configuration of the wireless area. With regard to ii), the wireless area, in which the user equipment or a nearby base station receives/transmits signals, may be referred to as the base station.

[29] Therefore, the mega cell, the macro cell, the micro cell, the pico cell, the femto cell, the small cell, the RRH, the antenna, the RU, the Low Power Node (LPN), the point, the eNB, the transmission/reception point, the transmission point, and the reception point may be collectively referred to as the base station.

[30] In the present specification, the user equipment and the base station have a generic meaning as being the uplink device and the downlink device, which are used to implement the technology or technical concept described herein, and the user equipment and the base station are not limited to a specific term or word. The user equipment and the base station have a generic meaning as the uplink device and the downlink device, which are used to implement the technology or technical concept described herein, and the user equipment and the base station are not limited to a specific term or word. Here, the uplink (UL) means a method in which the user equipment transmits and receives data to and from the base station, and the downlink (DL) means a method in which the base station transmits and receives data to and from the user equipment.

[31] Multiple access schemes applied to the wireless communication system are not limited. A variety of multiple access schemes, such as CDMA (Code Division Multiple Access), TDMA (Time Division Multiple Access), FDMA (Frequency Division Multiple Access), OFDMA (Orthogonal Frequency Division Multiple Access), OFDM-FDMA, OFDM-TDMA, or OFDM-CDMA, may be used. An embodiment of the present disclosure may be applied to the resource allocation of asynchronous wireless communications that have advanced from the GSM, the WCDMA, and the HSPA to the LTE and the LTE-Advanced, and synchronous wireless communications that have advanced to the CDMA, the CDMA-2000, and the UMB. The present disclosure should not be interpreted to be limited to a specific wireless communication, and should be construed to include all schemes to which the technical concept of the present disclosure may be applied.

[32] The uplink transmission and the downlink transmission may use a TDD (Time Division Duplex) scheme in which the data is transmitted at a different time, or may use an FDD (Frequency Division Duplex) scheme in which the data is transmitted by using different frequencies.

[33] In addition, the uplink and downlink may be configured as a standard based on a single carrier or a pair of carriers in the LTE or LTE-Advanced scheme. The uplink and downlink transmit control information through control channels, such as a PDCCH (Physical Downlink Control CHannel), a PCFICH (Physical Control Format Indicator CHannel), a PHICH (Physical Hybrid ARQ Indicator CHannel), a PUCCH (Physical Uplink Control CHannel), or an EPDCCH (Enhanced Physical Downlink Control CHannel), and transmit data by means of data channels, such as a PDSCH (Physical Downlink Shared CHannel) or a PUSCH (Physical Uplink Shared CHannel).

[34] Meanwhile, the control information may be transmitted by means of the EPDCCH (enhanced PDCCH or extended PDCCH) as well.

[35] In the present specification, the cell may refer to: the coverage of a signal that is transmitted from the transmission/reception point; a component carrier that has the coverage of a signal that is transmitted from the transmission point or transmission/reception point; or the transmission/reception point itself.

[36] The wireless communication system, to which the embodiments are applied, may be a coordinated multi-point transmission/reception system (CoMP system) in which two or more transmission/reception points cooperate with each other to transmit signals, a coordinated multi-antenna transmission system, or a coordinated multi-cell communication system. The CoMP system may include two or more multi-transmission/reception points and terminals.

[37] The multi-transmission/reception point may be: the base station or the macro cell (hereinafter, referred to as 'eNB'); or one or more RRHs that are connected with the eNB through optical cables or optical fibers to be wiredly controlled, and that have a high transmission power or have a low transmission power within the macro cell area.

[38] Hereinafter, the downlink refers to the communication or the communication path from the multi-transmission/reception point to the terminal, and the uplink refers to the communication or the communication path from the terminal to the multi-transmission/reception point. In the downlink, a transmitter may be a part of the multi-transmission/reception point, and a receiver may be a part of the terminal. In the uplink, a transmitter may be a part of the terminal, and a receiver may be a part of the multi-transmission/reception point.

[39] Hereinafter, the state in which the signals are transmitted/received through the channels, such as the PUCCH, the PUSCH, the PDCCH, the EPDCCH, or the

PDSCH, may be expressed as "transmitting/receiving the PUCCH, the PUSCH, the PDCCH, the EPDCCH, or the PDSCH."

[40] In addition, the transmitting/receiving of the PDCCH or the transmitting/receiving of signals through the PDCCH may include the transmitting/receiving of the EPDCCH or the transmitting/receiving of signals through the EPDCCH.

[41] In other words, the physical downlink control channel described below may refer to the PDCCH, the EPDCCH, or both the PDCCH and the EPDCCH.

[42] In addition, for the convenience of explanation, the description of the PDCCH may be applied to the embodiment of the EPDCCH, and the description of the EPDCCH may be applied to the embodiment of the PDCCH.

[43] Meanwhile, the higher layer signaling described below includes the RRC signaling to transmit RRC information that contains an RRC parameter.

[44] The base station 20 performs the downlink transmission to the terminal 10. The base station 20 may transmit i) a physical downlink shared channel (PDSCH), which is a main physical channel for unicast transmission and ii) a physical downlink control channel (PDCCH) for transmitting the downlink control information, such as scheduling information necessary for the reception of the PDSCH and scheduling grant information for the transmission in the uplink data channel {e.g., a physical uplink shared channel (PUSCH)}. Hereinafter, the transmission/reception of signals through each channel will be expressed as the transmission/reception of the corresponding channel.

[45] In the typical 3GPP LTE/LTE-Advanced system, the PUCCH resource mapping for the Hybrid Automatic Repeat Request (HARQ) ACK/NACK feedback with respect to the reception of the scheduled PDSCH through the legacy PDCCH of the terminal is determined by an upper layer {e.g. Radio Resource Control (RRC)} parameter and a Control Channel Element (CCE) index in which the corresponding downlink (DL) assignment Downlink Control Information (DCI) is transmitted as shown in Equation (1) and Equation (2) below.

[46]

$$\text{①}\quad n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH}}^{(1)}$$

$$\text{②}\quad n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH}}^{(1)}$$

[47] Equation (1) and Equation (2) represent the PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ for the HARQ ACK/NACK feedback in the antenna port 0 and the antenna port 1,

respectively, in the terminal that supports two antenna ports. n_{CCE} denotes a lowest CCE index value in which the corresponding DL scheduling grant is transmitted, and $N^{(1)}_{PUCCH}$ denotes a cell-specific parameter that is configured by the higher layer (RRC) signaling.

[48] However, the PUCCH resource mapping scheme by Equation (1) and Equation (2) is for the transmission of the HARQ ACK/NACK through the PUCCH format 1a/1b of the terminal for which a single serving cell is configured in the frame structure type 1 (FDD) system. Additionally, the PUCCH resource mapping rule about the terminal for which one or more serving cells are configured (i.e., the terminal to which carrier aggregation is applied) may be, similar to the scheme above, determined by a function of the lowest CCE index and the higher layer parameter, or may be determined by the ARI (ACK/NACK Resource Indication) scheme in which a plurality of candidate PUCCH resource values are pre-configured through the higher layer signaling and the PUCCH resources to be used are indicated among the plurality of candidate PUCCH resource values by means of a 'TPC command for PUCCH' information area of the actual DL scheduling grant.

[49] <Improvement of Coverage for Low-cost MTC>

[50] It is assumed that the MTC terminal is a low capability terminal that has low performance hardware and software compared with a typical LTE/LTE-Advanced terminal in order to reduce a unit price of a terminal. Accordingly, the transmission/reception performance of the MTC terminal with respect to the physical layer channels, which are designed based on the UE category of the existing LTE/LTE-Advanced terminal and the UE capability thereof, is expected to be deteriorated, so studies have been actively made for developing method to improve the transmission/reception performance for the corresponding physical layer channels in order to solve the problem above.

[51] To this end, a typical method is provided, in which the power boosting with respect to the corresponding physical layer channel and the repeated transmission through a plurality of subframes are performed. For example, in order to transmit a single DCI (Downlink Control Information) for the MTC terminal, the PDCCH, which is a downlink control channel, is repeatedly transmitted through a plurality of downlink subframes in order to thereby obtain the power gain. Likewise, a method is considered, in which the PDSCH is repeatedly transmitted through a plurality of downlink subframes in order to thereby improve the reception performance of the

MTC terminal.

[52] In the existing system of LTE/LTE-Advanced Release-11 or less, the DL assignment information for the reception of the PDSCH, which is a downlink data channel of a certain terminal, is transmitted through only the PDCCH of the same downlink subframe, except for the SPS (Semi-Persistent Scheduling). Thus, the PUCCH resource allocation rule for the uplink HARQ ACK/NACK transmission with respect to the reception of the corresponding PDSCH is determined by a function of the lowest CCE (Control Channel Element) in which the corresponding downlink allocation PDCCH or EPDCCH is transmitted. Accordingly, this can prevent a collision between the PUCCH resources by which each terminal transmits the HARQ ACK/NACK with respect to the PDSCH transmissions for different terminals, which are transmitted through the same downlink subframe. However, if the PDCCH for transmitting a single DCI is repeatedly transmitted through a plurality of downlink subframes in order to improve the PDCCH reception performance of the MTC terminal as described above, it may bring about an uncertainty for the definition of the CCE index value to be applied to the lowest CCE index. Furthermore, the repeated transmission of the PDSCH and the PUCCH of the terminal through the plurality of subframes may cause a collision between the PUCCH resource of the MTC terminal and the PUCCH resource for the HARQ ACK/NAKC feedback of a general LTE terminal other than the MTC terminal.

[53] In accordance with at least one embodiment of the present disclosure, a method and an apparatus may be provided for allocating the PUCCH resource for the uplink HARQ ACK/NACK feedback of the MTC terminal.

[54] **Embodiment 1. Reuse of PUCCH Resource Mapping Equation**

[55] Definition of new PUCCH Resource Start Offset

[56] FIG. 2 is a flowchart illustrating an exemplary method according to a first embodiment.

[57] Referring to FIG. 2, the base station defines a separate PUCCH resource start offset parameter $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal (S210). The base station includes the same in the corresponding RRC signaling and transmits the corresponding RRC signal to the terminal (S220). According to this, the MTC terminal determines the PUCCH resource by replacing $N_{PUCCH}^{(1)}$ with $N_{PUCCH,MTC}^{(1)}$ in the PUCCH resource mapping equations (1) and (2) above (S230), and the MTC

terminal transmits the HARQ ACK/NACK to the base station through the determined PUCCH resource (S240). That is, the MTC terminal may apply Equation (3) and Equation (4) as follows.

[58]

$$n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)} \quad (3)$$

$$n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)} \quad (4)$$

[59] The $N_{PUCCH,MTC}^{(1)}$ value may be configured for each MTC terminal by the UE-specific RRC signaling. According to another embodiment for signaling the $N_{PUCCH,MTC}^{(1)}$ value, the $N_{PUCCH,MTC}^{(1)}$ value may be broadcast to the MTC terminal in the corresponding cell through the cell-specific RRC signaling or the PBCH for the MTC terminal.

[60] FIG. 3 is a flowchart illustrating another exemplary method according to the first embodiment.

[61] Referring to FIG. 3, as another exemplary method for configuring a separate PUCCH resource start offset value for the MTC terminal, the base station may: define a plurality of candidate PUCCH resource start offset values for each MTC terminal through the higher layer RRC signaling (S310); transmit the plurality of candidate PUCCH resource start offset values to the terminal (S320); and control to provide the terminal with a signal of the PUCCH resource start offset value that is to be applied when allocating the PDSCH resource (S330). The terminal determines the resource of the PUCCH by using Equation (3) and Equation (4) (S340), and the terminal transmits the HARQ ACK/NACK to the base station through the PUCCH of the determined resource (S350).

[62] That is, the base station may provide the UE-specific RRC signaling or cell-specific RRC signaling for a certain MTC terminal. Or, the base station may signal the candidate PUCCH resource start offset parameter by the PBCH for the MTC terminal and may indicate the PUCCH resource start offset parameter to be applied through the downlink allocation DCI format for the MTC terminal. A method may be provided, in which a PUCCH resource start offset indicator information area is explicitly defined in the downlink allocation DCI format in order to indicate the PUCCH resource start offset, or it may be explicitly indicated by using the existing information area.

[63] For example, four candidate PUCCH resource start offset parameters

$N^{(1)}_{PUCCH,MTC1}$, $N^{(1)}_{PUCCH,MTC2}$, $N^{(1)}_{PUCCH,MTC3}$, $N^{(1)}_{PUCCH,MTC4}$ for the MTC terminal are configured, and the information area of 2 bits for indicating the corresponding PUCCH resource start offset is newly defined in the downlink allocation DCI format in order to thereby indicate the PUCCH resource start offset to be applied to the PUCCH resource mapping equations (3) and (4) through the same. Alternatively, the existing information area, such as a TPC command, may be used to indicate the corresponding PUCCH resource start offset without additionally defining a new information area.

[64] In another method, the value to be applied among the corresponding candidate PUCCH resource start offset may be implicitly informed of. For example, the applied PUCCH resource start offset value may be determined according to the number of PDCCH repetitions for transmitting the corresponding DCI (that is, the PDCCH aggregation level or repetition level).

[65] Definition of Lowest CCE Index for Repeated PDCCH

[66] FIG. 4 is a view showing that a PDCCH is repeatedly transmitted through a plurality of downlink subframes according to an embodiment of the present disclosure.

[67] The PDCCH may be defined to be repeatedly transmitted through a plurality of downlink subframes in order to improve the DCI reception performance of the MTC terminal as shown in FIG. 4.

[68] In this case, the lowest CCE index n_{CCE} should be defined in order to be applied to the equations (3) and (4) above. To this end, in accordance with at least one embodiment of the present disclosure, the n_{CCE} value may be defined to be applied to the PUCCH resource mapping equations (3) and (4) when the downlink allocation DCI for a certain MTC terminal is repeatedly transmitted through the PDCCHs of a plurality of downlink subframes.

[69] In the first embodiment, when the N PDCCHs are repeatedly used for transmitting a single downlink allocation DCI as shown in FIG. 4, the lowest CCE index among the CCEs that are used for the transmission of the first PDCCH may be defined as the corresponding n_{CCE} value. In another embodiment, the lowest CCE index of the Nth PDCCH, which is the last repeated PDCCH, may be defined as the corresponding n_{CCE} value. Lastly, the smallest CCE index among the CCE indexes, which are used for the transmission of the N repeated PDCCHs, may be defined as the corresponding n_{CCE} value.

[70] However, the method of defining the n_{CCE} value described above may be applied, in the same manner, to the method for defining the corresponding n_{CCE} value to be applied to the equations (1) and (2) in the case of reusing the PUCCH resource start offset value $N_{PUCCH}^{(1)}$ in the equation for the existing LTE/LTE-A terminal without defining a new PUCCH resource start offset for the MTC terminal as shown in FIG. 2 or FIG. 3 for the PUCCH resource mapping for the MTC terminal.

[71] **Embodiment 2. PUCCH Resource Allocation to Downlink Allocation DCI**

[72] FIG. 5 is a flowchart illustrating a method according to a second embodiment of the invention.

[73] Referring to FIG. 5, the base station may: pre-configure a candidate PUCCH resource value for a HARQ ACK/NACK feedback of the corresponding MTC terminal for each MTC terminal by the higher layer signaling as shown in Table 1 below (S510); define a PUCCH resource indicator field for indicating PUCCH resources to be used among the corresponding candidate PUCCH resource values by the downlink allocation DCI; and directly signal the same to the terminal (S520). The terminal determines the PUCCH resource (S530), and transmits the HARQ ACK/NACK to the base station through the PUCCH of the determined resource (S540).

[74] At this time, the number of candidate PUCCH resources may be determined according to the size of the PUCCH resource indicator field of the downlink allocation DCI. For example, if the corresponding PUCCH resource indicator field is 2 bits, four candidate PUCCH resource values may be configured by the higher layer signaling for the corresponding candidate PUCCH resource configuration. Therefore, the terminal may map the PUCCH resource value for transmitting the HARQ ACK/NACK feedback among the four PUCCH resource values according to a configuration value of the PUCCH resource indicator field that is contained in the downlink allocation DCI as shown in Table 1 below. Here, the PUCCH resource indicator field may be newly defined, or some of the information area contained in the downlink allocation may be utilized as the PUCCH resource indicator. As an example of utilizing the existing information area, the TPC command information area of 2 bits may be utilized for the PUCCH resource indicator.

[75] Table 1

[76]

PUCCH resource indicator value in downlink allocation DCI	$n_{PUCCH}^{(1,p)}$
'00'	First PUCCH resource value configured by higher layer
'01'	Second PUCCH resource value configured by higher layer
'01'	Third PUCCH resource value configured by higher layer
'11'	Fourth PUCCH resource value configured by higher layer

[77] In addition, each candidate PUCCH resource value may include the number of PUCCH repetitions. That is, the number of times in which the HARQ ACK/NACK feedback is repeatedly transmitted through the PUCCH resource over the uplink subframes may be configured for each PUCCH resource value, as well as the PUCCH resources to be used for the HARQ ACK/NACK feedback.

[78] **Embodiment 3. ACK Resource Offset for MTC**

[79] FIG. 6 is a flowchart illustrating a method according to a third embodiment of the invention.

[80] In the present embodiment, an additional ACK resource offset parameter Δ_{ARO_MTC} for the MTC terminal may be defined and applied to the PUCCH resource mapping equation. That is, an ACK Resource Offset (ARO) information area indicates the PUCCH resource offset value. The ARO information area may be additionally defined in the downlink allocation for a certain MTC terminal, and the Δ_{ARO_MTC} value to be applied to the PUCCH resource mapping equation for the certain MTC terminal may be signaled to the terminal (S610). The terminal determines the PUCCH resource (S620) and transmits the HARQ ACK/NACK to the base station through the PUCCH of the determined resource (S630).

[81] The Δ_{ARO_MTC} value according to the configuration value of the ARO in the downlink allocation DCI format may be defined such that a specific and fixed Δ_{ARO_MTC} value corresponds to each ARO value according to the table mapping

method as shown in Table 2, or the base station may configure the $\Delta_{ARO,MTC}$ value for each ARO value and may signal the same to the MTC terminal.

[82] Table 2

[83]

ACK/NACK resource offset field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D	$\Delta_{ARO,MTC}$
0	0
1	-1
2	-2
3	2

[84] According to this, equations (5) and (6) below may be applied instead of the existing PUCCH resource mapping equations (1) and (2) or the equations (3) and (4) for the terminal that receives the downlink allocation DCI through the PDCCH.

[85]

$$n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)} + \Delta_{ARO,MTC} \quad (5)$$

$$n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)} + \Delta_{ARO,MTC} \quad (6)$$

[86] In accordance with at least one embodiment of the present disclosure, the PUCCH resource mapping rule has been suggested for the MTC terminal. However, the PUCCH for the DL HARQ ACK feedback of a certain MTC terminal may be repeatedly transmitted through a plurality of uplink subframes for the coverage enhancement as well.

[87] In this case, the PUCCH resource for the DL HARQ ACK feedback in one uplink subframe is determined according to the method suggested above, and the DL HARQ ACK feedback may be defined to be repeatedly transmitted through the same PUCCH resource that is determined by the above-described methods in a plurality of uplink subframes according to the number of the repeated PUCCH transmissions.

[88] In addition, although the present disclosure does not show a detailed embodiment about the number of PUCCH repetitions for the HARQ ACK/NACK feedback of the MTC terminal, it is obvious that the embodiments suggested above may be applied in the same manner regardless of the number of PUCCH repetitions.

[89] FIG. 7 is a flowchart illustrating a PUCCH transmission method of the terminal, according to an embodiment of the present disclosure.

[90] Referring to FIG. 7, the terminal receives, from the base station, structural information for the PUCCH resource allocation through the higher layer (for

example, the RRC) signaling (S710).

[91] The terminal receives the DCI for the downlink allocation by the PDCCH or EPDCCH from the base station (S720).

[92] The terminal receives, from the base station, data by the PDSCH based on the scheduling information in the DCI (S730).

[93] The terminal determines the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH in which the HARQ ACK/NACK of the data received through the PDSCH is transmitted (S740).

[94] In one example, the terminal may receive structural information that contains the PUCCH resource start offset parameter $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal in operation S710, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4) in operation S740. Alternatively, the terminal may: receive structural information that contains a plurality of PUCCH resource start offset parameters $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal in operation S710; receive control information that indicates one of the plurality of parameters $N_{PUCCH,MTC}^{(1)}$ in operation S720; and determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4) in operation S740.

[95] In another example, the terminal may: receive structural information that contains a plurality of PUCCH resource start offset parameters $n_{PUCCH}^{(1,\tilde{p})}$ for the MTC terminal in operation S710; receive control information that indicates one of the plurality of parameters $n_{PUCCH}^{(1,\tilde{p})}$ in operation S720; and determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH based on the control information in operation S740.

[96] In another example, the terminal may receive control information that indicates one of a plurality of ACK resource offsets $\Delta_{ARO,MTC}$ in operation S720, and may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (5) and (6) in operation S740. At this time, the plurality of ACK resource offsets $\Delta_{ARO,MTC}$ may be pre-configured or may be transmitted from the base station to the

terminal in operation S710.

[97] When the PDCCH or EPDCCH is repeatedly transmitted through a plurality of subframes and when using the equations (3) and (4) or the equations (5) and (6), the lowest CCE index (n_{CCE}), in which the PDCCH or EPDCCH is transmitted, may be (i) the lowest CCE index that has been used for the transmission of the first PDCCH or EPDCCH, (ii) the lowest CCE index that has been used for the transmission of the last PDCCH or EPDCCH, or (iii) the minimum value among the lowest CCE indexes that have been used for the transmission of the PDCCH or EPDCCH.

[98] The terminal transmits, to the base station, the HARQ ACK/NACK of the data that is received through the PDSCH by using the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the determined PUCCH (S750).

[99] Although operation S740 and operation S750 have been described as being performed separately from each other, the operations may be performed in a single operation. That is, response information on the downlink data may be transmitted by using the resource of the uplink control channel, which is determined based on at least one piece of information on the resource of the downlink control channel for scheduling the downlink data, information on the resource to which the uplink control channel is allocated, or offset information of the resource to which the uplink control channel is allocated.

[100] FIG. 8 is a flowchart illustrating a PUCCH resource configuration method of the base station, according to an embodiment of the present disclosure.

[101] Referring to FIG. 8, the base station transmits structural information for the PUCCH resource allocation to the terminal by higher layer signaling (e.g., RRC signaling) (S810).

[102] The base station transmits the DCI for the downlink allocation to the terminal by the PDCCH or EPDCCH (S820).

[103] In addition, the base station transmits data to the terminal by the PDSCH (S830).

[104] In one example, the base station may transmit structural information that contains the PUCCH resource start offset parameter $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal in operation S810, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4). Alternatively, the base station may

transmit structural information that contains a plurality of PUCCH resource start offset parameters $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal in operation S810 and may transmit control information that indicates one of the plurality of parameters $N_{PUCCH,MTC}^{(1)}$ in operation S820, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4).

[105] In another example, the base station may transmit structural information that contains a plurality of PUCCH resource start offset parameters $n_{PUCCH}^{(1,\tilde{p})}$ for the MTC terminal in operation S810, and the base station may transmit control information that indicates one of the plurality of parameters $n_{PUCCH}^{(1,\tilde{p})}$ in operation S820, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH based on the control information.

[106] In another example, the base station may transmit control information that indicates one of a plurality of ACK resource offsets $\Delta_{ARO,MTC}$ in operation S820, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (5) and (6). At this time, the plurality of ACK resource offsets $\Delta_{ARO,MTC}$ may be pre-configured or may be transmitted from the base station to the terminal in operation S810.

[107] When the PDCCH or EPDCCH is repeatedly transmitted through a plurality of subframes and when using the equations (3) and (4) or the equations (5) and (6), the lowest CCE index (n_{CCE}), in which the PDCCH or EPDCCH is transmitted, may be (i) the lowest CCE index that has been used for the transmission of the first PDCCH or EPDCCH, (ii) the lowest CCE index that has been used for the transmission of the last PDCCH or EPDCCH, or (iii) the minimum value among the lowest CCE indexes that have been used for the transmission of the PDCCH or EPDCCH.

[108] FIG. 9 is a block diagram showing a configuration of a terminal, according to an embodiment of the present disclosure.

[109] Referring to FIG. 9, the terminal 900, according to an embodiment of the

present disclosure, includes a controller 910, a receiving unit 920, and a transmitting unit 930.

[110] The receiving unit 920 may receive, from the base station, the structural information for the PUCCH resource allocation through the higher layer (for example, RRC) signaling.

[111] In addition, the receiving unit 920 may receive the DCI for the downlink allocation by the PDCCH or EPDCCH from the base station, and the receiving unit 920 may receive the data through the PDSCH based on the scheduling information in the DCI.

[112] The controller 910 may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH in which the HARQ ACK/NACK of the data received through the PDSCH is transmitted.

[113] The transmitting unit 930 may transmit the HARQ ACK/NACK of the data received through the PDSCH to the base station by using the determined resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH.

[114] In one example, the receiving unit 920 may receive the structural information that contains the PUCCH resource start offset parameter $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal, and the controller 930 may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4). Alternatively, the receiving unit 920 may receive the structural information that contains a plurality of PUCCH resource start offset parameters $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal, and the receiving unit 920 may receive the control information that indicates one of the plurality of parameters $N_{PUCCH,MTC}^{(1)}$, and the controller 910 may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4).

[115] In another example, the receiving unit 920 may receive the structural information that contains a plurality of PUCCH resource start offset parameters $n_{PUCCH}^{(1,\tilde{p})}$ for the MTC terminal, and the receiving unit 920 may receive the control information that indicates one of the plurality of parameters $n_{PUCCH}^{(1,\tilde{p})}$, and the

controller 910 may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH based on the control information.

[116] In another example, the receiving unit 920 may receive the control information that indicates one of a plurality of ACK resource offsets $\Delta_{ARO,MTC}$, and the controller 910 may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (5) and (6). At this time, the plurality of ACK resource offsets $\Delta_{ARO,MTC}$ may be pre-configured or may be transmitted from the base station to the terminal through the higher layer signaling.

[117] When the PDCCH or EPDCCH is repeatedly transmitted through a plurality of subframes and when using the equations (3) and (4) or the equations (5) and (6), the lowest CCE index (n_{CCE}), in which the PDCCH or EPDCCH is transmitted, may be (i) the lowest CCE index that has been used for the transmission of the first PDCCH or EPDCCH, (ii) the lowest CCE index that has been used for the transmission of the last PDCCH or EPDCCH, or (iii) the minimum value among the lowest CCE indexes that have been used for the transmission of the PDCCH or EPDCCH.

[118] FIG. 10 is a block diagram showing a configuration of a base station, according to an embodiment of the present disclosure.

[119] Referring to FIG. 10, the base station 1000, according to an embodiment of the present disclosure, includes a controller 1010, a transmitting unit 1020, and a receiving unit 1030.

[120] The controller 1010 controls the overall operations of the base station in relation to the PUCCH resource allocation for the uplink HARQ ACK/NACK feedback of the MTC terminal, which are necessary to perform the invention described above.

[121] The transmitting unit 1020 may transmit the structural information for the PUCCH resource allocation to the terminal by the higher layer signaling (e.g., RRC) signaling.

[122] In addition, the transmitting unit 1020 may transmit the DCI for the downlink allocation to the terminal by the PDCCH or EPDCCH, and the transmitting unit 1020 may transmit data by means of the PDSCH.

[123] The receiving unit 1030 may receive the ACK/NACK for the PDSCH from

the terminal through the PUCCH.

[124] In one example, the transmitting unit 1020 may transmit the structural information that contains the PUCCH resource start offset parameter $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4). Alternatively, the transmitting unit 1020 may transmit the structural information that contains a plurality of PUCCH resource start offset parameters $N_{PUCCH,MTC}^{(1)}$ for the MTC terminal, and the transmitting unit 1020 may transmit the control information that indicates one of the plurality of parameters $N_{PUCCH,MTC}^{(1)}$, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (3) and (4).

[125] In another example, the transmitting unit 1020 may transmit the structural information that contains a plurality of PUCCH resource start offset parameters $n_{PUCCH}^{(1,\tilde{p})}$ for the MTC terminal, and the transmitting unit 1020 may transmit the control information that indicates one of the plurality of parameters $n_{PUCCH}^{(1,\tilde{p})}$, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH based on the control information.

[126] In another example, the transmitting unit 1020 may transmit the control information that indicates one of a plurality of ACK resource offsets $\Delta_{ARO,MTC}$, and the terminal may determine the resource ($n_{PUCCH}^{(1,\tilde{p})}$) of the PUCCH by using the equations (5) and (6). At this time, the plurality of ACK resource offsets $\Delta_{ARO,MTC}$ may be pre-configured or may be transmitted from the base station to the terminal in operation S810.

[127] When the PDCCH or EPDCCH is repeatedly transmitted through a plurality of subframes and when using the equations (3) and (4) or the equations (5) and (6), the lowest CCE index (n_{CCE}), in which the PDCCH or EPDCCH is transmitted, may be (i) the lowest CCE index that has been used for the transmission

of the first PDCCH or EPDCCH, (ii) the lowest CCE index that has been used for the transmission of the last PDCCH or EPDCCH, or (iii) the minimum value among the lowest CCE indexes that have been used for the transmission of the PDCCH or EPDCCH.

[128] The description of the reference content or reference documents mentioned above have been omitted in order to simplify the description of the specification, and shall constitute a part of the present specification. Therefore, the partial description of the reference content or reference documents, which may be added to the present specification or claims, should be interpreted to be included within the scope of the invention.

[129] The description above has been made to provide only examples of the technical concept of the present disclosure, and it may be possible for those skilled in the art to make various modifications and changes without departing from the essential subject matter of the present disclosure. Therefore, the embodiments described herein are only for explaining, and are not intended to limit, the technical concept of the present disclosure, and the scope of the present disclosure is not limited thereto. The scope of the invention should be construed by the following claims, and all techniques equivalent to the same should be construed as being included in the scope of the invention.

[130]

[131] **CROSS-REFERENCE TO RELATED APPLICATION**

[132] This application claims priority under 35 U.S.C. §119(a) on Patent Applications No. 10-2013-0115367 filed in Korea on September 27, 2013, and No. 10-2014-0057938 filed in Korea on May 14, 2014 , the entire contents of which are hereby incorporated by reference. In addition, this application claims priority in countries, other than the U.S., with the same reason based on the Korean Patent Application, the entire contents of which are hereby incorporated by reference.

Claims

1. A method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

receiving structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) offset information on the resource allocated to the uplink control channel;

receiving downlink control information for scheduling the downlink data;

receiving the downlink data; and

transmitting the response information on the downlink data by using the resource allocated to the uplink control channel,

wherein the resource allocated to the uplink control channel is determined based on at least one of: i) information on a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; or the offset information on the resource allocated to the uplink control channel.

2. The method of claim 1, wherein the offset information of the resource allocated to the uplink control channel is different from offset information for a terminal different from the MTC terminal.

3. The method of claim 2, wherein:

a plurality of pieces of offset information of the resource allocated to the uplink control channel are provided; and

the receiving of the downlink control information comprises receiving information that indicates one of the plurality of pieces of offset information.

4. The method of claim 1, wherein:

a plurality of pieces of information on the resource allocated to the uplink control channel are provided; and

the receiving of the downlink control information comprises receiving information that indicates one of the plurality of pieces of resource information.

5. The method of claim 1, wherein:

the receiving of the downlink control information comprises receiving information that indicates one of a plurality of additional offset values, and

the transmitting of the response information of the downlink data comprises determining the resource of the uplink control channel based on i) the information on the resource of the downlink control channel for scheduling the downlink data; ii) the offset information of the resource allocated to the uplink control channel; and iii) the additional offset values.

6. The method of claim 1, wherein when the downlink data and the control information for scheduling the downlink data are repeatedly transmitted, information on the resource of the downlink control channel for scheduling the downlink data is at least one of i) a resource of a first downlink control channel among a plurality of downlink control channels, ii) a resource of a last downlink control channel among the plurality of downlink control channels, and iii) a minimum value among the resources of the plurality of downlink control channels.

7. A method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in the base station, the method comprising:

transmitting structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) offset information on the resource allocated to the uplink control channel;

transmitting downlink control information for scheduling the downlink data; and

transmitting the downlink data,

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of information on i) a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the offset information on the resource allocated to the uplink control channel.

8. The method of claim 7, wherein the offset information is different from offset information on a terminal different from the MTC terminal.

9. The method of claim 8, wherein:

a plurality of pieces of offset information on the resource allocated to the uplink control channel are provided; and

the transmitting of the downlink control information comprises transmitting information that indicates one of the plurality of pieces of offset information.

10. The method of claim 7, wherein:

a plurality of pieces of information on the resource allocated to the uplink control channel for transmitting the response information are provided; and

the transmitting of the downlink control information comprises transmitting information that indicates one of the plurality of pieces of resource information.

11. The method of claim 7, wherein:

the transmitting of the downlink control information comprises transmitting information that indicates one of a plurality of additional offset values; and

the resource of the uplink control channel is determined based on i) the information on the resource of the downlink control channel for scheduling the downlink data; ii) the offset information of the resource allocated to the uplink control channel; and iii) the additional offset values.

12. The method of claim 7, wherein when the downlink data and the control information for scheduling the downlink data are repeatedly transmitted, the resource information of the downlink control channel for scheduling the downlink data is at least one of i) a resource of a first downlink control channel among a plurality of downlink control channels, ii) a resource of a last downlink control channel among the plurality of downlink control channels, and iii) a minimum value among the resources of the plurality of downlink control channels.

13. A terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a receiving unit configured to receive structural information that contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) offset information on the resource to which the uplink control channel is allocated, configured to receive downlink

control information for scheduling the downlink data, and configured to receive the downlink data;

a controller configured to determine a resource allocated to the uplink control channel for transmitting the response information of the downlink data based on at least one of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the offset information on the resource allocated to the uplink control channel; and

a transmitting unit configured to transmit the response information of the downlink data by using the determined resource of the uplink control channel.

14. The terminal of claim 13, wherein the offset information is different from offset information on a terminal different from the MTC terminal.

15. The terminal of claim 14, wherein:

a plurality of pieces of offset information on the resource allocated to the uplink control channel are provided; and

the receiving unit is configured to receive information that indicates one of the plurality of pieces of offset information through the downlink control information.

16. The terminal of claim 13, wherein:

a plurality of pieces of information on the resource allocated to the uplink control channel for transmitting the response information are provided; and

the receiving unit is configured to receive information that indicates one of the plurality of pieces of resource information through the downlink control information.

17. The terminal of claim 13, wherein:

the receiving unit is configured to receive information that indicates one of a plurality of additional offset values through the downlink control information; and

the controller is configured to determine the resource of the uplink control channel based on at least one of i) the information on the resource of the downlink control channel for scheduling the downlink data, ii) the offset information on the resource to which the uplink control channel is allocated, and iii) the additional

offset values.

18. The terminal of claim 13, wherein when the downlink data and the control information for scheduling the downlink data are repeatedly transmitted, the resource information of the downlink control channel for scheduling the downlink data is at least one of i) a resource of a first downlink control channel among a plurality of downlink control channels, ii) a resource of a last downlink control channel among the plurality of downlink control channels, and iii) a minimum value among the resources of the plurality of downlink control channels.

19. A base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a transmitting unit configured to transmit structural information, downlink control information for scheduling the downlink data, and the downlink data,

wherein the structural information contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) offset information on the resource allocated to the uplink control channel, and

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the offset information of the resource allocated to the uplink control channel.

Abstract

Provided are a method and an apparatus for PUCCH resource allocation for an uplink HARQ ACK/NACK feedback of a machine-type communication (MTC) terminal in a 3GPP LTE/LTE-Advanced system.

IPR2025-00138
Petitioner's Exhibit 1002
Page 000045

FIG.1

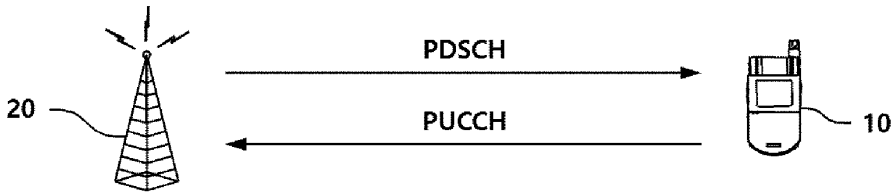


FIG.2

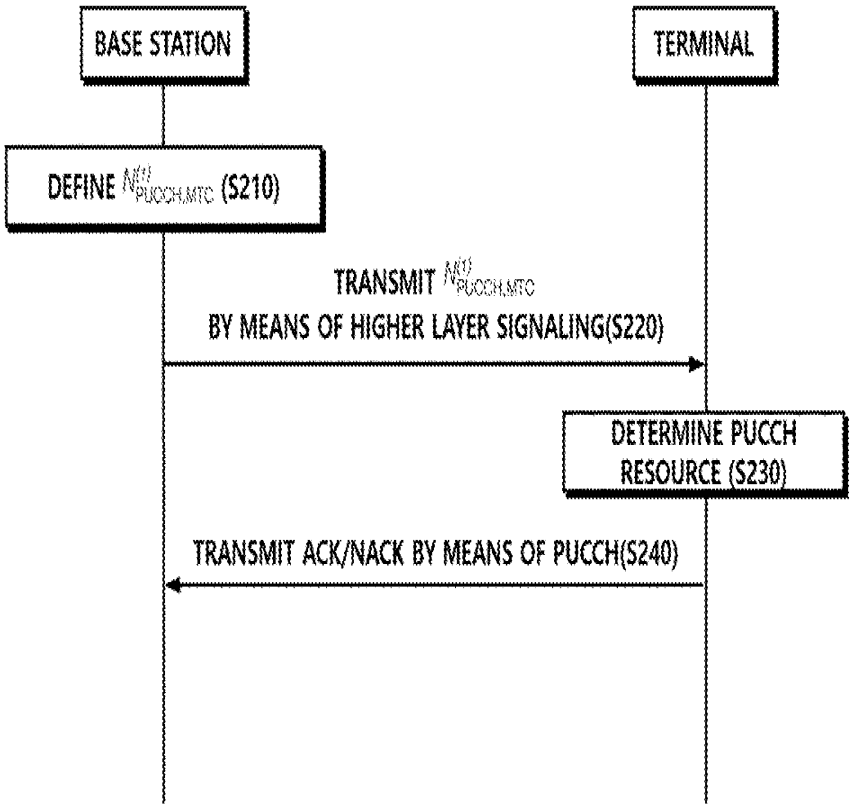

BASE STATION
TERMINAL
DEFINE $N^{(1)}_{PUCCH,MTC}$ (S210)
TRANSMIT $N^{(1)}_{PUCCH,MTC}$
BY MEANS OF HIGHER LAYER SIGNALING(S220)
DETERMINE PUCCH
RESOURCE (S230)
TRANSMIT ACK/NACK BY MEANS OF PUCCH(S240)

FIG.3

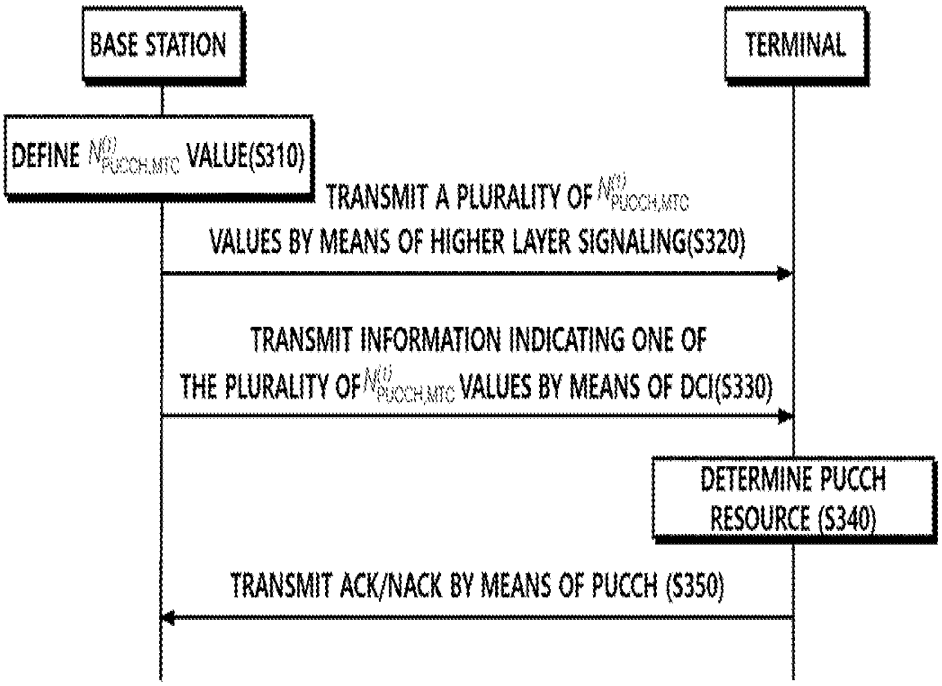

BASE STATION
TERMINAL
DEFINE $N^{(1)}_{PUCCH,MTC}$ VALUE(S310)
TRANSMIT A PLURALITY OF $N^{(1)}_{PUCCH,MTC}$ VALUES BY MEANS OF HIGHER LAYER SIGNALING(S320)
TRANSMIT INFORMATION INDICATING ONE OF THE PLURALITY OF $N^{(1)}_{PUCCH,MTC}$ VALUES BY MEANS OF DCI(S330)
DETERMINE PUCCH RESOURCE (S340)
TRANSMIT ACK/NACK BY MEANS OF PUCCH (S350)

FIG.4

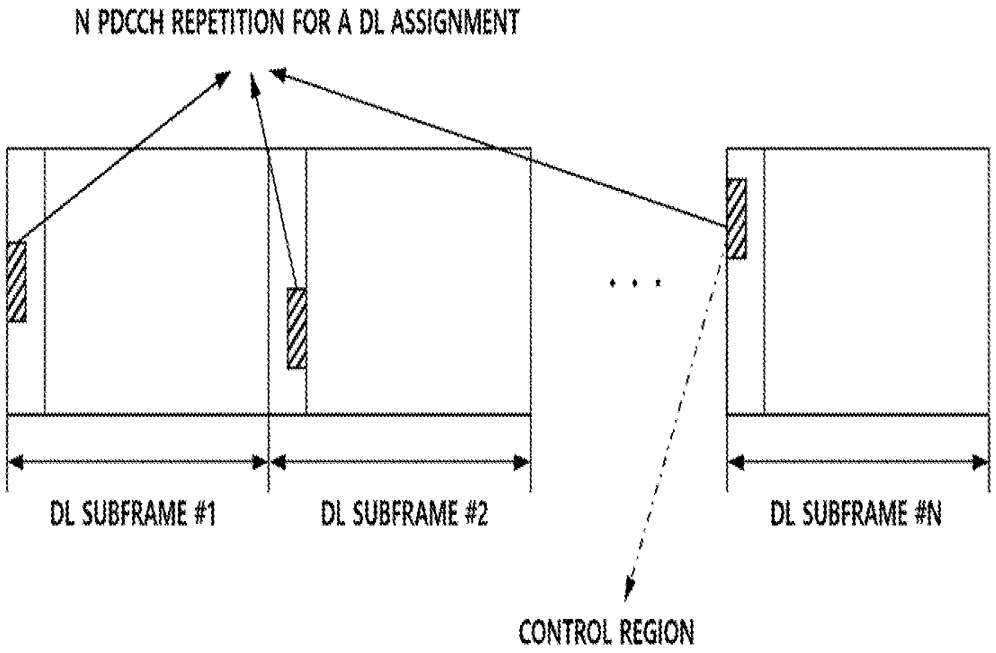

N PDCCH REPETITION FOR A DL ASSIGNMENT
DL SUBFRAME #1
DL SUBFRAME #2
DL SUBFRAME #N
CONTROL REGION

FIG.5

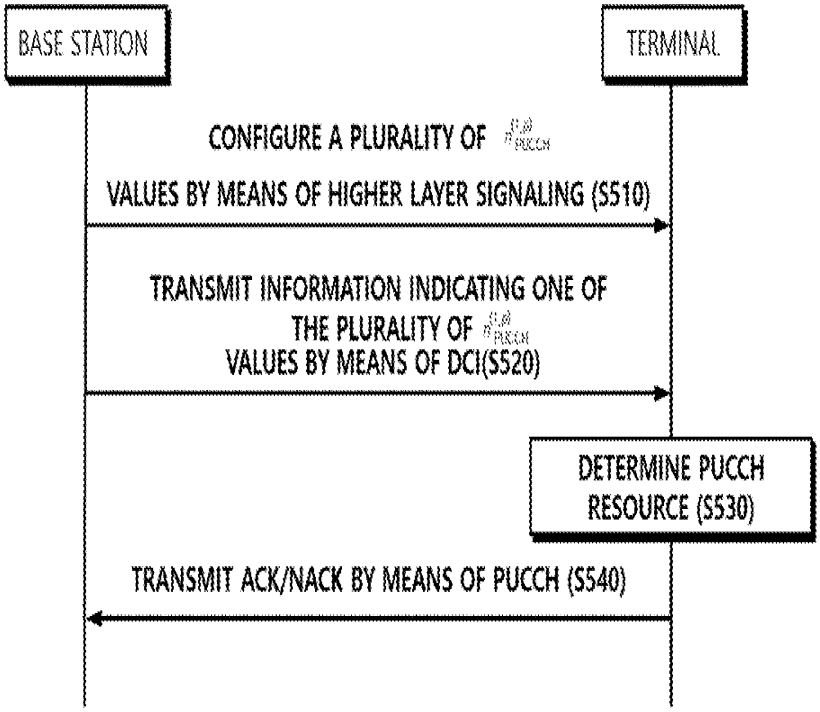

BASE STATION
TERMINAL
CONFIGURE A PLURALITY OF $f^{(p)}_{PUCCH}$ VALUES BY MEANS OF HIGHER LAYER SIGNALING (S510)
TRANSMIT INFORMATION INDICATING ONE OF THE PLURALITY OF $f^{(p)}_{PUCCH}$ VALUES BY MEANS OF DCI(S520)
DETERMINE PUCCH RESOURCE (S530)
TRANSMIT ACK/NACK BY MEANS OF PUCCH (S540)

FIG.6

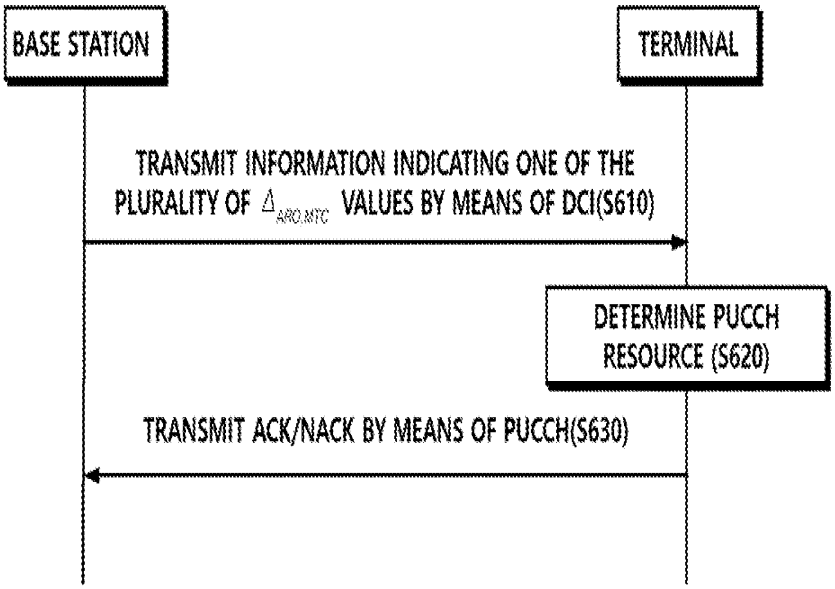

BASE STATION
TERMINAL
TRANSMIT INFORMATION INDICATING ONE OF THE PLURALITY OF $\Delta_{ARO,MTC}$ VALUES BY MEANS OF DCI(S610)
DETERMINE PUCCH RESOURCE (S620)
TRANSMIT ACK/NACK BY MEANS OF PUCCH(S630)

FIG. 7

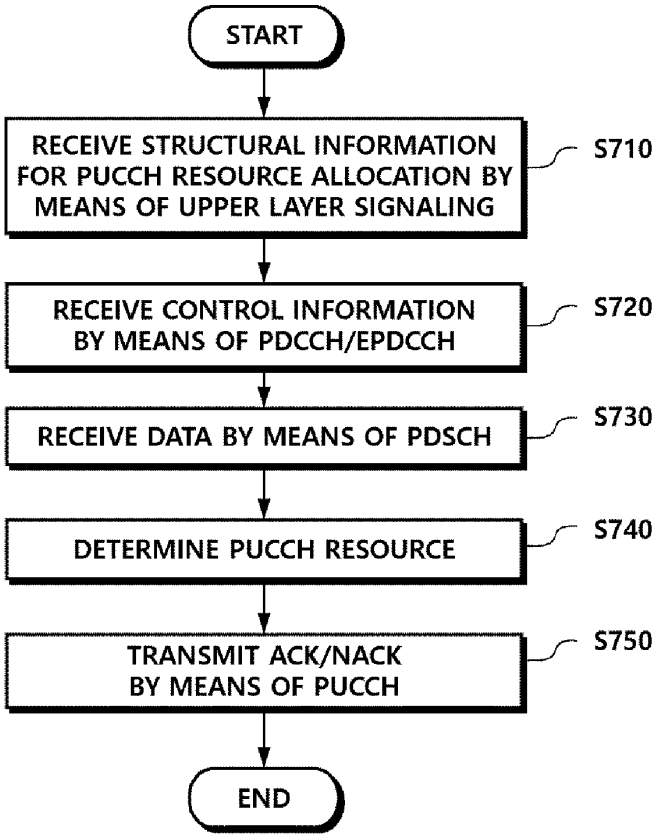

START
RECEIVE STRUCTURAL INFORMATION FOR PUCCH RESOURCE ALLOCATION BY MEANS OF UPPER LAYER SIGNALING
S710
RECEIVE CONTROL INFORMATION BY MEANS OF PDCCH/EPDCCH
S720
RECEIVE DATA BY MEANS OF PDSCH
S730
DETERMINE PUCCH RESOURCE
S740
TRANSMIT ACK/NACK BY MEANS OF PUCCH
S750
END

FIG.8

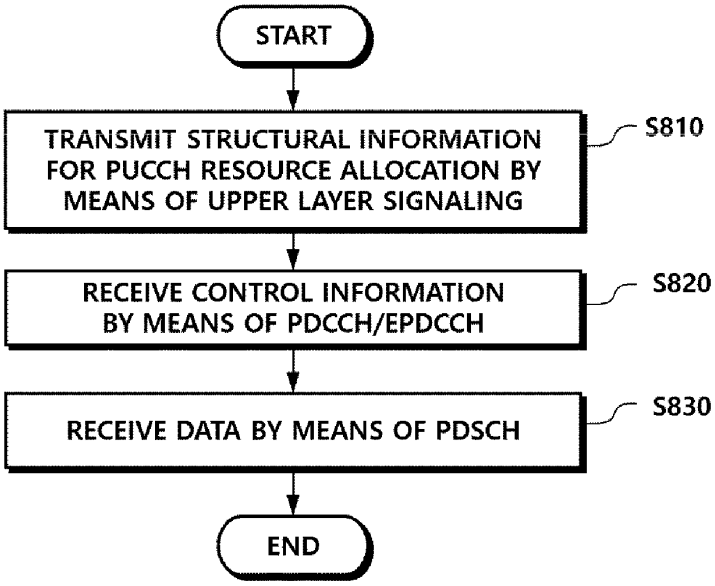

START
TRANSMIT STRUCTURAL INFORMATION FOR PUCCH RESOURCE ALLOCATION BY MEANS OF UPPER LAYER SIGNALING
S810
RECEIVE CONTROL INFORMATION BY MEANS OF PDCCH/EPDCCH
S820
RECEIVE DATA BY MEANS OF PDSCH
S830
END

FIG.9

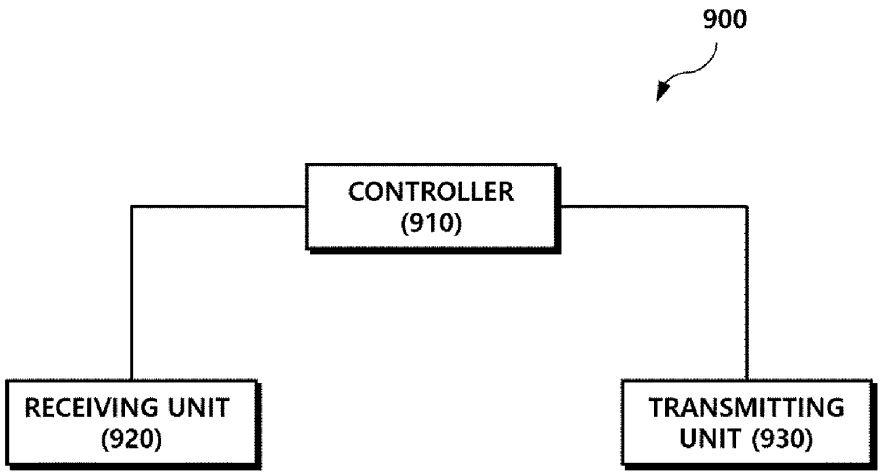
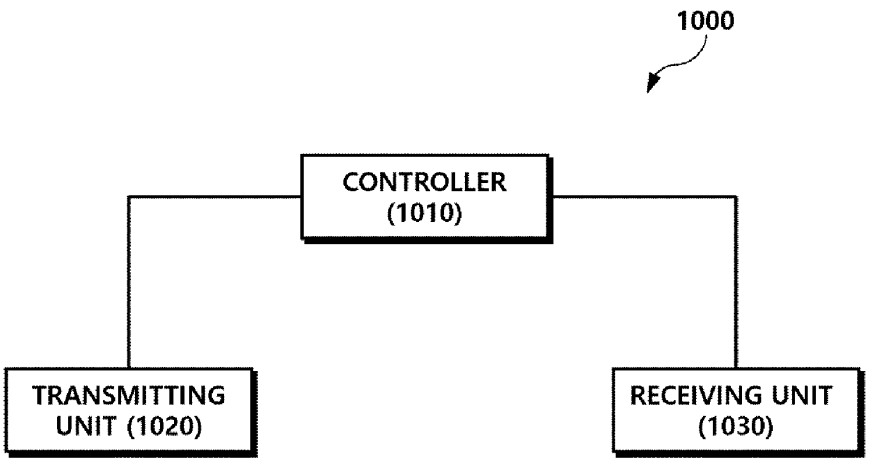

900
CONTROLLER (910)
RECEIVING UNIT (920)
TRANSMITTING UNIT (930)

FIG.10


1000
CONTROLLER
(1010)
TRANSMITTING
UNIT (1020)
RECEIVING UNIT
(1030)

(12) 특허협력조약에 의하여 공개된 국제출원

(19) 세계지식재산권기구
국제사무국

(43) 국제공개일
2015 년 4 월 2 일 (02.04.2015)

WIPO | PCT

(10) 국제공개번호
WO 2015/046831 A1

(51) 국제특허분류:
H04B 7/26 (2006.01) *H04W 72/04* (2009.01)

(21) 국제출원번호: PCT/KR2014/008765

(22) 국제출원일: 2014 년 9 월 22 일 (22.09.2014)

(25) 출원언어: 한국어

(26) 공개언어: 한국어

(30) 우선권정보:
10-2013-0115367 2013 년 9 월 27 일 (27.09.2013) KR
10-2014-0057938 2014 년 5 월 14 일 (14.05.2014) KR

(71) 출원인: 주식회사 케이티 (KT CORPORATION) [KR/KR]; 463-711 경기도 성남시 분당구 불정로 90 (정자동 206 번지), Gyeonggi-do (KR).

(72) 발명자: 박규진 (PARK, Kyujin); 137-140 서울시 서초구 태봉로 151 (우면동, KT 연구개발센터), Seoul (KR). 최우진 (CHOI, Woo-jin); 137-140 서울시 서초구 태봉로 151 (우면동, KT 연구개발센터), Seoul (KR).

(74) 대리인: 김은구 (KIM, Eungu) 등; 135-908 서울시 강남구 강남대로 94 길 59 (역삼동 상원빌딩 2 층), Seoul (KR).

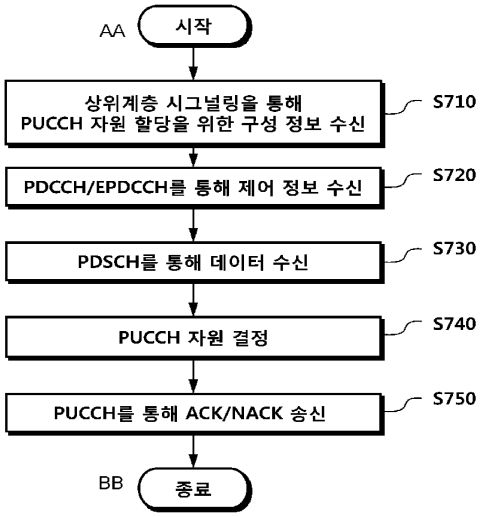
(81) 지정국 (별도의 표시가 없는 한, 가능한 모든 종류의 국내 권리의 보호를 위하여): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KZ, LA, LC, LK, LR, LS, LU, LY, MA,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

[다음 쪽 계속]

WO 2015/046831 A1

(54) Title: METHOD FOR DOWNLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREFOR

(54) 발명의 명칭 : 단말의 상향 링크 제어 채널 자원 할당 방법 및 그 장치



S710 ... Receive structural information for PUCCH resource allocation by means of upper layer signaling
S720 ... Receive control information by means of PDCCH/EPDCCH
S730 ... Receive data by means of PDSCH
S740 ... Determine PUCCH resource
S750 ... Transmit ACK/NACK by means of PUCCH
AA ... Start
BB ... End

(57) Abstract: Provided are a method and an apparatus for PUCCH resource allocation for an uplink HARQ ACK/NACK feedback of a machine-type communication (MTC) terminal in a 3GPP LTE/LTE-Advanced system.

(57) 요약서: 본 발명은 3GPP LTE/LTE-Advanced 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방법 및 장치를 제공한다.

(84) **지정국** (별도의 표시가 없는 한, 가능한 모든 종류의 역내 권리의 보호를 위하여): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), 유라시아 (AM, AZ, BY, KG, KZ, RU, TJ, TM), 유럽 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

공개:

— 국제조사보고서와 함께 (조약 제 21 조(3))

명세서

발명의 명칭: 단말의 상향 링크 제어 채널 자원 할당 방법 및 그 장치

기술분야

[1] 본 발명은 무선 통신 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ(Hybrid Automatic Repeat Request) ACK/NACK 피드백을 위한 상향링크 제어 채널의 자원 할당 방법 및 장치에 대해 제안한다.

배경기술

[2] 기계 형태 통신(machine type communication, 이하 "MTC" 통신이라 함)이란 데이터 통신의 한 가지 형태로 하나 이상의 개체가 반드시 인간의 상호작용을 필요로 하지 않는 기기 또는 사물간 (machine to machine) 통신을 나타낸다. 인간의 상호 작용을 필요로 하지 않는 MTC 통신은 통신 과정에 인간이 개입하지 않고 통신이 이루어지는 방식의 모든 통신 방식을 지칭한다.

[3] MTC 단말은 일반 단말에 비해 전파 환경이 나쁜 장소에 설치될 수 있다. MTC 단말이 일반 단말에 비해 전파 환경이 나쁜 장소에서 동작하기 위해서는, 하나의 서브프레임 단위로만 전송되는 각 물리 채널의 제어 정보 및/또는 데이터를 복수의 서브프레임에서 반복하여 전송할 필요가 있을 수 있다.

[4] 한편, 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 함수로 결정될 수 있다. 하지만, 상술한 바와 같이 MTC 단말의 제어 정보 수신 성능을 높이기 위해서 제어 정보가 반복되어 전송되는 경우, MTC 단말을 위한 상향링크 제어 채널의 자원을 결정하는 방법에 불확실성이 발생할 수 있고, MTC 단말을 위한 상향링크 제어 채널의 자원과 일반 단말의 위한 상향링크 제어 채널의 자원이 충돌할 가능성이 있다.

발명의 상세한 설명

기술적 과제

[5] 본 발명은 상술한 문제점을 극복하기 위해 MTC 단말의 상향링크 제어 채널의 자원 할당 방법 및 장치를 제공하는 것을 목적으로 한다.

과제 해결 수단

[6] 본 발명의 일 실시예는, MTC(Machine Type Communication) 단말의 하향링크 데이터의 응답 정보 전송 방법으로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하는 단계; 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하는 단계; 하향링크 데이터를 수신하는 단계; 및 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어

채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정된 상기 상향링크 제어 채널의 자원을 이용하여 하향링크 데이터의 응답 정보를 전송하는 단계를 포함하는 방법을 제공한다.

[7] 본 발명의 다른 실시예는, 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원 설정 방법으로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 송신하는 단계; 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 송신하는 단계; 및 하향링크 데이터를 송신하는 단계를 포함하고, 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 방법을 제공한다.

[8] 본 발명의 다른 실시예는, 기지국으로 하향링크 데이터의 응답 정보를 전송하는 단말로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하고, 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하며, 하향링크 데이터를 수신하는 수신부; 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 제어부; 및 결정된 상향링크 제어 채널의 자원을 이용하여 하향링크 데이터의 응답 정보를 전송하는 송신부를 포함하는 단말을 제공한다.

[9] 본 발명의 다른 실시예는, 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원을 설정하는 기지국으로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보, 하향링크 데이터를 스케줄링하는 하향링크 제어 정보, 및 하향링크 데이터를 송신하는 송신부를 포함하고, 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 기지국을 제공한다.

발명의 효과

[10] 상술한 본 발명에 따르면, MTC 단말의 상향링크 제어 채널의 자원 할당 방법 및 장치를 제공할 수 있다.

도면의 간단한 설명

[11] 도 1은 본 발명의 실시예가 적용되는 무선 통신 시스템의 예를 도시한 도면이다.

[12] 도 2는 본 발명의 실시예 1의 일 예에 따른 방법을 도시하는 흐름도이다.

[13] 도 3은 본 발명의 실시예 1의 다른 예에 따른 방법을 도시하는 흐름도이다.

[14] 도 4는 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

[15] 도 5는 본 발명의 실시예 2에 따른 방법을 도시하는 흐름도이다.

[16] 도 6은 본 발명의 실시예 3에 따른 방법을 도시하는 흐름도이다.

[17] 도 7은 본 발명의 일 실시예에 따른 단말의 PUCCH 송신 방법을 도시하는 흐름도이다.

[18] 도 8은 본 발명의 일 실시예에 따른 기지국의 PUCCH 설정 방법을 도시하는 흐름도이다.

[19] 도 9는 본 발명의 또 다른 실시예에 따른 단말의 구성을 도시하는 블록도이다.

[20] 도 10은 본 발명의 또 다른 실시예에 따른 기지국의 구성을 도시하는 블록도이다.

발명의 실시를 위한 형태

[21] 이하, 본 발명의 일부 실시예들을 예시적인 도면을 통해 상세하게 설명한다. 각 도면의 구성요소들에 참조부호를 부가함에 있어서, 동일한 구성요소들에 대해서는 비록 다른 도면상에 표시되더라도 가능한 한 동일한 부호를 가지도록 하고 있음에 유의해야 한다. 또한, 본 발명을 설명함에 있어, 관련된 공지 구성 또는 기능에 대한 구체적인 설명이 본 발명의 요지를 흐릴 수 있다고 판단되는 경우에는 그 상세한 설명은 생략한다.

[22] 본 명세서에서 MTC 단말은 low cost(또는 low complexity)를 지원하는 단말 또는 coverage enhancement를 지원하는 단말 등을 의미할 수 있다. 본 명세서에서 MTC 단말은 low cost(또는 low complexity) 및 coverage enhancement를 지원하는 단말 등을 의미할 수 있다. 또는 본 명세서에서 MTC 단말은 low cost(또는 low complexity) 및/또는 coverage enhancement를 지원하기 위한 특정 카테고리로 정의된 단말을 의미할 수 있다.

[23] 다시 말해 본 명세서에서 MTC 단말은 LTE 기반의 MTC 관련 동작을 수행하는 새롭게 정의된 3GPP Release-13 low cost(또는 low complexity) UE category/type을 의미할 수 있다. 또는 본 명세서에서 MTC 단말은 기존의 LTE coverage 대비 향상된 coverage를 지원하거나, 혹은 저전력 소모를 지원하는 기존의 3GPP Release-12 이하에서 정의된 UE category/type, 혹은 새롭게 정의된 Release-13 low cost(또는 low complexity) UE category/type을 의미할 수 있다.

[24] 도 1은 본 발명의 실시예가 적용되는 무선 통신 시스템의 예를 도시한다.

[25] 본 발명에서의 무선통신시스템은 음성, 패킷 데이터 등과 같은 다양한 통신

서비스를 제공하기 위해 널리 배치된다. 무선통신시스템은 사용자 단말(User Equipment, UE)(10) 및 기지국(Base Station, BS, 또는 eNB)(20)을 포함한다. 본 명세서에서의 사용자 단말은 무선 통신에서의 단말을 의미하는 포괄적 개념으로서, WCDMA 및 LTE, HSPA 등에서의 UE(User Equipment)는 물론, GSM에서의 MS(Mobile Station), UT(User Terminal), SS(Subscriber Station), 무선기기(wireless device) 등을 모두 포함하는 개념으로 해석되어야 할 것이다.

[26] 기지국(20) 또는 셀(cell)은 일반적으로 사용자 단말(10)과 통신하는 지점(station)을 말하며, 노드-B(Node-B), eNB(evolved Node-B), 섹터(Sector), 싸이트(Site), BTS(Base Transceiver System), 액세스 포인트(Access Point), 릴레이 노드(Relay Node), RRH(Remote Radio Head), RU(Radio Unit), small cell 등 다른 용어로 불릴 수 있다.

[27] 즉, 본 명세서에서 기지국 또는 셀(cell)은 CDMA에서의 BSC(Base Station Controller), WCDMA의 NodeB, LTE에서의 eNB 또는 섹터(싸이트) 등이 커버하는 일부 영역 또는 기능을 나타내는 포괄적인 의미로 해석되어야 하며, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀 및 릴레이 노드(relay node), RRH, RU, small cell 통신범위 등 다양한 커버리지 영역을 모두 포괄하는 의미이다.

[28] 나열된 다양한 셀은 각 셀을 제어하는 기지국이 존재하므로 기지국은 두 가지 의미로 해석될 수 있다. i) 무선 영역과 관련하여 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀, 스몰 셀을 제공하는 장치 그 자체이거나, ii) 무선영역 그 자체를 지시할 수 있다. i)에서 소정의 무선 영역을 제공하는 장치들이 동일한 개체에 의해 제어되거나 무선 영역을 협업으로 구성하도록 상호작용하는 모든 장치들을 모두 기지국으로 지시한다. 무선 영역의 구성 방식에 따라 eNB, RRH, 안테나, RU, LPN, 포인트, 송수신포인트, 송신 포인트, 수신 포인트 등은 기지국의 일 실시예가 된다. ii) 에서 사용자 단말의 관점 또는 이웃하는 기지국의 입장에서 신호를 수신하거나 송신하게 되는 무선 영역 그 자체를 기지국으로 지시할 수 있다.

[29] 따라서, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀, 스몰 셀, RRH, 안테나, RU, LPN(Low Power Node), 포인트, eNB, 송수신포인트, 송신 포인트, 수신포인트를 통칭하여 기지국으로 지칭한다.

[30] 본 명세서에서 사용자 단말과 기지국은 본 명세서에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 사용자 단말과 기지국은, 본 발명에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지(Uplink 또는 Downlink) 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 여기서, 상향링크(Uplink, UL, 또는 업링크)는 사용자 단말에 의해 기지국으로 데이터를 송수신하는 방식을 의미하며, 하향링크(Downlink, DL, 또는 다운링크)는 기지국에 의해 사용자 단말로 데이터를 송수신하는 방식을 의미한다.

[31] 무선통신시스템에 적용되는 다중 접속 기법에는 제한이 없다. CDMA(Code Division Multiple Access), TDMA(Time Division Multiple Access), FDMA(Frequency Division Multiple Access), OFDMA(Orthogonal Frequency Division Multiple Access), OFDM-FDMA, OFDM-TDMA, OFDM-CDMA와 같은 다양한 다중 접속 기법을 사용할 수 있다. 본 발명의 일 실시예는 GSM, WCDMA, HSPA를 거쳐 LTE 및 LTE-Advanced로 진화하는 비동기 무선통신과, CDMA, CDMA-2000 및 UMB로 진화하는 동기식 무선 통신 분야 등의 자원할당에 적용될 수 있다. 본 발명은 특정한 무선통신 분야에 한정되거나 제한되어 해석되어서는 아니 되며, 본 발명의 사상이 적용될 수 있는 모든 기술분야를 포함하는 것으로 해석되어야 할 것이다.

[32] 상향링크 전송 및 하향링크 전송은 서로 다른 시간을 사용하여 전송되는 TDD(Time Division Duplex) 방식이 사용될 수 있고, 또는 서로 다른 주파수를 사용하여 전송되는 FDD(Frequency Division Duplex) 방식이 사용될 수 있다.

[33] 또한, LTE, LTE-Advanced와 같은 시스템에서는 하나의 반송파 또는 반송파 쌍을 기준으로 상향링크와 하향링크를 구성하여 규격을 구성한다. 상향링크와 하향링크는, PDCCH(Physical Downlink Control CHannel), PCFICH(Physical Control Format Indicator CHannel), PHICH(Physical Hybrid ARQ Indicator CHannel), PUCCH(Physical Uplink Control CHannel), EPDCCH(Enhanced Physical Downlink Control CHannel) 등과 같은 제어채널을 통하여 제어정보를 전송하고, PDSCH(Physical Downlink Shared CHannel), PUSCH(Physical Uplink Shared CHannel) 등과 같은 데이터채널로 구성되어 데이터를 전송한다.

[34] 한편 EPDCCH(enhanced PDCCH 또는 extended PDCCH)를 이용해서도 제어 정보를 전송할 수 있다.

[35] 본 명세서에서 셀(cell)은 송수신 포인트로부터 전송되는 신호의 커버리지 또는 송수신 포인트(transmission point 또는 transmission/reception point)로부터 전송되는 신호의 커버리지를 가지는 요소 반송파(component carrier), 그 송수신 포인트 자체를 의미할 수 있다.

[36] 실시예들이 적용되는 무선통신 시스템은 둘 이상의 송수신 포인트들이 협력하여 신호를 전송하는 다중 포인트 협력형 송수신 시스템(coordinated multi-point transmission/reception System; CoMP 시스템) 또는 협력형 다중 안테나 전송방식(coordinated multi-antenna transmission system), 협력형 다중 셀 통신시스템일 수 있다. CoMP 시스템은 적어도 두 개의 다중 송수신 포인트와 단말들을 포함할 수 있다.

[37] 다중 송수신 포인트는 기지국 또는 매크로 셀(macro cell, 이하 'eNB'라 함)과, eNB에 광케이블 또는 광섬유로 연결되어 유선 제어되는, 높은 전송파워를 갖거나 매크로 셀 영역 내의 낮은 전송파워를 갖는 적어도 하나의 RRH일 수도 있다.

[38] 이하에서 하향링크(downlink)는 다중 송수신 포인트에서 단말로의 통신 또는

통신 경로를 의미하며, 상향링크(uplink)는 단말에서 다중 송수신 포인트으로의 통신 또는 통신 경로를 의미한다. 하향링크에서 송신기는 다중 송수신 포인트의 일부분일 수 있고, 수신기는 단말의 일부분일 수 있다. 상향링크에서 송신기는 단말의 일부분일 수 있고, 수신기는 다중 송수신 포인트의 일부분일 수 있다.

[39] 이하에서는 PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH 등과 같은 채널을 통해 신호가 송수신되는 상황을 'PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH를 전송, 수신한다'는 형태로 표기하기도 한다.

[40] 또한 이하에서는 PDCCH를 전송 또는 수신하거나 PDCCH를 통해서 신호를 전송 또는 수신한다는 기재는 EPDCCH를 전송 또는 수신하거나 EPDCCH를 통해서 신호를 전송 또는 수신하는 것을 포함하는 의미로 사용될 수 있다.

[41] 즉, 이하에서 기재하는 물리 하향링크 제어채널은 PDCCH를 의미하거나, EPDCCH를 의미할 수 있으며, PDCCH 및 EPDCCH 모두를 포함하는 의미로도 사용된다.

[42] 또한, 설명의 편의를 위하여 PDCCH로 설명한 부분에도 본 발명의 일 실시예인 EPDCCH를 적용할 수 있으며, EPDCCH로 설명한 부분에도 본 발명의 일 실시예로 EPDCCH를 적용할 수 있다.

[43] 한편, 이하에서 기재하는 상위계층 시그널링(High Layer Signaling)은 RRC 파라미터를 포함하는 RRC 정보를 전송하는 RRC시그널링을 포함한다.

[44] 기지국(20)은 단말(10)들로 하향링크 전송을 수행한다. 기지국(20)은 유니캐스트 전송(unicast transmission)을 위한 주 물리 채널인 물리 하향링크 공유채널(Physical Downlink Shared Channel, PDSCH), 그리고 PDSCH의 수신에 필요한 스케줄링 등의 하향링크 제어 정보 및 상향링크 데이터 채널(예를 들면 물리 상향링크 공유채널(Physical Uplink Shared Channel, PUSCH))에서의 전송을 위한 스케줄링 승인 정보를 전송하기 위한 물리 하향링크 제어채널(Physical Downlink Control Channel, PDCCH)을 전송할 수 있다. 이하에서는, 각 채널을 통해 신호가 송수신 되는 것을 해당 채널이 송수신되는 형태로 기재하기로 한다.

[45] 기존의 3GPP LTE/LTE-Advanced 시스템에서 단말의 legacy PDCCH를 통해 스케줄링된 PDSCH 수신에 대한 HARQ(Hybrid Automatic Repeat Request) ACK/NACK 피드백을 위한 PUCCH 자원 매핑은 아래의 수학식 (1), (2)와 같이 상위계층(예를 들면, RRC(Radio Resource Control)) 파라미터와 해당 하향링크 할당(DL assignment) DCI(Downlink Control Information)가 전송된 CCE(Control Channel Element) 인덱스에 의해 결정된다.

[46]

(1) $$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH}}^{(1)}$$

(2) $$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH}}^{(1)}$$

[47] 상기의 수학식 (1)과 (2)는 각각 해당 단말에서 두 개의 안테나 포트(two antenna port) 전송이 지원되는 단말에서의 각각 안테나 포트 0와 안테나 포트 1에서의

HARQ ACK/NACK 피드백을 위한 PUCCH 자원 $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ 를 지칭하며, n_{CCE} 는 해당 DL 스케줄링 그랜트(DL scheduling grant)가 전송된 최하위 CCE 인덱스(lowest CCE index) 값을 나타내고, $N_{\mathrm{PUCCH}}^{(1)}$ 는 상위 계층(RRC) 시그널링(higher layer(RRC) signaling)에 의해 설정된 셀 특이적 파라미터(cell-specific parameter)이다.

[48] 단, 상기의 수학식 (1), (2)에 의한 PUCCH 자원 매핑(resource mapping) 방안은 프레임 구조 타입 1(frame structure type 1)(FDD) 시스템에서 하나의 서빙 셀(serving cell)이 설정된 단말의 PUCCH 포맷 1a/1b를 통한 HARQ ACK/NACK 전송을 위한 PUCCH 자원 매핑 방안이다. 추가적으로 하나 이상의 serving cell이 설정된 단말(즉, Carrier Aggregation이 적용된 단말)에 대한 PUCCH 자원 매핑 룰(resource mapping rule)은 상기의 방안과 유사하게 최하위 CCE 인덱스 및 상위 계층 파라미터의 함수로서 결정되거나, 혹은 미리 상위 계층 시그널링을 통해 복수의 후보 PUCCH 자원 값(candidate PUCCH resource value)를 설정하고, 실제 DL 스케줄링 그랜트의 'TPC command for PUCCH' 정보 영역을 통해 상기의 복수의 후보 PUCCH 자원 값(candidate PUCCH resource value) 중 사용할 PUCCH 자원을 지시하는 ARI(ACK/NACK Resource Indication) 방식이 사용될 수도 있다.

[49] <저가 MTC를 위한 커버리지 향상>

[50] MTC 단말의 경우, 단말 단가를 줄이기 위해 기존의 LTE/LTE-Advanced 단말에 비해 하드웨어 및 소프트웨어 성능이 낮은 low capability 단말을 가정하고 있다. 이에 따라 기존의 LTE/LTE-Advanced 단말의 UE category 및 그에 따른 UE capability를 기반으로 설계된 물리 계층 채널들에 대한 MTC 단말의 송수신 성능 열화가 예상되며, 이를 해결하기 위한 방안으로 해당 물리 계층 채널들에 대한 송수신 성능을 향상시키기 위한 논의가 진행 중이다.

[51] 이를 위한 일반적인 방안으로 해당 물리 계층 채널에 대한 전력 부스팅(power boosting) 및 복수의 서브프레임을 통해 반복(repetition)하여 전송하는 방안이 제안되고 있다. 이에 대한 한 예로써, MTC 단말을 위한 하나의 DCI(Downlink Control Information)를 전송하기 위해 하향 링크 제어 채널인 PDCCH를 복수의 하향 링크 서브프레임을 통해 반복해서 전송함으로써 전력 게이인(power gain)을 얻는 방안이 고려되고 있다. 마찬가지로 PDSCH의 경우에도 복수의 하향 링크 서브프레임을 통해 반복하여 전송함으로써 MTC 단말의 수신 성능을 높이는 방안이 고려되고 있다.

[52] 기존의 LTE/LTE-Advanced Release-11 이하의 시스템에서, SPS(Semi-Persistent Scheduling)을 제외하면, 임의의 단말의 하향 링크 데이터 채널인 PDSCH 수신을 위한 하향링크 할당(DL assignment) 정보는 동일한 하향 링크 서브프레임의 PDCCH를 통해서만 전송되었다. 또한 그에 따라 해당 PDSCH 수신에 대한 상향 링크 HARQ ACK/NACK 전송을 위한 PUCCH 자원 할당 규칙은 해당 하향링크

할당 PDCCH 혹은 EPDCCH가 전송된 최하위 CCE(Control Channel Element)의 함수로서 결정되었다. 이에 따라 동일한 하향 링크 서브프레임을 통해 전송된 서로 다른 단말을 위한 PDSCH 전송들에 대해 각각의 단말이 HARQ ACK/NACK을 전송하기 위한 PUCCH 자원 간에 충돌을 피할 수 있었다. 하지만, 상기에서 서술한 바와 같이 MTC 단말의 PDCCH 수신 성능을 높이기 위해 하나의 DCI를 전송하기 위한 PDCCH를 복수의 하향 링크 서브프레임에 걸쳐 반복하여 전송할 경우, 해당 최하위 CCE 인덱스에 적용할 CCE 인덱스 값의 정의 등에 대한 불확실성이 발생할 뿐 아니라, PDSCH 전송 및 단말의 PUCCH 전송 역시 복수의 서브프레임을 통해 반복되어 전송될 경우, MTC 단말이 아닌 일반 LTE 단말의 HARQ ACK/NAKC 피드백을 위한 PUCCH 자원과 MTC 단말의 PUCCH 자원 간의 충돌이 발생할 수 있다.

[53] 본 발명은 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방법 및 장치를 제공한다.

[54] **실시예 1. PUCCH 자원 매핑 식의 재사용**

[55] 새로운 PUCCH 자원 시작 옵셋을 정의

[56] 도 2는 실시예 1의 일 예에 따른 방법을 도시하는 흐름도이다.

[57] 도 2를 참조하면, 기지국은 MTC 단말을 위한 별도의 PUCCH 자원 시작 옵셋 파라미터, $N_{PUCCH,MTC}^{(1)}$ 값을 정의하여(S210), 이를 해당 RRC 시그널링에 포함하여 단말로 전송한다(S220). 이를 통해 MTC 단말의 경우, 상기의 PUCCH 자원 매핑 수학식 (1), (2)에서 $N_{PUCCH}^{(1)}$ 을 $N_{PUCCH,MTC}^{(1)}$ 로 대체하여 적용하여 PUCCH의 자원을 결정하고(S230), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S240). 즉, MTC 단말의 경우, 아래의 수학식 (3) 과 (4)와 같이 적용될 수 있다.

[58]

$$(3)\quad n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)}$$

$$(4)\quad n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)}$$

[59] $N_{PUCCH,MTC}^{(1)}$ 값은 단말 특이적 RRC(UE-specific RRC) 시그널링을 통해 각각의 MTC 단말 별로 설정될 수 있다. $N_{PUCCH,MTC}^{(1)}$ 값을 signaling하기 위한 또 다른 실시예로 셀 특이적 RRC(cell-specific RRC) 시그널링 혹은 MTC 단말을 위한 PBCH을 통해 해당 셀 내의 MTC 단말에게 브로드캐스팅(broadcasting) 될 수 있다.

[60] 도 3은 실시예 1의 다른 예에 따른 방법을 도시하는 흐름도이다.

[61] 도 3을 참조하면, 기지국은 MTC 단말을 위한 별도의 PUCCH 자원 시작 옵셋 값을 설정하는 또 다른 실시예로 상위 계층 RRC 시그널링을 통해 각각의 MTC 단말 별로 복수의 후보 PUCCH 자원 시작 옵셋 값을 정의하고(S310), 복수의 후보 PUCCH 자원 시작 옵셋 값을 단말로 전송하고(S320), PDSCH 자원 할당 시 적용할 PUCCH 자원 시작 옵셋 값을 단말에게 시그널링 해주도록 할 수 있다(S330). 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원을 결정하고(S340), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S350).

[62] 즉, 임의의 MTC 단말을 위한 단말 특이적 RRC(UE-specific RRC) 시그널링 혹은 셀 특이적 RRC(cell-specific RRC) 시그널링이나 MTC 단말을 위한 PBCH를 후보 PUCCH 자원 시작 옵셋 파라미터를 시그널링 해주도록 하고, MTC 단말을 위한 하향링크 할당 DCI 포맷을 통해 적용할 PUCCH 자원 시작 옵셋 파라미터를 지시해주도록 할 수 있다. 해당 PUCCH 자원 시작 옵셋 지시를 위해서 하향링크 할당 DCI 포맷 내에 명시적(explicit)으로 PUCCH 자원 시작 옵셋 인디케이터(indicator) 정보 영역을 정의하거나, 혹은 기존의 정보 영역을 사용하여 지시해주는 명시적인 방법이 사용될 수 있다.

[63] 예를 들어, MTC 단말을 위한 $N_{PUCCH,MTC1}^{(1)}$, $N_{PUCCH,MTC2}^{(1)}$, $N_{PUCCH,MTC3}^{(1)}$, $N_{PUCCH,MTC4}^{(1)}$ 의 4개의 후보 PUCCH 자원 시작 옵셋 파라미터를 설정하고, 하향링크 할당 DCI 포맷에 해당 PUCCH 자원 시작 옵셋을 지시해주기 위한 2 비트로 구성된 정보 영역을 새롭게 정의하여, 이를 통해 PUCCH 자원 매핑 수학식 (3), (4)에 적용할 PUCCH 자원 시작 옵셋을 지시해주도록 할 수 있다. 혹은 새로운 정보 영역을 추가적으로 정의하지 않고, TPC command와 같은 기존의 정보 영역을 해당 PUCCH 자원 시작 옵셋을 지시하기 위해 사용하도록 할 수 있다.

[64] 또 다른 방법으로 해당 후보 PUCCH 자원 시작 옵셋 중, 적용할 값을 암시적(implicit)으로 알려줄 수 있다. 예를 들어, PDCCH 집적 레벨(PDCCH aggregation level) 혹은 반복 레벨(repetition level), 즉 해당 DCI를 전송하기 위해 PDCCH 반복 횟수에 따라 적용 PUCCH 자원 시작 옵셋 값을 결정하도록 할 수 있다.

[65] <u>반복되는 PDCCH에 대한 최하위 CCE 인덱스의 정의</u>

[66] 도 4는 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

[67] 도 4와 같이 MTC 단말의 DCI 수신 성능을 향상시키기 위해 PDCCH를 복수의 하향 링크 서브프레임을 통해 반복하여 전송하도록 정의할 수 있다.

[68] 이 경우, 상기의 수학식 (3), (4)에 적용하기 위한 최하위 CCE 인덱스인 n_{CCE}

값에 대한 정의가 필요하다. 이를 위해 본 발명에서는 임의의 MTC 단말을 위한 하향링크 할당 DCI가 복수의 하향 링크 서브프레임의 PDCCH를 통하여 반복되어 전송된 경우, PUCCH 자원 매핑 수학식 (3) 혹은 (4)에 적용되는 n_{CCE} 값을 정의하는 실시예들을 제공한다.

[69] 첫 번째 실시예로는 도 4에서와 같이 하나의 하향링크 할당 DCI를 전송하기 위해 N개의 반복된 PDCCH가 사용된 경우, 첫 번째 PDCCH 전송을 위해 사용된 CCE 중 최하위 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 또 다른 실시예로는 해당 마지막 반복된 PDCCH인 N번째 PDCCH의 최하위 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 마지막으로 각각의 N개의 반복된 PDCCH의 전송을 위해 사용된 모든 CCE 인덱스들 중에서 가장 작은 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다.

[70] 단, MTC 단말을 위한 PUCCH 자원 매핑을 위해 상기의 도 2 또는 도 3과 같이 MTC 단말을 위한 새로운 PUCCH 자원 시작 옵셋을 정의하지 않고, 기존의 LTE/LTE-A 단말을 위한 수학식에서 PUCCH 자원 시작 옵셋 값인 $N_{\mathrm{PUCCH}}^{(1)}$ 를 재사용할 경우에도 수학식 (1), (2)에 적용하기 위한 위해 적용할 해당 n_{CCE} 값을 정의하는 방법도 상기에서 서술한 n_{CCE} 값을 정의하는 방법이 동일하게 적용될 수 있다.

[71] **실시예 2. 하향링크 할당 DCI에 PUCCH 자원 할당**

[72] 도 5는 본 발명의 실시예 2에 따른 방법을 도시하는 흐름도이다.

[73] 도 5를 참조하면, 기지국은 각각의 MTC 단말 별로 아래의 표 1과 같이 해당 MTC 단말의 HARQ ACK/NACK 피드백을 위한 후보 PUCCH 자원 값을 상위 계층 시그널링을 통해 미리 설정해주고(S510), 하향링크 할당 DCI를 통해 해당 후보 PUCCH 자원 값 중 사용할 PUCCH 자원을 지시하기 위한 PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)를 정의하여 이를 단말에게 직접 시그널링 해주도록 할 수 있다(S520). 단말은 PUCCH 자원을 결정하고(S530), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S540).

[74] 이 때, 후보 PUCCH 자원 값의 개수는 하향링크 할당 DCI의 PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)의 크기에 따라 결정될 수 있다. 예를 들어 해당 PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)2 비트들로 구성되는 경우, 해당 후보 PUCCH 자원 설정을 위한 상위 계층 시그널링을 통해 4개의 후보 PUCCH 자원 값이 설정될 수 있으며, 이에 따라 하향링크 할당 DCI에 포함된 PUCCH 자원 인디케이터 필드(PUCCH resource

indicator field)의 설정 값에 따라 아래의 표 1과 같이 해당 4개의 PUCCH 자원 값 중 단말이 HARQ ACK/NACK 피드백을 전송할 PUCCH 자원 값을 매핑하도록 할 수 있다. 단, PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)는 새롭게 정의되거나 하향링크 할당에 포함된 정보 영역들 중 일부를 해당 PUCCH 자원 인디케이터(PUCCH resource indicator)로서 활용할 수 있다. 기존 정보 영역을 활용하는 한 예로서, 2bits로 구성된 TPC 코맨드(command) 정보 영역을 해당 PUCCH 자원 인디케이터(PUCCH resource indicator) 용도로 활용할 수 있다.

[75] [표 1]

[76]

하향링크 할당 DCI 내 PUCCH 자원 인디케이터의 값	$n_{\mathrm{PUCCH}}^{(1,p)}$
'00'	상위계층에 의해 구성된 제 1 PUCCH 자원 값
'01'	상위계층에 의해 구성된 제 2 PUCCH 자원 값
'10'	상위계층에 의해 구성된 제 3 PUCCH 자원 값
'11'	상위계층에 의해 구성된 제 4 PUCCH 자원 값

[77] 또한 각각의 후보 PUCCH 자원 값은 PUCCH 반복의 개수 값을 포함하도록 할 수 있다. 즉 해당 HARQ ACK/NACK 피드백을 위해 사용할 PUCCH 자원뿐 아니라, 몇 번의 상향 링크 서브프레임을 걸쳐 해당 PUCCH 자원을 통해 HARQ ACK/NACK 피드백을 반복하여 전송할 것인지 각각의 PUCCH 자원 값 별로 설정하도록 정의할 수 있다.

[78] **실시예 3. MTC를 위한 ACK 자원 옵셋**

[79] 도 6은 본 발명의 실시예 3에 따른 방법을 도시하는 흐름도이다.

[80] 본 실시예에서, MTC 단말을 위한 추가적인 ACK 자원 옵셋 파라미터(ACK Resource Offset parameter)인 $\Delta_{ARO,\mathrm{MTC}}$ 를 정의하여 이를 PUCCH 자원 매핑 식에 적용하도록 할 수 있다. 즉, 임의의 MTC 단말에 대해, 해당 MTC 단말을 위한 상기의 하향링크 할당 내에 추가적으로 PUCCH 자원 옵셋(PUCCH resource offset)값을 지시하기 위한 ARO(ACK Resource Offset) 정보 영역을 정의하도록 하고, 이를 통해 임의의 MTC 단말을 위한 PUCCH 자원 매핑 식에 적용할 $\Delta_{ARO,\mathrm{MTC}}$ 값을 해당 단말에게 signaling해주도록 할 수 있다(S610). 단말은 PUCCH 자원을 결정하고(S620), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S630).

[81] 해당 하향링크 할당 DCI 포맷의 ARO의 설정 값에 따른 $\Delta_{ARO,\mathrm{MTC}}$ 값은

테이블 매핑 방식으로 아래의 표 2와 같이 각각의 ARO 값 별로 임의의 고정된 $\Delta_{ARO,\mathrm{MTC}}$ 값이 정의되거나, 혹은 기지국이 각각의 ARO value 별 $\Delta_{ARO,\mathrm{MTC}}$ 값을 설정하여 해당 MTC 단말에 시그널링해줄 수 있다.

[82] [표 2]

[83]

DCI 포맷 1A/1B/1D/1/2A/2/2B/2C/2D 에서 ACK/NACK 자원 옵셋 필드	$\Delta_{ARO.MTC}$
0	0
1	-1
2	-2
3	2

[84] 이에 따라, PDCCH를 통해 하향링크 할당 DCI를 수신하는 단말을 위한 기존의 PUCCH 자원 매핑 수학식 (1)과 (2) 혹은 수학식 (3)과 (4) 대신 아래의 수학식(5), (6)이 적용될 수 있다.

[85]

$$(5)\quad n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH,MTC}}^{(1)} + \Delta_{ARO,\mathrm{MTC}}$$

$$(6)\quad n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH,MTC}}^{(1)} + \Delta_{ARO,\mathrm{MTC}}$$

[86] 본 발명에서는 MTC 단말을 위한 PUCCH 자원 매핑 규칙에 대해 제안하였다. 단, 임의의 MTC 단말의 DL HARQ ACK 피드백을 위한 PUCCH 역시 커버리지 향상(coverage enhancement)를 위해 복수의 상향 링크 서브프레임을 통해 반복되어 전송될 수 있다.

[87] 이 경우 상기에서 제안된 방법에 따라 하나의 상향 링크 서브프레임에서 DL HARQ ACK 피드백을 위한 PUCCH 자원이 결정되며, 해당 PUCCH 반복 전송 횟수에 따라 복수의 상향 링크 서브프레임에서 상기의 방법들에 의해 결정된 동일한 PUCCH 자원을 통해 DL HARQ ACK 피드백을 반복 전송하도록 정의될 수 있다.

[88] 또한, 본 발명은 MTC 단말의 HARQ ACK/NACK 피드백을 위한 PUCCH 반복 횟수 등에 대한 구체적인 실시예는 포함하고 있지 않지만, 상기에서 제안된 실시예들은 PUCCH 반복의 횟수에 관계없이 동일하게 적용될 수 있음은 명백하다.

[89] 도 7은 본 발명의 일 실시예에 따른 단말의 PUCCH 송신 방법을 도시하는 흐름도이다.

[90] 도 7을 참조하면, 단말은 기지국으로부터 상위계층(예를 들면, RRC)

시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 수신한다(S710).

[91] 단말은 기지국으로부터 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 수신한다(S720).

[92] 단말은 기지국으로부터 DCI 내의 스케줄링 정보에 기초하여 PDSCH를 통해 데이터를 수신한다(S730).

[93] 단말은 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK이 전송되는 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정한다(S740).

[94] 일 예에서, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 수신하고, S740 단계에서 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함하는 구성 정보를 수신하고, S720 단계에서 복수의 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 중 하나를 지시하는 제어 정보를 수신하며, S740 단계에서 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[95] 다른 예에서, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{\mathrm{PUCCH}}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 수신하고, S720 단계에서 복수의 $n_{\mathrm{PUCCH}}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 수신하며, S740 단계에서 제어 정보에 기초하여 PUCCH의 자원 ($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[96] 또 다른 예에서, 단말은 S720 단계에서 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 중 하나를 지시하는 제어 정보를 수신하고, S740 단계에서 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 는 사전에 설정되거나 S710 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

[97] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우,

수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소 값일 수 있다.

[98] 단말은 결정된 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 이용하여 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK을 기지국으로 전송한다(S750).

[99] 전술한 실시예에서 S740 단계와 S750단계가 별도로 수행되는 것으로 설명하였으나 하나의 단계로 수행될 수도 있다. 다시 말해 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정된 상향링크 제어 채널의 자원을 이용하여 하향링크 데이터의 응답 정보를 전송할 수도 있다.

[100] 도 8은 본 발명의 일 실시예에 따른 기지국의 PUCCH 자원 설정 방법을 도시하는 흐름도이다.

[101] 도 8을 참조하면, 기지국은 단말로 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 송신한다(S810).

[102] 기지국은 단말로 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 송신한다(S820).

[103] 그리고, 기지국은 단말로 PDSCH를 통해 데이터를 송신한다(S830).

[104] 일 예에서, 기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 송신하고, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는,

기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함하는 구성 정보를 송신하고, S820 단계에서 복수의 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[105] 다른 예에서, 기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{\mathrm{PUCCH}}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 송신하고, S820

$n_{\mathrm{PUCCH}}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 제어 정보에 기초하여 PUCCH의 자원 ($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[106] 또 다른 예에서, 기지국은 S820 단계에서 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 중 하나를 지시하는 제어 정보를 송신하고, 단말은 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 는 사전에 설정되거나 S810 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

[107] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

[108] 도 9는 본 발명의 또 다른 실시예에 따른 단말의 구성을 도시하는 블록도이다.

[109] 도 9를 참조하면, 본 발명의 또 다른 실시예에 따른 단말(900)은 제어부(910), 수신부(920), 및 송신부(930)를 포함한다.

[110] 수신부(920)는 기지국으로부터 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 수신할 수 있다.

[111] 또한, 수신부(920)는 기지국으로부터 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 수신하고, DCI 내의 스케줄링 정보에 기초하여 PDSCH를 통해 데이터를 수신할 수 있다.

[112] 제어부(910)는 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK이 전송되는 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[113] 송신부(930)는 결정된 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 이용하여 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK을 기지국으로 전송할 수 있다.

[114] 일 예에서, 수신부(920)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 수신하고, 제어부(930)는 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는,

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수신부(920)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{PUCCH,MTC}^{(1)}$ 를 복수 개 포함하는 구성 정보를 수신하고, 복수의 $N_{PUCCH,MTC}^{(1)}$ 중 하나를 지시하는 제어 정보를 수신하며, 제어부(910)는 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

[115] 다른 예에서, 수신부(920)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{PUCCH}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 수신하고, 복수의 $n_{PUCCH}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 수신하며, 제어부(910)는 제어 정보에 기초하여 PUCCH의 자원 ($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

[116] 또 다른 예에서, 수신부(920)는 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$ 중 하나를 지시하는 제어 정보를 수신하고, 제어부(910)는 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$ 는 사전에 설정되거나 상위 계층 시그널링을 통해 기지국으로부터 단말로 전달된 것일 수 있다.

[117] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

[118] 도 10은 본 발명의 또 다른 실시예에 따른 기지국의 구성을 도시하는 블록도이다.

[119] 도 10을 참조하면, 본 발명의 또 다른 실시예에 따른 기지국(1000)은 제어부(1010), 송신부(1020), 및 수신부(1030)를 포함한다.

[120] 제어부(1010)는 전술한 본 발명을 수행하기에 필요한 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당에 따른 전반적인 기지국의 동작을 제어한다.

[121] 송신부(1020)는 단말로 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 송신할 수 있다.

[122] 또한, 송신부(1020)는 단말로 PDCCH 또는 EPDCCH를 통해 하향링크 할당을

위한 DCI를 송신하고, PDSCH를 통해 데이터를 송신할 수 있다.

[123] 수신부(1030)는 단말로부터 PUCCH를 통해 PDSCH에 대한 ACK/NACK을 수신할 수 있다.

[124] 일 예에서, 송신부(1020)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 송신하고, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 송신부(1020)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함하는 구성 정보를 송신하고, 복수의 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[125] 다른 예에서, 송신부(1020)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{\mathrm{PUCCH}}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 송신하고, 복수의 $n_{\mathrm{PUCCH}}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 제어 정보에 기초하여 PUCCH의 자원 ($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[126] 또 다른 예에서, 송신부(1020)는 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 중 하나를 지시하는 제어 정보를 송신하고, 단말은 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 는 사전에 설정되거나 S810 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

[127] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

[128] 전술한 실시예에서 언급한 표준내용 또는 표준문서들은 명세서의 설명을 간략하게 하기 위해 생략한 것으로 본 명세서의 일부를 구성한다. 따라서, 위 표준내용 및 표준문서들의 일부의 내용을 본 명세서에 추가하거나 청구범위에

기재하는 것은 본 발명의 범위에 해당하는 것으로 해석되어야 한다.

[129] 이상의 설명은 본 발명의 기술 사상을 예시적으로 설명한 것에 불과한 것으로서, 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자라면 본 발명의 본질적인 특성에서 벗어나지 않는 범위에서 다양한 수정 및 변형이 가능할 것이다. 따라서, 본 발명에 개시된 실시예들은 본 발명의 기술 사상을 한정하기 위한 것이 아니라 설명하기 위한 것이고, 이러한 실시예에 의하여 본 발명의 기술사상의 범위가 한정되는 것은 아니다. 본 발명의 보호 범위는 아래의 청구범위에 의하여 해석되어야 하며, 그와 동등한 범위 내에 있는 모든 기술 사상은 본 발명의 권리범위에 포함되는 것으로 해석되어야 할 것이다.

[130]

[131] **CROSS-REFERENCE TO RELATED APPLICATION**

[132] 본 특허출원은 2013년 09월 27일 한국에 출원한 특허출원번호 제 10-2013-0115367 호 및 2014년 05월 14일 한국에 출원한 특허출원번호 제 10-2014-0057938 호에 대해 미국 특허법 119(a)조 (35 U.S.C § 119(a))에 따라 우선권을 주장하며, 그 모든 내용은 참고문헌으로 본 특허출원에 병합된다. 아울러, 본 특허출원은 미국 이외에 국가에 대해서도 위와 동일한 이유로 우선권을 주장하면 그 모든 내용은 참고문헌으로 본 특허출원에 병합된다.

청구범위

[청구항 1] MTC(Machine Type Communication) 단말의 하향링크 데이터의 응답 정보 전송 방법으로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하는 단계;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하는 단계;
상기 하향링크 데이터를 수신하는 단계;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정된 상기 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 단계를 포함하는 방법.

[청구항 2] 제 1 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 방법.

[청구항 3] 제 2 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,
상기 하향링크 제어 정보를 수신하는 단계는 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 수신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 4] 제 1 항에 있어서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,
상기 하향링크 제어 정보를 수신하는 단계는 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 수신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 5] 제 1 항에 있어서,
상기 하향링크 제어 정보를 수신하는 단계는 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 수신하는 단계를 포함하고,
상기 하향링크 데이터의 응답 정보를 전송하는 단계에서, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및

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상기 추가 옵셋 값에 기초하여 상기 상향링크 제어 채널의 자원을 결정하는 것을 특징으로 하는 방법.

[청구항 6] 제 1 항에 있어서,
상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 방법.

[청구항 7] 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원 설정 방법으로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 송신하는 단계;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 송신하는 단계; 및
상기 하향링크 데이터를 송신하는 단계를 포함하고,
상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 방법.

[청구항 8] 제 7 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 방법.

[청구항 9] 제 8 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,
상기 하향링크 제어 정보를 송신하는 단계는 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 송신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 10] 제 7 항에 있어서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,
상기 하향링크 제어 정보를 송신하는 단계는 상기 복수 개의 자원

정보 중 하나를 지시하는 정보를 송신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 11] 제 7 항에 있어서,
상기 하향링크 제어 정보를 송신하는 단계는 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 송신하는 단계를 포함하고,
상기 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 결정되는 것을 특징으로 하는 방법.

[청구항 12] 제 7 항에 있어서,
상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 방법.

[청구항 13] 기지국으로 하향링크 데이터의 응답 정보를 전송하는 단말로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하고, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하며, 상기 하향링크 데이터를 수신하는 수신부;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 제어부; 및
상기 결정된 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 송신부를 포함하는 단말.

[청구항 14] 제 13 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 단말.

[청구항 15] 제 14 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,

상기 수신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 수신하는 것을 특징으로 하는 단말.

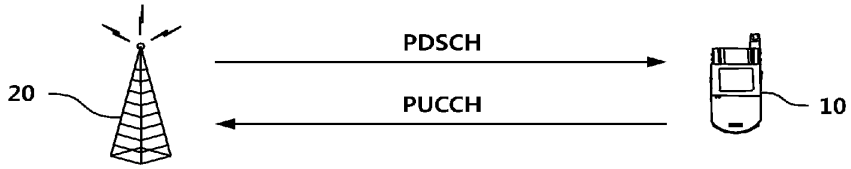
[청구항 16] 제 13 항에 있어서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,
상기 수신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 수신하는 것을 특징으로 하는 단말.

[청구항 17] 제 13 항에 있어서,
상기 수신부는 상기 하향링크 제어 정보를 통해 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 수신하고,
상기 제어부는 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 상기 상향링크 제어 채널의 자원을 결정하는 것을 특징으로 하는 단말.

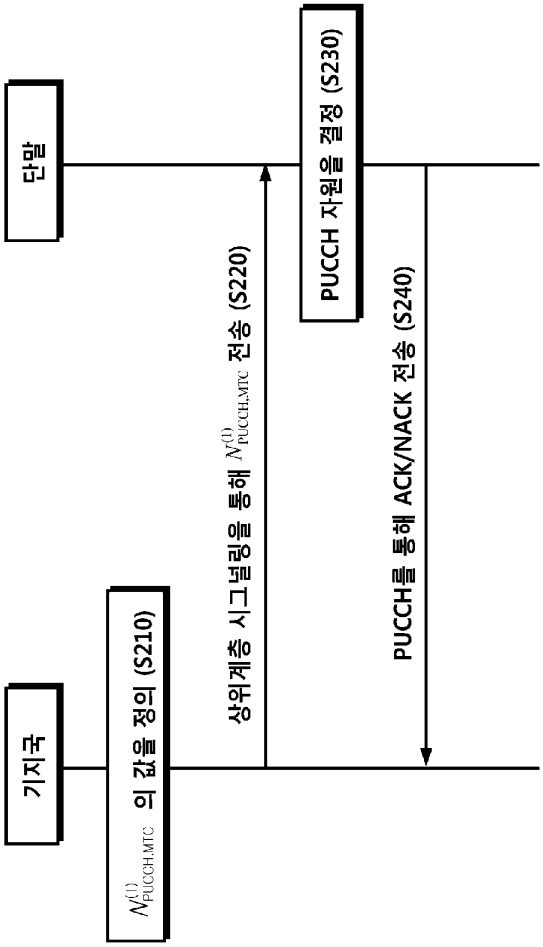
[청구항 18] 제 13 항에 있어서,
상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 단말.

[청구항 19] MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원을 설정하는 기지국으로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보, 및 상기 하향링크 데이터를 송신하는 송신부를 포함하고,
상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 기지국.

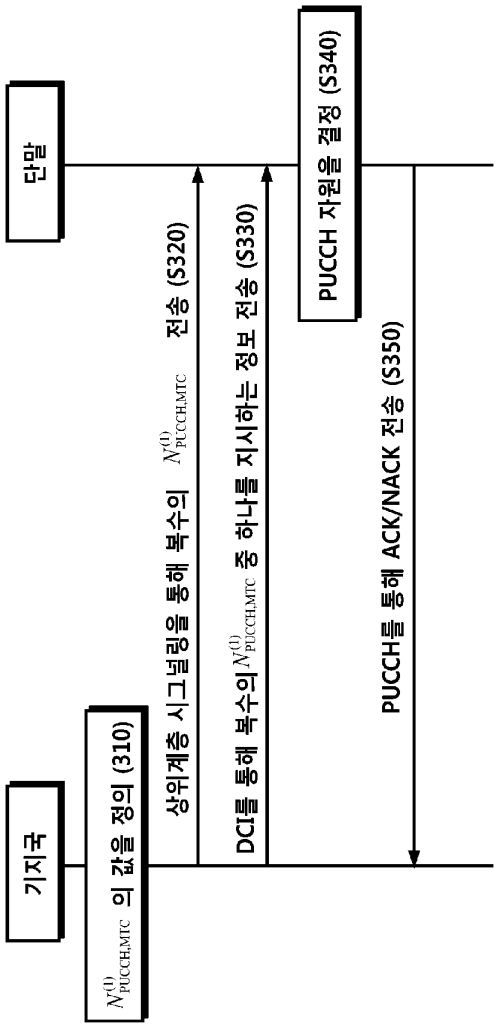
[Fig. 1]


PDSCH
PUCCH
20
10

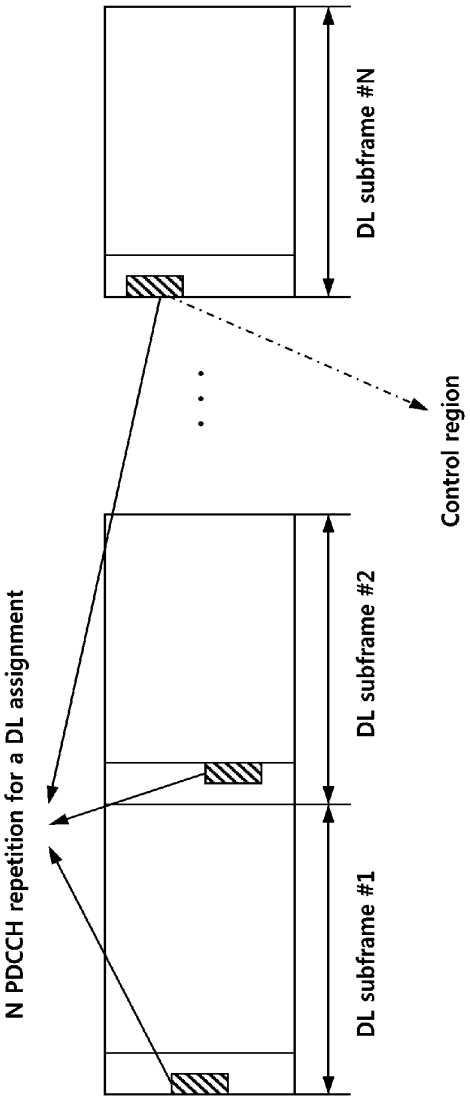
[Fig. 2]


단말
기지국
PUCCH 자원을 결정 (S230)
상위계층 시그널링을 통해 $N^{(1)}_{PUCCH,MTC}$ 전송 (S220)
PUCCH를 통해 ACK/NACK 전송 (S240)
$N^{(1)}_{PUCCH,MTC}$ 의 값을 정의 (S210)

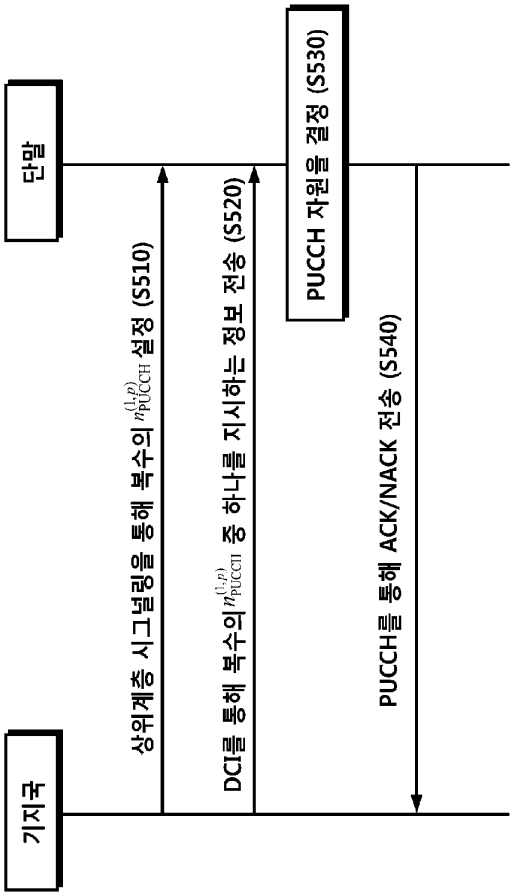
[Fig. 3]


단말
기지국
$N_{PUCCH,MTC}^{(1)}$ 의 값을 정의 (310)
상위계층 시그널링을 통해 복수의 $N_{PUCCH,MTC}^{(1)}$ 전송 (S320)
DCI를 통해 복수의 $N_{PUCCH,MTC}^{(1)}$ 중 하나를 지시하는 정보 전송 (S330)
PUCCH 자원을 결정 (S340)
PUCCH를 통해 ACK/NACK 전송 (S350)

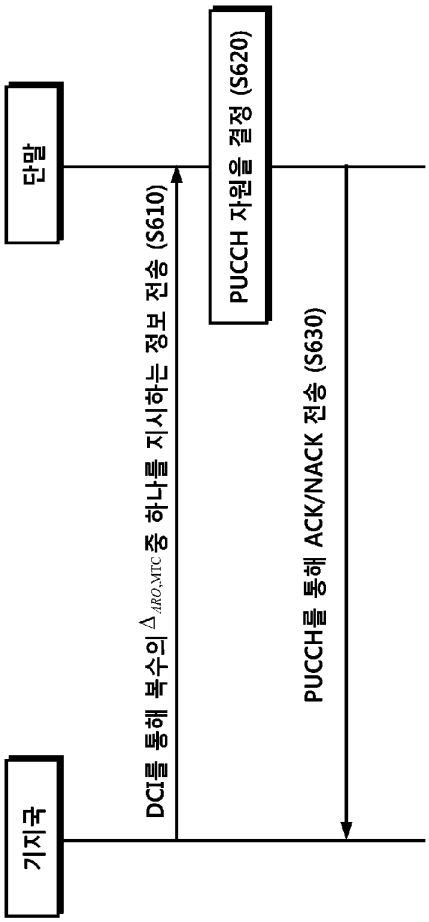
[Fig. 4]


DL subframe #N
Control region
DL subframe #2
DL subframe #1
N PDCCH repetition for a DL assignment

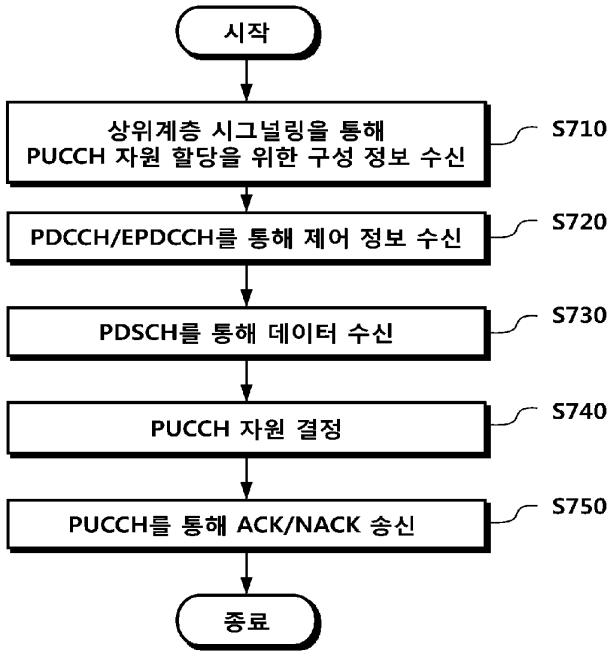
[Fig. 5]


단말
기지국
상위계층 시그널링을 통해 복수의 $n_{PUCCH}^{(1,p)}$ 설정 (S510)
DCI를 통해 복수의 $n_{PUCCH}^{(1,p)}$ 중 하나를 지시하는 정보 전송 (S520)
PUCCH 자원을 결정 (S530)
PUCCH를 통해 ACK/NACK 전송 (S540)

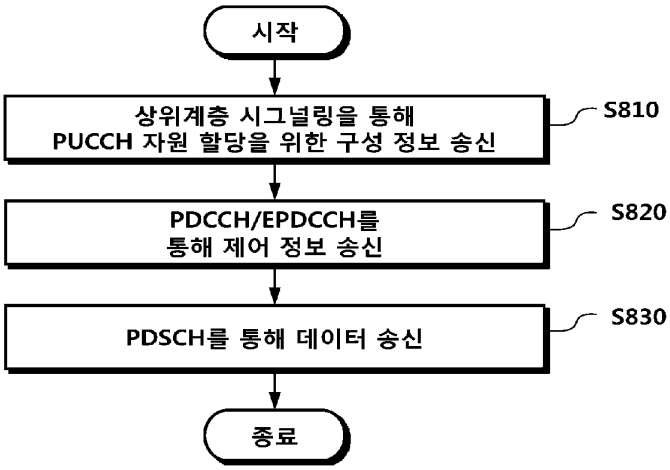
[Fig. 6]


단말
기지국
PUCCH 자원을 결정 (S620)
DCI를 통해 복수의 $\Delta_{ARO,MTC}$ 중 하나를 지시하는 정보 전송 (S610)
PUCCH를 통해 ACK/NACK 전송 (S630)

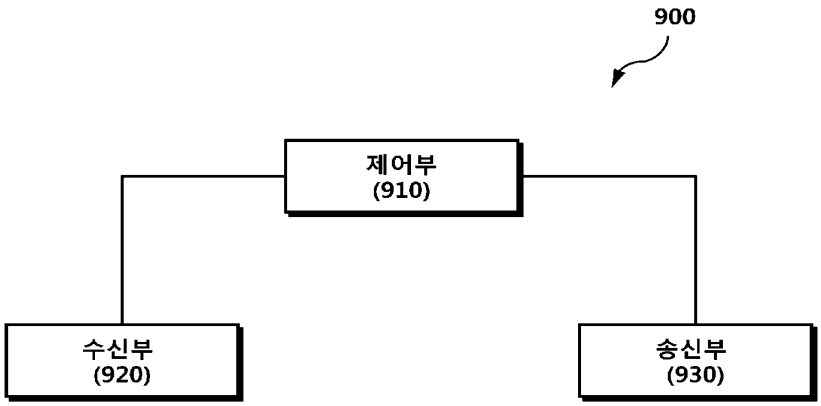
[Fig. 7]


시작
상위계층 시그널링을 통해
PUCCH 자원 할당을 위한 구성 정보 수신
S710
PDCCH/EPDCCH를 통해 제어 정보 수신
S720
PDSCH를 통해 데이터 수신
S730
PUCCH 자원 결정
S740
PUCCH를 통해 ACK/NACK 송신
S750
종료

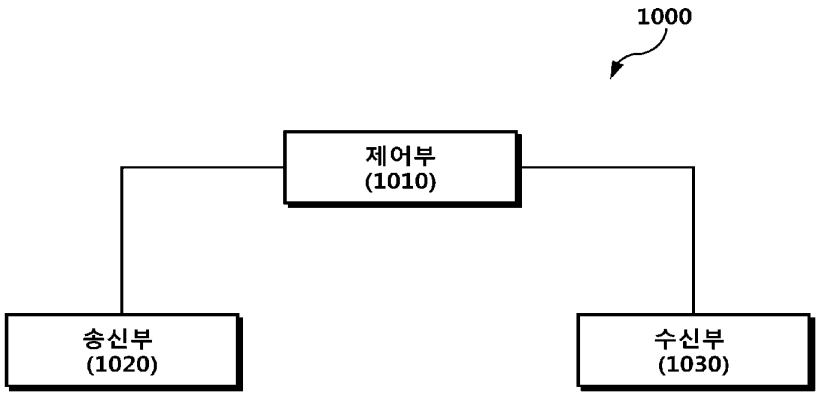
[Fig. 8]


시작
상위계층 시그널링을 통해
PUCCH 자원 할당을 위한 구성 정보 송신
S810
PDCCH/EPDCCH를
통해 제어 정보 송신
S820
PDSCH를 통해 데이터 송신
S830
종료

[Fig. 9]



[Fig. 10]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2014/008765

A. CLASSIFICATION OF SUBJECT MATTER

H04B 7/26(2006.01)i, H04W 72/04(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04B 7/26; H04J 11/00; H04W 72/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: machine type communication, uplink control channel resource, uplink control channel resource offset, downlink control information, response information

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013-015637 A2 (LG ELECTRONICS INC.) 31 January 2013 See paragraphs 73-108; and figures 6, 7.	1,2,7,8,13,14,19
Y		4,5,10,11,16,17
A		3,6,9,12,15,18
Y	3GPP TS 36.213 V11.4.0, "3GPP; TSGRAN; E-UTRA; Physical layer procedures (Release 11)", 20 September 2013 (http://www.3gpp.org/ftp/Specs/archive/36_series/36.213/36213-b40.zip) See pages 141-144; and tables 10.1.2.1-1, 10.1.2.2.1-2.	4,5,10,11,16,17
A	HTC, "Remaining issues on PUCCH A/N resource allocation for EPDCCH", R1-124356, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 08-12 October 2012 (http:/www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124356.zip) See pages 1-3.	1-19
A	CATT, "PUCCH resource for E-PDCCH", R1-124107, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 08-12 October 2012 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124107.zip) See pages 1-3.	1-19

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 DECEMBER 2014 (16.12.2014)	**16 DECEMBER 2014 (16.12.2014)**
Name and mailing address of the ISA/**KR** Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TEXAS INSTRUMENTS, "Outstanding aspects of PUCCH resource allocation for EPDCCH", R1-124141, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 08-12 October 2012 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124141.zip) See pages 1-2.	1-19

IPR2025-00138
Petitioner's Exhibit 1002
Page 000088

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2014/008765

Patent document cited in search report	Publication date	Patent family member	Publication date
WO 2013-015637 A2	31/01/2013	KR 10-2014-0036013 A	24/03/2014
		US 2014-0169319 A1	19/06/2014
		WO 2013-015637 A3	21/03/2013

IPR2025-00138
Petitioner's Exhibit 1002
Page 000089

국 제 조 사 보 고 서

국제출원번호
PCT/KR2014/008765

A. 발명이 속하는 기술분류(국제특허분류(IPC))

H04B 7/26(2006.01)i, H04W 72/04(2009.01)i

B. 조사된 분야

조사된 최소문헌(국제특허분류를 기재)
H04B 7/26; H04J 11/00; H04W 72/04

조사된 기술분야에 속하는 최소문헌 이외의 문헌
한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC
일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC

국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우))
eKOMPASS(특허청 내부 검색시스템) & 키워드: machine type communication, 상향링크 제어 채널 자원, 상향링크 제어 채널 자원 옵셋, 하향링크 제어 정보, 응답 정보

C. 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
X	WO 2013-015637 A2 (엘지전자 주식회사) 2013.01.31 단락 73-108; 및 도면 6, 7 참조.	1,2,7,8,13,14,19
Y		4,5,10,11,16,17
A		3,6,9,12,15,18
Y	3GPP TS 36.213 V11.4.0, `3GPP; TSGRAN; E-UTRA; Physical layer procedures (Release 11)', 2013.09.20 (http://www.3gpp.org/ftp/Specs/archive/36_series/36.213/36213-b40.zip) 페이지 141-144; 및 테이블 10.1.2.1-1, 10.1.2.2.1-2 참조.	4,5,10,11,16,17
A	HTC, `Remaining issues on PUCCH A/N resource allocation for EPDCCH', R1-124356, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 2012.10.08-12 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124356.zip) 페이지 1-3 참조.	1-19
A	CATT, `PUCCH resource for E-PDCCH', R1-124107, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 2012.10.08-12 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124107.zip) 페이지 1-3 참조.	1-19

☒ 추가 문헌이 C(계속)에 기재되어 있습니다.

☒ 대응특허에 관한 별지를 참조하십시오.

* 인용된 문헌의 특별 카테고리:

"A" 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌

"E" 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌

"L" 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌

"O" 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌

"P" 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌

"T" 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌

"X" 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다.

"Y" 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다.

"&" 동일한 대응특허문헌에 속하는 문헌

국제조사의 실제 완료일	국제조사보고서 발송일
2014년 12월 16일 (16.12.2014)	2014년 12월 16일 (16.12.2014)

ISA/KR의 명칭 및 우편주소
대한민국 특허청
(302-701) 대전광역시 서구 청사로 189,
4동 (둔산동, 정부대전청사)
팩스 번호 +82-42-472-7140

심사관
강희곡
전화번호 +82-42-481-8264

서식 PCT/ISA/210 (두 번째 용지) (2009년 7월)

C (계속). 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
A	TEXAS INSTRUMENTS, `Outstanding aspects of PUCCH resource allocation for EPDCCH', R1-124141, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 2012.10.08-12 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124141.zip) 페이지 1-2 참조.	1-19

IPR2025-00138
Petitioner's Exhibit 1002
Page 000091

국 제 조 사 보 고 서
대응특허에 관한 정보

국제출원번호
PCT/KR2014/008765

국제조사보고서에서 인용된 특허문헌	공개일	대응특허문헌	공개일
WO 2013-015637 A2	2013/01/31	KR 10-2014-0036013 A	2014/03/24
		US 2014-0169319 A1	2014/06/19
		WO 2013-015637 A3	2013/03/21

IPR2025-00138
Petitioner's Exhibit 1002
Page 000092

Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82A (07-12)
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NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B or equivalent) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5. If the Power of Attorney by Applicant form is not accompanied by this transmittal form or an equivalent, the Power of Attorney will not be recognized in the application.

Application Number	TBD
Filing Date	March 25, 2016
First Named Inventor	Kyujin PARK
Title	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	811.0053

SIGNATURE of Applicant or Patent Practitioner

Signature	/Ian M. Hughes/	Date	03/25/2016
Name	Ian M. Hughes	Telephone	571-267-7183
Registration Number	41,083		

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

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

76277

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent):

Name	Registration Number		Name	Registration Number

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

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OR

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City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

☐ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	10/29/2012
Name	CHOI, Ji-Myung	Telephone	82-31-727-2661
Title and Company	General Manager of KT CORPORATION		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

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The information provided by you in this form will be subject to the following routine uses:

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Filer:	Joung Kook Park
Attorney Docket Number:	811.0053

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
National Stage Fee	1631	1	280	280
Natl Stage Search Fee - Report provided	1642	1	480	480
National Stage Exam - all other cases	1633	1	720	720
Pages:				
Claims:				
Independent claims in excess of 3	1614	1	420	420
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1900**

Electronic Acknowledgement Receipt

EFS ID:	25312771
Application Number:	15025262
International Application Number:	PCT/KR2014/008765
Confirmation Number:	1007
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Customer Number:	76277
Filer:	Joung Kook Park
Filer Authorized By:	
Attorney Docket Number:	811.0053
Receipt Date:	25-MAR-2016
Filing Date:	
Time Stamp:	22:29:01
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1900
RAM confirmation Number	7862
Deposit Account	505881
Authorized User	KIM, KYUNG H.
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 CFR 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 CFR 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 CFR 1.19 (Document supply fees)

Charge any Additional Fees required under 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	018110053Transmittal.pdf	219655 4e3784118d38c8b2943710b1d732dca1c5e3fd67	no	4
Warnings:					
Information:					
2	Application Data Sheet	028110053NewADS.pdf	1828741 fab7c16532fdb567aa05157d5f177e8d62ad40ba	no	8
Warnings:					
Information:					
3	Oath or Declaration filed	038110053ExecutedDeclarations.pdf	162379 1e31064bce122135c03ce558f4a3883eb28e3c5f	no	2
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Information:					
4	Preliminary Amendment	048110053PreliminaryAmendment.pdf	89640 dae8bbfbbc83e398fafa1c44d3dbcb74a74c4c6e	no	3
Warnings:					
Information:					
5		058110053EnglishSpecification1.pdf	1609007 f78183e353905179d10e66d8969580320e710064	yes	38

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	22
Claims	23	27
Abstract	28	28
Drawings-only black and white line drawings	29	38

Warnings:

Information:					
6	Documents submitted with 371 Applications	068110053WOPubandISR.pdf	1426995 7ea907b51e77672d2e6b649066a494569dcf13b1	no	37
Warnings:					
Information:					
7	Power of Attorney	078110053PoATransmittal.pdf	179304 5c041796940a65eaee6db64118a97d39a32a5c7a	no	3
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Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	36974 a4fe816d462958c4605d9a79e2e7653238115caa	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	5552695	

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New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	15025262
	Filing Date	2016-03-25
	First Named Inventor	Kyujin PARK
	Art Unit	
	Examiner Name	
	Attorney Docket Number	811.0053

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20140169319	A1	2014-06-19	Suckchel Yang et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2013/015637	WO	A2	2013-01-31	LG ELECTRONICS INC.		X

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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Page 000101

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15025262
	Filing Date	2016-03-25
	First Named Inventor	Kyujin PARK
	Art Unit	
	Examiner Name	
	Attorney Docket Number	811.0053

	1	3GPP TS 36.213 V11.4.0, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 11)", September 20, 2013	☒
	2	HTC, "Remaining issues on PUCCH A/N resource allocation for EPDCCH", R1-124356, 3GPP TSG RAN WG1 #70bis, San Diego, USA, October 8-12, 2012	☒
	3	CATT, "DPUCCH resource for E-PDCCH", R1-124107, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, October 8th – 12th, 2012	☒
	4	TEXAS INSTRUMENTS, "Outstanding aspects of PUCCH resource allocation for EPDCCH", R1-124141, 3GPP TSG RAN WG1 #70bis, San Diego, USA, October 8 – 12, 2012	☒

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Petitioner's Exhibit 1002
Page 000102

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15025262
	Filing Date	2016-03-25
	First Named Inventor	Kyujin PARK
	Art Unit	
	Examiner Name	
	Attorney Docket Number	811.0053

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Ian M. Hughes/	Date (YYYY-MM-DD)	2016-03-25
Name/Print	Ian M. Hughes	Registration Number	41083

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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(12) 특허협력조약에 의하여 공개된 국제출원

(19) 세계지식재산권기구
국제사무국

(43) 국제공개일
2013 년 1 월 31 일 (31.01.2013)

WIPO | PCT

(10) 국제공개번호
WO 2013/015637 A2

(51) 국제특허분류:
H04J 11/00 (2006.01) *H04L 1/16* (2006.01)
H04B 7/26 (2006.01)

(21) 국제출원번호: PCT/KR2012/005978

(22) 국제출원일: 2012 년 7 월 26 일 (26.07.2012)

(25) 출원언어: 한국어

(26) 공개언어: 한국어

(30) 우선권정보:
61/511,968 2011 년 7 월 26 일 (26.07.2011) US

(71) 출원인 (US 을(를) 제외한 모든 지정국에 대하여): **엘지전자 주식회사 (LG ELECTRONICS INC.)** [KR/KR]; 150-721 서울 영등포구 여의도동 20, Seoul (KR).

(72) 발명자; 겸

(75) 발명자/출원인 (US 에 한하여): **양석철 (YANG, Suckchel)** [KR/KR]; 431-080 경기도 안양시 동안구 호계 1 동 533 번지 엘지전자 특허센터, Gyeonggi-do (KR). **안준기 (AHN, Joonkui)** [KR/KR]; 431-080 경기도 안양시 동안구 호계 1 동 533 번지 엘지전자 특허센터, Gyeonggi-do (KR). **서동연 (SEO, Dongyoun)** [KR/KR]; 431-080 경기도 안양시 동안구 호계 1 동 533 번지 엘지전자 특허센터, Gyeonggi-do (KR).

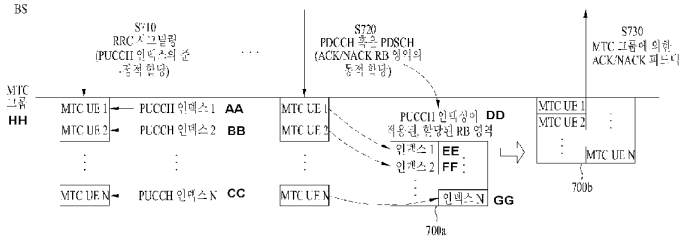
(74) 대리인: **김용인 (KIM, Yong In)** 등; 138-861 서울 송파구 잠실동 175-9 현대빌딩 7 층 KBK 특허법률사무소, Seoul (KR).

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

[다음 쪽 계속]

(54) **Title**: METHOD FOR TRANSMITTING UPLINK SIGNAL, USER EQUIPMENT, METHOD FOR RECEIVING UPLINK SIGNAL, AND BASE STATION

(54) **발명의 명칭** : 상향링크 신호 전송방법 및 사용자기기, 상향링크 신호 수신방법 및 기지국



AA, EE ... PUCCH index 1
BB, FF ... PUCCH index 2
CC, GG ... PUCCH index N
DD ... Allocated RB region to which PUCCH indexing is applied
HH ... MTC group
S710 ... RRC signaling (quasi-static allocation of PUCCH index)
S720 ... PDCCH or PDSCH (dynamic allocation of ACK/NACK RB region)
S730 ... ACK/NACK feedback by MTC group

(57) **Abstract**: The present invention provides a method for a user equipment, which is included in a user equipment group that comprises a plurality of user equipments, transmitting to a base station an Acknowledgement/Negative ACK (ACK/NACK) signal with respect to downlink data that is received from the base station. The base station, according to the present invention, quasi-statically sets physical uplink control channel (PUCCH) resource identification information, which would be used by each of the plurality of user equipments, and dynamically allocates to the user equipment group a collection of PUCCH resources usable for transmitting ACK/NACK of the user equipment group. The user equipment, according to the present invention, transmits the ACK/NACK signal to the base station by using the PUCCH resource that is allocated to the user equipment from the collection of the PUCCH resources, which are dynamically allocated to the user equipment group, based on the PUCCH resource identification information that is quasi-statically allocated to the user equipment.

(57) **요약서**:

[다음 쪽 계속]

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(84) **지정국** (별도의 표시가 없는 한, 가능한 모든 종류의 역내 권리의 보호를 위하여): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), 유라시아 (AM, AZ, BY, KG, KZ, RU, TJ, TM), 유럽 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

공개:

— 국제조사보고서 없이 공개하며 보고서 접수 후 이를 별도 공개함 (규칙 48.2(g))

본 발명은 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기가 기지국으로부터 수신한 하향링크 데이터에 대한 ACK/NACK(ACKnowledgement/Negative ACK) 신호를 상기 기지국으로 전송하는 방법을 제공한다. 본 발명의 기지국은 상기 복수의 사용자기기들이 각각 사용할 PUCCH(physical uplink control channel) 자원 식별 정보를 준-정적으로 설정하고, 상기 사용자기기 그룹의 ACK/NACK 전송에 이용가능한 PUCCH 자원들의 모음을 상기 사용자기기 그룹에 동적으로 할당한다. 본 발명의 사용자기기는 상기 사용자기기는 자신에게 준-정적으로 할당된 PUCCH 자원 식별 정보를 기반으로 상기 사용자기기 그룹에 동적으로 할당된 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 PUCCH 자원을 이용하여 상기 ACK/NACK 신호를 상기 기지국에게 전송한다.

명세서

발명의 명칭: 상향링크 신호 전송방법 및 사용자기기, 상향링크 신호 수신방법 및 기지국

기술분야

[1] 본 발명은 무선 통신 시스템에 관한 것이다. 특히, 본 발명은 상향링크 신호를 전송/수신하는 방법 및 장치에 관한 것이다.

배경기술

[2] 기기간(Machine-to-Machine, M2M) 통신과, 높은 데이터 전송량을 요구하는 스마트폰, 태블릿 PC 등의 다양한 장치 및 기술이 출현 및 보급되고 있다. 이에 따라, 셀룰러 망에서 처리될 것이 요구되는 데이터 양이 매우 빠르게 증가하고 있다. 이와 같이 빠르게 증가하는 데이터 처리 요구량을 만족시키기 위해, 더 많은 주파수 대역을 효율적으로 사용하기 위한 반송파 집성(carrier aggregation) 기술, 인지무선(cognitive radio) 기술 등과, 한정된 주파수 내에서 전송되는 데이터 용량을 높이기 위한 다중 안테나 기술, 다중 기지국 협력 기술 등이 발전하고 있다. 또한, 사용자기기가 주변에서 엑세스할 수 있는 노드의 밀도가 높아지는 방향으로 통신 환경이 진화하고 있다. 노드라 함은 하나 이상의 안테나를 구비하여 사용자기기와 무선 신호를 전송/수신할 수 있는 고정된 지점(point)을 말한다. 높은 밀도의 노드를 구비한 통신 시스템은 노드들 간의 협력에 의해 더 높은 성능의 통신 서비스를 사용자기기에게 제공할 수 있다.

[3] 새로운 무선 통신 기술의 도입에 따라, 기지국이 소정 자원영역에서 서비스를 제공해야 하는 사용자기기들의 개수가 증가할 뿐만 아니라, 상기 기지국이 서비스를 제공하는 사용자기기들로부터 수신해야 하는 상향링크 데이터와 상향링크 제어정보의 양이 증가하고 있다. 기지국과 사용자기기(들)과의 통신에 이용가능한 무선 자원의 양은 유한하므로, 유한한 무선 자원을 이용하여 상/하향링크 신호를 효율적으로 전송/수신하기 위한 새로운 방안이 요구된다.

발명의 상세한 설명

기술적 과제

[4] 복수의 사용자기기들로 구성된 사용자기기 그룹과 기지국 간의 효율적인 통신을 위한 상향링크 신호 또는 하향링크 신호의 전송/수신 방법 및 장치를 제공한다.

[5] 본 발명이 이루고자 하는 기술적 과제들은 이상에서 언급한 기술적 과제들로 제한되지 않으며, 언급되지 않은 또 다른 기술적 과제들은 이하의 발명의 상세한 설명으로부터 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 명확하게 이해될 수 있을 것이다.

과제 해결 수단

[6] 본 발명의 일 양상으로, 무선 통신 시스템에서 복수의 사용자기기들을

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포함하는 사용자기기 그룹에 포함된 사용자기기가 기지국에게 상향링크 신호를 전송함에 있어서, 상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 기지국으로부터 수신하고; 상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는 ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 기지국으로부터 수신하며; 상기 기지국으로부터 수신한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 기지국에게 전송하는, 상향링크 신호 전송방법이 제공된다.

[7] 본 발명의 다른 양상으로, 무선 통신 시스템에서 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기가 기지국에게 상향링크 신호를 전송함에 있어서, 신호를 전송/수신하도록 구성된 무선주파수(radio frequency, RF) 유닛; 및 상기 RF 유닛을 제어하도록 구성된 프로세서를 포함하며, 상기 프로세서는 상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 기지국으로부터 수신하도록 상기 RF 유닛을 제어하고, 상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는 ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 기지국으로부터 수신하도록 상기 RF 유닛을 제어하며, 상기 기지국으로부터 수신한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 기지국에게 전송하도록 상기 RF 유닛을 제어하는, 사용자기기가 제공된다.

[8] 본 발명의 또 다른 양상으로, 무선 통신 시스템에서 기지국이 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기로부터 상향링크 신호를 수신함에 있어서, 상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 사용자기기에게 전송하고; 상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는 ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 사용자기기에게 전송하며; 상기 사용자기기에게 전송한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 사용자기기로부터 수신하는, 상향링크 신호 수신방법이 제공된다.

[9] 본 발명의 또 다른 양상으로, 무선 통신 시스템에서 기지국이 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기로부터 상향링크 신호를 수신함에 있어서, 신호를 전송/수신하도록 구성된 무선주파수(radio frequency, RF) 유닛; 및 상기 RF 유닛을 제어하도록 구성된 프로세서를 포함하며, 상기 프로세서는 상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 사용자기기에게 전송하도록 상기 RF 유닛을 제어하고, 상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는 ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 사용자기기에게 전송하도록 상기 RF 유닛을 제어하며, 상기 사용자기기에게 전송한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 사용자기기로부터 수신하도록 상기 RF 유닛을 제어하는, 기지국이 제공된다.

[10] 본 발명의 각 양상에 있어서, 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보는 상기 PUCCH 자원들의 모음 내에서 일 PUCCH 자원을 식별하는 정보일 수 있다.

[11] 본 발명의 각 양상에 있어서, 상기 ACK/NACK 자원 정보는 상기 PUCCH 자원들의 모음 중 첫번째 PUCCH 자원을 지시하는 정보 혹은 상기 PUCCH 자원들의 모음이 점유하는 하나 이상의 자원블록을 지시하는 정보일 수 있다.

[12] 본 발명의 각 양상에 있어서, 상기 ACK/NACK 자원 정보가 수신되는 상기 PDCCH는 상기 하향링크 데이터에 대한 하향링크 제어정보가 전송되는 PDCCH와는 다른 PDCCH일 수 있다.

[13] 상기 과제 해결방법들은 본 발명의 실시예들 중 일부에 불과하며, 본원 발명의 기술적 특징들이 반영된 다양한 실시예들이 당해 기술분야의 통상적인 지식을 가진 자에 의해 이하 상술할 본 발명의 상세한 설명을 기반으로 도출되고 이해될 수 있다.

발명의 효과

[14] 본 발명에 의하면, 복수의 사용자기기들에 대한 상/하향링크 신호가 효율적으로 전송/수신될 수 있다.

[15] 본 발명에 따른 효과는 이상에서 언급한 효과들로 제한되지 않으며, 언급되지 않은 또 다른 효과는 이하의 발명의 상세한 설명으로부터 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에게 명확하게 이해될 수 있을 것이다.

도면의 간단한 설명

[16] 본 발명에 관한 이해를 돕기 위해 상세한 설명의 일부로 포함되는, 첨부 도면은 본 발명에 대한 실시예를 제공하고, 상세한 설명과 함께 본 발명의 기술적

사상을 설명한다.

[17] 도 1 무선 통신 시스템에서 사용되는 무선 프레임(radio frame) 구조의 일 예를 나타낸 것이다.

[18] 도 2는 무선 통신 시스템에서 하향링크(downlink, DL)/상향링크(Uplink, UL) 슬롯(slot) 구조의 일례를 나타낸 것이다.

[19] 도 3은 3GPP(3rd Generation Partnership Project) LTE(Long Term Evoluntion)/LTE-A(Advanced) 시스템에서 사용되는 DL 서브프레임(subframe) 구조를 예시한 것이다.

[20] 도 4는 3GPP LTE/LTE-A 시스템에서 사용되는 상향링크 서브프레임 구조의 일례를 나타낸 것이다.

[21] 도 5는 하나의 셀(cell)에서 사용되는 PUCCH(Physical Uplink Control CHannel) 자원들의 논리적 배열을 예시한 것이다.

[22] 도 6은 3GPP LTE-(A) 시스템에서 ACK/NACK(ACKnowlegement/Negative ACK)을 위한 PUCCH 자원을 결정하는 예를 나타낸 것이다.

[23] 도 7은 본 발명에 따른 UL ACK/NACK 전송을 예시한 것이다.

[24] 도 8은 본 발명을 수행하는 전송장치(10) 및 수신장치(20)의 구성요소를 나타내는 블록도이다.

발명의 실시를 위한 형태

[25] 이하, 본 발명에 따른 바람직한 실시 형태를 첨부된 도면을 참조하여 상세하게 설명한다. 첨부된 도면과 함께 이하에 개시될 상세한 설명은 본 발명의 예시적인 실시형태를 설명하고자 하는 것이며, 본 발명이 실시될 수 있는 유일한 실시형태를 나타내고자 하는 것이 아니다. 이하의 상세한 설명은 본 발명의 완전한 이해를 제공하기 위해서 구체적 세부사항을 포함한다. 그러나, 당업자는 본 발명이 이러한 구체적 세부사항 없이도 실시될 수 있음을 안다.

[26] 몇몇 경우, 본 발명의 개념이 모호해지는 것을 피하기 위하여 공지의 구조 및 장치는 생략되거나, 각 구조 및 장치의 핵심기능을 중심으로 한 블록도 형식으로 도시될 수 있다. 또한, 본 명세서 전체에서 동일한 구성요소에 대해서는 동일한 도면 부호를 사용하여 설명한다.

[27] 본 발명에 있어서, 사용자기기(User Equipment, UE)는 고정되거나 이동성을 가질 수 있으며, BS와 통신하여 사용자데이터 및/또는 각종 제어정보를 송수신하는 각종 기기들이 이에 속한다. UE는 단말(Terminal Equipment), MS(Mobile Station), MT(Mobile Terminal), UT(User Terminal), SS(Subscribe Station), 무선기기(wireless device), PDA(Personal Digital Assistant), 무선 모뎀(wireless modem), 휴대기기(handheld device) 등으로 불릴 수 있다. 또한, 본 발명에 있어서, 기지국(Base Station, BS)은 일반적으로 UE 및/또는 다른 BS와 통신하는 고정국(fixed station)을 말하며, UE 및 타 BS과 통신하여 각종 데이터 및 제어정보를 교환한다. BS는 ABS(Advanced Base Station), NB(Node-B),

eNB(evolved-NodeB), BTS(Base Transceiver System), 엑세스 포인트(Access Point), PS(Processing Server) 등 다른 용어로 불릴 수 있다.

[28] 본 발명에서 노드라 함은 사용자기기와 통신하여 무선 신호를 전송/수신할 수 있는 고정된 지점(point)을 말한다. 다양한 형태의 BS들이 그 명칭에 관계없이 노드로서 이용될 수 있다. 예를 들어, BS, NB, eNB, 피코-셀 eNB(PeNB), 홈 eNB(HeNB), 릴레이, 리피터 등이 노드가 될 수 있다. 또한, 노드는 BS가 아니어도 될 수 있다. 예를 들어, 무선 리모트 헤드(radio remote head, RRH), 무선 리모트 유닛(radio remote unit, RRU)가 될 수 있다. 일 노드에는 최소 하나의 안테나가 설치된다. 상기 안테나는 물리 안테나를 의미할 수도 있으며, 안테나 포트, 가상 안테나, 또는 안테나 그룹을 의미할 수도 있다. 노드는 포인트(point)라고 불리기도 한다. 안테나들이 기지국에 집중되어 위치하여 하나의 BS 컨트롤러(controller)에 의해 제어되는 기존의 중앙 집중형 안테나 시스템(centralized antenna system, CAS)(즉, 단일 노드 시스템)과 달리, 다중 노드 시스템에서 복수의 노드는 통상 일정 간격 이상으로 떨어져 위치한다. 상기 복수의 노드는 각 노드의 동작을 제어하거나, 각 노드를 통해 송/수신될 데이터를 스케줄링(scheduling)하는 하나 이상의 BS 혹은 BS 컨트롤러에 의해 관리될 수 있다. 각 노드는 해당 노드를 관리하는 BS 혹은 BS 컨트롤러와 케이블(cable) 혹은 전용회선(dedicated line)을 통해 연결될 수 있다. 다중 노드 시스템에서, 복수의 노드들로의/로부터의 통한 신호 전송/수신에는 동일한 셀 식별자(identifier, ID)가 이용될 수도 있고 서로 다른 셀 ID가 이용될 수도 있다. 복수의 노드들이 동일한 셀 ID를 갖는 경우, 상기 복수의 노드 각각은 하나의 셀의 일부 안테나 집단처럼 동작한다. 다중 노드 시스템에서 노드들이 서로 다른 셀 ID를 갖는다면, 이러한 다중 노드 시스템은 다중 셀(예를 들어, 매크로-셀/펨토-셀/피코-셀) 시스템이라고 볼 수 있다. 복수의 노드들 각각이 형성한 다중 셀들이 커버리지에 따라 오버레이되는 형태로 구성되면, 상기 다중 셀들이 형성한 네트워크를 특히 다중-계층(multi-tier) 네트워크라 부른다.

[29] 한편, 본 발명에서 셀이라 함은 하나 이상의 노드가 통신 서비스를 제공하는 일정 지리적 영역을 말한다. 따라서, 본 발명에서 특정 셀과 통신한다고 함은 상기 특정 셀에 통신 서비스를 제공하는 BS 혹은 노드와 통신하는 것을 의미할 수 있다. 또한, 특정 셀의 하향링크/상향링크 신호는 상기 특정 셀에 통신 서비스를 제공하는 BS 혹은 노드로부터의/로의 하향링크/상향링크 신호를 의미한다. 또한, 특정 셀의 채널 상태/품질은 상기 특정 셀에 통신 서비스를 제공하는 BS 혹은 노드와 UE 사이에 형성된 채널 혹은 통신 링크의 채널 상태/품질을 의미한다.

[30] 본 발명에서 PDCCH(Physical Downlink Control CHannel)/PCFICH(Physical Control Format Indicator CHannel)/PHICH((Physical Hybrid automatic retransmit request Indicator CHannel)/PDSCH(Physical Downlink Shared CHannel)은 각각 DCI(Downlink Control Information)/CFI(Control Format Indicator)/하향링크

ACK/NACK(ACKnowlegement/Negative ACK)/하향링크 데이터를 나르는 시간-주파수 자원의 집합 혹은 자원요소의 집합을 의미한다. 또한, PUCCH(Physical Uplink Control CHannel)/PUSCH(Physical Uplink Shared CHannel)/PRACH(Physical Random Access CHannel)는 각각 UCI(Uplink Control Information)/상향링크 데이터/랜덤 엑세스 신호를 나르는 시간-주파수 자원의 집합 혹은 자원요소의 집합을 의미한다. 본 발명에서는, 특히, PDCCH/PCFICH/PHICH/PDSCH/PUCCH/PUSCH/PRACH에 할당되거나 이에 속한 시간-주파수 자원 혹은자원요소(Resource Element, RE)를 각각 PDCCH/PCFICH/PHICH/PDSCH/PUCCH/PUSCH/PRACH RE 또는 PDCCH/PCFICH/PHICH/PDSCH/PUCCH/PUSCH/PRACH 자원이라고 칭한다. 이하에서 사용자기기가 PUCCH/PUSCH/PRACH를 전송한다는 표현은, 각각, PUSCH/PUCCH/PRACH 상에서 혹은 통해서 상향링크 제어정보/상향링크 데이터/랜덤 엑세스 신호를 전송한다는 것과 동일한 의미로 사용된다. 또한, BS가 PDCCH/PCFICH/PHICH/PDSCH를 전송한다는 표현은, 각각, PDCCH/PCFICH/PHICH/PDSCH 상에서 혹은 통해서 하향링크 데이터/제어정보를 전송한다는 것과 동일한 의미로 사용된다.

[31] 도 1 무선 통신 시스템에서 사용되는 무선 프레임 구조의 일 예를 나타낸 것이다. 특히, 도 1(a)는 3GPP LTE/LTE-A 시스템에서 사용되는 FDD(Frequecy Division Duplex)용 프레임 구조를 나타낸 것이고, 도 1(b)는 3GPP LTE/LTE-A 시스템에서 사용되는 TDD(Time Division Duplex)용 프레임 구조를 나타낸 것이다.

[32] 도 1을 참조하면, 3GPP LTE/LTE-A 시스템에서 사용되는 무선프레임은 10ms($307200T_s$)의 길이를 가지며, 10개의 균등한 크기의 서브프레임(subframe, SF)으로 구성된다. 일 무선프레임 내 10개의 서브프레임에는 각각 번호가 부여될 수 있다. 여기에서, T_s는 샘플링 시간을 나타내고, T_s=1/(2048*15kHz)로 표시된다. 각각의 서브프레임은 1ms의 길이를 가지며 2개의 슬롯으로 구성된다. 일 무선프레임 내에서 20개의 슬롯들은 0부터 19까지 순차적으로 넘버링될 수 있다. 각각의 슬롯은 0.5ms의 길이를 가진다. 일 서브프레임을 전송하기 위한 시간은 전송시간간격(TTI: transmission time interval)로 정의된다. 시간 자원은 무선프레임 번호(혹은 무선 프레임 인덱스라고도 함)와 서브프레임 번호(혹은 서브프레임 번호라고도 함), 슬롯 번호(혹은 슬롯 인덱스) 등에 의해 구분될 수 있다.

[33] 무선 프레임은 듀플레스(duplex) 모드에 따라 다르게 설정(configure)될 수 있다. 예를 들어, FDD(Frequency Division Duplex) 모드에서, 하향링크 전송 및 상향링크 전송은 주파수에 의해 구분되므로, 무선 프레임은 특정 주파수 대역에 대해 하향링크 서브프레임 또는 상향링크 서브프레임 중 하나만을 포함한다. TDD 모드에서 하향링크 전송 및 상향링크 전송은 시간에 의해 구분되므로, 특정 주파수 대역에 대해 무선 프레임은 하향링크 서브프레임과 상향링크

서브프레임을 모두 포함한다.

[34] 표 1은 TDD 모드에서, 무선 프레임 내 서브프레임들의 DL-UL 설정(configuration)을 예시한 것이다.

[35] 표 1

[Table 1]

DL-UL configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5ms	D	S	U	U	U	D	S	U	U	U
1	5ms	D	S	U	U	D	D	S	U	U	D
2	5ms	D	S	U	D	D	D	S	U	D	D
3	10ms	D	S	U	U	U	D	D	D	D	D
4	10ms	D	S	U	U	D	D	D	D	D	D
5	10ms	D	S	U	D	D	D	D	D	D	D
6	5ms	D	S	U	U	U	D	S	U	U	D

[36] 표 1에서, D는 하향링크 서브프레임을, U는 상향링크 서브프레임을, S는 특이(special) 서브프레임을 나타낸다. 특이 서브프레임은 DwPTS(Downlink Pilot TimeSlot), GP(Guard Period), UpPTS(Uplink Pilot TimeSlot)의 3개 필드를 포함한다. DwPTS는 하향링크 전송용으로 유보되는 시간 구간이며, UpPTS는 상향링크 전송용으로 유보되는 시간 구간이다. 표 2는 특이 프레임의 설정(configuration)을 예시한 것이다.

[37] 표 2

[Table 2]

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	$6592 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$	$7680 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			-	-	-
8	$24144 \cdot T_s$			-	-	-

[38] 도 2는 무선 통신 시스템에서 하향링크/상향링크(DL/UL) 슬롯 구조의 일례를 나타낸 것이다. 특히, 도 2는 3GPP LTE/LTE-A 시스템의 자원격자(resource grid)의 구조를 나타낸다. 안테나 포트당 1개의 자원격자가 있다.

[39] 도 2를 참조하면, 슬롯은 시간 도메인(time domain)에서 복수의 OFDM(Orthogonal Frequency Division Multiplexing) 심볼을 포함하고, 주파수 도메인에서 복수의 자원블록(resource block, RB)을 포함한다. OFDM 심볼은 일 심볼 구간을 의미하기도 한다. 도 2를 참조하면, 각 슬롯에서 전송되는 신호는 $N^{DL/UL}_{RB} * N^{RB}_{sc}$개의 부반송파(subcarrier)와 $N^{DL/UL}_{symb}$개의 OFDM 심볼로 구성되는 자원격자(resource grid)로 표현될 수 있다. 여기서, N^{DL}_{RB}은 하향링크 슬롯에서의 자원블록(resource block, RB)의 개수를 나타내고, N^{UL}_{RB}은 UL 슬롯에서의 RB의 개수를 나타낸다. N^{DL}_{RB}와 N^{UL}_{RB}은 DL 전송 대역폭과 UL 전송 대역폭에 각각 의존한다. N^{DL}_{symb}은 하향링크 슬롯 내 OFDM 심볼의 개수를 나타내며, N^{UL}_{symb}은 UL 슬롯 내 OFDM 심볼의 개수를 나타낸다. N^{RB}_{sc}는 하나의 RB를 구성하는 부반송파의 개수를 나타낸다.

[40] OFDM 심볼은 다중 접속 방식에 따라 OFDM 심볼, SC-FDM 심볼 등으로 불릴 수 있다. 하나의 슬롯에 포함되는 OFDM 심볼의 수는 채널 대역폭, CP(cyclic prefix)의 길이에 따라 다양하게 변경될 수 있다. 예를 들어, 정규(normal) CP의 경우에는 하나의 슬롯이 7개의 OFDM 심볼을 포함하나, 확장(extended) CP의

경우에는 하나의 슬롯이 6개의 OFDM 심볼을 포함한다. 도 2에서는 설명의 편의를 위하여 하나의 슬롯이 7 OFDM 심볼로 구성되는 서브프레임을 예시하였으나, 본 발명의 실시예들은 다른 개수의 OFDM 심볼을 갖는 서브프레임들에도 마찬가지의 방식으로 적용될 수 있다. 도 2를 참조하면, 각 OFDM 심볼은, 주파수 도메인에서, $N^{DL/UL}_{RB}*N^{RB}_{sc}$개의 부반송파를 포함한다. 부반송파의 유형은 데이터 전송을 위한 데이터 부반송파, 참조신호(reference signal)의 전송 위한 참조신호 부반송파, 가드 밴드(guard band) 및 직류(Direct Current, DC) 성분을 위한 널(null) 부반송파로 나뉠 수 있다. DC 성분을 위한 널 부반송파는 미사용인 채 남겨지는 부반송파로서, OFDM 신호 생성 과정 혹은 주파수 상향변환 과정에서 반송파 주파수(carrier frequency, f_0)로 맵핑된다. 반송파 주파수는 중심 주파수(center frequency)라고도 한다.

[41] 일 RB는 시간 도메인에서 $N^{DL/UL}_{symb}$개(예를 들어, 7개)의 연속하는 OFDM 심볼로서 정의되며, 주파수 도메인에서 N^{RB}_{sc}개(예를 들어, 12개)의 연속하는 부반송파에 의해 정의된다. 참고로, 하나의 OFDM 심볼과 하나의 부반송파로 구성된 자원을 자원요소(resource element, RE) 혹은 톤(tone)이라고 한다. 따라서, 하나의 RB는 $N^{DL/UL}_{symb}*N^{RB}_{sc}$개의 자원요소로 구성된다. 자원격자 내 각 자원요소는 일 슬롯 내 인덱스 쌍 (k, 1)에 의해 고유하게 정의될 수 있다. k는 주파수 도메인에서 0부터 $N^{DL/UL}_{RB}*N^{RB}_{sc}$-1까지 부여되는 인덱스이며, 1은 시간 도메인에서 0부터 $N^{DL/UL}_{symb}$-1까지 부여되는 인덱스이다.

[42] 일 서브프레임에서 N^{RB}_{sc}개의 연속하는 동일한 부반송파를 점유하면서, 상기 서브프레임의 2개의 슬롯 각각에 1개씩 위치하는 2개의 RB를 물리자원블록(physical resource block, PRB) 쌍(pair)이라고 한다. PRB 쌍을 구성하는 2개의 RB는 동일한 PRB 번호(혹은, PRB 인덱스(index)라고도 함)를 갖는다.

[43] 도 3은 3GPP LTE/LTE-A 시스템에서 사용되는 DL 서브프레임 구조를 예시한 것이다.

[44] 도 3을 참조하면, DL 서브프레임은 시간 도메인에서 제어영역(control region)과 데이터영역(data region)으로 구분된다. 도 3을 참조하면, 서브프레임의 첫 번째 슬롯에서 앞부분에 위치한 최대 3(혹은 4)개의 OFDM 심볼은 제어 채널이 할당되는 제어영역(control region)에 대응한다. 이하, DL 서브프레임에서 PDCCH 전송에 이용가능한 자원영역을 PDCCH 영역이라 칭한다. 제어영역으로 사용되는 OFDM 심볼(들)이 아닌 남은 OFDM 심볼들은 PDSCH(Physical Downlink Shared CHannel)가 할당되는 데이터영역(data region)에 해당한다. 이하, DL 서브프레임에서 PDSCH 전송에 이용가능한 자원영역을 PDSCH 영역이라 칭한다. 3GPP LTE에서 사용되는 DL 제어 채널의 예는 PCFICH(Physical Control Format Indicator Channel), PDCCH(Physical Downlink Control Channel), PHICH(Physical hybrid ARQ indicator Channel) 등을 포함한다. PCFICH는 서브프레임의 첫 번째 OFDM 심볼에서 전송되고 서브프레임 내에서 제어

채널의 전송에 사용되는 OFDM 심볼의 개수에 관한 정보를 나른다. PHICH는 UL 전송에 대한 응답으로 HARQ(Hybrid Automatic Repeat Request) ACK/NACK(acknowledgment/negative-acknowledgment) 신호를 나른다.

[45] PDCCH를 통해 전송되는 제어 정보를 DCI(Downlink Control Information)라고 지칭한다. DCI는 UE 또는 UE 그룹을 위한 자원 할당 정보 및 다른 제어 정보를 포함한다. 예를 들어, DCI는 DL 공유 채널(downlink shared channel, DL-SCH)의 전송 포맷 및 자원 할당 정보, UL 공유 채널(uplink shared channel, UL-SCH)의 전송 포맷 및 자원 할당 정보, 페이징 채널(paging channel, PCH) 상의 페이징 정보, DL-SCH 상의 시스템 정보, PDSCH 상에서 전송되는 임의 접속 응답과 같은 상위 계층(upper layer) 제어 메시지의 자원 할당 정보, UE 그룹 내의 개별 UE들에 대한 전송 전력 제어 명령(Transmit Control Command Set), 전송 전력 제어(Transmit Power Control) 명령, VoIP(Voice over IP)의 활성화(activation) 지시 정보, DAI(Downlink Assignment Index) 등을 포함한다. DL 공유 채널(downlink shared channel, DL-SCH)의 전송 포맷(Transmit Format) 및 자원 할당 정보는 DL 스케줄링 정보 혹은 DL 그랜트(DL grant)라고도 불리며, UL 공유 채널(uplink shared channel, UL-SCH)의 전송 포맷 및 자원 할당 정보는 UL 스케줄링 정보 혹은 UL 그랜트(UL grant)라고도 불린다.

[46] PDCCH는 하나 또는 복수의 연속된 제어 채널 요소(control channel element, CCE)들의 집성(aggregation) 상에서 전송된다. CCE는 PDCCH에 무선 채널 상태에 기초한 부호화율(coding rate)를 제공하기 위해 사용되는 논리적 할당 유닛(unit)이다. CCE는 복수의 자원 요소 그룹(resource element group, REG)에 대응한다. 예를 들어, 하나의 CCE는 9개의 REG에 대응되고 하나의 REG는 4개의 RE에 대응한다. 3GPP LTE 시스템의 경우, 각각의 UE을 위해 PDCCH가 위치할 수 있는 CCE 세트를 정의하였다. UE가 자신의 PDCCH를 발견할 수 있는 CCE 세트를 PDCCH 탐색 공간, 간단히 탐색 공간(Search Space, SS)라고 지칭한다. 탐색 공간 내에서 PDCCH가 전송될 수 있는 개별 자원을 PDCCH 후보(candidate)라고 지칭한다. UE가 모니터링(monitoring)할 PDCCH 후보들의 모음은 탐색 공간으로 정의된다. 3GPP LTE/LTE-A 시스템에서 각각의 DCI 포맷을 위한 탐색 공간은 다른 크기를 가질 수 있으며, 전용(dedicated) 탐색 공간과 공통(common) 탐색 공간이 정의되어 있다. 전용 탐색 공간은 UE-특정(specific) 탐색 공간이며, 각각의 개별 UE를 위해 설정(configuration)된다. 공통 탐색 공간은 복수의 UE들을 위해 설정된다. 하나의 PDCCH 후보는 CCE 집성 레벨(aggregation level)에 따라 1, 2, 4 또는 8개의 CCE에 대응한다. BS는 탐색 공간 내의 임의의 PDCCH 후보 상에서 실제 PDCCH (DCI)를 전송하고, UE는 PDCCH (DCI)를 찾기 위해 탐색 공간을 모니터링한다. 여기서, 모니터링이라 함은 모든 모니터링되는 DCI 포맷들에 따라 해당 탐색 공간 내의 각 PDCCH의 복호를 시도(attempt)하는 것을 의미한다. UE는 상기 복수의 PDCCH를 모니터링하여, 자신의 PDCCH를 검출할 수 있다. 기본적으로

UE는 자신의 PDCCH가 전송되는 위치를 모르기 때문에, 매 서브프레임마다 해당 DCI 포맷의 모든 PDCCH를 자신의 식별자를 가진 PDCCH를 검출할 때까지 PDCCH의 복호를 시도하는데, 이러한 과정을 블라인드 검출(blind detection)(블라인드 복호(blind decoding, BD))이라고 한다.

[47] BS는 데이터영역을 통해 UE 혹은 UE 그룹을 위한 데이터를 전송할 수 있다. 상기 데이터영역을 통해 전송되는 데이터를 사용자데이터라 칭하기도 한다. 사용자데이터의 전송을 위해, 데이터영역에는 PDSCH(Physical Downlink Shared CHannel)가 할당될 수 있다. PCH(Paging channel) 및 DL-SCH(Downlink-shared channel)는 PDSCH를 통해 전송된다. UE는 PDCCH를 통해 전송되는 제어정보를 복호하여 PDSCH를 통해 전송되는 데이터를 읽을 수 있다. 일 PDCCH가 나르는 DCI는 DCI 포맷에 따라서 그 크기와 용도가 다르며, 부호화율에 따라 그 크기가 달라질 수 있다. PDSCH의 데이터가 어떤 UE 혹은 UE 그룹에게 전송되는지, 상기 UE 혹은 UE 그룹이 어떻게 PDSCH 데이터를 수신하고 복호해야 하는지 등을 나타내는 정보가 PDCCH에 포함되어 전송된다. 예를 들어, 특정 PDCCH가 "A"라는 RNTI(Radio Network Temporary Identity)로 CRC(cyclic redundancy check) 마스킹(masking)되어 있고, "B"라는 무선자원(예, 주파수 위치) 및 "C"라는 전송형식정보(예, 전송 블록 사이즈, 변조 방식, 코딩 정보 등)를 이용해 전송되는 데이터에 관한 정보가 특정 DL 서브프레임을 통해 전송된다고 가정한다. UE는 자신이 가지고 있는 RNTI 정보를 이용하여 PDCCH를 모니터링하고, "A"라는 RNTI를 가지고 있는 UE는 PDCCH를 검출하고, 수신한 PDCCH의 정보를 통해 "B"와 "C"에 의해 지시되는 PDSCH를 수신한다.

[48] 도 4는 3GPP LTE/LTE-A 시스템에서 사용되는 상향링크 서브프레임 구조의 일례를 나타낸 것이다.

[49] 도 4를 참조하면, UL 서브프레임은 주파수 도메인에서 제어영역과 데이터영역으로 구분될 수 있다. 하나 또는 여러 PUCCH(physical uplink control channel)가 UCI(uplink control information)를 나르기 위해, 상기 제어영역에 할당될 수 있다. 하나 또는 여러 PUSCH(physical uplink shared channel)가 사용자 데이터를 나르기 위해, UL 서브프레임의 데이터영역에 할당될 수 있다. UL 서브프레임 내 제어영역과 데이터영역은 PUCCH 영역과 PUSCH 영역으로 각각 불리기도 한다. 상기 데이터영역에는 사운딩 참조신호(sounding reference signal, SRS)가 할당될 수도 있다. SRS는 시간 도메인에서는 UL 서브프레임의 가장 마지막에 위치하는 OFDM 심볼, 주파수 도메인에서는 상기 UL 서브프레임의 데이터 전송 대역, 즉, 데이터영역 상에서 전송된다. 동일한 서브프레임의 마지막 OFDM 심볼에서 전송/수신되는 여러 UE들의 SRS들은 주파수 위치/시퀀스에 따라 구분이 가능하다.

[50] UE가 UL 전송에 SC-FDMA 방식을 채택하는 경우, 단일 반송파 특성을 유지하기 위해, 3GPP LTE 릴리즈(release) 8 혹은 릴리즈 9 시스템에서는, 일 반송파 상에서는 PUCCH와 PUSCH를 동시에 전송할 수 없다. 3GPP LTE 릴리즈

10 시스템에서는, PUCCH와 PUSCH의 동시 전송 지원 여부가 상위 계층에서 지시될 수 있다.

[51] UL 서브프레임에서는 DC(Direct Current) 부반송파를 기준으로 거리가 먼 부반송파들이 제어영역으로 활용된다. 다시 말해, UL 전송 대역폭의 양쪽 끝부분에 위치하는 부반송파들이 상향링크 제어정보의 전송에 할당된다. DC 부반송파는 신호 전송에 사용되지 않고 남겨지는 성분으로서, 주파수 상향변환 과정에서 반송파 주파수 f_0로 맵핑된다. 일 UE에 대한 PUCCH는 일 서브프레임에서, 일 반송파 주파수에서 동작하는 자원들에 속한 RB 쌍에 할당되며, 상기 RB 쌍에 속한 RB들은 두 개의 슬롯에서 각각 다른 부반송파를 점유한다. 이와 같이 할당되는 PUCCH를, PUCCH에 할당된 RB 쌍이 슬롯 경계에서 주파수 호핑된다고 표현한다. 다만, 주파수 호핑이 적용되지 않는 경우에는, RB 쌍이 동일한 부반송파를 점유한다.

[52] PUCCH는 다음의 제어 정보를 전송하는데 사용될 수 있다.

[53] - SR(Scheduling Request): 상향링크 UL-SCH 자원을 요청하는데 사용되는 정보이다. OOK(On-Off Keying) 방식을 이용하여 전송된다.

[54] - HARQ-ACK: PDCCH에 대한 응답 및/또는 PDSCH 상의 하향링크 데이터 패킷(예, 코드워드)에 대한 응답이다. PDCCH 혹은 PDSCH가 성공적으로 수신되었는지 여부를 나타낸다. 단일 하향링크 코드워드에 대한 응답으로 HARQ-ACK 1비트가 전송되고, 두 개의 하향링크 코드워드에 대한 응답으로 HARQ-ACK 2비트가 전송된다. HARQ-ACK 응답은 포지티브 ACK(간단히, ACK), 네거티브 ACK(이하, NACK), DTX(Discontinuous Transmission) 또는 NACK/DTX를 포함한다. 여기서, HARQ-ACK은 HARQ ACK/NACK, ACK/NACK과 혼용된다.

[55] - CSI(Channel State Information): 하향링크 채널에 대한 피드백 정보(feedback information)이다. MIMO(Multiple Input Multiple Output)-관련 피드백 정보는 RI(Rank Indicator) 및 PMI(Precoding Matrix Indicator)를 포함한다.

[56] UE가 서브프레임에서 전송할 수 있는 상향링크 제어정보(UCI)의 양은 제어 정보 전송에 가용한 SC-FDMA의 개수에 의존한다. UCI에 가용한 SC-FDMA는 서브프레임에서 참조 신호 전송을 위한 SC-FDMA 심볼을 제외하고 남은 SC-FDMA 심볼을 의미하고, SRS(Sounding Reference Signal)가 설정된 서브프레임의 경우에는 서브프레임의 마지막 SC-FDMA 심볼도 제외된다. 참조 신호는 PUCCH의 코히어런트 검출에 사용된다. PUCCH는 전송되는 정보에 따라 다양한 포맷을 지원한다.

[57] 표 3은 LTE/LTE-A 시스템에서 PUCCH 포맷과 UCI의 매핑 관계를 나타낸다.

[58] 표 3

[Table 3]

PUCCH format	Modulation scheme	Number of bits per subframe	Usage	Etc.
1	N/A	N/A (exist or absent)	SR (Scheduling Request)	
1a	BPSK	1	ACK/NACK orSR + ACK/NACK	One codeword
1b	QPSK	2	ACK/NACK orSR + ACK/NACK	Two codeword
2	QPSK	20	CQI/PMI/RI	Joint coding ACK/NACK (extended CP)
2a	QPSK+BPSK	21	CQI/PMI/RI + ACK/NACK	Normal CP only
2b	QPSK+QPSK	22	CQI/PMI/RI + ACK/NACK	Normal CP only
3	QPSK	48	ACK/NACK orSR + ACK/NACK orCQI/PMI/RI + ACK/NACK	

[59] 표 3을 참조하면, PUCCH 포맷 1 계열과 PUCCH 포맷 3 계열은 주로 ACK/NACK 정보를 전송하는 데 사용되며, PUCCH 포맷 2 계열은 주로 CQI/PMI/RI 등의 채널상태정보(channel state information, CSI)를 나르는 데 사용된다.

[60] UE는 상위 계층 시그널링 혹은 동적 제어 시그널링 혹은 암묵적(implicit) 방식에 의해 BS로부터 UCI의 전송을 위한 PUCCH 자원을 할당 받는다. PUCCH를 위해 사용되는 물리자원들은 상위 계층에 의해 주어지는 2개의 파라미터, $N^{(2)}_{RB}$ 및 $N^{(1)}_{cs}$에 의존한다. 변수 $N^{(2)}_{RB} \geq 0$은 각 슬롯에서 PUCCH 포맷 2/2a/2b 전송에 이용가능한 대역폭을 나타내며, N^{RB}_{sc}개의 정수배로 표현된다. 변수 $N^{(1)}_{cs}$는 포맷 1/1a/1b 및 2/2a/2b의 혼합을 위해 사용되는 자원블록에서 PUCCH 포맷 1/1a/1b를 위해 사용된 순환쉬프트(cyclic shift, CS)의 개수를 나타낸다. $N^{(1)}_{cs}$의 값은 {0, 1,..., 7}의 범위 내에서 Δ^{PUCCH}_{shift}의 정수배가 된다. Δ^{PUCCH}_{shift}는 상위 계층에 의해 제공된다. $N^{(1)}_{cs}=0$이면 혼합된 자원블록이 없게 되며, 각 슬롯에서 많아야 1개 자원블록이 포맷 1/1a/1b 및 2/2a/2b의 혼합을 지원한다.

안테나 포트 p에 의해 PUCCH 포맷 1/1a/1b, 2/2a/2b 및 3의 전송을 위해 사용되는 자원들은 음이 아닌 정수 인덱스인 $n^{(1,p)}_{PUCCH}$, $n^{(2,p)}_{PUCCH} < N^{(2)}_{RB}N^{RB}_{sc} + ceil(N^{(1)}_{cs}/8)\cdot(N^{RB}_{sc} - N^{(1)}_{cs} - 2)$ 및 $n^{(2,p)}_{PUCCH}$에 의해 각각 표현된다.

[61] 구체적으로, PUCCH 포맷별로 기정의된 특성 규칙에 따라, PUCCH 자원 인덱스로부터 해당 UCI에 적용될 직교시퀀스(직교커버시퀀스(orthogonal cover sequence, OC) 혹은 직교커버코드(orthogonal cover code, OCC)) 및/또는 순환쉬프트(cyclic shift, CS)가 결정되며 PUCCH가 맵핑될, 서브프레임 내 2개 자원블록들의 인덱스들이 주어진다. 예를 들어, 슬롯 n_s에서 PUCCH의 전송을 위한 PRB가 다음과 같이 주어진다.

[62] 수학식 1

$$n_{PRB} = \begin{cases} \left\lfloor \frac{m}{2} \right\rfloor & \text{if } (m + n_s \bmod 2) \bmod 2 = 0 \\ N^{UL}_{RB} - 1 - \left\lfloor \frac{m}{2} \right\rfloor & \text{if } (m + n_s \bmod 2) \bmod 2 = 1 \end{cases}$$

[63] 수학식 1에서, 변수 m은 PUCCH 포맷에 의존하며, PUCCH 포맷 1/1a/1b, PUCCH 포맷 2/2a/2b 및 PUCCH 포맷 3에 수학식 2, 수학식 3, 수학식 4와 같이 각각 주어진다.

[64] 수학식 2

$$m = \begin{cases} N^{(2)}_{RB} & \text{if } n^{(1,\tilde{p})}_{PUCCH} < c \cdot N^{(1)}_{cs} / \Delta^{PUCCH}_{shift} \\ \left\lfloor \frac{n^{(1,\tilde{p})}_{PUCCH} - c \cdot N^{(1)}_{cs} / \Delta^{PUCCH}_{shift}}{c \cdot N^{RB}_{sc} / \Delta^{PUCCH}_{shift}} \right\rfloor + N^{(2)}_{RB} + \left\lceil \frac{N^{(1)}_{cs}}{8} \right\rceil & \text{otherwise} \end{cases}$$

$$c = \begin{cases} 3 & \text{normal cyclic prefix} \\ 2 & \text{extended cyclic prefix} \end{cases}$$

[65] 수학식 2에서, $n^{(1,p)}_{PUCCH}$는 PUCCH 포맷 1/1a/1b을 위한 안테나 포트 p의 PUCCH 자원 인덱스로서, ACK/NACK PUCCH의 경우, 해당 PDSCH의 스케줄링 정보를 나르는 PDCCH의 첫번째 CCE 인덱스에 의해 암묵적으로 정해지는 값이다.

[66] 수학식 3

$$m = \left\lfloor n^{(2,\tilde{p})}_{PUCCH} / N^{RB}_{sc} \right\rfloor$$

[67] $n^{(2,p)}_{PUCCH}$는 PUCCH 포맷 2/2a/2b을 위한 안테나 포트 p의 PUCCH 자원 인덱스로서, 상위 계층 시그널링에 의해 BS로부터 UE에 전송되는 값이다.

[68] 수학식 4

$$m = \left\lfloor n^{(3,\tilde{p})}_{PUCCH} / N^{PUCCH}_{SF,0} \right\rfloor$$

[69] $n^{(3,p)}_{PUCCH}$는 PUCCH 포맷 3을 위한 안테나 포트 p의 PUCCH 자원 인덱스로서,

상위 계층 시그널링에 의해 BS로부터 UE에 전송되는 값이다. $N^{PUCCH}_{SF,0}$는 서브프레임의 첫 번째 슬롯을 위한 확장인자(spreading factor)를 나타낸다. 일반 PUCCH 포맷 3를 사용하는 서브프레임 내 2개 슬롯 모두에 대해 $N^{PUCCH}_{SF,0}$는 5이며, 축소된 PUCCH 포맷 3를 사용하는 서브프레임에서 첫 번째 슬롯 및 두 번째 슬롯에 대해 $N^{PUCCH}_{SF,0}$는 각각 5와 4이다. 이하, PDCCH의 CCE 인덱스에 링크되어 결정되는 PUCCH자원을 암묵적 PUCCH 자원이라 칭하고, BS가 PUCCH 자원 인덱스를 명시적(explicit)으로 UE에게 전송함으로써 결정되는 PUCCH 자원을 명시적 PUCCH 자원이라 칭한다.

[70] 도 5는 하나의 셀(cell)에서 사용되는 PUCCH 자원들의 논리적 배열을 예시한 것이다.

[71] PUCCH 자원들은 셀 ID를 기반으로 설정(configuration)된다. 하나의 셀 ID를 기반으로 설정되는 PUCCH 자원들은 CSI를 위한 PUCCH 자원들, SPS(semi-persistent scheduling) ACK/NACK 및 SR을 위한 PUCCH 자원들, 동적 ACK/NACK을 위한 PUCCH 자원들(즉, PDCCH와 링킹(linking)되어 동적으로 할당되는 PUCCH 자원)을 포함한다. 이하, CSI를 위한 PUCCH 자원을 CSI PUCCH 자원 혹은 CSI 자원이라 칭하고, SPS ACK/NACK을 위한 PUCCH 자원을 SPS ACK/NACK PUCCH 자원 혹은 SPS ACK/NACK 자원이라 칭하며, SR을 위한 PUCCH 자원을 SR PUCCH 자원 혹은 SR 자원이라 칭하고, PDCCH와 연관된 ACK/NACK을 위한 PUCCH 자원을 ACK/NACK PUCCH 자원 혹은 ACK/NACK 자원이라 칭한다.

[72] 도 5를 참조하면, 하나의 셀 ID를 기반으로 한 PUCCH 자원들은, DC(Direct Current) 부반송파를 기준으로 거리가 먼 부반송파들로부터 DC 부반송파 방향으로, CSI PUCCH 자원들, SPS ACK/NACK 및 SR PUCCH 자원들, ACK/NACK PUCCH 자원들 순으로 배열된다. 다시 말해, 상위 계층 시그널링에 의해 준-정적(semi-static)으로 설정되는 PUCCH 자원들은 UL 전송 대역폭의 바깥쪽에 위치하고 동적으로 설정되는 ACK/NACK PUCCH 자원들은 상기 준-정적으로 설정되는 PUCCH 자원들보다 중심 주파수에 가까이 위치한다.

[73] 다시 수학식 2를 참조하면, 동적 ACK/NACK을 위한 PUCCH 자원은 각 UE에 미리 할당되어 있지 않고, 복수의 PUCCH 자원을 셀 내의 복수의 UE들이 매 시점마다 나눠서 사용한다. 예를 들어, UE가 ACK/NACK을 전송하기 위해 사용하는 PUCCH 자원은 해당 하향링크 데이터를 나르는 PDSCH에 대한 스케줄링 정보를 나르는 PDCCH를 기반으로 동적으로 결정된다. 각각의 DL 서브프레임에서 PDCCH가 전송되는 전체 영역은 복수의 CCE로 구성되고, UE에게 전송되는 PDCCH는 하나 이상의 CCE로 구성된다. UE는 자신이 수신한 PDCCH를 구성하는 CCE들 중 특정 CCE(예를 들어, 첫 번째 CCE)에 링크된 PUCCH 자원을 통해 상기 PDCCH에 대한 ACK/NACK 혹은 상기 PDCCH에 의해 스케줄링된 PDSCH에 대한 ACK/NACK을 전송한다.

[74] 도 6은 3GPP LTE-(A) 시스템에서 ACK/NACK을 위한 PUCCH 자원을 결정하는

예를 나타낸 것이다. 특히, 도 6은 DL 서브프레임에 최대 M개의 CCE가 존재하고, UL 서브프레임에 최대 M개의 ACK/NACK PUCCH 자원이 예약되는 경우를 예시한 것이다.

[75] 도 6을 참조하면, 각각의 ACK/NACK PUCCH 자원 인덱스는 ACK/NACK을 위한 PUCCH 자원에 대응된다. 도 6에서와 같이, 4~6번 CCE로 구성된 PDCCH를 통해 PDSCH에 대한 스케줄링 정보가 UE에 전송되고, 4번 CCE가 PUCCH 자원 인덱스 4에 링킹된다고 가정할 경우, 상기 UE는 상기 PDCCH를 구성하는 4번 CCE에 대응하는 4번 ACK/NACK PUCCH 자원을 통해 ACK/NACK을 BS에 전송한다. 구체적으로, 3GPP LTE/LTE-A 시스템에서 2개 안테나 포트(p_0 및 p_1)에 의한 전송을 위한 PUCCH 자원 인덱스는 다음과 같이 정해진다.

[76] 수학식 5

$$n_{PUCCH}^{(1,p=p_0)} = n_{CCE} + N_{PUCCH}^{(1)}$$

[77] 수학식 6

$$n_{PUCCH}^{(1,p=p_1)} = n_{CCE} + 1 + N_{PUCCH}^{(1)}$$

[78] 여기서, $n^{(1,p=p0)}_{PUCCH}$는 안테나 포트 p_0가 사용할 PUCCH 자원의 인덱스(즉, 번호)를 나타내고, $n^{(1,p=p1)}_{PUCCH}$는 안테나 포트 p_1이 사용할 PUCCH 자원 인덱스를 나타내며, $N^{(1)}_{PUCCH}$는 상위 계층으로부터 전달받는 시그널링 값을 나타낸다. n_{CCE}는 PDCCH 전송에 사용된 CCE 인덱스들 중에서 가장 작은 값에 해당한다. 예를 들어, CCE 집성 레벨이 2 이상인 경우에는 PDCCH 전송을 위해 집성된 복수의 CCE들의 인덱스들 중 첫 번째 CCE 인덱스가 ACK/NACK PUCCH 자원의 결정에 사용된다.

[79] 각 UE에서 ACK/NACK 신호는 CG-CAZAC(Computer-Generated Constant Amplitude Zero Auto Correlation) 시퀀스의 서로 다른 순환 쉬프트(주파수 도메인 코드)와 직교커버코드(시간 도메인 확산 코드)로 구성된 서로 다른 자원을 통해 전송된다. OC는 예를 들어 왈쉬(Walsh)/DFT(Discrete Fourier Transform) 직교 코드를 포함한다. 직교 시퀀스(예를 들어, [w0,w1,w2,w3])는 (FFT(Fast Fourier Transform) 변조 후에) 임의의 시간 도메인에서 또는 (FFT 변조 전에) 임의의 주파수 도메인에서 적용될 수 있다. CS의 개수가 6개이고 OC의 개수가 3개이면, 단일 안테나를 기준으로 총 18개의 UE가 동일한 PRB(Physical Resource Block) 안에서 다중화(multiplexing)될 수 있다. 다시 말해, ACK/NACK 신호의 전송에 이용되는 PUCCH 자원들은 OCC, CS(혹은 CCS(CAZAC CS)) 및 PRB에 의해 구분될 수 있으며, OCC, CS 및 PRB가 중 어느 하나가 다르면 다른 PUCCH 자원이라고 볼 수 있다.

[80] 현재까지의 3GPP LTE/LTE-A 시스템에 의하면, 특정 셀에서 서비스되는 모든 UE들은 동일한 $N^{(1)}_{PUCCH}$를 나타내는 정보를 준-정적(semi-static)으로 상기 셀의

BS로부터 수신한다. 즉, 기존의 3GP LTE/LTE-A 시스템에 따르면, 특정 셀에 위치한 UE들이 $N^{(1)}_{PUCCH}$ 이후의 PUCCH 자원들을 공유하며, 상기 PUCCH 자원들 각각은 상기 특정 셀에 공통적으로 적용되는 CCE 인덱스들과 각각 링크된다.

[81] 최근, 기계 타입 통신(machine type communication, MTC)이 중요한 통신 표준화 이슈들 중 하나로서 대두되고 있다. MTC라 함은 주로 사람의 개입 없이 혹은 사람의 개입을 최소화한 채 기계(machine)와 기지국 사이에서 수행되는 정보 교환을 의미한다. 예를 들어, MTC는 계량기검침, 수위측정, 감시카메라의 활용, 자판기의 재고 보고 등과 같은 측정/감지/보고 등의 데이터 통신 등에 이용될 수 있으며, 소정 특성을 공유하는 복수의 UE들에 대한 자동 어플리케이션 혹은 펌웨어의 갱신 과정 등에 이용될 수 있다. MTC는 사람의 개입 없이 기계(machine)와 기지국 사이에서 수행되는 정보 교환을 의미한다. MTC의 경우, 전송 데이터 양이 적고 한 셀에 속하여 동작하는 UE의 개수가 많기 때문에, 매 순간 각 UE를 위해 일일이 상/하향링크 스케줄링/피드백을 위한 신호 전송을 수행하면 BS의 부담이 매우 커진다. 이 때문에, 본 발명은 공통된 상향링크 혹은 하향링크 전송의 대상이 되는 복수의 UE들을 그룹핑하고, UE 그룹별로 상/하향링크 스케줄링을 수행함으로써 제어채널의 오버헤드를 줄인다. 예를 들어, DL 그랜트를 나르는 PDCCH(이하, DL 그랜트 PDCCH)가 스케줄링하는 PDSCH영역에서는 일 UE 그룹에 속한 복수의 UE들에 대한 하향링크 데이터 신호들이 다중화되어 동시에 전송될 수 있다. UL 그랜트를 나르는 PDCCH(이하, UL 그랜트 PDCCH)가 스케줄링하는 PUSCH 영역은 일 UE 그룹에 속한 복수의 UE들에 할당되는 PUSCH 전송 자원들을 포함할 수 있다. 이하의 설명에서, DL/UL 그랜트 PDCCH는 UE 그룹 단위의 스케줄링 혹은 피드백을 목적으로 전송되는 PDCCH를 의미한다.

[82] UE 그룹별로 UL 스케줄링이 수행되는 경우, 일 UL 그랜트 PDCCH가 스케줄링하는 PUSCH 영역 내에서 UE 그룹 내 복수의 UE들은 서로 다른 UL RB 인덱스 및/또는 DMRS(DeModulation Reference Signal) 순환 쉬프트(cyclic shift)를 사용하여 개별적인 PUSCH를 통해 각자의 상향링크 데이터를 전송하는 형태로 다중화되는 것이 바람직할 수 있다. 이 경우, 해당 PUSCH에 대한 ACK/NACK 신호의 전송을 위한 PHICH 자원은 별도의 추가 시그널링을 수반하지 않고도 UE 그룹 내 UE 각각에 대하여 서로 다르게 구분되어 할당될 수 있다. 다시 말해, BS는 기존의 PHICH 할당 방식만을 재사용하여 UE 그룹 내 UE들에게 서로 다른 PHICH 자원을 할당할 수 있다. 하지만 DL 스케줄링의 경우, UE 그룹 내 복수 UE들에 대한 하향링크 데이터의 스케줄링 정보가 하나의 DL 그랜트 PDCCH만을 통해 전송되고 해당 PDCCH의 첫 번째 CCE 인덱스(n_{CCE})에 링크된 PUCCH 자원은 하나뿐이므로, 해당 UE 그룹 내 상기 복수의 UE들이 ACK/NACK을 전송할 수 있도록 하는 새로운 방안이 요구된다. 다음과 같은 방식이 일 PDCCH에 의해 하향링크 전송이 스케줄링되는 UE 그룹 내 복수의 UE들을 위한 ACK/NACK을 전송하는 방안으로 고려될 수 있다.

[83] i) BS는 RRC(radio resource control) 시그널링 등을 통해 각 UE별로 ACK/NACK PUCCH 자원을 미리 예약해 둘 수 있다. 즉, UE 그룹을 위한 복수의 PUCCH 자원들이 명시적으로 예약되어 사용될 수 있다.

[84] ii) 암묵적 PUCCH 자원들이 UE 그룹 내 복수의 UE들 각자의 ACK/NACK 전송을 위해 TDM(Time Division Multiplexing) 방식으로 사용될 수 있다.

[85] iii) 복수개의 암묵적 PUCCH들이 DL 그랜트 PDCCH의 CCE들(예를 들어, n_{CCE}, $n_{CCE}+1$, ...)에 링크되어 동적으로 UE들에게 할당될 수 있다.

[86] 그러나, i)의 경우는 시변하는 시스템 상황(예를 들어, PUCCH 영역 재설정(reconfiguration) 혹은 채널 상태 변화 등)에 적응하기 위해 수반되는 시그널링 오버헤드 부담이 크다는 단점이 있다. 또한, ii)의 경우는 해당 암묵적 PUCCH 자원이 링크된 CCE가 일정 시간구간 동안 PDCCH 전송용으로 사용될 수 없게 되어, BS가 스케줄링을 수행함에 있어서 제약으로서 작용할 가능성이 존재한다. 또한, iii)의 경우는 역시 복수개의 암묵적 PUCCH 자원들이 링크된 복수 CCE들이 해당 서브프레임에서는 PDCCH 전송용으로 사용될 수 없기 때문에 BS가 상기 해당 서브프레임에 대한 스케줄링을 수행함에 있어서 제약으로서 작용하게 된다.

[87] 따라서, 본 발명은 하향링크 시그널링 오버헤드 부담 및 BS에의 스케줄링 제약을 줄이면서 시변하는 시스템 상황에 적절히 적응할 수 있는 UE 그룹 기반의 ACK/NACK 자원 할당 및 ACK/NACK 신호 전송 방법을 제안한다. 이하, MTC를 예로 하여 본 발명의 실시예들을 설명하나, 복수의 UE들이 소정 특성을 공유하여 상기 복수의 UE들에 대한 UL/DL 데이터 전송이 하나의 하향링크 제어채널이 나르는 하향링크 제어정보에 의해 스케줄링되는 경우이면, 그 명칭 여하에 관계없이 본 발명의 실시예들이 적용될 수 있다. 이하, MTC에 이용되는 사용자기기를 MTC 기기 혹은 MTC UE라고 칭하고, 일 PDCCH가 나르는 DCI에 의해 스케줄링되는 MTC UE들의 모음을 MTC 그룹이라 칭한다. 본 발명의 구체적인 실시예들을 도 7을 참조하여 설명한다.

[88] 도 7은 본 발명에 따른 UL ACK/NACK 전송을 예시한 것이다. 참고로, 도 7에서 기재된 "PUCCH 인덱스" 및 "인덱스"는 모두 PUCCH 자원 인덱스를 간략히 표기한 것이다.

[89] 본 발명은 MTC 그룹 내 복수 MTC UE 각각이 사용할 ACK/NACK PUCCH 자원 식별 정보를 RRC 시그널링 등의 상위 계층 시그널링(upper layer signaling)을 통해 사전에 준-정적(semi-static)으로 지정/설정해 둘 수 있다(S710). 본 발명의 BS는 RRC 등의 상위 계층에 의해 설정된, MTC 그룹 내 복수 MTC UE들 각각을 위한, 복수의 ACK/NACK PUCCH 자원 식별 정보를 포함하는 (상위 계층) 신호를 상기 MTC 그룹에 전송할 수 있다. 혹은, 본 발명의 BS는 RRC 등의 상위 계층에 의해 설정된, 상기 MTC 그룹 내 특정 MTC UE를 위한, PUCCH 자원 식별 정보를 포함하는 (상위 계층) 신호를 상기 특정 MTC UE에게 전송할 수 있다. PUCCH 자원 식별 정보는 PUCCH 자원 인덱스/순서(order)를 지시하는 정보 혹은 RB

인덱스 및 OCC, CS의 조합을 지시하는 정보일 수 있다. 본 발명에서 PUCCH 자원 식별 정보는 일 MTC 그룹이 사용할 ACK/NACK PUCCH 자원들 중에서 상기 MTC 그룹 내 해당 MTC UE가 사용할 ACK/NACK PUCCH 자원의 식별에 사용된다. 도 7은 MTC UE i(i=1,2,...,N)에 PUCCH 자원 인덱스 i(i=1,2,...,N)가 할당된 경우를 예시한 것이다.

[90] 본 발명에서 MTC UE에게 할당된 PUCCH 자원 식별 정보는 해당 셀에서 사용되는 전체 PUCCH 자원들 중 일 PUCCH 자원을 식별한다기보다는 일부 PUCCH 자원들 중에서 일 PUCCH 자원을 식별한다는 점에서, PDCCH의 CCE 인덱스와 링크된 기존의 PUCCH 자원 인덱스와 차이가 있다. 다시 말해, 기존 PUCCH 자원 인덱스들이 해당 셀에서 사용되는 PUCCH 자원들에 정적 혹은 준-정적으로 링크된 절대적 인덱스들 혹은 물리적 인덱스들이라면, 본 발명의 PUCCH 자원 식별 정보들은 특정 PUCCH 자원들과 정적 혹은 준-정적으로 각각 링크된 것이 아니라, MTC 그룹 내 MTC UE들에 준-정적으로 할당된 논리적 인덱스들이라고 볼 수 있다. 본 발명에 따라 MTC 그룹 내 UE별로 할당되는 PUCCH 자원 식별 정보는 일부 PUCCH 자원들 중에서 일 PUCCH 자원을 식별하므로, 기존 PUCCH 자원 인덱스에 비해 그 크기가 상대적으로 작다. 즉, 본 발명의 MTC UE별 PUCCH 자원 식별 정보로서 PUCCH 자원 인덱스가 사용되는 경우, 본 발명의 MTC UE별 PUCCH 자원 인덱스는 기존 PUCCH 자원 인덱스와 비교하면 짧은 인덱스(short index)가 되며, 기존 PUCCH 자원 인덱스는 본 발명의 MTC UE별 PUCCH 자원 인덱스에 비해 긴(long index)가 된다. 따라서, 본 발명에 의하면, 기존 PUCCH 자원 인덱스들을 이용하여 MTC 그룹을 위한 PUCCH 자원들을 준-정적으로 미리 예약하는 i)의 경우에 비해 시그널링 오버헤드가 감소될 수 있다.

[91] 한편, 본 발명에서 MTC 그룹 내 각 UE가 사용할 실제 ACK/NACK PUCCH 자원들은 동적으로 할당된다(S720). 이하, MTC 그룹을 위한 ACK/NACK PUCCH 자원들의 모음을 MTC 그룹을 위한 ACK/NACK 자원 영역이라 칭한다. 본 발명의 BS는 MTC 그룹의 ACK/NACK 전송을 위한 ACK/NACK 자원 영역을 설정하고, 상기 ACK/NACK 자원 영역에 대한 정보(이하, ACK/NACK 자원 정보 혹은 PUCCH 자원 정보)를 동적으로 상기 MTC 그룹에 전송할 수 있다. ACK/NACK 자원 영역은 ACK/NACK 전송에 사용되는 하나 이상의 RB로 구성될 수 있으며, 이 경우, ACK/NACK 신호의 전송에 이용되는 상기 하나 이상의 RB(이하, ACK/NACK RB) 영역을 지시하는 정보가 BS로부터 MTC 그룹에게 전송될 수 있다. BS는 MTC 그룹을 위한 PUCCH 자원들 중에서 첫번째 PUCCH 자원의 인덱스를 ACK/NACK 자원 정보로서 상기 MTC 그룹에 전송할 수 있다. 상기 첫번째 PUCCH 자원을 지시하는 인덱스는 해당 셀에서 사용되는 복수의 PUCCH 자원들 중 일 PUCCH 자원에 부여된 일종의 물리적 인덱스로서, 앞서 언급한 ACK/NACK 자원 식별 정보에 의해 MTC 그룹의 각 UE에게 할당되는 논리적 인덱스와는 다르다.

[92] 본 발명에서 MTC 그룹에 대한 상기 ACK/NACK 자원 식별 정보는 복수의 서브프레임에 해당하는 시간 구간 동안 해당 설정이 유지된다는 점에서 준-정적인 정보이고, MTC 그룹을 위한 ACK/NACK PUCCH 자원들을 지시하는 정보인 ACK/NACK 자원 정보는 PDCCH 혹은 PDSCH에 의해 상대적으로 적은 개수(예를 들어, 1개)의 서브프레임에 해당하는 시간 구간 동안에만 유효하다는 점에서 동적인 정보로 볼 수 있다.

[93] 상기 ACK/NACK 자원 정보는 예를 들어 다음과 같은 방법들 중 하나를 사용하여 BS로부터 UE에게 전송될 수 있다. 다시 말해, ACK/NACK 자원 영역이 다음과 같은 방법들 중 하나에 따라 일 MTC 그룹에 할당될 수 있다.

[94] ■ 방법 1: DL 그랜트 PDCCH를 통한 ACK/NACK 자원 영역 할당

[95] DL 그랜트 PDCCH를 통해 MTC 그룹을 위한 ACK/NACK 자원 정보가 BS로부터 상기 MTC 그룹에게 전송될 수 있다. 본 발명의 방법 1에 따른 BS는 DL 그랜트 PDCCH가 스케줄링하는 MTC 그룹의 PDSCH에 대한 ACK/NACK의 전송을 위한 ACK/NACK RB 영역 혹은 첫번째 ACK/NACK PUCCH 자원을 상기 DL 그랜트 PDCCH를 통해 상기 MTC 그룹에게 알려줄 수 있다.

[96] PDCCH를 통해 MTC 그룹을 위한 ACK/NACK 자원 영역이 할당되는 경우, PDCCH의 CCE에 링크된 ACK/NACK PUCCH 자원(이하, 암묵적 PUCCH 자원)이 존재한다. PDCCH의 CCE에 링크된 ACK/NACK PUCCH 자원이 사용되지 않고 낭비되는 것을 방지하기 위하여, 상기 MTC 그룹에 속한 하나 이상의 UE는 예외적으로 상기 암묵적 PUCCH 자원을 사용하도록 설정될 수 있다. 암묵적 PUCCH 자원을 사용하는 UE는 BS에 의해 명시적으로 지시될 수도 있고, 혹은 특정 UE(예를 들어, 해당 MTC 그룹 내 첫번째 혹은 마지막 MTC UE)가 암묵적 PUCCH 자원을 사용하도록 미리 정의될 수도 있다.

[97] ■ 방법 2: PDSCH를 통한 ACK/NACK 자원 영역 할당

[98] DL 그랜트 PDCCH가 스케줄링하는 MTC 그룹의 PDSCH를 통해 상기 MTC 그룹을 위한 ACK/NACK 자원 영역에 관한 정보인 ACK/NACK 자원 정보가 BS로부터 상기 MTC 그룹에게 전송될 수 있다. 본 발명의 방법 2에 따른 BS는 DL 그랜트 PDCCH가 스케줄링하는 MTC 그룹의 PDSCH 내 페이로드(payload)를 통해 상기 PDSCH에 대한 ACK/NACK의 전송을 위한 ACK/NACK RB 영역 혹은 첫번째 ACK/NACK PUCCH 자원을 상기 MTC 그룹에게 알려줄 수 있다.

[99] 이때, ACK/NACK 자원 정보는 DL 데이터 부분(part)과 조인트 부호화(joint coding)되거나 혹은 DL 데이터 부분과는 별개로 분리 부호화(separate coding)되어, PDSCH를 통해 BS로부터 UE에게 전송될 수 있다. ACK/NACK 자원 정보가 DL 데이터 부분과 조인트 부호화되는 경우, UE가 PDSCH를 통하여 하향링크 신호를 성공적으로 수신하였다고 판단, 즉, ACK으로 판정하는 경우에만 상기 ACK/NACK 자원 정보를 검출할 수 있다. 따라서, 이 경우, MTC UE는 ACK 혹은 DTX만을 BS에게 피드백하게 될 것이다. ACK/NACK 자원 정보가 DL 데이터 부분과 조인트 부호화되는 경우, BS는 상기 DL 데이터의

재전송시 HARQ 컴바이닝(combining)을 수행하지 않으면서 ACK/NACK 자원 영역을 변경하거나, 혹은 ACK/NACK 자원 영역은 변경하지 않은 채로 HARQ 컴바이닝을 수행하는 것도 가능하다.

[100] ■ 방법 3: ACK/NACK 그랜트 PDCCH를 통한 ACK/NACK 자원 영역 할당

[101] ACK/NACK PUCCH 자원들의 모음인 ACK/NACK 자원 영역을 지시하는 정보인 ACK/NACK 자원 정보를 나르도록 별도의 PDCCH가 정의될 수 있다. 즉, 하향링크 데이터에 대한 하향링크 제어정보의 전송에 이용되는 DL 그랜트 PDCCH와는 별도로 ACK/NACK 자원 정보의 전송을 위한 PDCCH가 별도로 정의될 수 있다. 이하, ACK/NACK PUCCH 자원들의 모음인 ACK/NACK 자원 영역을 지시하는 ACK/NACK 자원 정보를 나르도록 별도로 정의된 PDCCH를 ACK/NACK 그랜트 PDCCH라 칭한다. ACK/NACK 그랜트 PDCCH를 위해, MTC 그룹에 ACK/NACK 자원의 할당을 위해 별도로 설정된 ACK/NACK-전용 DCI 포맷이 사용되거나 혹은 일반적인 UL 그랜트용 DCI 포맷이 (수정되어) 재사용될 수 있다. ACK/NACK 그랜트 PDCCH와 일반적인 UL 스케줄링용 PDCCH(즉, UL 그랜트 PDCCH)는 서로 다른 MTC 그룹 ID(예를 들어, RNTI)에 의해 구분되거나, 혹은 서로 다른 페이로드 크기(size)를 갖는 DCI 포맷에 의해 구분되거나, 혹은 해당 PDCCH를 통해 전송된 DCI가 UL 그랜트용인지 아니면 ACK/NACK 자원 영역 할당용인지를 설정하는 별도의 지시 플래그(혹은 특정 필드 값들의 조합)에 의해 구분될 수 있다.

[102] 본 발명의 방법 3에 따른 BS는 ACK/NACK 그랜트 PDCCH를 통해 MTC 그룹의 PDSCH에 대한 ACK/NACK의 전송을 위한 ACK/NACK RB 영역 혹은 첫번째 ACK/NACK PUCCH 자원을 상기 MTC 그룹에게 알려줄 수 있다. ACK/NACK 그랜트 PDCCH가 나르는 DCI는 ACK/NACK 자원 정보 외에 ACK/NACK 전송 전력을 조절하기 위한 TPC(transmit power control) 명령 등을 공통적(common)으로 혹은 UE-특정적으로 더 포함할 수 있다.

[103] ACK/NACK 그랜트 PDCCH를 통해 MTC 그룹을 위한 ACK/NACK 자원 영역이 할당되는 경우, ACK/NACK 그랜트 PDCCH의 CCE에 링크된 ACK/NACK PUCCH 자원(이하, 암묵적 PUCCH 자원)이 존재할 수 있다. 상기 암묵적 PUCCH 자원이 사용되지 않고 낭비되는 것을 방지하기 위하여, 상기 MTC 그룹에 속한 하나 이상의 UE는 예외적으로 상기 암묵적 PUCCH 자원을 사용하도록 설정될 수 있다. 암묵적 PUCCH 자원을 사용하는 UE는 BS에 의해 명시적으로 지시될 수도 있고, 혹은 특정 UE(예를 들어, 해당 MTC 그룹 내 첫번째 혹은 마지막 MTC UE)가 암묵적 PUCCH 자원을 사용하도록 미리 정의될 수도 있다.

[104] 본 발명의 UE는 상기 UE에게 준-정적으로 할당/설정된 ACK/NACK PUCCH 자원 식별 정보를 포함하는 (상위 계층) 신호를 BS로부터 수신할 수 있고(S710), 전술한 방법들 중 어느 하나에 따라 BS로부터 ACK/NACK 자원 정보를 수신할 수 있다(S720). 상기 UE는 ACK/NACK PUCCH 자원 식별 정보를 이용하여 상기 ACK/NACK 자원 영역에 포함된 ACK/NACK PUCCH 자원들 중에서 상기 UE를

위한 ACK/NACK PUCCH 자원을 식별할 수 있다. BS가 ACK/NACK RB 영역을 지시함으로써 ACK/NACK 자원 영역을 MTC 그룹에 할당하는 경우, 상기 MTC 그룹 내 각 UE는 상기 MTC 그룹에 할당된 상기 ACK/NACK RB 영역만을 대상으로 PUCCH(혹은 RB/OCC/CCS) 인덱싱을 적용(700a)했을 때 자신에게 지정된 혹은 할당된 PUCCH 자원 인덱스/순서(혹은 RB 인덱스/OCC/CCS 조합)와 일치하는 PUCCH 자원(700b)을 사용하여, 자신의 PDSCH를 통해 수신한 DL 데이터에 대한 ACK/NACK 신호를 상기 BS에게 전송할 수 있다(S730). BS가 첫번째 ACK/NACK PUCCH를 이용하여 ACK/NACK 자원 영역을 MTC 그룹에 할당하는 경우, 상기 MTC 그룹 내 각 UE는 상기 첫번째 ACK/NACK PUCCH 자원을 시작으로 PUCCH 자원들을 순차적으로 인덱싱하고(700a), 상기 PUCCH 자원들 중 자신에게 할당된 PUCCH 자원 인덱스/순서와 일치하는 PUCCH 자원(700b)을 이용하여, 자신의 PDSCH를 통해 수신한 DL 데이터와 연관된 ACK/NACK 신호를 상기 BS에게 전송할 수 있다(S730). 예를 들어, MTC UE i(i=1,2,...,N)에 PUCCH 자원 인덱스 i(i=1,2,...,N)가 준-정적으로 할당되었다고 가정하고 도 7을 참조하면, MTC UE n(여기서, 1≤n≤N인 정수)은 해당 MTC 그룹을 위한 ACK/NACK 자원 영역에 포함된 PUCCH 자원들 중에서 상기 MTC UE n에 할당된 PUCCH 자원 인덱스 n에 해당하는 PUCCH 자원을 상기 MTC UE n의 ACK/NACK 신호의 전송을 위한 PUCCH 자원인 것으로 판단할 수 있다.

[105] 전술한 본 발명의 방법 3에 있어서, PDSCH를 스케줄링 받지 않은 (혹은, 해당 PDSCH를 스케줄링하는 DL 그랜트 PDCCH 검출에 실패한) MTC UE가 ACK/NACK 자원 정보를 수신한 경우에는 A) ACK/NACK 피드백을 생략(즉, DTX)하거나, 혹은 B) NACK 신호를 BS에게 전송할 수 있다. A)의 경우, BS는 해당 MTC UE가 PDSCH를 스케줄링하는 DL 그랜트 PDCCH의 검출에 실패해서 ACK/NACK 피드백을 수행하지 않은 것인지 아니면 ACK/NACK 자원 정보를 나르는 ACK/NACK 그랜트 PDCCH의 검출에 실패해서 ACK/NACK 피드백을 전송하지 않은 것인지 구분할 수 없다. 그러나, A)의 경우, BS는 상기 ACK/NACK 자원 정보에 따라 해당 MTC UE에게 할당된 PUCCH 자원을 상기 해당 MTC UE가 속한 MTC 그룹과는 다른 MTC 그룹에 속하면서 PDSCH가 스케줄링된 타 MTC UE에 할당하더라도 상기 해당 MTC UE의 ACK/NACK 신호와 상기 타 MTC UE의 ACK/NACK 신호 간 충돌이 방지될 수 있다. 한편, B)의 경우, BS는 해당 MTC UE가 PDSCH를 스케줄링하는 DL 그랜트 PDCCH의 검출에 실패하여 NACK을 전송한 것인지 아니면 PDSCH를 통한 신호의 수신/복호 결과가 NACK으로 판정되어 NACK을 정송한 것인지 구분할 수 없다. 그러나, B)의 경우, BS는 해당 MTC UE가 ACK/NACK 자원 정보를 나르는 ACK/NACK 그랜트 PDCCH의 검출에 싱공했음은 인지할 수 있으므로, 상기 BS는 ACK/NACK 자원 정보의 재할당이라는 불필요한 과정을 수행하지 않고 바로 PDSCH 재전송을 수행할 수 있다. B)의 경우, 해당 MTC UE는 ACK/NACK 그랜트 PDCCH의 검출에는 성공했으므로 상기 PDCCH를 통해 수신한

ACK/NACK 자원 정보를 기반으로 ACK/NACK을 전송하면 된다.

[106] 전술한 본 발명의 실시예들에 있어서, BS는 ACK/NACK 자원 정보를 수신한 MTC 그룹 내 UE들 중에서 실제로 ACK/NACK 전송이 요구되는 혹은 ACK/NACK 전송이 금지되는 MTC UE를 선택/지정하고, 상기 선택 혹은 지정된 MTC UE(들)을 지시하는 정보를 DL 그랜트 PDCCH 혹은 PDSCH 혹은 ACK/NACK 그랜트 PDCCH를 통해 상기 MTC 그룹에 전송하는 것도 가능하다. 상기 선택 혹은 지정된 MTC UE(들)을 지시하는 상기 정보 비트맵 등의 형태로 구성될 수 있다. 이때 사용되는 각 MTC UE의 인덱스 혹은 각 MTC UE에 대응되는 비트맵 내 비트 위치 등은 RRC 시그널링 등을 통해 설정되거나, 혹은 별도의 시그널링없이 본 발명에 따라 MTC UE 별로 지정된 PUCCH 자원 인덱스/순서 혹은 RB 인덱스/OCC/CCS 조합에 의해 순차적으로 결정될 수 있다.

[107] 또한, 전술한 본 발명의 실시예들에 있어서, 하나의 PDCCH를 통해 복수 MTC UE들에 대한 하향링크 데이터가 스케줄링되는 MTC 그룹(이하. DL-MTC 그룹)과 하나의 PDCCH를 통해 복수 MTC UE들에 대한 ACK/NACK 자원 정보가 할당되는 MTC 그룹(이하. A/N-MTC 그룹)은 동일하게 혹은 독립적으로 설정될 수 있다. BS는 하나의 A/N-MTC 그룹이 복수의 DL-MTC 그룹을 포함하거나 혹은 반대로 하나의 DL-MTC 그룹이 복수의 A/N-MTC 그룹을 포함하거나 혹은 하나의 DL-MTC 그룹이 하나의 A/N-MTC 그룹에 일대일로 대응되도록 MTC 그룹(들)을 설정할 수 있다. 한편, PDSCH를 통한 신호 전송 및/또는 ACK/NACK 피드백 자유도를 높이기 위해, BS는 하나의 MTC UE가 하나 이상의 DL-MTC 그룹 및/또는 하나 이상의 A/N-MTC 그룹에 속하도록 MTC 그룹(들)을 설정할 수도 있다.

[108] 또한, 하나의 PDCCH를 통해 복수 MTC UE들에 대한 하향링크 데이터를 스케줄링 받는 DL-MTC 그룹과 하나의 PDCCH를 통해 복수 MTC UE들에 대한 상향링크 데이터 전송 자원 정보를 수신하는 MTC 그룹(이하, UL-MTC 그룹)은 동일하게 혹은 독립적으로 설정될 수 있다. BS는 하나의 UL-MTC 그룹이 복수의 DL-MTC 그룹을 포함하거나 혹은 반대로 하나의 DL-MTC 그룹이 복수의 UL-MTC 그룹을 포함하거나 혹은 하나의 DL-MTC 그룹이 하나의 UL-MTC 그룹에 일대일로 대응되도록 MTC 그룹(들)을 설정할 수 있다. 한편, PDSCH를 통한 신호 전송 및/또는 PUSCH를 통한 신호 전송의 자유도를 높이기 위해, BS는 하나의 MTC UE가 하나 이상의 DL-MTC 그룹 및/또는 하나 이상의 UL-MTC 그룹에 속하도록 MTC 그룹(들)을 설정할 수 있다.

[109] 도 8은 본 발명을 수행하는 전송장치(10) 및 수신장치(20)의 구성요소를 나타내는 블록도이다.

[110] 전송장치(10) 및 수신장치(20)는 정보 및/또는 데이터, 신호, 메시지 등을 나르는 무선 신호를 전송 또는 수신할 수 있는 RF(Radio Frequency) 유닛(13, 23)과, 무선통신 시스템 내 통신과 관련된 각종 정보를 저장하는 메모리(12, 22), 상기 RF 유닛(13, 23) 및 메모리(12, 22)등의 구성요소와 동작적으로 연결되어,

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상기 구성요소를 제어하여 해당 장치가 전술한 본 발명의 실시예들 중 적어도 하나를 수행하도록 메모리(12, 22) 및/또는 RF 유닛(13,23)을 제어하도록 구성된 프로세서(11, 21)를 각각 포함한다.

[111] 메모리(12, 22)는 프로세서(11, 21)의 처리 및 제어를 위한 프로그램을 저장할 수 있고, 입/출력되는 정보를 임시 저장할 수 있다. 메모리(12, 22)가 버퍼로서 활용될 수 있다.

[112] 프로세서(11, 21)는 통상적으로 전송장치 또는 수신장치 내 각종 모듈의 전반적인 동작을 제어한다. 특히, 프로세서(11, 21)는 본 발명을 수행하기 위한 각종 제어 기능을 수행할 수 있다. 프로세서(11, 21)는 컨트롤러(controller), 마이크로 컨트롤러(microcontroller), 마이크로 프로세서(microprocessor), 마이크로 컴퓨터(microcomputer) 등으로도 불릴 수 있다. 프로세서(11, 21)는 하드웨어(hardware) 또는 펌웨어(firmware), 소프트웨어, 또는 이들의 결합에 의해 구현될 수 있다. 하드웨어를 이용하여 본 발명을 구현하는 경우에는, 본 발명을 수행하도록 구성된 ASICs(application specific integrated circuits) 또는 DSPs(digital signal processors), DSPDs(digital signal processing devices), PLDs(programmable logic devices), FPGAs(field programmable gate arrays) 등이 프로세서(400a, 400b)에 구비될 수 있다. 한편, 펌웨어나 소프트웨어를 이용하여 본 발명을 구현하는 경우에는 본 발명의 기능 또는 동작들을 수행하는 모듈, 절차 또는 함수 등을 포함하도록 펌웨어나 소프트웨어가 구성될 수 있으며, 본 발명을 수행할 수 있도록 구성된 펌웨어 또는 소프트웨어는 프로세서(11, 21) 내에 구비되거나 메모리(12, 22)에 저장되어 프로세서(11, 21)에 의해 구동될 수 있다.

[113] 전송장치(10)의 프로세서(11)는 상기 프로세서(11) 또는 상기 프로세서(11)와 연결된 스케줄러로부터 스케줄링되어 외부로 전송될 신호 및/또는 데이터에 대하여 소정의 부호화(coding) 및 변조(modulation)를 수행한 후 RF 유닛(13)에 전송한다. 예를 들어, 프로세서(11)는 전송하고자 하는 데이터 열을 역다중화 및 채널 부호화, 스크램블링, 변조과정 등을 거쳐 K개의 레이어로 변환한다. 부호화된 데이터 열은 코드워드로 지칭되기도 하며, MAC 계층이 제공하는 데이터 블록인 전송 블록과 등가이다. 일 전송블록(transport block, TB)은 일 코드워드로 부호화되며, 각 코드워드는 하나 이상의 레이어의 형태로 수신장치에 전송되게 된다. 주파수 상향 변환을 위해 RF 유닛(13)은 오실레이터(oscillator)를 포함할 수 있다. RF 유닛(13)은 N_t개(N_t는 1보다 이상의 양의 정수)의 전송 안테나를 포함할 수 있다.

[114] 수신장치(20)의 신호 처리 과정은 전송장치(10)의 신호 처리 과정의 역으로 구성된다. 프로세서(21)의 제어 하에, 수신장치(20)의 RF 유닛(23)은 전송장치(10)에 의해 전송된 무선 신호를 수신한다. 상기 RF 유닛(23)은 N_r개의 수신 안테나를 포함할 수 있으며, 상기 RF 유닛(23)은 수신 안테나를 통해 수신된 신호 각각을 주파수 하향 변환하여(frequency down-convert) 기저대역 신호로 복원한다. RF 유닛(23)은 주파수 하향 변환을 위해 오실레이터를 포함할 수 있다.

상기 프로세서(21)는 수신 안테나를 통하여 수신된 무선 신호에 대한 복호(decoding) 및 복조(demodulation)를 수행하여, 전송장치(10)가 본래 전송하고자 했던 데이터를 복원할 수 있다.

[115] RF 유닛(13, 23)은 하나 이상의 안테나를 구비한다. 안테나는, 프로세서(11, 21)의 제어 하에 본 발명의 일 실시예에 따라, RF 유닛(13, 23)에 의해 처리된 신호를 외부로 전송하거나, 외부로부터 무선 신호를 수신하여 RF 유닛(13, 23)으로 전달하는 기능을 수행한다. 안테나는 안테나 포트로 불리기도 한다. 각 안테나는 하나의 물리 안테나에 해당하거나 하나보다 많은 물리 안테나 요소(element)의 조합에 의해 구성될 수 있다. 각 안테나로부터 전송된 신호는 수신장치(20)에 의해 더 이상 분해될 수 없다. 해당 안테나에 대응하여 전송된 참조신호(reference signal, RS)는 수신장치(20)의 관점에서 본 안테나를 정의하며, 채널이 일 물리 안테나로부터의 단일(single) 무선 채널인지 혹은 상기 안테나를 포함하는 복수의 물리 안테나 요소(element)들로부터의 합성(composite) 채널인지에 관계없이, 상기 수신장치(20)로 하여금 상기 안테나에 대한 채널 추정을 가능하게 한다. 즉, 안테나는 상기 안테나 상의 심볼을 전달하는 채널이 상기 동일 안테나 상의 다른 심볼이 전달되는 상기 채널로부터 도출될 수 있도록 정의된다. 복수의 안테나를 이용하여 데이터를 송수신하는 다중 입출력(Multi-Input Multi-Output, MIMO) 기능을 지원하는 RF 유닛의 경우에는 2개 이상의 안테나와 연결될 수 있다.

[116] 본 발명의 실시예들에 있어서, UE는 상향링크에서는 전송장치(10)로 동작하고, 하향링크에서는 수신장치(20)로 동작한다. 본 발명의 실시예들에 있어서, BS는 상향링크에서는 수신장치(20)로 동작하고, 하향링크에서는 전송장치(10)로 동작한다. 이하, UE에 구비된 프로세서, RF 유닛 및 메모리를 UE 프로세서, UE RF 유닛 및 UE 메모리라 각각 칭하고, BS에 구비된 프로세서, RF 유닛 및 메모리를 BS 프로세서, BS RF 유닛 및 BS 메모리라 각각 칭한다.

[117] 본 발명의 실시예들에 따라, BS 프로세서는 PDCCH 및 PDSCH, PHICH를 전송하도록 BS RF 유닛을 제어하며, UE 프로세서는 PDCCH 및 PDSCH, PHICH를 수신하도록 UE RF 유닛을 제어한다. 본 발명의 실시예들에 따라, UE 프로세서는 PUCCH 및 PUSCH를 전송하도록 BS RF 유닛을 제어하며, BS 프로세서는 PUCCH 및 PUSCH를 수신하도록 BS RF 유닛을 제어한다.

[118] 본 발명의 BS 프로세서는 MTC 그룹 내 복수 MTC UE 각각이 사용할 ACK/NACK PUCCH 자원 식별 정보를 준-정적(semi-static)으로 지정/설정할 수 있다. 상기 PUCCH 자원 식별 정보는 상기 BS 프로세서의 상위 계층에 의해 설정될 수 있다. 도 7을 참조하면, 상기 BS 프로세서는 상기 PUCCH 자원 식별 정보를 상기 MTC 그룹에 속한 하나 이상의 UE에게 전송하도록 상기 BS RF 유닛을 제어할 수 있다(S710). 본 발명의 BS 프로세서는 MTC 그룹 내 복수 MTC UE들 각각을 위한 복수의 ACK/NACK PUCCH 자원 식별 정보를 포함하는 (상위 계층) 신호를 상기 MTC 그룹 내 상기 복수 MTC UE들에 전송하도록 상기 BS RF

유닛을 제어할 수 있다. 혹은, 본 발명의 BS 프로세서는 상기 MTC 그룹 내 특정 MTC UE를 위한 PUCCH 자원 식별 정보를 포함하는 (상위 계층) 신호를 상기 특정 MTC UE에게 전송하도록 상기 RF 유닛을 제어할 수 있다.

[119] 한편, 본 발명의 BS 프로세서는 MTC 그룹을 위한 ACK/NACK PUCCH 자원들의 모음인 ACK/NACK 자원 영역을 동적으로 설정/할당할 수 있다(S720). 상기 BS 프로세서는 상기 설정/할당된 ACK/NACK 자원 영역을 나타내는 정보인 ACK/NACK 자원 정보를 상기 MTC 그룹에 속한 UE(들)에 전송하도록 상기 BS RF 유닛을 제어할 수 있다. 상기 BS 프로세서는 상기 ACK/NACK 자원 정보를 DL 그랜트 PDCCH 혹은 상기 DL 그랜트 PDCCH에 의해 스케줄링되는 PDSCH 혹은 ACK/NACK 자원 정보의 전송을 위해 별도로 정의된 ACK/NACK 그랜트 PDCCH를 통해 전송하도록 상기 BS RF 유닛을 제어할 수 있다.

[120] 본 발명의 UE RF 유닛은, UE 프로세서의 제어 하에, 해당 UE에게 준-정적으로 할당/지정된 ACK/NACK PUCCH 자원 식별 정보를 포함하는 (상위 계층) 신호를 BS로부터 수신할 수 있고(S710) 전술한 방법들 중 어느 하나에 따라 ACK/NACK 자원 정보를 PDCCH 혹은 PDSCH를 통해 상기 BS로부터 수신할 수 있다(S720). 상기 UE 프로세서는 상기 PUCCH 자원 식별 정보와 상기 ACK/NACK 자원 정보를 기반으로 상기 BS로부터 수신한 DL 데이터에 대한 ACK/NACK 정보를 상기 BS에게 전송하도록 UE RF 유닛으로 제어할 수 있다. 상기 UE 프로세서는 상기 ACK/NACK 자원 정보에 의해 지시된 ACK/NACK PUCCH 자원들 중에서 상기 UE에게 할당된 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 ACK/NACK 정보를 전송하도록 상기 UE RF 유닛을 제어할 수 있다. 상기 ACK/NACK 자원 정보가 ACK/NACK RB 영역을 지시하는 정보인 경우, 상기 UE 프로세서는 상기 UE가 속한 MTC 그룹에 할당된 상기 ACK/NACK RB 영역만을 대상으로 PUCCH(혹은 RB/OCC/CCS) 인덱싱을 적용할 수 있다(700a). 상기 UE 프로세서는 상기 UE에게 스케줄링된 PDSCH를 통해 수신한 DL 데이터에 대한 ACK/NACK 신호를 상기 UE에게 지정된 혹은 할당된 PUCCH 자원 인덱스/순서(혹은 RB 인덱스/OCC/CCS 조합)와 일치하는 PUCCH 자원(700b)을 사용하여 상기 BS에게 전송하도록 상기 UE RF 유닛을 제어할 수 있다. 상기 ACK/NACK 정보가 첫번째 ACK/NACK PUCCH를 지시하는 정보인 경우, 상기 UE 프로세서는 상기 UE가 속한 MTC 그룹에 할당된 상기 첫번째 ACK/NACK PUCCH 자원을 시작으로 PUCCH 자원들을 순차적으로 인덱싱할 수 있다(700a). 상기 UE 프로세서는 PDSCH를 통해 수신한 상기 UE의 DL 데이터와 연관된 ACK/NACK 신호를 상기 PUCCH 자원들 중에서 상기 UE에게 할당된 PUCCH 자원 인덱스/순서와 일치하는 PUCCH 자원(700b)을 이용하여 상기 BS에게 전송하도록 상기 UE RF 유닛을 제어할 수 있다(S730).

[121] 복수의 UE들과 BS간 통신에 본 발명에서의 제안한 실시예들을 적용하면 보다 효율적인 ACK/NACK 피드백 전송이 가능하다. 본 발명은 복수 MTC UE들과 BS간의 저속 통신뿐 아니라 복수의 일반 UE들과 BS간의 다양한 형태/목적의

통신에도 응용 가능함은 앞서 언급한 바 있다.

[122] 상술한 바와 같이 개시된 본 발명의 바람직한 실시예들에 대한 상세한 설명은 당업자가 본 발명을 구현하고 실시할 수 있도록 제공되었다. 상기에서는 본 발명의 바람직한 실시예들을 참조하여 설명하였지만, 해당 기술 분야의 숙련된 당업자는 하기의 특허 청구의 범위에 기재된 본 발명의 사상 및 영역으로부터 벗어나지 않는 범위 내에서 본 발명을 다양하게 수정 및 변경시킬 수 있음을 이해할 수 있을 것이다. 따라서, 본 발명은 여기에 나타난 실시형태들에 제한되려는 것이 아니라, 여기서 개시된 원리들 및 신규한 특징들과 일치하는 최광의 범위를 부여하려는 것이다.

산업상 이용가능성

[123] 본 발명의 실시예들은 무선 통신 시스템에서, 기지국, 릴레이 또는 사용자기기, 기타 다른 장비에 사용될 수 있다.

청구범위

[청구항 1] 무선 통신 시스템에서 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기가 기지국에게 상향링크 신호를 전송함에 있어서,
상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 기지국으로부터 수신하고;
상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는 ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 기지국으로부터 수신하며;
상기 기지국으로부터 수신한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 기지국에게 전송하는,
상향링크 신호 전송방법.

[청구항 2] 제1항에 있어서,
상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보는 상기 PUCCH 자원들의 모음 내에서 일 PUCCH 자원을 식별하는 정보인,
상향링크 신호 전송방법.

[청구항 3] 제1항에 있어서,
상기 ACK/NACK 자원 정보는 상기 PUCCH 자원들의 모음 중 첫번째 PUCCH 자원을 지시하는 정보 혹은 상기 PUCCH 자원들의 모음이 점유하는 하나 이상의 자원블록을 지시하는 정보인,
상향링크 신호 전송방법.

[청구항 4] 제1항에 있어서,
상기 ACK/NACK 자원 정보가 수신되는 상기 PDCCH는 상기 하향링크 데이터에 대한 하향링크 제어정보가 전송되는 PDCCH와는 다른,
상향링크 신호 전송방법.

[청구항 5] 무선 통신 시스템에서 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기가 기지국에게 상향링크 신호를 전송함에 있어서,
신호를 전송/수신하도록 구성된 무선주파수(radio frequency, RF) 유닛; 및

상기 RF 유닛을 제어하도록 구성된 프로세서를 포함하며,
상기 프로세서는 상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 기지국으로부터 수신하도록 상기 RF 유닛을 제어하고, 상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는 ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 기지국으로부터 수신하도록 상기 RF 유닛을 제어하며, 상기 기지국으로부터 수신한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 기지국에게 전송하도록 상기 RF 유닛을 제어하는,
사용자기기.

[청구항 6] 제5항에 있어서,
상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보는 상기 PUCCH 자원들의 모음 내에서 일 PUCCH 자원을 식별하는 정보인,
사용자기기.

[청구항 7] 제5항에 있어서,
상기 ACK/NACK 자원 정보는 상기 PUCCH 자원들의 모음 중 첫번째 PUCCH 자원을 지시하는 정보 혹은 상기 PUCCH 자원들의 모음이 점유하는 하나 이상의 자원블록을 지시하는 정보인,
사용자기기.

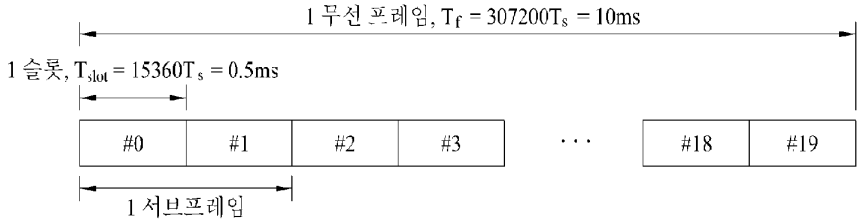
[청구항 8] 제5항에 있어서,
상기 ACK/NACK 자원 정보가 수신되는 상기 PDCCH는 상기 하향링크 데이터에 대한 하향링크 제어정보가 전송되는 PDCCH와는 다른,
사용자기기.

[청구항 9] 무선 통신 시스템에서 기지국이 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기로부터 상향링크 신호를 수신함에 있어서,
상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 사용자기기에게 전송하고;
상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는

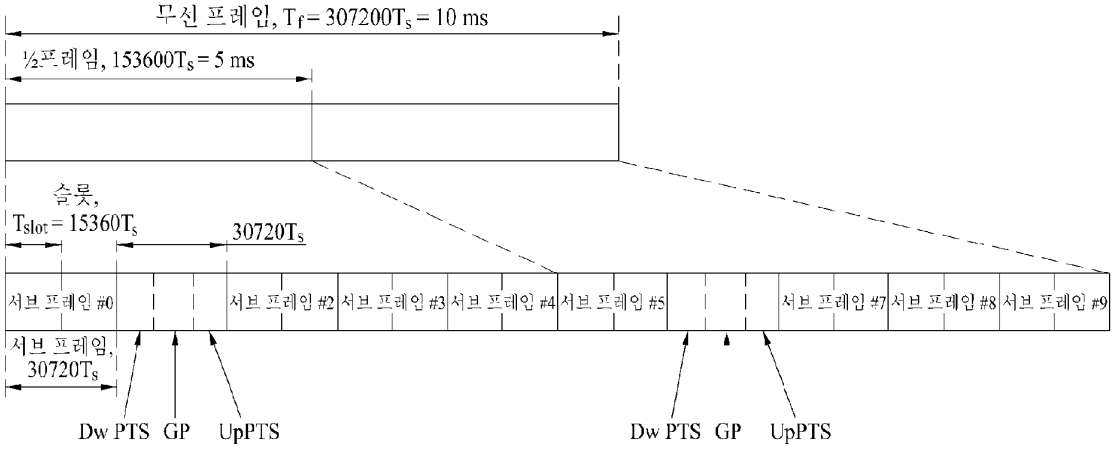
ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 사용자기기에게 전송하며;
상기 사용자기기에게 전송한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 사용자기기로부터 수신하는,
상향링크 신호 수신방법.

[청구항 10] 무선 통신 시스템에서 기지국이 복수의 사용자기기들을 포함하는 사용자기기 그룹에 포함된 사용자기기로부터 상향링크 신호를 수신함에 있어서,
신호를 전송/수신하도록 구성된 무선주파수(radio frequency, RF) 유닛; 및
상기 RF 유닛을 제어하도록 구성된 프로세서를 포함하며,
상기 프로세서는 상기 사용자기기에 할당된 PUCCH(physical uplink control channel) 자원 식별 정보를 포함하는 상위 계층 신호를 상기 사용자기기에게 전송하도록 상기 RF 유닛을 제어하고, 상기 사용자기기 그룹의 ACK/NACK(ACKnowledgement/Negative ACK) 전송에 이용가능한 PUCCH 자원들의 모음을 나타내는 ACK/NACK 자원 정보를 PDCCH(physical downlink control channel) 혹은 PDSCH(physical downlink shared channel)를 통해 상기 사용자기기에게 전송하도록 상기 RF 유닛을 제어하며, 상기 사용자기기에게 전송한 하향링크 데이터에 대한 ACK/NACK 신호를 상기 PUCCH 자원들의 모음 중에서 상기 사용자기기에 할당된 상기 PUCCH 자원 식별 정보에 대응하는 PUCCH 자원을 이용하여 상기 사용자기기로부터 수신하도록 상기 RF 유닛을 제어하는,
기지국.

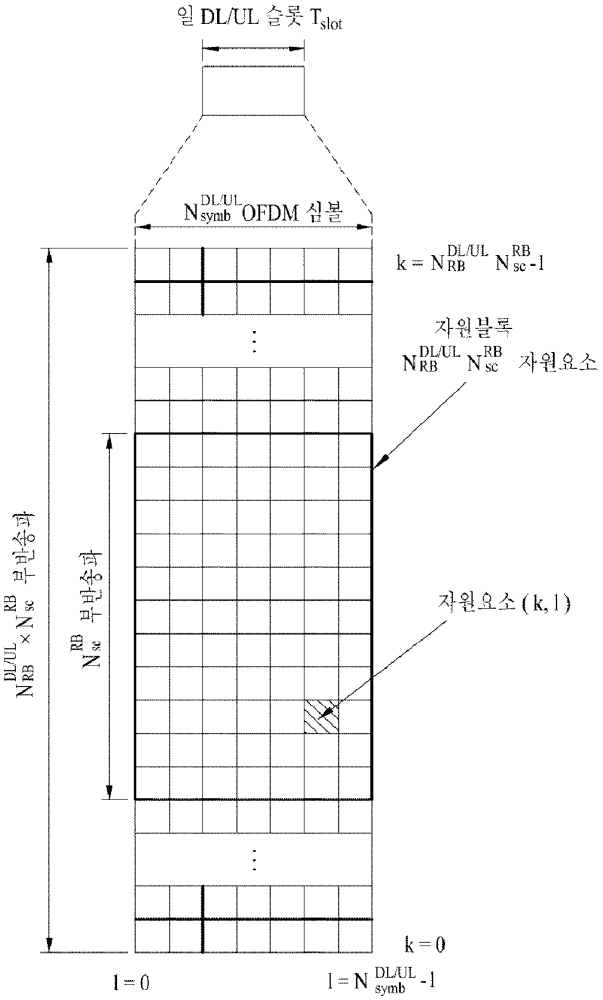
[Fig. 1]


1 무선 프레임, $T_f = 307200T_s = 10ms$
1 슬롯, $T_{slot} = 15360T_s = 0.5ms$
#0
#1
#2
#3
#18
#19
1 서브프레임

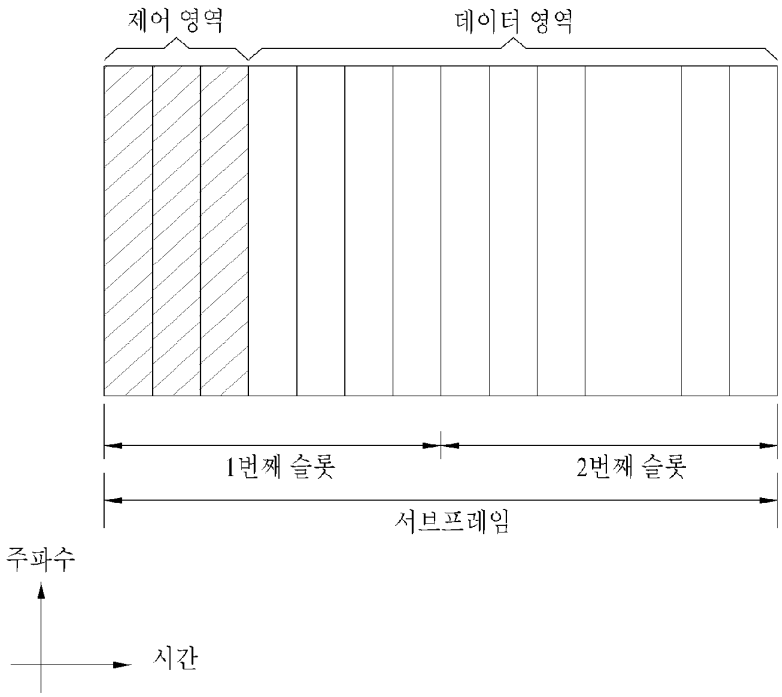
(a)


무선 프레임, $T_f = 307200T_s = 10$ ms
½프레임, $153600T_s = 5$ ms
슬롯,
$T_{slot} = 15360T_s$
$30720T_s$
서브 프레임 #0
서브 프레임 #2
서브 프레임 #3
서브 프레임 #4
서브 프레임 #5
서브 프레임 #7
서브 프레임 #8
서브 프레임 #9
서브 프레임,
$30720T_s$
Dw PTS
GP
UpPTS
Dw PTS
GP
UpPTS

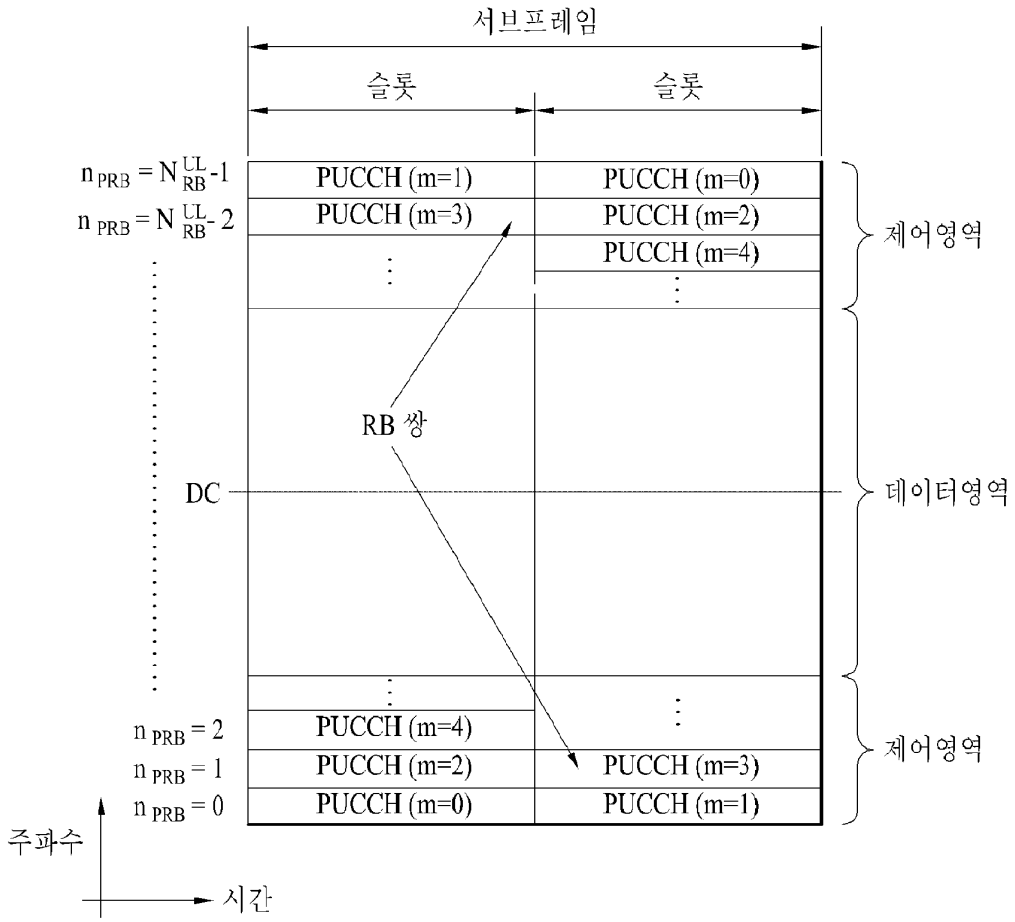
[Fig. 2]


일 DL/UL 슬롯 T_{slot}
$N_{symb}^{DL/UL}$ OFDM 심볼
$k = N_{RB}^{DL/UL} N_{sc}^{RB} - 1$
자원블록
$N_{RB}^{DL/UL} N_{sc}^{RB}$ 자원요소
$N_{RB}^{DL/UL} \times N_{sc}^{RB}$ 부반송파
N_{sc}^{RB} 부반송파
자원요소 (k, l)
k = 0
l = 0
$l = N_{symb}^{DL/UL} - 1$

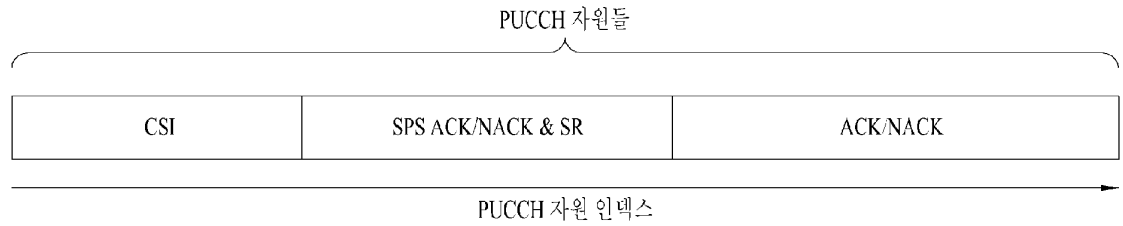
[Fig. 3]



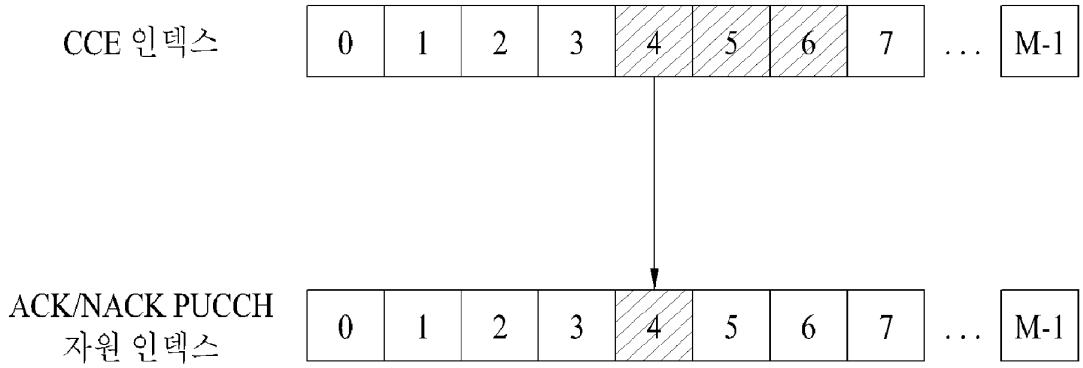
[Fig. 4]


서브프레임
슬롯
슬롯
$n_{PRB} = N_{RB}^{UL}-1$
$n_{PRB} = N_{RB}^{UL}-2$
$n_{PRB} = 2$
$n_{PRB} = 1$
$n_{PRB} = 0$
PUCCH (m=1)
PUCCH (m=0)
PUCCH (m=3)
PUCCH (m=2)
PUCCH (m=4)
PUCCH (m=4)
PUCCH (m=2)
PUCCH (m=3)
PUCCH (m=0)
PUCCH (m=1)
RB 쌍
DC
제어영역
데이터영역
제어영역
주파수
시간

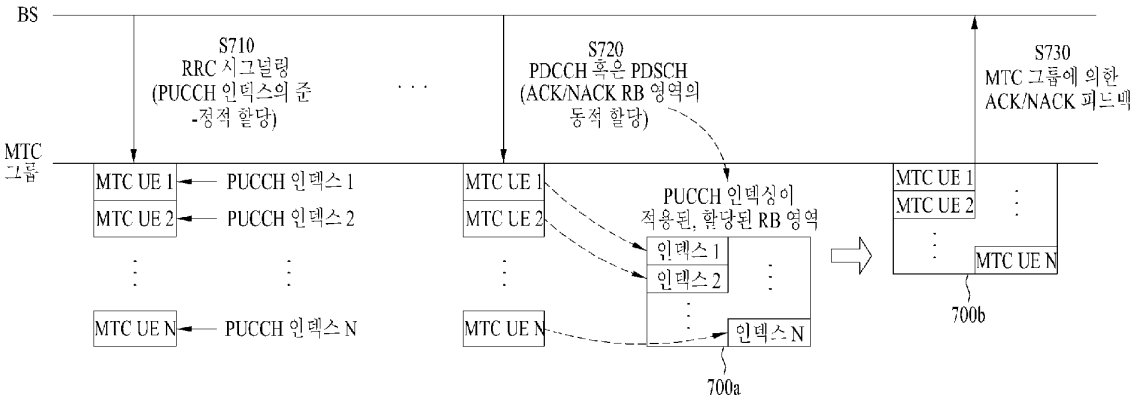
[Fig. 5]


PUCCH 자원들
CSI
SPS ACK/NACK & SR
ACK/NACK
PUCCH 자원 인덱스

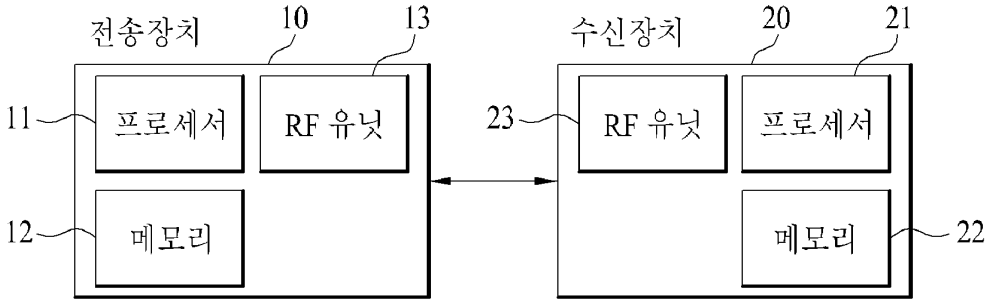
[Fig. 6]



[Fig. 7]



[Fig. 8]



Electronic Acknowledgement Receipt

EFS ID:	25312800
Application Number:	15025262
International Application Number:	
Confirmation Number:	1007
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Customer Number:	76277
Filer:	Joung Kook Park
Filer Authorized By:	
Attorney Docket Number:	811.0053
Receipt Date:	25-MAR-2016
Filing Date:	
Time Stamp:	23:04:36
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	088110053IDSForm1.pdf	612784 72e237f2fb26eb5af73fd0191652d6de577058d3	no	4
Warnings:					
Information:					

2	Foreign Reference	088110053Ref1.pdf	1802196 fe498d8ae59313fc9259d41cfeda0863b1bab882	no	37
Warnings:					
Information:					
3	Non Patent Literature	088110053Ref2nonpatent11_Part1.pdf	24483998 244d7fb4c1a130d7c05b01da66dadfb5b6433dee	no	91
Warnings:					
Information:					
4	Non Patent Literature	088110053Ref2nonpatent11_Part2.pdf	26054309 0d8efd80b2ef95281dc0a8d24ff5177d48d09b19	no	91
Warnings:					
Information:					
5	Non Patent Literature	088110053Ref3nonpatent2.pdf	443535 aea553ea0c999cfef030db4f8e17c2a7e3378350	no	3
Warnings:					
Information:					
6	Non Patent Literature	088110053Ref4nonpatent3.pdf	620043 4c27b3ffe7d96cb64f135a53b7edfe2cfec7f69c	no	3
Warnings:					
Information:					
7	Non Patent Literature	088110053Ref5nonpatent4.pdf	355000 e6ed621e377bbe6d5ced157feac0fa6b5ea7f8fd	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	54371865		

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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

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

[redacted]

대한민국 특허청
KOREAN INTELLECTUAL PROPERTY OFFICE

별첨 사본은 아래 출원의 원본과 동일함을 증명함.

This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office

출 원 번 호 : 10-2014-0057938
Application Number

출 원 년 월 일 : 2014년 05월 14일
Filing Date MAY 14, 2014

출 원 인 : 주식회사 케이티
Applicant(s) KT Corporation

2014 년 09 월 24 일

특 허 청
COMMISSIONER

[redacted]

2014-05-14

【서지사항】

【서류명】 특허출원서

【출원구분】 특허출원

【출원인】

【명칭】 주식회사 케이티

【출원인코드】 2-1998-005456-3

【대리인】

【성명】 김은구

【대리인코드】 9-1999-000318-1

【포괄위임등록번호】 2011-023059-1

【대리인】

【성명】 송해모

【대리인코드】 9-2002-000179-4

【포괄위임등록번호】 2011-023060-3

【발명의 국문명칭】 단말을 위한 상향 링크 제어 채널 자원 설정 방법 및 장치

【발명의 영문명칭】 Apparatus and methods of uplink control channel resource mapping for User Equipments

【발명자】

【성명】 박규진

【성명의 영문표기】 PARK, Kyu Jin

【주민등록번호】 811018-1XXXXXX

【우편번호】 137-140

【주소】 서울특별시 서초구 우면동 17 KT연구개발센터

【국적】 KR

【발명자】

【성명】 최우진

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Page 000146

【성명의 영문표기】 CHOI, Woo Jin

【주민등록번호】 660822-1XXXXXX

【우편번호】 137-140

【주소】 서울특별시 서초구 우면동 17 KT연구개발센터

【국적】 KR

【우선권 주장】

【출원국명】 KR

【출원번호】 10-2013-0115367

【출원일자】 2013.09.27

【증명서류】 첨부

【취지】 위와 같이 특허청장에게 제출합니다.

대리인 김은구 (서명 또는 인)

대리인 송해모 (서명 또는 인)

【수수료】

【출원료】	0	면	46,000 원
【가산출원료】	49	면	0 원
【우선권주장료】	1	건	18,000 원
【심사청구료】	0	항	0 원
【합계】	64,000 원		

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Page 000147

【명세서】

【발명의 명칭】

단말을 위한 상향 링크 제어 채널 자원 설정 방법 및 장치{Apparatus and methods of uplink control channel resource mapping for User Equipments}

【기술분야】

<1> 본 발명은 3GPP LTE/LTE-Advanced 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ(Hybrid Automatic Repeat Request) ACK/NACK 피드백을 위한 상향링크 제어 채널의 자원 할당 방안에 대해 제안한다.

【배경기술】

<2> 기계 형태 통신(machine type communication, 이하 "MTC" 통신이라 한다)이란 데이터 통신의 한 가지 형태로 하나 이상의 개체가 반드시 인간의 상호작용을 필요로 하지 않는 기기 또는 사물간 (machine to machine) 통신을 나타낸다. 인간의 상호 작용을 필요로 하지 않는 MTC 통신은 통신 과정에 인간이 개입하지 않고 통신이 이루어지는 방식의 모든 통신 방식을 지칭한다.

<3> MTC 단말은 일반 단말에 비해 전파 환경이 나쁜 장소에 설치될 수 있다. MTC 단말이 일반 단말에 비해 전파 환경이 나쁜 장소에서 동작하기 위해서는, 하나의 서브프레임 단위로만 전송되는 각 물리 채널의 제어 정보 및/또는 데이터를 복수의 서브프레임에서 반복하여 전송할 필요가 있을 수 있다.

<4> 한편, 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원

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은 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 함수로 결정될 수 있다. 하지만, 상술한 바와 같이 MTC 단말의 제어 정보 수신 성능을 높이기 위해서 제어 정보가 반복되어 전송되는 경우, MTC 단말을 위한 상향링크 제어 채널의 자원을 결정하는 방법에 불확실성이 발생할 수 있고, MTC 단말을 위한 상향링크 제어 채널의 자원과 일반 단말의 위한 상향링크 제어 채널의 자원이 충돌할 가능성이 있다.

【발명의 내용】

【해결하려는 과제】

<5> 본 발명은 상술한 문제점을 극복하기 위해 MTC 단말의 상향링크 제어 채널의 자원 할당 방안을 제공하는 것을 목적으로 한다.

【과제의 해결 수단】

<6> 본 발명의 일 실시예는, MTC(Machine Type Communication) 단말의 하향링크 데이터의 응답 정보 전송 방법으로서, 상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하는 단계; 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하는 단계; 상기 하향링크 데이터를 수신하는 단계; 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 상기 하향링크 데이터의

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응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 단계; 및 상기 결정된 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 단계를 포함하는 방법을 제공한다.

<7> 본 발명의 다른 실시예는, 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원 설정 방법으로서, 상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 송신하는 단계; 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 송신하는 단계; 및 상기 하향링크 데이터를 송신하는 단계를 포함하고, 상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 방법을 제공한다.

<8> 본 발명의 다른 실시예는, 기지국으로 하향링크 데이터의 응답 정보를 전송하는 단말로서, 상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하고, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하며, 상기 하향링크 데이터를 수신하는 수신부; 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보

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중 적어도 하나에 기초하여 상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 제어부; 및 상기 결정된 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 송신부를 포함하는 단말을 제공한다.

<9> 본 발명의 다른 실시예는, 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원을 설정하는 기지국으로서, 상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보, 및 상기 하향링크 데이터를 송신하는 송신부를 포함하고, 상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 기지국을 제공한다.

【발명의 효과】

<10> 상술한 본 발명에 따르면, MTC 단말의 상향링크 제어 채널의 자원 할당 방안을 제공할 수 있다.

【도면의 간단한 설명】

<11> 도 1은 본 발명의 실시예가 적용되는 무선 통신 시스템의 예를 도시한 도면

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이다.

도 2는 본 발명의 방안 1의 일 예에 따른 방법을 도시하는 흐름도이다.

도 3은 본 발명의 방안 1의 다른 예에 따른 방법을 도시하는 흐름도이다.

도 4는 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

도 5는 본 발명의 방안 2에 따른 방법을 도시하는 흐름도이다.

도 6은 본 발명의 방안 3에 따른 방법을 도시하는 흐름도이다.

도 7은 본 발명의 일 실시예에 따른 단말의 PUCCH 송신 방법을 도시하는 흐름도이다.

도 8은 본 발명의 일 실시예에 따른 기지국의 PUCCH 설정 방법을 도시하는 흐름도이다.

도 9는 본 발명의 일 실시예에 따른 단말의 구성을 도시하는 블록도이다.

도 10은 본 발명의 일 실시예에 따른 기지국의 구성을 도시하는 블록도이다.

【발명을 실시하기 위한 구체적인 내용】

<12> 이하, 본 발명의 일부 실시예들을 예시적인 도면을 통해 상세하게 설명한다. 각 도면의 구성요소들에 참조부호를 부가함에 있어서, 동일한 구성요소들에 대해서는 비록 다른 도면상에 표시되더라도 가능한 한 동일한 부호를 가지도록 하고 있음에 유의해야 한다. 또한, 본 발명을 설명함에 있어, 관련된 공지 구성 또는 기능에 대한 구체적인 설명이 본 발명의 요지를 흐릴 수 있다고 판단되는 경우에는 그 상

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세한 설명은 생략한다.

<13> 도 1은 본 발명의 실시예가 적용되는 무선 통신 시스템의 예를 도시한다.

<14> 본 발명에서의 무선통신시스템은 음성, 패킷 데이터 등과 같은 다양한 통신 서비스를 제공하기 위해 널리 배치된다. 무선통신시스템은 사용자 단말(User Equipment, UE)(10) 및 기지국(Base Station, BS, 또는 eNB)(20)을 포함한다. 본 명세서에서의 사용자 단말은 무선 통신에서의 단말을 의미하는 포괄적 개념으로서, WCDMA 및 LTE, HSPA 등에서의 UE(User Equipment)는 물론, GSM에서의 MS(Mobile Station), UT(User Terminal), SS(Subscriber Station), 무선기기(wireless device) 등을 모두 포함하는 개념으로 해석되어야 할 것이다.

<15> 기지국(20) 또는 셀(cell)은 일반적으로 사용자 단말(10)과 통신하는 지점(station)을 말하며, 노드-B(Node-B), eNB(evolved Node-B), 섹터(Sector), 싸이트(Site), BTS(Base Transceiver System), 액세스 포인트(Access Point), 릴레이 노드(Relay Node), RRH(Remote Radio Head), RU(Radio Unit), small cell 등 다른 용어로 불릴 수 있다.

<16> 즉, 본 명세서에서 기지국 또는 셀(cell)은 CDMA에서의 BSC(Base Station Controller), WCDMA의 NodeB, LTE에서의 eNB 또는 섹터(싸이트) 등이 커버하는 일부 영역 또는 기능을 나타내는 포괄적인 의미로 해석되어야 하며, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀 및 릴레이 노드(relay node), RRH, RU, small cell 통신범위 등 다양한 커버리지 영역을 모두 포괄하는 의미이다.

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<17> 상기 나열된 다양한 셀은 각 셀을 제어하는 기지국이 존재하므로 기지국은 두 가지 의미로 해석될 수 있다. i) 무선 영역과 관련하여 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토 셀, 스몰 셀을 제공하는 장치 그 자체이거나, ii) 상기 무선 영역 그 자체를 지시할 수 있다. i)에서 소정의 무선 영역을 제공하는 장치들이 동일한 개체에 의해 제어되거나 상기 무선 영역을 협업으로 구성하도록 상호작용하는 모든 장치들을 모두 기지국으로 지시한다. 무선 영역의 구성 방식에 따라 eNB, RRH, 안테나, RU, LPN, 포인트, 송수신포인트, 송신 포인트, 수신 포인트 등은 기지국의 일 실시예가 된다. ii) 에서 사용자 단말의 관점 또는 이웃하는 기지국의 입장에서 신호를 수신하거나 송신하게 되는 무선 영역 그 자체를 기지국으로 지시할 수 있다.

<18> 따라서, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토 셀, 스몰 셀, RRH, 안테나, RU, LPN(Low Power Node), 포인트, eNB, 송수신포인트, 송신 포인트, 수신포인트를 통칭하여 기지국으로 지칭한다.

<19> 본 명세서에서 사용자 단말과 기지국은 본 명세서에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 사용자 단말과 기지국은, 본 발명에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지(Uplink 또는 Downlink) 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 여기서, 상향링크(Uplink, UL, 또는 업링크)는 사용자 단말에 의해 기지국으로 데이터를 송수신하는 방식을 의미하

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며, 하향링크(Downlink, DL, 또는 다운링크)는 기지국에 의해 사용자 단말로 데이터를 송수신하는 방식을 의미한다.

<20> 무선통신시스템에 적용되는 다중 접속 기법에는 제한이 없다. CDMA(Code Division Multiple Access), TDMA(Time Division Multiple Access), FDMA(Frequency Division Multiple Access), OFDMA(Orthogonal Frequency Division Multiple Access), OFDM-FDMA, OFDM-TDMA, OFDM-CDMA와 같은 다양한 다중 접속 기법을 사용할 수 있다. 본 발명의 일 실시예는 GSM, WCDMA, HSPA를 거쳐 LTE 및 LTE-Advanced로 진화하는 비동기 무선통신과, CDMA, CDMA-2000 및 UMB로 진화하는 동기식 무선 통신 분야 등의 자원할당에 적용될 수 있다. 본 발명은 특정한 무선통신 분야에 한정되거나 제한되어 해석되어서는 아니 되며, 본 발명의 사상이 적용될 수 있는 모든 기술분야를 포함하는 것으로 해석되어야 할 것이다.

<21> 상향링크 전송 및 하향링크 전송은 서로 다른 시간을 사용하여 전송되는 TDD(Time Division Duplex) 방식이 사용될 수 있고, 또는 서로 다른 주파수를 사용하여 전송되는 FDD(Frequency Division Duplex) 방식이 사용될 수 있다.

<22> 또한, LTE, LTE-Advanced와 같은 시스템에서는 하나의 반송파 또는 반송파쌍을 기준으로 상향링크와 하향링크를 구성하여 규격을 구성한다. 상향링크와 하향링크는, PDCCH(Physical Downlink Control CHannel), PCFICH(Physical Control Format Indicator CHannel), PHICH(Physical Hybrid ARQ Indicator CHannel), PUCCH(Physical Uplink Control CHannel), EPDCCH(Enhanced Physical Downlink

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Control CHannel) 등과 같은 제어채널을 통하여 제어정보를 전송하고, PDSCH(Physical Downlink Shared CHannel), PUSCH(Physical Uplink Shared CHannel) 등과 같은 데이터채널로 구성되어 데이터를 전송한다.

<23> 한편 EPDCCH(enhanced PDCCH 또는 extended PDCCH)를 이용해서도 제어 정보를 전송할 수 있다.

<24> 본 명세서에서 셀(cell)은 송수신 포인트로부터 전송되는 신호의 커버리지 또는 송수신 포인트(transmission point 또는 transmission/reception point)로부터 전송되는 신호의 커버리지를 가지는 요소반송파(component carrier), 그 송수신 포인트 자체를 의미할 수 있다.

<25> 실시예들이 적용되는 무선통신 시스템은 둘 이상의 송수신 포인트들이 협력하여 신호를 전송하는 다중 포인트 협력형 송수신 시스템(coordinated multi-point transmission/reception System; CoMP 시스템) 또는 협력형 다중 안테나 전송방식(coordinated multi-antenna transmission system), 협력형 다중 셀 통신시스템일 수 있다. CoMP 시스템은 적어도 두 개의 다중 송수신 포인트와 단말들을 포함할 수 있다.

<26> 다중 송수신 포인트는 기지국 또는 매크로 셀(macro cell, 이하 'eNB'라 함)과, eNB에 광케이블 또는 광섬유로 연결되어 유선 제어되는, 높은 전송파워를 갖거나 매크로 셀영역 내의 낮은 전송파워를 갖는 적어도 하나의 RRH일 수도 있다.

<27> 이하에서 하향링크(downlink)는 다중 송수신 포인트에서 단말로의 통신 또는

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통신 경로를 의미하며, 상향링크(uplink)는 단말에서 다중 송수신 포인트으로의 통신 또는 통신 경로를 의미한다. 하향링크에서 송신기는 다중 송수신 포인트의 일부분일 수 있고, 수신기는 단말의 일부분일 수 있다. 상향링크에서 송신기는 단말의 일부분일 수 있고, 수신기는 다중 송수신 포인트의 일부분일 수 있다.

<28> 이하에서는 PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH 등과 같은 채널을 통해 신호가 송수신되는 상황을 'PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH를 전송, 수신한다'는 형태로 표기하기도 한다.

<29> 또한 이하에서는 PDCCH를 전송 또는 수신하거나 PDCCH를 통해서 신호를 전송 또는 수신한다는 기재는 EPDCCH를 전송 또는 수신하거나 EPDCCH를 통해서 신호를 전송 또는 수신하는 것을 포함하는 의미로 사용될 수 있다.

<30> 즉, 이하에서 기재하는 물리 하향링크 제어채널은 PDCCH를 의미하거나, EPDCCH를 의미할 수 있으며, PDCCH 및 EPDCCH 모두를 포함하는 의미로도 사용된다.

<31> 또한, 설명의 편의를 위하여 PDCCH로 설명한 부분에도 본 발명의 일 실시예인 EPDCCH를 적용할 수 있으며, EPDCCH로 설명한 부분에도 본 발명의 일 실시예로 EPDCCH를 적용할 수 있다.

<32> 한편, 이하에서 기재하는 상위계층 시그널링(High Layer Signaling)은 RRC 파라미터를 포함하는 RRC 정보를 전송하는 RRC시그널링을 포함한다.

<33> 기지국(20)은 단말(10)들로 하향링크 전송을 수행한다. 기지국(20)은 유니캐스트 전송(unicast transmission)을 위한 주 물리 채널인 물리 하향링크 공유채널

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(Physical Downlink Shared Channel, PDSCH), 그리고 PDSCH의 수신에 필요한 스케줄링 등의 하향링크 제어 정보 및 상향링크 데이터 채널(예를 들면 물리 상향링크 공유채널(Physical Uplink Shared Channel, PUSCH))에서의 전송을 위한 스케줄링 승인 정보를 전송하기 위한 물리 하향링크 제어채널(Physical Downlink Control Channel, PDCCH)을 전송할 수 있다. 이하에서는, 각 채널을 통해 신호가 송수신 되는 것을 해당 채널이 송수신되는 형태로 기재하기로 한다.

<34> 기존의 3GPP LTE/LTE-Advanced 시스템에서 단말의 legacy PDCCH를 통해 스케줄링된 PDSCH 수신에 대한 HARQ(Hybrid Automatic Repeat Request) ACK/NACK 피드백을 위한 PUCCH 리소스 맵핑은 아래의 식 (1), (2)와 같이 상위계층(예를 들면, RRC(Radio Resource Control)) 파라미터와 해당 하향링크 할당(DL assignment) DCI(Downlink Control Information)가 전송된 CCE(Control Channel Element) 인덱스에 의해 결정된다.

【0035】 (1) $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH}}^{(1)}$

(2) $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH}}^{(1)}$

<36> 상기의 식 (1)과 (2)는 각각 해당 단말에서 두 개의 안테나 포트(two antenna port) 전송이 지원되는 단말에서의 각각 안테나 포트 0와 안테나 포트 1에서의 HARQ ACK/NACK 피드백을 위한 PUCCH 리소스 $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ 를 지칭하며, n_{CCE}는

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해당 DL 스케줄링 그랜트(DL scheduling grant)가 전송된 최하위 CCE 인덱스 (lowest CCE index) 값을 나타내고, $N_{PUCCH}^{(1)}$ 는 상위 계층(RRC) 시그널링(higher layer(RRC) signaling)에 의해 설정된 셀 특이적 파라미터(cell-specific parameter)이다.

<37> 단, 상기의 식 (1), (2)에 의한 PUCCH 리소스 매핑(resource mapping) 방안은 프레임 구조 타입 1(frame structure type 1)(FDD) 시스템에서 하나의 서빙 셀(serving cell)이 설정된 단말의 PUCCH format 1a/1b를 통한 HARQ ACK/NACK 전송을 위한 PUCCH 리소스 매핑 방안이다. 추가적으로 하나 이상의 serving cell이 설정된 단말(즉, Carrier Aggregation이 적용된 단말)에 대한 PUCCH 리소스 매핑 룰(resource mapping rule)은 상기의 방안과 유사하게 최하위 CCE 인덱스 및 상위 계층 파라미터의 함수로서 결정되거나, 혹은 미리 상위 계층 시그널링을 통해 복수의 candidate PUCCH resource value를 설정하고, 실제 DL 스케줄링 그랜트의 'TPC command for PUCCH' 정보 영역을 통해 상기의 candidate PUCCH resource value 중 사용할 PUCCH resource를 지시하는 ARI(ACK/NACK Resource Indication) 방식이 사용될 수도 있다.

<38> 구체적으로 현재의 3GPP LTE/LTE-Advanced 시스템에서 정의된 UL HARQ ACK/NACK 리소스 매핑을 위한 PUCCH 리소스 매핑 방안은 appendix [1]의 TS36.213 문서를 발췌하여 첨부하고, 이와 관련된 PDCCH의 CCE indexing에 관한 내용은 [2]

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의 TS36.211문서를 발췌하여 첨부한다.

<39> <저가 MTC를 위한 커버리지 향상>

<40> MTC 단말의 경우, 단말 단가를 줄이기 위해 기존의 LTE/LTE-A 단말에 비해 하드웨어 및 소프트웨어 성능이 낮은 low capability 단말을 가정하고 있다. 이에 따라 기존의 LTE/LTE-A 단말의 UE category 및 그에 따른 UE capability를 기반으로 설계된 물리 계층 채널들에 대한 MTC 단말의 송수신 성능 열화가 예상되며, 이를 해결하기 위한 방안으로 해당 물리 계층 채널들에 대한 송수신 성능을 향상시키기 위한 논의가 진행 중이다.

<41> 이를 위한 일반적인 방안으로 해당 물리 계층 채널에 대한 power boosting 및 복수의 서브프레임을 통해 반복(repetition)하여 전송하는 방안이 제안되고 있다. 이에 대한 한 예로써, MTC 단말을 위한 하나의 DCI(Downlink Control Information)를 전송하기 위해 하향 링크 제어 채널인 PDCCH를 복수의 하향 링크 서브프레임을 통해 반복해서 전송함으로써 power gain을 얻는 방안이 고려되고 있다. 마찬가지로 PDSCH의 경우에도 복수의 하향 링크 서브프레임을 통해 반복하여 전송함으로써 MTC 단말의 수신 성능을 높이는 방안이 고려되고 있다.

<42> 기존의 LTE/LTE-Advanced rel-11 이하의 시스템에서, SPS(Semi-Persistent

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Scheduling)을 제외하면, 임의의 단말의 하향 링크 데이터 채널인 PDSCH 수신을 위한 하향링크 할당(DL assignment) 정보는 동일한 하향 링크 서브프레임의 PDCCH를 통해서만 전송되었다. 또한 그에 따라 해당 PDSCH 수신에 대한 상향 링크 HARQ ACK/NACK 전송을 위한 PUCCH 자원 할당 규칙은 해당 DL assignment PDCCH 혹은 EPDCCH가 전송된 최하위 CCE(Control Channel Element)의 함수로서 결정되었다. 이에 따라 동일한 하향 링크 서브프레임을 통해 전송된 서로 다른 단말을 위한 PDSCH 전송들에 대해 각각의 단말이 HARQ ACK/NACK을 전송하기 위한 PUCCH 자원 간에 충돌을 피할 수 있었다. 하지만, 상기에서 서술한 바와 같이 MTC 단말의 PDCCH 수신 성능을 높이기 위해 하나의 DCI를 전송하기 위한 PDCCH를 복수의 하향 링크 서브프레임에 걸쳐 반복하여 전송할 경우, 해당 최하위 CCE 인덱스에 적용할 CCE index 값의 정의 등에 대한 불확실성이 발생할 뿐 아니라, PDSCH 전송 및 단말의 PUCCH 전송 역시 복수의 서브프레임을 통해 반복되어 전송될 경우, MTC 단말이 아닌 일반 LTE 단말의 HARQ ACK/NAKC 피드백을 위한 PUCCH 자원과 MTC 단말의 PUCCH 자원 간의 충돌이 발생할 수 있다.

<43> 본 발명에서는 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방안에 대해 제안한다.

<44> 방안 1. PUCCH 리소스 맵핑 식의 재사용

<45> <u>새로운 PUCCH 리소스 시작 옵셋을 정의</u>

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<46> 도 2는 방안 1의 일 예에 따른 방법을 도시하는 흐름도이다.

<47> 도 2를 참조하면, 기지국은 MTC 단말을 위한 별도의 PUCCH 리소스 시작 옵셋 파라미터, $N_{PUCCH,MTC}^{(1)}$ 값을 정의하여(S210), 이를 해당 RRC 시그널링에 포함하여 단말로 전송한다(S220). 이를 통해 MTC 단말의 경우, 상기의 PUCCH 리소스 매핑 식 (1), (2)에서 $N_{PUCCH}^{(1)}$ 을 $N_{PUCCH,MTC}^{(1)}$ 로 대체하여 적용하여 PUCCH의 자원을 결정하고(S230), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S240). 즉, MTC 단말의 경우, 아래의 식 (3) 과 식 (4)와 같이 적용될 수 있다.

【0048】

$$(3)\quad n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)}$$

$$(4)\quad n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)}$$

<49> 상기 $N_{PUCCH,MTC}^{(1)}$ 값은 UE-specific RRC 시그널링을 통해 각각의 MTC 단말 별로 설정될 수 있다. $N_{PUCCH,MTC}^{(1)}$ 값을 signaling하기 위한 또 다른 방안으로 cell-specific RRC 시그널링 혹은 MTC 단말을 위한 PBCH을 통해 해당 셀 내의 MTC 단말에게 broadcasting 될 수 있다.

<50> 도 3은 방안 1의 다른 예에 따른 방법을 도시하는 흐름도이다.

<51> 도 3을 참조하면, 기지국은 MTC 단말을 위한 별도의 PUCCH 리소스 시작 옵셋

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값을 설정하는 또 다른 방안으로 상위 계층 RRC 시그널링을 통해 각각의 MTC 단말별로 복수의 candidate PUCCH 리소스 시작 옵셋 값을 정의하고(S310), 복수의 candidate PUCCH 리소스 시작 옵셋 값을 단말로 전송하고(S320), PDSCH 리소스 할당 시 적용할 PUCCH 리소스 시작 옵셋 값을 단말에게 시그널링 해주도록 할 수 있다(S330). 단말은 식 (3) 및 (4)를 이용하여 PUCCH의 자원을 결정하고(S340), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S350).

<52> 즉, 임의의 MTC 단말을 위한 UE-specific RRC 시그널링 혹은 cell-specific RRC 시그널링이나 MTC 단말을 위한 PBCH를 candidate PUCCH 리소스 시작 옵셋 파라미터를 시그널링 해주도록 하고, MTC 단말을 위한 DL assignment DCI 포맷을 통해 적용할 PUCCH 리소스 시작 옵셋 파라미터를 지시해주도록 할 수 있다. 해당 PUCCH 리소스 시작 옵셋 지시를 위해서 DL assignment DCI format 내에 명시적(explicit)으로 PUCCH 리소스 시작 옵셋 인디케이터 정보 영역을 정의하거나, 혹은 기존의 정보 영역을 사용하여 지시해주는 명시적인 방법이 사용될 수 있다. 예를 들어, MTC 단말을 위한 $N_{PUCCH,MTC1}^{(1)}$, $N_{PUCCH,MTC2}^{(1)}$, $N_{PUCCH,MTC3}^{(1)}$, $N_{PUCCH,MTC4}^{(1)}$의 4개의 candidate PUCCH 리소스 시작 옵셋 파라미터를 설정하고, DL assignment DCI format에 해당 PUCCH 리소스 시작 옵셋을 지시해주기 위한 2 비트로 구성된 정보 영역을 새롭게 정의하여, 이를 통해 PUCCH 리소스 매핑 식 (3), (4)에 적용할 PUCCH 리소스 시작 옵셋을 지시해주도록 할 수 있다. 혹은 새로운 정보 영역을 추가적으로 정의하지 않고, TPC command와 같은 기존의 정보 영역을 해당 PUCCH 리소

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스 시작 옵셋을 지시하기 위해 사용하도록 할 수 있다. 또 다른 방법으로 해당 candidate PUCCH 리소스 시작 옵셋 중, 적용할 값을 암시적(implicit)으로 알려줄 수 있다. 예를 들어, PDCCH 집적 레벨(PDCCH aggregation level) 혹은 반복 레벨(repetition level), 즉 해당 DCI를 전송하기 위해 PDCCH 반복 횟수에 따라 적용 PUCCH 리소스 시작 옵셋 값을 결정하도록 할 수 있다.

<53> 반복되는 PDCCH에 대한 최하위 CCE 인덱스의 정의

<54> 도 4는 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

<55> 도 4와 같이 MTC 단말의 DCI 수신 성능을 향상시키기 위해 PDCCH를 복수의 하향 링크 서브프레임을 통해 반복하여 전송하도록 정의할 수 있다.

<56> 이 경우, 상기의 식 (3), (4)에 적용하기 위한 최하위 CCE 인덱스인 n_{CCE} 값에 대한 정의가 필요하다. 이를 위해 본 발명에서는 임의의 MTC 단말을 위한 DL assignment DCI가 복수의 하향 링크 서브프레임의 PDCCH를 통하여 반복되어 전송된 경우, PUCCH 리소스 매핑 식 (3) 혹은 (4)에 적용되는 n_{CCE}값을 정의하는 방안으로 세 가지 방안을 제안하도록 한다. 첫 번째 방안으로는 도 4에서와 같이 하나의 DL assignment DCI를 전송하기 위해 N개의 반복된 PDCCH가 사용된 경우, 첫 번째 PDCCH 전송을 위해 사용된 CCE 중 최하위 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 또 다른 방안으로는 해당 마지막 반복된 PDCCH인 N

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번째 PDCCH의 최하위 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 마지막으로 각각의 N개의 반복된 PDCCH의 전송을 위해 사용된 모든 CCE 인덱스들 중에서 가장 작은 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다.

<57> 단, MTC 단말을 위한 PUCCH 리소스 매핑을 위해 상기의 도 2 또는 도 3과 같이 MTC 단말을 위한 새로운 PUCCH 리소스 시작 옵셋을 정의하지 않고, 기존의 LTE/LTE-A 단말을 위한 식에서 PUCCH 리소스 시작 옵셋 값인 $N_{PUCCH}^{(1)}$ 를 재사용할 경우에도 식 (1), (2)에 적용하기 위한 위해 적용할 해당 n_{CCE}값을 정의하는 방법도 상기에서 서술한 n_{CCE} 값을 정의하는 방법이 동일하게 적용될 수 있다.

<58> 방안 2. 하향링크 할당 DCI에 PUCCH 리소스 할당

<59> 도 5는 본 발명의 방안 2에 따른 방법을 도시하는 흐름도이다.

<60> 도 5를 참조하면, 기지국은 각각의 MTC 단말 별로 아래의 표 1과 같이 해당 MTC 단말의 HARQ ACK/NACK 피드백을 위한 candidate PUCCH 리소스 값을 상위 계층 시그널링을 통해 미리 설정해주고(S510), DL assignment DCI를 통해 해당 candidate PUCCH 리소스 값 중 사용할 PUCCH 리소스를 지시하기 위한 PUCCH resource indicator field를 정의하여 이를 단말에게 직접 시그널링 해주도록 할 수 있다(S520). 단말은 PUCCH 자원을 결정하고(S530), 결정된 자원의 PUCCH를 통해

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HARQ ACK/NACK을 기지국으로 전송한다(S540).

<61> 이 때, candidate PUCCH 리소스 값의 개수는 DL assignment DCI의 PUCCH resource indicator field의 크기에 따라 결정될 수 있다. 예를 들어 해당 PUCCH resource indicator field가 2 bits로 구성되는 경우, 해당 candidate PUCCH resource 설정을 위한 상위 계층 시그널링을 통해 4개의 candidate PUCCH 리소스 값이 설정될 수 있으며, 이에 따라 DL assignment DCI에 포함된 PUCCH resource indicator field의 설정 값에 따라 아래의 표 1과 같이 해당 4개의 PUCCH 리소스 값 중 단말이 HARQ ACK/NACK 피드백을 전송할 PUCCH 리소스 값을 맵핑하도록 할 수 있다. 단, PUCCH resource value indicator field는 새롭게 정의되거나 DL assignment에 포함된 정보 영역들 중 일부를 해당 PUCCH resource indicator로서 활용할 수 있다. 기존 정보 영역을 활용하는 한 예로서, 2bits로 구성된 TPC command 정보 영역을 해당 PUCCH resource indicator 용도로 활용할 수 있다.

<62> 【표 1】

DL assignment DCI 내 PUCCH 리소스 인디케이터의 값	$n_{PUCCH}^{(1,p)}$
'00'	상위계층에 의해 구성된 제 1 PUCCH 리소스 값
'01'	상위계층에 의해 구성된 제 2 PUCCH 리소스 값
'10'	상위계층에 의해 구성된 제 3 PUCCH 리소스 값
'11'	상위계층에 의해 구성된 제 4 PUCCH 리소스 값

<63> 또한 각각의 candidate PUCCH 리소스 값은 PUCCH 반복의 개수 값을 포함하도록 할 수 있다. 즉 해당 HARQ ACK/NACK 피드백을 위해 사용할 PUCCH 자원 뿐 아니라, 몇 번의 상향 링크 서브프레임을 걸쳐 해당 PUCCH 자원을 통해 HARQ ACK/NACK

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피드백을 반복하여 전송할 것인지 각각의 PUCCH 리소스 값 별로 설정하도록 정의할 수 있다.

<64> 방안 3. MTC를 위한 ACK 리소스 옵셋

<65> 도 6은 본 발명의 방안 3에 따른 방법을 도시하는 흐름도이다.

<66> 본 방안에서, MTC 단말을 위한 추가적인 ACK Resource Offset parameter인 $\Delta_{ARO,MTC}$ 를 정의하여 이를 PUCCH 리소스 매핑 식에 적용하도록 할 수 있다. 즉, 임의의 MTC 단말에 대해, 해당 MTC 단말을 위한 상기의 DL assignment 내에 추가적으로 PUCCH resource offset값을 지시하기 위한 ARO(ACK Resource Offset) 정보 영역을 정의하도록 하고, 이를 통해 임의의 MTC 단말을 위한 PUCCH 리소스 매핑 식에 적용할 $\Delta_{ARO,MTC}$ 값을 해당 단말에게 signaling해주도록 할 수 있다(S610). 단말은 PUCCH 자원을 결정하고(S620), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S630).

<67> 해당 DL assignment DCI format의 ARO의 설정값에 따른 $\Delta_{ARO,MTC}$값은 테이블 맵핑 방식으로 아래의 표 2와 같이 각각의 ARO 값 별로 임의의 고정된 $\Delta_{ARO,MTC}$값이 정의가 되거나, 혹은 기지국이 각각의 ARO value 별 $\Delta_{ARO,MTC}$값을 설정하여 해당 MTC 단말에 시그널링해줄 수 있다.

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<68> 【표 2】

DCI 포맷 1A/1B/1D/1/2A/2/2B/2C/2D에서 ACK/NACK 리소스 옵셋 필드	Δ_{ARQMTC}
0	0
1	-1
2	-2
3	2

<69> 이에 따라, PDCCH를 통해 DL assignment DCI를 수신하는 단말을 위한 기존의 PUCCH 리소스 매핑 식 (1)과 (2) 혹은 식 (3)과 (4) 대신 아래의 식(5), (6)이 적용될 수 있다.

【0070】

$$(5)\quad n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)} + \Delta_{ARO,MTC}$$

$$(6)\quad n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)} + \Delta_{ARO,MTC}$$

<71> 본 발명에서는 MTC 단말을 위한 PUCCH 리소스 매핑 규칙에 대해 제안하였다. 단, 임의의 MTC 단말의 DL HARQ ACK 피드백을 위한 PUCCH 역시 커버리지 향상(coverage enhancement)를 위해 복수의 상향 링크 서브프레임을 통해 반복되어 전송될 수 있다. 이 경우 상기에서 제안된 방법에 따라 하나의 상향 링크 서브프레임에서 DL HARQ ACK 피드백을 위한 PUCCH 리소스가 결정되며, 해당 PUCCH 반복 전송 횟수에 따라 복수의 상향 링크 서브프레임에서 상기의 방법들에 의해 결정된 동일한 PUCCH 리소스를 통해 DL HARQ ACK 피드백을 반복 전송하도록 정의될 수 있다.

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또한, 본 발명은 MTC 단말의 HARQ ACK/NACK 피드백을 위한 PUCCH 반복 횟수 등에 대한 구체적인 방안은 포함하고 있지 않지만, 상기에서 제안된 방안들은 PUCCH 반복의 횟수에 관계없이 동일하게 적용될 수 있음은 명백하다.

<72> 도 7은 본 발명의 일 실시예에 따른 단말의 PUCCH 송신 방법을 도시하는 흐름도이다.

<73> 도 7을 참조하면, 단말은 기지국으로부터 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 수신한다(S710).

<74> 단말은 기지국으로부터 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 수신한다(S720).

<75> 단말은 기지국으로부터 DCI 내의 스케줄링 정보에 기초하여 PDSCH를 통해 데이터를 수신한다(S730).

<76> 단말은 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK이 전송되는 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정한다(S740).

<77> 일 예에서, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 수신하고, S740 단계에서 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 단말은 S710

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단계에서 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{PUCCH,MTC}^{(1)}$를 복수 개 포함하는 구성 정보를 수신하고, S720 단계에서 복수의 $N_{PUCCH,MTC}^{(1)}$ 중 하나를 지시하는 제어 정보를 수신하며, S740 단계에서 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<78> 다른 예에서, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $n_{PUCCH}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 수신하고, S720 단계에서 복수의 $n_{PUCCH}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 수신하며, S740 단계에서 제어 정보에 기초하여 PUCCH의 자원 ($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<79> 또 다른 예에서, 단말은 S720 단계에서 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$ 중 하나를 지시하는 제어 정보를 수신하고, S740 단계에서 식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$는 사전에 설정되거나 S710 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

<80> 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 식 (3) 및 (4), 또는 식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE

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인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

<81> 단말은 결정된 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 이용하여 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK을 기지국으로 전송한다(S750).

<82> 도 8은 본 발명의 일 실시예에 따른 기지국의 PUCCH 자원 설정 방법을 도시하는 흐름도이다.

<83> 도 8을 참조하면, 기지국은 단말로 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 송신한다(S810).

<84> 기지국은 단말로 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 송신한다(S820).

<85> 그리고, 기지국은 단말로 PDSCH를 통해 데이터를 송신한다(S830).

<86> 일 예에서, 기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{PUCCH,MTC}^{(1)}$ 를 포함하는 구성 정보를 송신하고, 단말은 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{PUCCH,MTC}^{(1)}$ 를 복수개 포함하는 구성 정보를 송신하고, S820 단계에서 복수의 $N_{PUCCH,MTC}^{(1)}$ 중 하나

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를 지시하는 제어 정보를 송신하며, 단말은 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<87> 다른 예에서, 기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $n_{PUCCH}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 송신하고, S820 단계에서 복수의 $n_{PUCCH}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 제어 정보에 기초하여 PUCCH의 자원 ($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<88> 또 다른 예에서, 기지국은 S820 단계에서 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$ 중 하나를 지시하는 제어 정보를 송신하고, 단말은 식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$는 사전에 설정되거나 S810 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

<89> 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 식 (3) 및 (4), 또는 식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

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<90> 도 9는 본 발명의 실시예에 따른 단말의 구성을 도시하는 블록도이다.

<91> 도 9를 참조하면, 단말(900)은 제어부(910), 수신부(920), 및 송신부(930)를 포함함다.

<92> 수신부(920)는 기지국으로부터 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 수신할 수 있다.

<93> 또한, 수신부(920)는 기지국으로부터 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 수신하고, DCI 내의 스케줄링 정보에 기초하여 PDSCH를 통해 데이터를 수신할 수 있다.

<94> 제어부(910)는 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK이 전송되는 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

<95> 송신부(930)는 결정된 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 이용하여 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK을 기지국으로 전송할 수 있다.

<96> 일 예에서, 수신부(920)는 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 수신하고, 제어부(930)는 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 수신부(920)는 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함

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하는 구성 정보를 수신하고, 복수의 $N_{PUCCH,MTC}^{(1)}$ 중 하나를 지시하는 제어 정보를 수신하며, 제어부(910)는 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<97> 다른 예에서, 수신부(920)는 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $n_{PUCCH}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 수신하고, 복수의 $n_{PUCCH}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 수신하며, 제어부(910)는 제어 정보에 기초하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<98> 또 다른 예에서, 수신부(920)는 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$ 중 하나를 지시하는 제어 정보를 수신하고, 제어부(910)는 식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$는 사전에 설정되거나 상위 계층 시그널링을 통해 기지국으로부터 단말로 전달된 것일 수 있다.

<99> 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 식 (3) 및 (4), 또는 식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스

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중 최소값일 수 있다.

<100> 도 10은 본 발명의 실시예에 따른 기지국의 구성을 도시하는 블록도이다.

<101> 도 10을 참조하면, 기지국(1000)은 제어부(1010), 송신부(1020), 및 수신부(1030)를 포함한다.

<102> 제어부(1010)는 전술한 본 발명을 수행하기에 필요한 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당에 따른 전반적인 기지국의 동작을 제어한다.

<103> 송신부(1020)는 단말로 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 송신할 수 있다.

<104> 또한, 송신부(1020)는 단말로 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 송신하고, PDSCH를 통해 데이터를 송신할 수 있다.

<105> 수신부(1030)는 단말로부터 PUCCH를 통해 PDSCH에 대한 ACK/NACK을 수신할 수 있다.

<106> 일 예에서, 송신부(1020)는 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{PUCCH,MTC}^{(1)}$를 포함하는 구성 정보를 송신하고, 단말은 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 송신부(1020)는 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $N_{PUCCH,MTC}^{(1)}$를 복수 개 포함하는 구성 정

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보를 송신하고, 복수의 $N_{PUCCH,MTC}^{(1)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<107> 다른 예에서, 송신부(1020)는 MTC 단말을 위한 PUCCH 리소스 시작 옵셋 파라미터 $n_{PUCCH}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 송신하고, 복수의 $n_{PUCCH}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 제어 정보에 기초하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다.

<108> 또 다른 예에서, 송신부(1020)는 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$ 중 하나를 지시하는 제어 정보를 송신하고, 단말은 식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{PUCCH}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,MTC}$는 사전에 설정되거나 S810 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

<109> 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 식 (3) 및 (4), 또는 식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

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<110> 이상의 설명은 본 발명의 기술 사상을 예시적으로 설명한 것에 불과한 것으로서, 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자라면 본 발명의 본질적인 특성에서 벗어나지 않는 범위에서 다양한 수정 및 변형이 가능할 것이다. 따라서, 본 발명에 개시된 실시예들은 본 발명의 기술 사상을 한정하기 위한 것이 아니라 설명하기 위한 것이고, 이러한 실시예에 의하여 본 발명의 기술사상의 범위가 한정되는 것은 아니다. 본 발명의 보호 범위는 아래의 청구범위에 의하여 해석되어야 하며, 그와 동등한 범위 내에 있는 모든 기술 사상은 본 발명의 권리범위에 포함되는 것으로 해석되어야 할 것이다.

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【특허청구범위】

【청구항 1】

MTC(Machine Type Communication) 단말의 하향링크 데이터의 응답 정보 전송 방법으로서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하는 단계;

상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하는 단계;

상기 하향링크 데이터를 수신하는 단계;

상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 단계; 및

상기 결정된 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 단계를 포함하는 방법.

【청구항 2】

제 1 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 방법.

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【청구항 3】

제 2 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,

상기 하향링크 제어 정보를 수신하는 단계는 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 수신하는 단계를 포함하는 것을 특징으로 하는 방법.

【청구항 4】

제 1 항에 있어서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,

상기 하향링크 제어 정보를 수신하는 단계는 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 수신하는 단계를 포함하는 것을 특징으로 하는 방법.

【청구항 5】

제 1 항에 있어서,

상기 하향링크 제어 정보를 수신하는 단계는 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 수신하는 단계를 포함하고,

상기 상향링크 제어 채널의 자원을 결정하는 단계는, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 상기 상향링크 제어 채널의 자원을 결정하는 것을 특징으로 하는 방법.

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【청구항 6】

제 1 항에 있어서,

상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 방법.

【청구항 7】

기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원 설정 방법으로서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 송신하는 단계;

상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 송신하는 단계; 및

상기 하향링크 데이터를 송신하는 단계를 포함하고,

상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의

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자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 방법.

【청구항 8】

제 7 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 방법.

【청구항 9】

제 8 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,

상기 하향링크 제어 정보를 송신하는 단계는 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 송신하는 단계를 포함하는 것을 특징으로 하는 방법.

【청구항 10】

제 7 항에 있어서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,

상기 하향링크 제어 정보를 송신하는 단계는 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 송신하는 단계를 포함하는 것을 특징으로 하는 방법.

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【청구항 11】

제 7 항에 있어서,

상기 하향링크 제어 정보를 송신하는 단계는 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 송신하는 단계를 포함하고,

상기 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 결정되는 것을 특징으로 하는 방법.

【청구항 12】

제 7 항에 있어서,

상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 방법.

【청구항 13】

기지국으로 하향링크 데이터의 응답 정보를 전송하는 단말로서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및

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상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하고, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하며, 상기 하향링크 데이터를 수신하는 수신부;

상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 제어부; 및

상기 결정된 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 송신부를 포함하는 단말.

【청구항 14】

제 13 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 단말.

【청구항 15】

제 14 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,

상기 수신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 수신하는 것을 특징으로 하는 단말.

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【청구항 16】

제 13 항에 있어서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,

상기 수신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 수신하는 것을 특징으로 하는 단말.

【청구항 17】

제 13 항에 있어서,

상기 수신부는 상기 하향링크 제어 정보를 통해 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 수신하고,

상기 제어부는 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 상기 상향링크 제어 채널의 자원을 결정하는 것을 특징으로 하는 단말.

【청구항 18】

제 13 항에 있어서,

상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자

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원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 단말.

【청구항 19】

기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원을 설정하는 기지국으로서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보, 및 상기 하향링크 데이터를 송신하는 송신부를 포함하고,

상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 기지국.

【청구항 20】

제 19 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단

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말을 위한 옵셋 정보와 다른 것을 특징으로 하는 기지국.

【청구항 21】

제 20 항에 있어서,

상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,

상기 송신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 송신하는 것을 특징으로 하는 기지국.

【청구항 22】

제 19 항에 있어서,

상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,

상기 송신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 송신하는 것을 특징으로 하는 기지국.

【청구항 23】

제 19 항에 있어서,

상기 송신부는 상기 하향링크 제어 정보를 통해 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 송신하고,

상기 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 결정되는 것을 특징으로 하는 기지국.

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【청구항 24】

제 19 항에 있어서,

상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 기지국.

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【요약서】

【요약】

본 발명은 3GPP LTE/LTE-Advanced 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방안에 대해 제안한다.

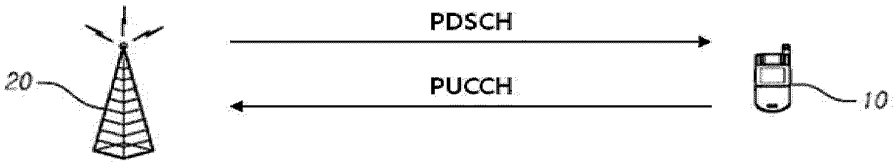
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도 7

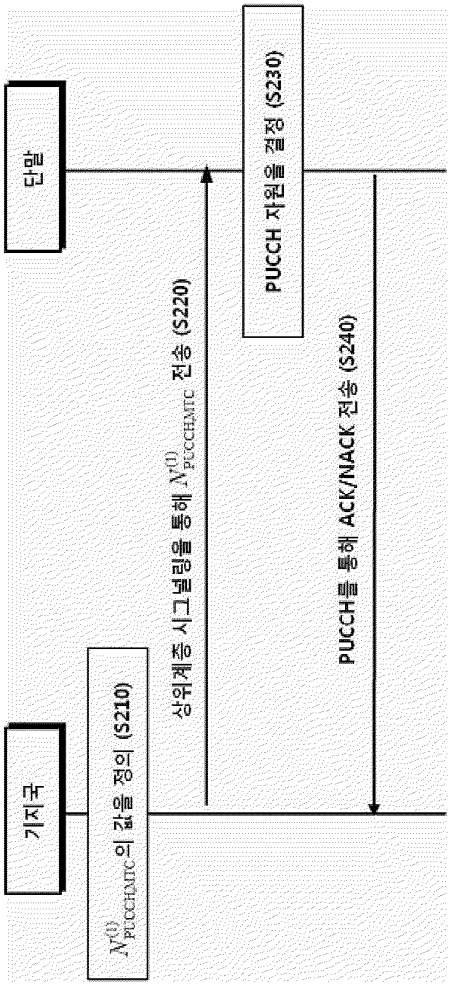
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【도면】

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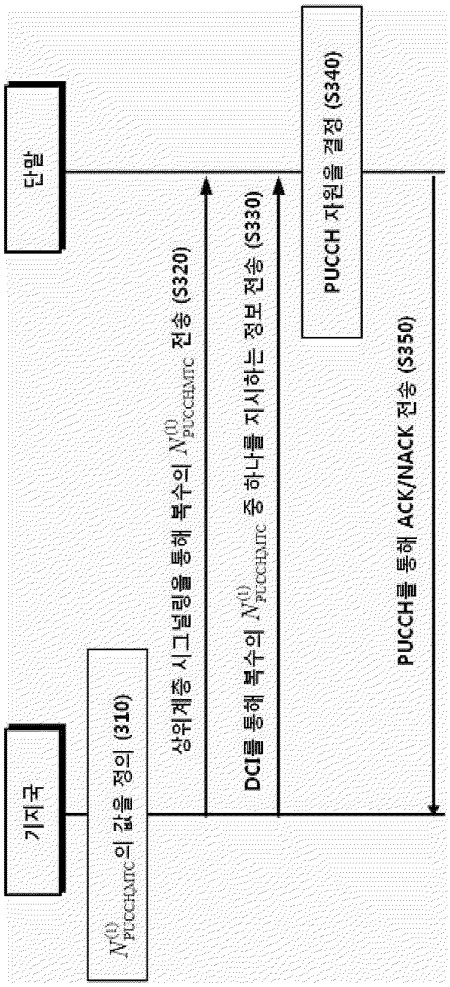


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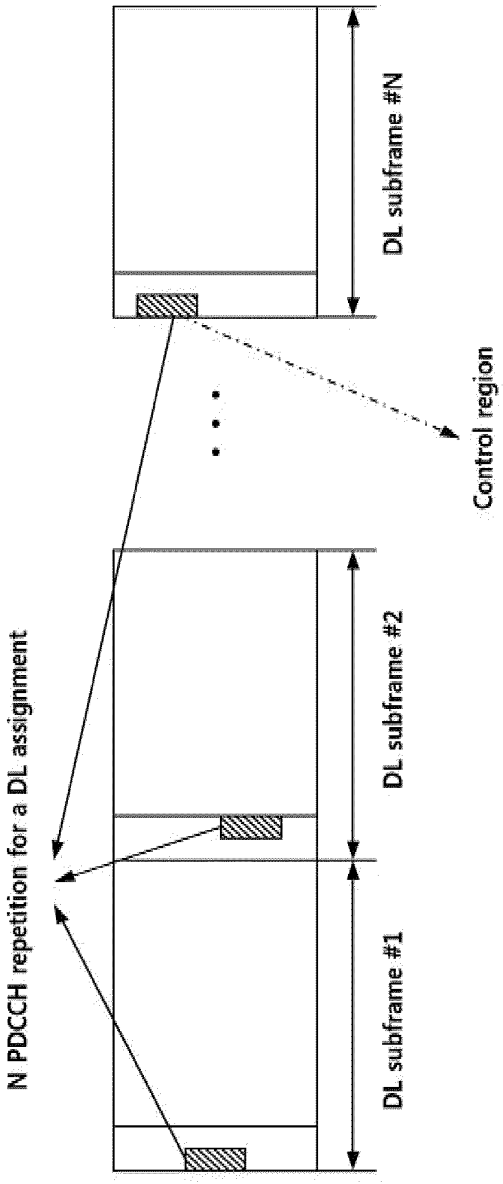
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【도 3】



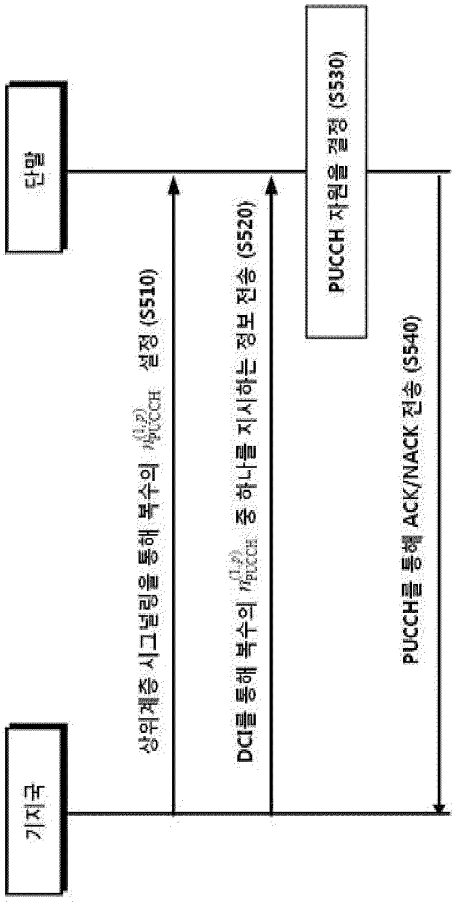
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【도 4】



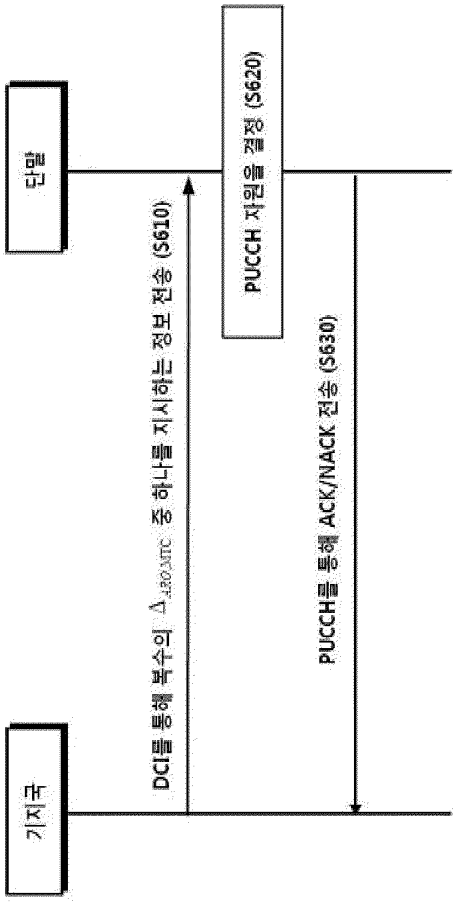
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【도 5】



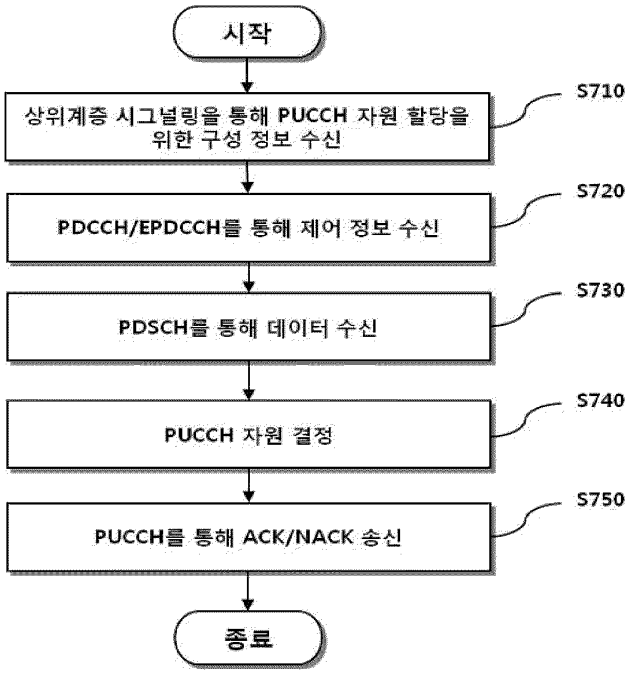
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【도 6】

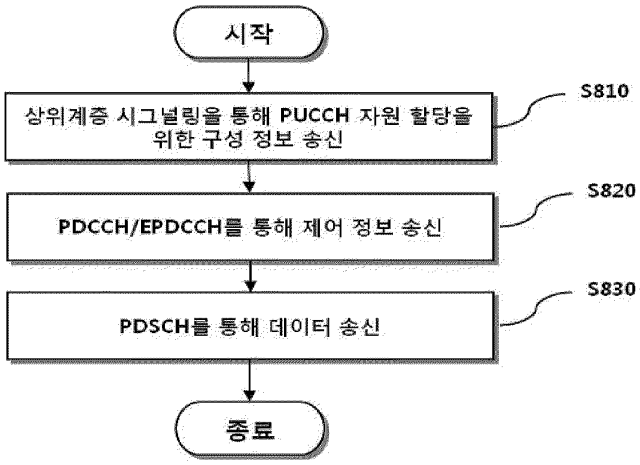


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【도 7】

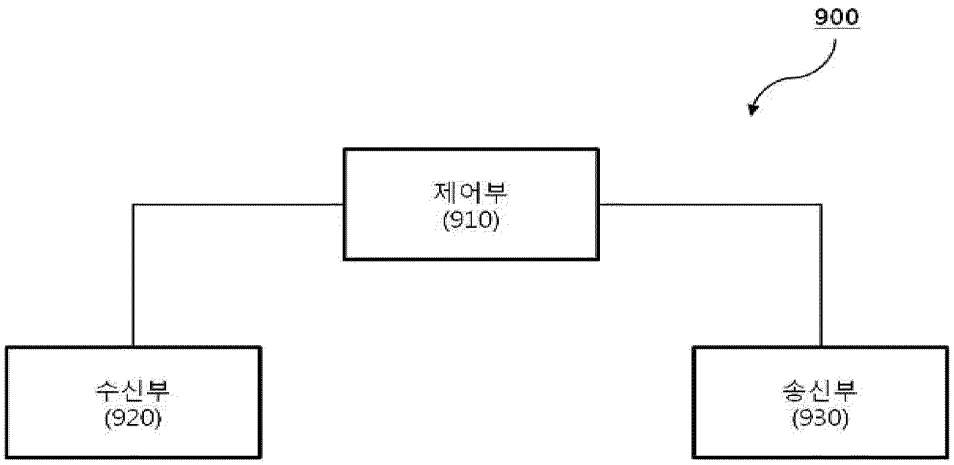


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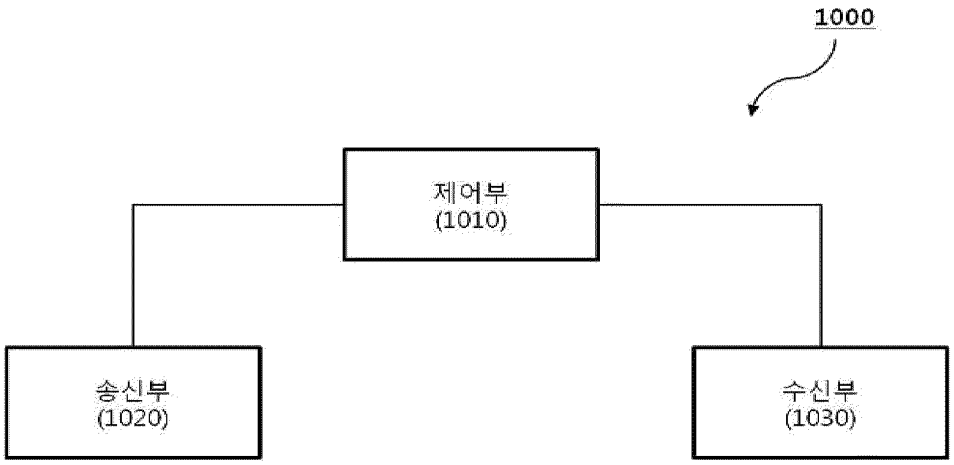


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【도 9】



【도 10】



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International application number:		**PCT/KR2014/008765**
International filing date:		**22 September 2014 (22.09.2014)**
Document type:		**Certified copy of priority document**
Document details:	Country/Office:	**KR**
	Number:	**10-2014-0057938**
	Filing date:	**14 May 2014 (14.05.2014)**
Date of receipt at the International Bureau:		**25 September 2014 (25.09.2014)**

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-*bis*)

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PCT 출원서

출력(전자적 형태가 원본)

0	**수리관청 전용**	
0-1	국제출원번호	**PCT/KR2014/008765**
0-2	국제출원일자	**2014년 09월 22일 (22.09.2014)**
0-3	수리관청 명칭 및 "PCT 국제출원"	**RO/KR**

0-4	**서식 PCT/RO/101 - PCT 출원서**	
0-4-1	우측에 기재된 바와 같이 작성되었다.	**PCT-SAFE** **버전 3.51.057.233 MT/FOP 20130101/0.20.5.20**
0-5	**신청** 아래 서명인은 본 국제 출원서가 특허협력조약에 의해 처리될 것을 청구합니다.	
0-6	**출원인이 지정한 수리관청**	**대한민국 특허청 (RO/KR)**
0-7	**출원인 또는 대리인의 서류참조기호**	**PCT14-706**
I	**발명의 명칭**	**단말의 상향 링크 제어 채널 자원 할당 방법 및 그 장치**
II	**출원인**	
II-1	이 사람은	**오직 출원인 (applicant only)**
II-2	우측 지정국에 관한 출원인	**모든 지정국 (all designated States)**
II-4ko	성명	**주식회사 케이티**
II-4en	Name:	**KT CORPORATION**
II-5ko	주소	**대한민국** **463-711** **경기도 성남시 분당구 불정로 90 (정자동 206번지)**
II-5en	Address:	**(206, Jeongja-dong) 90, Buljeong-ro, Bundang-gu, Seongnam-si, Gyeonggi-do 463-711** **Republic of Korea**
II-6	국적	**대한민국 KR**
II-7	거주국	**대한민국 KR**
II-8	전화번호	**+82-31-727-1133**
II-9	팩스번호	**+82-31-727-1546**
II-10	이메일 주소	**standard@kt.com**
II-11	출원인 코드	**2-1998-005456-3**

PCT 출원서

출력(전자적 형태가 원본)

III-1	**출원인 및/또는 발명자**	
III-1-1	이 사람은	오직 발명자 (inventor only)
III-1-3	우측 지정국에 관한 발명자	
III-1-4ko	성명	박규진
III-1-4en	Name (LAST, First):	**PARK, Kyujin**
III-1-5ko	주소	대한민국 **137-140** 서울시 서초구 태봉로 **151** (우면동, **KT**연구개발센터)
III-1-5en	Address:	**(Korea Telecom Research Center, Umyeon-dong) 151, Taebong-ro** **Seocho-gu Seoul 137-140** **Republic of Korea**
III-2	**출원인 및/또는 발명자**	
III-2-1	이 사람은	오직 발명자 (inventor only)
III-2-3	우측 지정국에 관한 발명자	
III-2-4ko	성명	최우진
III-2-4en	Name (LAST, First):	**CHOI, Woo-jin**
III-2-5ko	주소	대한민국 **137-140** 서울시 서초구 태봉로 **151** (우면동, **KT**연구개발센터)
III-2-5en	Address:	**(Korea Telecom Research Center, Umyeon-dong) 151, Taebong-ro** **Seocho-gu Seoul 137-140** **Republic of Korea**
IV-1	**대리인 또는 대표자** 아래에 기재된 자는 관할 국제기관에 대하여 우측에 표시된 자격으로 출원인을 대리하는 것으로 선임되었다.	대리인
IV-1-1ko	성명	김은구
IV-1-1en	Name (LAST, First):	**KIM, Eungu**
IV-1-2ko	주소	대한민국 **135-908** 서울시 강남구 강남대로**94**길 **59** (역삼동 상원빌딩 **2**층)
IV-1-2en	Address:	**(2F Sangwon Bldg., Yeoksam-dong) 59, Gangnam-daero 94-gil,** **Gangnam-gu Seoul 135-908** **Republic of Korea**
IV-1-3	전화번호	**+82-2-568-6177**
IV-1-4	팩스번호	**+82-2-568-6176**
IV-1-5	이메일 주소	**ip@highestip.com**
IV-1-5(a)	이메일 사용동의 수리관청, 국제조사기관, 국제사무국, 국제예비심사기관이 필요 시 이 이메일 주소를 사용하여 이 국제 출원과 관련하여 발행된 통지서를 송부할 것에 동의한다.	서면 통지서에 앞서 선람용 사본 송부
IV-1-6	대리인 코드	**9-1999-000318-1**
IV-2	추가 대리인	최초 기재된 대리인과 동일한 주소를 갖는 새로운 대리인(들)

PCT 출원서

출력(전자적 형태가 원본)

IV-2-1ko	성명	**송, 해모(9-2002-000179-4)**	
IV-2-1en	Name(s)	**SONG, Haemo(9-2002-000179-4)**	
V	지정국		
V-1	**본 출원서의 제출로, 규칙 4.9(a)에 따라, 부여될 수 있는 모든 종류의 권리 보호를 위하여, 그리고 해당하는 경우 지역특허 및 국내특허 모두를 위하여 당해 국제출원일에 PCT에 기속되는 모든 체약국이 지정된다.**		
V-2	**V-2란은 출원서 제출시 또는 규칙 26의2.1에 의해 그 이후 출원서 제6기재란에 위 특정 관련 체약국의 국내 선출원에 대한 우선권주장이 포함되어 있을 경우 당해 체약국의 국내법에 의해 해당 국내 선출원의 효력이 상실되는 것을 방지하기 위한 목적으로 당해 체약국의 지정을 제외하는 데에만 사용될 수 있다 (지정 제외시 이의 취소 불가능).**	**KR**	
VI-1	**선국내출원에 대한 우선권 주장**		
VI-1-1	출원일	**2013년 09월 27일 (27.09.2013)**	
VI-1-2	출원번호	**10-2013-0115367**	
VI-1-3	국가	**KR**	
VI-2	**선국내출원에 대한 우선권 주장**		
VI-2-1	출원일	**2014년 05월 14일 (14.05.2014)**	
VI-2-2	출원번호	**10-2014-0057938**	
VI-2-3	국가	**KR**	
VI-3	**우선권서류 신청** 수리관청에 대하여 위에 명시된 선출원의 인증등본을 준비하여 국제사무국에 송부하여 줄 것을 신청한다.	**VI-1** **VI-2**	
VI-4	**인용에 의한 보완** 조약 제11조(1)(iii)(d) 또는 (e)에서 규정하는 국제출원의 요소, 또는 규칙 20.5(a)에서 규정하는 명세서, 청구 범위 또는 도면의 일부가 본 국제출원에는 포함되어 있지 않지만 조약 제11조(1)(iii) 규정의 요소 중 하나 이상이 수리관청에 최초로 접수된 날에 우선권주장의 기초가 된 선출원에 완전히 포함되어 있는 경우, 그 요소 또는 부분은 규칙 20.6 규정에 의한 확인을 조건으로, 규칙 20.6의 규정과 관련하여 본 국제출원에 있어서 인용에 의해 보완된다.		
VII-1	**국제조사기관(ISA) 선택**	**대한민국 특허청 (ISA/KR)**	
VIII	**선언서**	선언서 개수	
VIII-1	발명자의 신원에 관한 선언	-	
VIII-2	국제출원일에 특허출원 및 특허를 받을 수 있는 출원인의 자격에 관한 선언	-	
VIII-3	국제출원일에 선출원의 우선권을 주장할 수 있는 출원인의 자격에 관한 선언	-	
VIII-4	발명자 선언(미국에 대한 지정의 경우에 한함)	-	
VIII-5	신규성을 해치지 아니하는 개시 또는 신규성 상실의 예외에 관한 선언	-	

PCT 출원서

출력(전자적 형태가 원본)

IX	**체크 리스트**	용지 수	전자적 파일 첨부
IX-1	출원서(선언서 포함)	**4**	✓
IX-2	명세서	**18**	✓
IX-3	청구범위	**4**	✓
IX-4	요약서	**1**	✓
IX-5	도면	**7**	✓
IX-7	용지매수 소계	**34**	
	첨부 항목	서면 첨부	전자적 파일 첨부
IX-8	수수료 계산 용지	-	✓
IX-11	포괄위임장 사본	-	**포괄위임장 번호 PCT14-706**
IX-18	PCT-SAFE 전자출원 매체	-	-
IX-20	**요약서에 수반되어야 할 도면 번호**	**7**	
IX-21	**국제출원의 출원 언어**	**한국어**	
X-1	**출원인, 대리인 또는 대표자의 서명 또는 날인**	**(PKCS7 전자서명)**	
X-1-1	성명	김 은구	
X-1-2	서명인의 성명		
X-1-3	권한 (출원서를 통해 서명자의 자격이 명백하지 않은 경우에는 그 자격도 표시)		

수리관청 전용

10-1	**국제출원으로 제출된 서류의 실제 접수일**	**2014년 09월 22일 (22.09.2014)**
10-2	**도면**	
10-2-1	접수	
10-2-2	미접수	
10-3	**국제출원으로 제출된 서류를 완성하는 서류 또는 도면의 추후 기간내 제출에 따른 정정된 실제 접수일**	
10-4	**PCT 제11조(2)에 따라 제출이 요구된 보완서로서 기간내 제출된 보완서의 접수일**	
10-5	**국제조사기관(ISA)**	**ISA/KR**
10-6	**조사료 납부시까지 지연된 조사용 사본의 송부**	

국제 사무국 전용

11-1	**국제 사무국의 기록원본 접수일**	

[redacted]

대한민국 특허청
KOREAN INTELLECTUAL PROPERTY OFFICE

별첨 사본은 아래 출원의 원본과 동일함을 증명함.

This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office

출 원 번 호 : 10-2013-0115367
Application Number

출 원 년 월 일 : 2013년 09월 27일
Filing Date SEP 27, 2013

출 원 인 : 주식회사 케이티
Applicant(s) KT Corporation

2014 년 09 월 24 일

특 허 청
COMMISSIONER

[redacted]

2013-09-27

【서지사항】

【서류명】 특허출원서

【출원구분】 특허출원

【출원인】

【명칭】 주식회사 케이티

【출원인코드】 2-1998-005456-3

【대리인】

【성명】 김은구

【대리인코드】 9-1999-000318-1

【포괄위임등록번호】 2011-023059-1

【대리인】

【성명】 송해모

【대리인코드】 9-2002-000179-4

【포괄위임등록번호】 2011-023060-3

【발명의 국문명칭】 MTC 단말을 위한 상향 링크 제어 채널 자원 설정 방법 및 장치

【발명의 영문명칭】 Apparatus and methods of PUCCH resource mapping for MTC UEs

【발명자】

【성명】 박규진

【성명의 영문표기】 PARK, Kyu Jin

【주민등록번호】 811018-1XXXXXX

【우편번호】 137-140

【주소】 서울특별시 서초구 우면동 17 KT연구개발센터

【국적】 KR

【발명자】

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【성명】 최우진

【성명의 영문표기】 CHOI, Woo Jin

【주민등록번호】 660822-1XXXXXX

【우편번호】 137-140

【주소】 서울특별시 서초구 우면동 17 KT연구개발센터

【국적】 KR

【취지】 위와 같이 특허청장에게 제출합니다.

대리인 김은구 (서명 또는 인)

대리인 송해모 (서명 또는 인)

【수수료】

【출원료】 0 면 38,000 원

【가산출원료】 23 면 0 원

【우선권주장료】 0 건 0 원

【심사청구료】 0 항 0 원

【합계】 38,000 원

【첨부서류】 1.기타첨부서류_1통 2.기타첨부서류_1통

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【명세서】

【발명의 명칭】

MTC 단말을 위한 상향 링크 제어 채널 자원 설정 방법 및 장치{Apparatus and methods of PUCCH resource mapping for MTC UEs}

【기술분야】

<1> 본 발명은 3GPP LTE/LTE-Advanced 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방안에 대해 제안한다.

【발명의 내용】

【과제의 해결 수단】

<2> 본 발명은 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방법에 있어서, MTC 단말을 위한 별도의 파라미터 또는 테이블 값 또는 상기 MTC 단말을 위한 추가적인 파라미터를 정의하는 단계 및 파리미터 또는 테이블 값 또는 테이블을 지시하는 지시 정보를 포함하는 상위계층 시그널링을 전송하는 단계를 포함하는 방법 및 장치를 제공한다.

【도면의 간단한 설명】

<3> 도 1은 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

도 2는 본 발명의 다른 실시예에 의한 기지국의 구성을 보여주는 도면이다.

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도 3은 본 발명의 또 다른 실시예에 의한 사용자 단말의 구성을 보여주는 도면이다.

【발명을 실시하기 위한 구체적인 내용】

<4> 이하, 본 발명의 일부 실시예들을 예시적인 도면을 통해 상세하게 설명한다. 각 도면의 구성요소들에 참조부호를 부가함에 있어서, 동일한 구성요소들에 대해서는 비록 다른 도면상에 표시되더라도 가능한 한 동일한 부호를 가지도록 하고 있음에 유의해야 한다. 또한, 본 발명을 설명함에 있어, 관련된 공지 구성 또는 기능에 대한 구체적인 설명이 본 발명의 요지를 흐릴 수 있다고 판단되는 경우에는 그 상세한 설명은 생략한다.

<5> 본 발명에서의 무선통신시스템은 음성, 패킷 데이터 등과 같은 다양한 통신 서비스를 제공하기 위해 널리 배치된다. 무선통신시스템은 사용자 단말(User Equipment, UE) 및 기지국(Base Station, BS, 또는 eNB)을 포함한다. 본 명세서에서의 사용자 단말은 무선 통신에서의 단말을 의미하는 포괄적 개념으로서, WCDMA 및 LTE, HSPA 등에서의 UE(User Equipment)는 물론, GSM에서의 MS(Mobile Station), UT(User Terminal), SS(Subscriber Station), 무선기기(wireless device) 등을 모두 포함하는 개념으로 해석되어야 할 것이다.

<6> 기지국 또는 셀(cell)은 일반적으로 사용자 단말과 통신하는 지점(station)을 말하며, 노드-B(Node-B), eNB(evolved Node-B), 섹터(Sector), 싸이트(Site), BTS(Base Transceiver System), 액세스 포인트(Access Point), 릴레이 노드(Relay

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Node), RRH(Remote Radio Head), RU(Radio Unit), small cell 등 다른 용어로 불릴 수 있다.

<7> 즉, 본 명세서에서 기지국 또는 셀(cell)은 CDMA에서의 BSC(Base Station Controller), WCDMA의 NodeB, LTE에서의 eNB 또는 섹터(싸이트) 등이 커버하는 일부 영역 또는 기능을 나타내는 포괄적인 의미로 해석되어야 하며, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀 및 릴레이 노드(relay node), RRH, RU, small cell 통신범위 등 다양한 커버리지 영역을 모두 포괄하는 의미이다.

<8> 상기 나열된 다양한 셀은 각 셀을 제어하는 기지국이 존재하므로 기지국은 두 가지 의미로 해석될 수 있다. i) 무선 영역과 관련하여 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토 셀, 스몰 셀을 제공하는 장치 그 자체이거나, ii) 상기 무선 영역 그 자체를 지시할 수 있다. i)에서 소정의 무선 영역을 제공하는 장치들이 동일한 개체에 의해 제어되거나 상기 무선 영역을 협업으로 구성하도록 상호작용하는 모든 장치들을 모두 기지국으로 지시한다. 무선 영역의 구성 방식에 따라 eNB, RRH, 안테나, RU, LPN, 포인트, 송수신포인트, 송신 포인트, 수신 포인트 등은 기지국의 일 실시예가 된다. ii) 에서 사용자 단말의 관점 또는 이웃하는 기지국의 입장에서 신호를 수신하거나 송신하게 되는 무선 영역 그 자체를 기지국으로 지시할 수 있다.

<9> 따라서, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토 셀, 스몰 셀, RRH, 안테나, RU, LPN(Low Power Node), 포인트, eNB, 송수신포인트, 송신 포인트, 수신포인트를 통칭하여 기지국으로 지칭한다.

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<10> 본 명세서에서 사용자 단말과 기지국은 본 명세서에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 사용자 단말과 기지국은, 본 발명에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지(Uplink 또는 Downlink) 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 여기서, 상향링크(Uplink, UL, 또는 업링크)는 사용자 단말에 의해 기지국으로 데이터를 송수신하는 방식을 의미하며, 하향링크(Downlink, DL, 또는 다운링크)는 기지국에 의해 사용자 단말로 데이터를 송수신하는 방식을 의미한다.

<11> 무선통신시스템에 적용되는 다중 접속 기법에는 제한이 없다. CDMA(Code Division Multiple Access), TDMA(Time Division Multiple Access), FDMA(Frequency Division Multiple Access), OFDMA(Orthogonal Frequency Division Multiple Access), OFDM-FDMA, OFDM-TDMA, OFDM-CDMA와 같은 다양한 다중 접속 기법을 사용할 수 있다. 본 발명의 일 실시예는 GSM, WCDMA, HSPA를 거쳐 LTE 및 LTE-Advanced로 진화하는 비동기 무선통신과, CDMA, CDMA-2000 및 UMB로 진화하는 동기식 무선 통신 분야 등의 자원할당에 적용될 수 있다. 본 발명은 특정한 무선통신 분야에 한정되거나 제한되어 해석되어서는 아니 되며, 본 발명의 사상이 적용될 수 있는 모든 기술분야를 포함하는 것으로 해석되어야 할 것이다.

<12> 상향링크 전송 및 하향링크 전송은 서로 다른 시간을 사용하여 전송되는 TDD(Time Division Duplex) 방식이 사용될 수 있고, 또는 서로 다른 주파수를 사용

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하여 전송되는 FDD(Frequency Division Duplex) 방식이 사용될 수 있다.

<13> 또한, LTE, LTE-Advanced와 같은 시스템에서는 하나의 반송파 또는 반송파 쌍을 기준으로 상향링크와 하향링크를 구성하여 규격을 구성한다. 상향링크와 하향링크는, PDCCH(Physical Downlink Control CHannel), PCFICH(Physical Control Format Indicator CHannel), PHICH(Physical Hybrid ARQ Indicator CHannel), PUCCH(Physical Uplink Control CHannel), EPDCCH(Enhanced Physical Downlink Control CHannel) 등과 같은 제어채널을 통하여 제어정보를 전송하고, PDSCH(Physical Downlink Shared CHannel), PUSCH(Physical Uplink Shared CHannel) 등과 같은 데이터채널로 구성되어 데이터를 전송한다.

<14> 한편 EPDCCH(enhanced PDCCH 또는 extended PDCCH)를 이용해서도 제어 정보를 전송할 수 있다.

<15> 본 명세서에서 셀(cell)은 송수신 포인트로부터 전송되는 신호의 커버리지 또는 송수신 포인트(transmission point 또는 transmission/reception point)로부터 전송되는 신호의 커버리지를 가지는 요소반송파(component carrier), 그 송수신 포인트 자체를 의미할 수 있다.

<16> 실시예들이 적용되는 무선통신 시스템은 둘 이상의 송수신 포인트들이 협력하여 신호를 전송하는 다중 포인트 협력형 송수신 시스템(coordinated multi-point transmission/reception System; CoMP 시스템) 또는 협력형 다중 안테나 전송방식(coordinated multi-antenna transmission system), 협력형 다중 셀 통신시스템일 수 있다. CoMP 시스템은 적어도 두개의 다중 송수신 포인트와 단말들을 포함할 수

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있다.

<17> 다중 송수신 포인트는 기지국 또는 매크로 셀(macro cell, 이하 'eNB'라 함)과, eNB에 광케이블 또는 광섬유로 연결되어 유선 제어되는, 높은 전송파워를 갖거나 매크로 셀영역 내의 낮은 전송파워를 갖는 적어도 하나의 RRH일 수도 있다.

<18> 이하에서 하향링크(downlink)는 다중 송수신 포인트에서 단말로의 통신 또는 통신 경로를 의미하며, 상향링크(uplink)는 단말에서 다중 송수신 포인트으로의 통신 또는 통신 경로를 의미한다. 하향링크에서 송신기는 다중 송수신 포인트의 일부분일 수 있고, 수신기는 단말의 일부분일 수 있다. 상향링크에서 송신기는 단말의 일부분일 수 있고, 수신기는 다중 송수신 포인트의 일부분일 수 있다.

<19> 이하에서는 PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH 등과 같은 채널을 통해 신호가 송수신되는 상황을 'PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH를 전송, 수신한다' 는 형태로 표기하기도 한다.

<20> 또한 이하에서는 PDCCH를 전송 또는 수신하거나 PDCCH를 통해서 신호를 전송 또는 수신한다는 기재는 EPDCCH를 전송 또는 수신하거나 EPDCCH를 통해서 신호를 전송 또는 수신하는 것을 포함하는 의미로 사용될 수 있다.

<21> 즉, 이하에서 기재하는 물리 하향링크 제어채널은 PDCCH를 의미하거나, EPDCCH를 의미할 수 있으며, PDCCH 및 EPDCCH 모두를 포함하는 의미로도 사용된다.

<22> 또한, 설명의 편의를 위하여 PDCCH로 설명한 부분에도 본 발명의 일 실시예인 EPDCCH를 적용할 수 있으며, EPDCCH로 설명한 부분에도 본 발명의 일 실시예로

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EPDCCH를 적용할 수 있다.

<23> 한편, 이하에서 기재하는 상위계층 시그널링(High Layer Signaling)은 RRC 파라미터를 포함하는 RRC 정보를 전송하는 RRC시그널링을 포함한다.

<24> eNB은 단말들로 하향링크 전송을 수행한다. eNB은 유니캐스트 전송(unicast transmission)을 위한 주 물리 채널인 물리 하향링크 공유채널(Physical Downlink Shared Channel, PDSCH), 그리고 PDSCH의 수신에 필요한 스케줄링 등의 하향링크 제어 정보 및 상향링크 데이터 채널(예를 들면 물리 상향링크 공유채널(Physical Uplink Shared Channel, PUSCH))에서의 전송을 위한 스케줄링 승인 정보를 전송하기 위한 물리 하향링크 제어채널(Physical Downlink Control Channel, PDCCH)을 전송할 수 있다. 이하에서는, 각 채널을 통해 신호가 송수신 되는 것을 해당 채널이 송수신되는 형태로 기재하기로 한다.

<25> 기존의 3GPP LTE/LTE-Advanced 시스템에서 단말의 legacy PDCCH를 통해 스케줄링된 PDSCH 수신에 대한 HARQ ACK/NACK 피드백을 위한 PUCCH resource mapping은 아래의 식 (1), (2)와 같이 higher layer(RRC) parameter와 해당 DL assignment DCI(Downlink Control Information)가 전송된 CCE(Control Channel Element) index에 의해 결정된다.

(1) $$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH}}^{(1)}$$

【0026】 (2) $$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH}}^{(1)}$$

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<27> 상기의 식 (1)과 (2)는 각각 해당 단말에서 two antenna port 전송이 지원되는 단말에서의 각각 antenna port 0와 antenna port 1에서의 HARQ ACK/NACK 피드백을 위한 PUCCH resource $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ 를 지칭하며, n_{CCE} 는 해당 DL scheduling grant가 전송된 lowest CCE index값을 나타내고, $N_{\mathrm{PUCCH}}^{(1)}$ 는 higher layer(RRC) signaling에 의해 설정된 cell-specific parameter이다.

<28> 단, 상기의 식 (1), (2)에 의한 PUCCH resource mapping 방안은 frame structure type 1(FDD) 시스템에서 하나의 serving cell이 설정된 단말의 PUCCH format 1a/1b를 통한 HARQ ACK/NACK 전송을 위한 PUCCH resource mapping 방안이다. 추가적으로 하나 이상의 serving cell이 설정된 단말(즉, Carrier Aggregation이 적용된 단말)에 대한 PUCCH resource mapping rule은 상기의 방안과 유사하게 lowest CCE index 및 higher layer parameter의 함수로서 결정되거나, 혹은 미리 higher layer signaling을 통해 복수의 candidate PUCCH resource value를 설정하고, 실제 DL scheduling grant의 'TPC command for PUCCH' 정보 영역을 통해 상기의 candidate PUCCH resource value 중 사용할 PUCCH resource를 indication해주는 ARI(ACK/NACK Resource Indication) 방식이 사용될 수도 있다.

<29> 구체적으로 현재의 3GPP LTE/LTE-Advanced 시스템에서 정의된 UL HARQ ACK/NACK resource mapping을 위한 PUCCH resource mapping 방안은 appendix [1]의

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TS36.213 문서를 발췌하여 첨부하고, 이와 관련된 PDCCH의 CCE indexing에 관한 내용은 [2]의 TS36.211문서를 발췌하여 첨부한다.

<30> <Coverage enhancement for low cost MTC>

<31> MTC 단말의 경우, 단말 단가를 줄이기 위해 기존의 LTE/LTE-A 단말에 비해 하드웨어 및 소프트웨어 성능이 낮은 low capability 단말을 가정하고 있다. 이에 따라 기존의 LTE/LTE-A 단말의 UE category 및 그에 따른 UE capability를 기반으로 설계된 물리 계층 채널들에 대한 MTC 단말의 송수신 성능 열하가 예상되며, 이를 해결하기 위한 방안으로 해당 물리 계층 채널들에 대한 송수신 성능을 향상시키기 위한 논의가 진행 중이다.

<32> 이를 위한 일반적인 방안으로 해당 물리 계층 채널에 대한 power boosting 및 복수의 subframe을 통해 repetition하여 전송하는 방안이 제안되고 있다. 이에 대한 한 예로써, MTC 단말을 위한 하나의 DCI(Downlink Control Information)를 전송하기 위해 하향 링크 제어 채널인 PDCCH를 복수의 하향 링크 서브프레임을 통해 repetition해서 전송함으로써 power gain을 얻는 방안이 고려되고 있다. 마찬가지로 PDSCH의 경우에도 복수의 하향 링크 서브프레임을 통해 repetition하여 전송함으로써 MTC 단말의 수신 성능을 높이는 방안이 고려되고 있다.

<33> 기존의 LTE/LTE-Advanced rel-11 이하의 시스템에서의 SPS(Semi-Persistent

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Scheduling)을 제외하면, 임의의 단말의 하향 링크 데이터 채널인 PDSCH 수신을 위한 DL assignment 정보는 동일한 하향 링크 서브프레임의 PDCCH를 통해서만 전송되었다. 또한 그에 따라 해당 PDSCH 수신에 대한 상향 링크 HARQ ACK/NACK 전송을 위한 PUCCH 자원 할당 rule은 해당 DL assignment PDCCH 혹은 EPDCCH가 전송된 lowest CCE(Control Channel Element)의 함수로서 결정되었다. 이에 따라 동일한 하향 링크 서브프레임을 통해 전송된 서로 다른 단말을 위한 PDSCH 전송들에 대해 각각의 단말이 HARQ ACK/NACK을 전송하기 위한 PUCCH 자원 간에 collision을 피할 수 있었다. 하지만, 상기에서 서술한 바와 같이 MTC 단말의 PDCCH 수신 성능을 높이기 위해 하나의 DCI를 전송하기 위한 PDCCH를 복수의 하향 링크 서브프레임에 걸쳐 repetition하여 전송할 경우, 해당 lowest CCE index에 적용할 CCE index 값의 정의 등에 대한 ambiguity가 발생할 뿐 아니라, PDSCH 전송 및 단말의 PUCCH 전송 역시 복수의 서브프레임을 통해 반복되어 전송될 경우, normal LTE 단말의 HARQ ACK/NAKC 피드백을 위한 PUCCH 자원과 MTC 단말의 PUCCH 자원 간의 collision이 발생할 수 있다.

<34> 본 발명에서는 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방안에 대해 제안한다.

<35> 방안 1. Reuse of PUCCH resource mapping equation

<36> point 1. Definition of new PUCCH resource start offset

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<37> MTC 단말을 위한 별도의 PUCCH resource start offset parameter, $N_{PUCCH,MTC}^{(1)}$ 값을 정의하여, 이를 해당 RRC signaling에 포함하도록 한다. 이를 통해 MTC 단말의 경우, 상기의 PUCCH resource mapping 식 (1), (2)에서 $N_{PUCCH}^{(1)}$ 을 $N_{PUCCH,MTC}^{(1)}$ 로 대체하여 적용하도록 한다. 즉, MTC 단말의 경우, 아래의 식 (3) 과 식 (4)와 같이 적용될 수 있다.

【0038】

(3) $$n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)}$$

(4) $$n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)}$$

<39> 상기 $N_{PUCCH,MTC}^{(1)}$ 값은 UE-specific RRC signaling을 통해 각각의 MTC 단말 별로 설정될 수 있다. $N_{PUCCH,MTC}^{(1)}$ 값을 signaling하기 위한 또 다른 방안으로 cell-specific RRC signaling 혹은 MTC 단말을 위한 PBCH을 통해 해당 셀 내의 MTC 단말에게 broadcasting될 수 있다.

<40> MTC 단말을 위한 별도의 PUCCH resource starting offset값을 설정하는 또 다른 방안으로 higher layer RRC signaling을 통해 각각의 MTC 단말 별로 복수의 candidate PUCCH resource start offset값을 정의하고, PDSCH resource allocation 시 적용할 PUCCH resource start offset값을 단말에게 signaling해주도록 할 수 있다. 즉, 임의의 MTC 단말을 위한 UE-specific RRC signaling 혹은 cell-specific

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RRC signaling이나 MTC 단말을 위한 PBCH를 andidate PUCCH resource start offset parameter를 signaling해주도록 하고, MTC 단말을 위한 DL assignment DCI format을 통해 적용할 PUCCH resource start offset parameter를 지시해주도록 할 수 있다. 해당 PUCCH resource start offset 지시를 위해서 DL assignment DCI format 내에 explicit한 PUCCH resource start offset indicator 정보 영역 정의하거나, 혹은 기존의 정보 영역을 사용하여 지시해주는 explicit한 방법이 사용될 수 있다. 예를 들어, MTC 단말을 위한

【0041】 $N_{PUCCH,MTC1}^{(1)}$, $N_{PUCCH,MTC2}^{(1)}$, $N_{PUCCH,MTC3}^{(1)}$, $N_{PUCCH,MTC4}^{(1)}$ 의 4개의 candidate PUCCH resource start offset parameter를 설정하고, DL assignment DCI format에 해당 PUCCH resource start offset을 지시해주기 위한 2 bits로 구성된 정보 영역을 새롭게 정의하여, 이를 통해 PUCCH resource mapping 식 (3), (4)에 적용할 PUCCH resource start offset을 지시해주도록 할 수 있다. 혹은 새로운 정보 영역을 추가적으로 정의하지 않고, TPC command와 같은 기존의 정보 영역을 해당 PUCCH resource start offset을 지시하기 위해 사용하도록 할 수 있다. 또 다른 방법으로 해당 candidate PUCCH resource start offset 중, 적용할 값을 implicit하게 알려줄 수 있다. 예를 들어, PDCCH aggregation level 혹은 repetition level, 즉 해당 DCI를 전송하기 위해 PDCCH repetition 횟수에 따라 적용 PUCCH resource start offset값을 결정하도록 할 수 있다.

<42> Point 2. Definition of low CCE index for PDCCH repetition

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<43> 도 1은 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

<44> 도 1과 같이 MTC 단말의 DCI 수신 성능을 향상시키기 위해 PDCCH를 복수의 하향 링크 서브프레임을 통해 repetition하여 전송하도록 정의할 수 있다.

<45> 이 경우, 상기의 식 (3), (4)에 적용하기 위한 lowest CCE index인 n_{CCE} 값에 대한 정의가 필요하다. 이를 위해 본 발명에서는 임의의 MTC 단말을 위한 DL assignment DCI가 복수의 하향 링크 서브프레임의 PDCCH를 통하여 repetition되어 전송된 경우, PUCCH resource mapping 식 (3) 혹은 (4)에 적용하기 n_{CCE}값을 정의하는 방안으로 세 가지 방안을 제안하도록 한다. 첫 번째 방안으로는 도 1에서와 같이 하나의 DL assignment DCI를 전송하기 위해 N개의 repeated PDCCH가 사용된 경우, 첫 번째 PDCCH 전송을 위해 사용된 CCE 중 lowest CCE index를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 또 다른 방안으로는 해당 마지막 repeated PDCCH인 N번째 PDCCH의 lowest CCE index를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 마지막으로 각각의 N개의 repeated PDCCH의 전송을 위해 사용된 모든 CCE index들 중에서 가장 작은 CCE index를 해당 n_{CCE} 값으로 정의하도록 할 수 있다.

<46> 단, MTC 단말을 위한 PUCCH resource mapping을 위해 상기의 point 1과 같이 MTC 단말을 위한 새로운 PUCCH resource starting offset을 정의하지 않고, 기존의

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LTE/LTE-A 단말을 위한 식 PUCCH resource starting offset 값인 $N_{PUCCH}^{(1)}$ 를 재사용할 경우에도 식 (1), (2)에 적용하기 위한 위해 적용할 해당 n_{CCE}값을 정의하는 방법도 상기에서 서술한 n_{CCE} 값을 정의하는 방법이 동일하게 적용될 수 있다.

<47> 방안 2. PUCCH resource allocation in DL assignment DCI

<48> 각각의 MTC 단말 별로 아래의 table 1과 같이 해당 MTC 단말의 HARQ ACK/NACK 피드백을 위한 candidate PUCCH resource value를 higher layer signaling을 통해 미리 설정해주고, DL assignment DCI를 통해 해당 candidate PUCCH resource value 중 사용할 PUCCH resource를 indication해주기 위한 PUCCH resource indicator field를 정의하여 이를 단말에게 직접 signaling해주도록 할 수 있다. 이 때, number of candidate PUCCH resource value는 DL assignment DCI의 PUCCH resource indicator field의 size에 따라 결정될 수 있다. 예를 들어 해당 PUCCH resource indicator field가 2 bits로 구성되는 경우, 해당 candidate PUCCH resource 설정을 위한 higher layer signaling을 통해 4개의 candidate PUCCH resource value가 설정될 수 있으며, 이에 따라 DL assignment DCI에 포함된 PUCCH resource indicator field의 설정 값에 따라 아래의 table 1과 같이 해당 4개의 PUCCH resource value 중 단말이 HARQ ACK/NACK 피드백을 전송할 PUCCH

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resource value를 mapping하도록 할 수 있다. 단, PUCCH resource value indicator field는 새롭게 정의되거나 DL assignment에 포함된 정보 영역들 중 일부를 해당 PUCCH resource indicator로서 활용할 수 있다. 기존 정보 영역을 활용하는 한 예로서, 2bits로 구성된 TPC command 정보 영역을 cross-subframe scheduling이 설정된 경우, 해당 PUCCH resource indicator 용도로 활용할 수 있다.

<49> 또한 각각의 candidate PUCCH resource value는 number of PUCCH repetition 값을 포함하도록 할 수 있다. 즉 해당 HARQ ACK/NACK 피드백을 위해 사용할 PUCCH 자원 뿐 아니라, 몇 번의 상향 링크 서브프레임을 걸쳐 해당 PUCCH 자원을 통해 HARQ ACK/NACK 피드백을 repetition하여 전송할 것인지 각각의 PUCCH resource value 별로 설정하도록 정의할 수 있다.

Value of PUCCH resource indicator in DL assignment DCI	$n_{\mathrm{PUCCH}}^{(1,p)}$
'00'	The first PUCCH resource value configured by the higher layers
'01'	The second PUCCH resource value configured by the higher layers
'10'	The third PUCCH resource value configured by the higher layers
'11'	The fourth PUCCH resource value configured by the higher layers

【0050】 Table 1. PUCCH Resource value for an MTC UE

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<51> 방안 3. Ack Resource Offset for MTC

<52> MTC 단말을 위한 추가적인 ACK Resource Offset parameter인 $\Delta_{ARO,MTC}$를 정의하여 이를 PUCCH resource mapping 식에 적용하도록 할 수 있다. 즉, 임의의 MTC 단말에 대해, 해당 MTC 단말을 위한 상기의 DL assignment 내에 추가적으로 PUCCH resource offset값을 지시하기 위한 ARO 정보 영역을 정의하도록 하고, 이를 통해 임의의 MTC 단말을 위한 PUCCH resource mapping 식에 적용할 $\Delta_{ARO,MTC}$값을 해당 단말에게 signaling해주도록 할 수 있다. 해당 DL assignment DCI format의 ARO의 설정값에 따른 $\Delta_{ARO,MTC}$ 값은 table mapping 방식으로 아래의 table 2과 같이 각각의 ARO value 별로 임의의 고정된 $\Delta_{ARO,MTC}$ 값이 정의가 되거나, 혹은 기지국이 각각의 ARO value 별 $\Delta_{ARO,MTC}$ 값을 설정하여 해당 MTC 단말에 signaling해줄 수 있다.

ACK/NACK Resource offset field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D	$\Delta_{ARO,MTC}$
0	0
1	-1
2	-2
3	2

【0053】 Table 2. $\Delta_{ARO,MTC}$ mapping table

<54> 이에 따라, PDCCH를 통해 DL assignment DCI를 수신하는 단말을 위한 기존의

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PUCCH resource mapping 식 (1)과 (2) 혹은 식 (3),(4) 대신 아래의 식(5), (6)이 적용될 수 있다.

【0055】

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH,MTC}}^{(1)} + \Delta_{ARO,\mathrm{MTC}} \quad (5)$$

$$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH,MTC}}^{(1)} + \Delta_{ARO,\mathrm{MTC}} \quad (6)$$

<56> 본 발명에서는 MTC 단말을 위한 PUDCCH resource mapping rule에 대해 제안하였다. 본 발명은 MTC 단말의 HARQ ACK/NACK 피드백을 위한 PUCCH repetition 횟수 등에 대한 구체적인 방안은 포함하고 있지 않지만, 상기에서 제안된 방안들은 PUCCH repetition의 횟수에 관계없이 동일하게 적용될 수 있음은 명백하다.

<57> 도 2는 본 발명의 다른 실시예에 의한 기지국의 구성을 보여주는 도면이다.

<58> 도 2를 참조하면, 다른 실시예에 의한 기지국(1000)은 제어부(1010), 송신부(1020) 및 수신부(1030)를 포함한다.

<59> 제어부(1010)는 전술한 본 발명을 수행하기에 필요한 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당에 따른 전반적인 기지국의 동작을 제어한다.

<60> 송신부(1020)와 수신부(1030)는 전술한 본 발명을 수행하기에 필요한 신호나 메시지, 데이터를 단말과 송수신하는데 사용된다.

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<61> 도 3은 또 다른 실시예에 의한 사용자 단말의 구성을 보여주는 도면이다.

<62> 도 3을 참조하면, 또 다른 실시예에 의한 사용자 단말(1100)은 수신부(1110), 제어부(1120) 및 송신부(1130)를 포함한다.

<63> 수신부(1110)는 기지국으로부터 하향링크 제어정보 및 데이터, 메시지를 해당 채널을 통해 수신한다.

<64> 또한 제어부(1120)는 전술한 본 발명을 수행하기에 필요한 MTC 단말의 상향링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방안에 따른 전반적인 단말의 동작을 제어한다.

<65> 송신부(1130)는 기지국에 상향링크 제어정보 및 데이터, 메시지를 해당 채널을 통해 전송한다.

<66> 전술한 실시예에서 언급한 표준내용 또는 표준문서들은 명세서의 설명을 간략하게 하기 위해 생략한 것으로 본 명세서의 일부를 구성한다. 따라서, 위 표준내용 및 표준문서들의 일부의 내용을 본 명세서에 추가하거나 청구범위에 기재하는 것은 본 발명의 범위에 해당하는 것으로 해석되어야 한다.

<67> 1. FDD HARQ-ACK 피드백 절차에 대한 TS 36.213 v.11.4.0의 specification 내용 section 10.1.2 및 10.1.3

<68> 2. 물리 하향링크 제어 채널에 대한 TS 36.211 v.11.4.0의 specification 내용 section 6.8 및 9.1

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<69> 이상의 설명은 본 발명의 기술 사상을 예시적으로 설명한 것에 불과한 것으로서, 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자라면 본 발명의 본질적인 특성에서 벗어나지 않는 범위에서 다양한 수정 및 변형이 가능할 것이다. 따라서, 본 발명에 개시된 실시예들은 본 발명의 기술 사상을 한정하기 위한 것이 아니라 설명하기 위한 것이고, 이러한 실시예에 의하여 본 발명의 기술사상의 범위가 한정되는 것은 아니다. 본 발명의 보호 범위는 아래의 청구범위에 의하여 해석되어야 하며, 그와 동등한 범위 내에 있는 모든 기술 사상은 본 발명의 권리범위에 포함되는 것으로 해석되어야 할 것이다.

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【특허청구범위】

【청구항 1】

MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방법에 있어서,

MTC 단말을 위한 별도의 파라미터 또는 테이블 값 또는 상기 MTC 단말을 위한 추가적인 파라미터를 정의하는 단계; 및

상기 파리미터 또는 테이블 값 또는 테이블을 지시하는 지시 정보를 포함하는 상위계층 시그널링을 전송하는 단계를 포함하는 방법.

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【요약서】

【요약】

본 발명은 3GPP LTE/LTE-Advanced 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방안에 대해 제안한다.

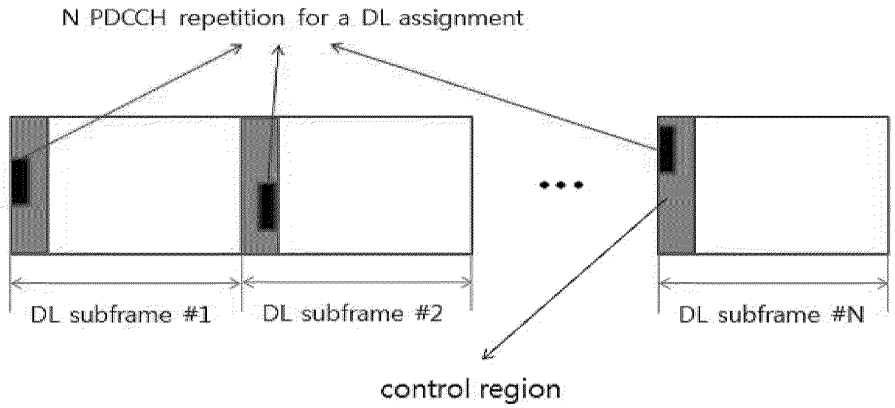
【대표도】

도 1

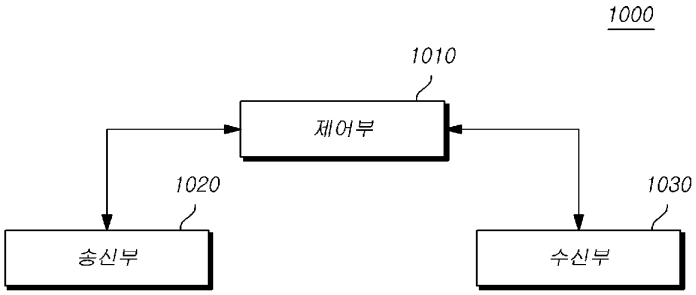
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【도면】

【도 1】

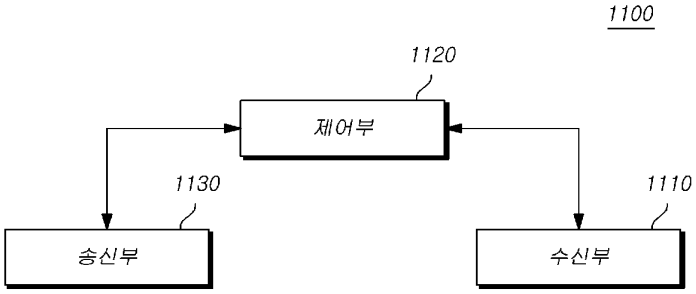


【도 2】



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【도 3】



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DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

International application number:		**PCT/KR2014/008765**
International filing date:		**22 September 2014 (22.09.2014)**
Document type:		**Certified copy of priority document**
Document details:	Country/Office:	**KR**
	Number:	**10-2013-0115367**
	Filing date:	**27 September 2013 (27.09.2013)**
Date of receipt at the International Bureau:		**25 September 2014 (25.09.2014)**

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-*bis*)

34, chemin des Colombettes
1211 Geneva 20, Switzerland
www.wipo.int

(12) 특허협력조약에 의하여 공개된 국제출원

(19) 세계지식재산권기구
국제사무국

(43) 국제공개일
2015 년 4 월 2 일 (02.04.2015)

WIPO | PCT

(10) 국제공개번호
WO 2015/046831 A1

(51) 국제특허분류:
H04B 7/26 (2006.01) *H04W 72/04* (2009.01)

(21) 국제출원번호: PCT/KR2014/008765

(22) 국제출원일: 2014 년 9 월 22 일 (22.09.2014)

(25) 출원언어: 한국어

(26) 공개언어: 한국어

(30) 우선권정보:
10-2013-0115367 2013 년 9 월 27 일 (27.09.2013) KR
10-2014-0057938 2014 년 5 월 14 일 (14.05.2014) KR

(71) 출원인: 주식회사 케이티 (KT CORPORATION) [KR/KR]; 463-711 경기도 성남시 분당구 불정로 90 (정자동 206 번지), Gyeonggi-do (KR).

(72) 발명자: 박규진 (PARK, Kyujin); 137-140 서울시 서초구 태봉로 151 (우면동, KT 연구개발센터), Seoul (KR). 최우진 (CHOI, Woo-jin); 137-140 서울시 서초구 태봉로 151 (우면동, KT 연구개발센터), Seoul (KR).

(74) 대리인: 김은구 (KIM, Eungu) 등; 135-908 서울시 강남구 강남대로 94 길 59 (역삼동 상원빌딩 2 층), Seoul (KR).

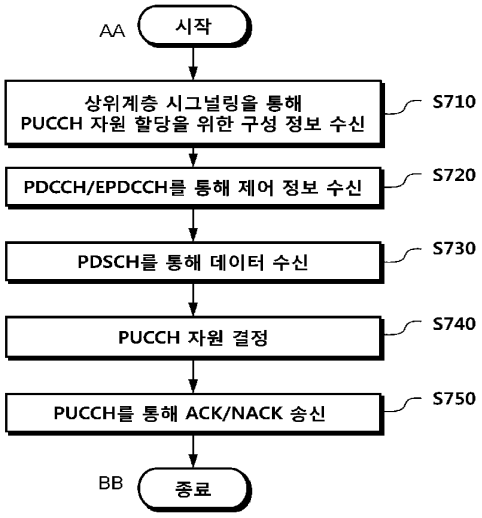
(81) 지정국 (별도의 표시가 없는 한, 가능한 모든 종류의 국내 권리의 보호를 위하여): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KZ, LA, LC, LK, LR, LS, LU, LY, MA,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

[다음 쪽 계속]

WO 2015/046831 A1

(54) Title: METHOD FOR DOWNLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREFOR

(54) 발명의 명칭 : 단말의 상향 링크 제어 채널 자원 할당 방법 및 그 장치



S710 ... Receive structural information for PUCCH resource allocation by means of upper layer signaling
S720 ... Receive control information by means of PDCCH/EPDCCH
S730 ... Receive data by means of PDSCH
S740 ... Determine PUCCH resource
S750 ... Transmit ACK/NACK by means of PUCCH
AA ... Start
BB ... End

(57) Abstract: Provided are a method and an apparatus for PUCCH resource allocation for an uplink HARQ ACK/NACK feedback of a machine-type communication (MTC) terminal in a 3GPP LTE/LTE-Advanced system.

(57) 요약서: 본 발명은 3GPP LTE/LTE-Advanced 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방법 및 장치를 제공한다.

(84) **지정국** (별도의 표시가 없는 한, 가능한 모든 종류의 역내 권리의 보호를 위하여): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), 유라시아 (AM, AZ, BY, KG, KZ, RU, TJ, TM), 유럽 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

공개:

— 국제조사보고서와 함께 (조약 제 21 조(3))

명세서

발명의 명칭: 단말의 상향 링크 제어 채널 자원 할당 방법 및 그 장치

기술분야

[1] 본 발명은 무선 통신 시스템에서 MTC(Machine Type Communication) 단말의 상향 링크 HARQ(Hybrid Automatic Repeat Request) ACK/NACK 피드백을 위한 상향링크 제어 채널의 자원 할당 방법 및 장치에 대해 제안한다.

배경기술

[2] 기계 형태 통신(machine type communication, 이하 "MTC" 통신이라 함)이란 데이터 통신의 한 가지 형태로 하나 이상의 개체가 반드시 인간의 상호작용을 필요로 하지 않는 기기 또는 사물간 (machine to machine) 통신을 나타낸다. 인간의 상호 작용을 필요로 하지 않는 MTC 통신은 통신 과정에 인간이 개입하지 않고 통신이 이루어지는 방식의 모든 통신 방식을 지칭한다.

[3] MTC 단말은 일반 단말에 비해 전파 환경이 나쁜 장소에 설치될 수 있다. MTC 단말이 일반 단말에 비해 전파 환경이 나쁜 장소에서 동작하기 위해서는, 하나의 서브프레임 단위로만 전송되는 각 물리 채널의 제어 정보 및/또는 데이터를 복수의 서브프레임에서 반복하여 전송할 필요가 있을 수 있다.

[4] 한편, 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 함수로 결정될 수 있다. 하지만, 상술한 바와 같이 MTC 단말의 제어 정보 수신 성능을 높이기 위해서 제어 정보가 반복되어 전송되는 경우, MTC 단말을 위한 상향링크 제어 채널의 자원을 결정하는 방법에 불확실성이 발생할 수 있고, MTC 단말을 위한 상향링크 제어 채널의 자원과 일반 단말의 위한 상향링크 제어 채널의 자원이 충돌할 가능성이 있다.

발명의 상세한 설명

기술적 과제

[5] 본 발명은 상술한 문제점을 극복하기 위해 MTC 단말의 상향링크 제어 채널의 자원 할당 방법 및 장치를 제공하는 것을 목적으로 한다.

과제 해결 수단

[6] 본 발명의 일 실시예는, MTC(Machine Type Communication) 단말의 하향링크 데이터의 응답 정보 전송 방법으로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하는 단계; 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하는 단계; 하향링크 데이터를 수신하는 단계; 및 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어

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채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정된 상기 상향링크 제어 채널의 자원을 이용하여 하향링크 데이터의 응답 정보를 전송하는 단계를 포함하는 방법을 제공한다.

[7] 본 발명의 다른 실시예는, 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원 설정 방법으로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 송신하는 단계; 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 송신하는 단계; 및 하향링크 데이터를 송신하는 단계를 포함하고, 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 방법을 제공한다.

[8] 본 발명의 다른 실시예는, 기지국으로 하향링크 데이터의 응답 정보를 전송하는 단말로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하고, 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하며, 하향링크 데이터를 수신하는 수신부; 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 제어부; 및 결정된 상향링크 제어 채널의 자원을 이용하여 하향링크 데이터의 응답 정보를 전송하는 송신부를 포함하는 단말을 제공한다.

[9] 본 발명의 다른 실시예는, 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원을 설정하는 기지국으로서, 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보, 하향링크 데이터를 스케줄링하는 하향링크 제어 정보, 및 하향링크 데이터를 송신하는 송신부를 포함하고, 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 기지국을 제공한다.

발명의 효과

[10] 상술한 본 발명에 따르면, MTC 단말의 상향링크 제어 채널의 자원 할당 방법 및 장치를 제공할 수 있다.

도면의 간단한 설명

[11] 도 1은 본 발명의 실시예가 적용되는 무선 통신 시스템의 예를 도시한 도면이다.

[12] 도 2는 본 발명의 실시예 1의 일 예에 따른 방법을 도시하는 흐름도이다.

[13] 도 3은 본 발명의 실시예 1의 다른 예에 따른 방법을 도시하는 흐름도이다.

[14] 도 4는 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

[15] 도 5는 본 발명의 실시예 2에 따른 방법을 도시하는 흐름도이다.

[16] 도 6은 본 발명의 실시예 3에 따른 방법을 도시하는 흐름도이다.

[17] 도 7은 본 발명의 일 실시예에 따른 단말의 PUCCH 송신 방법을 도시하는 흐름도이다.

[18] 도 8은 본 발명의 일 실시예에 따른 기지국의 PUCCH 설정 방법을 도시하는 흐름도이다.

[19] 도 9는 본 발명의 또 다른 실시예에 따른 단말의 구성을 도시하는 블록도이다.

[20] 도 10은 본 발명의 또 다른 실시예에 따른 기지국의 구성을 도시하는 블록도이다.

발명의 실시를 위한 형태

[21] 이하, 본 발명의 일부 실시예들을 예시적인 도면을 통해 상세하게 설명한다. 각 도면의 구성요소들에 참조부호를 부가함에 있어서, 동일한 구성요소들에 대해서는 비록 다른 도면상에 표시되더라도 가능한 한 동일한 부호를 가지도록 하고 있음에 유의해야 한다. 또한, 본 발명을 설명함에 있어, 관련된 공지 구성 또는 기능에 대한 구체적인 설명이 본 발명의 요지를 흐릴 수 있다고 판단되는 경우에는 그 상세한 설명은 생략한다.

[22] 본 명세서에서 MTC 단말은 low cost(또는 low complexity)를 지원하는 단말 또는 coverage enhancement를 지원하는 단말 등을 의미할 수 있다. 본 명세서에서 MTC 단말은 low cost(또는 low complexity) 및 coverage enhancement를 지원하는 단말 등을 의미할 수 있다. 또는 본 명세서에서 MTC 단말은 low cost(또는 low complexity) 및/또는 coverage enhancement를 지원하기 위한 특정 카테고리로 정의된 단말을 의미할 수 있다.

[23] 다시 말해 본 명세서에서 MTC 단말은 LTE 기반의 MTC 관련 동작을 수행하는 새롭게 정의된 3GPP Release-13 low cost(또는 low complexity) UE category/type을 의미할 수 있다. 또는 본 명세서에서 MTC 단말은 기존의 LTE coverage 대비 향상된 coverage를 지원하거나, 혹은 저전력 소모를 지원하는 기존의 3GPP Release-12 이하에서 정의된 UE category/type, 혹은 새롭게 정의된 Release-13 low cost(또는 low complexity) UE category/type을 의미할 수 있다.

[24] 도 1은 본 발명의 실시예가 적용되는 무선 통신 시스템의 예를 도시한다.

[25] 본 발명에서의 무선통신시스템은 음성, 패킷 데이터 등과 같은 다양한 통신

서비스를 제공하기 위해 널리 배치된다. 무선통신시스템은 사용자 단말(User Equipment, UE)(10) 및 기지국(Base Station, BS, 또는 eNB)(20)을 포함한다. 본 명세서에서의 사용자 단말은 무선 통신에서의 단말을 의미하는 포괄적 개념으로서, WCDMA 및 LTE, HSPA 등에서의 UE(User Equipment)는 물론, GSM에서의 MS(Mobile Station), UT(User Terminal), SS(Subscriber Station), 무선기기(wireless device) 등을 모두 포함하는 개념으로 해석되어야 할 것이다.

[26] 기지국(20) 또는 셀(cell)은 일반적으로 사용자 단말(10)과 통신하는 지점(station)을 말하며, 노드-B(Node-B), eNB(evolved Node-B), 섹터(Sector), 싸이트(Site), BTS(Base Transceiver System), 액세스 포인트(Access Point), 릴레이 노드(Relay Node), RRH(Remote Radio Head), RU(Radio Unit), small cell 등 다른 용어로 불릴 수 있다.

[27] 즉, 본 명세서에서 기지국 또는 셀(cell)은 CDMA에서의 BSC(Base Station Controller), WCDMA의 NodeB, LTE에서의 eNB 또는 섹터(싸이트) 등이 커버하는 일부 영역 또는 기능을 나타내는 포괄적인 의미로 해석되어야 하며, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀 및 릴레이 노드(relay node), RRH, RU, small cell 통신범위 등 다양한 커버리지 영역을 모두 포괄하는 의미이다.

[28] 나열된 다양한 셀은 각 셀을 제어하는 기지국이 존재하므로 기지국은 두 가지 의미로 해석될 수 있다. i) 무선 영역과 관련하여 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀, 스몰 셀을 제공하는 장치 그 자체이거나, ii) 무선영역 그 자체를 지시할 수 있다. i)에서 소정의 무선 영역을 제공하는 장치들이 동일한 개체에 의해 제어되거나 무선 영역을 협업으로 구성하도록 상호작용하는 모든 장치들을 모두 기지국으로 지시한다. 무선 영역의 구성 방식에 따라 eNB, RRH, 안테나, RU, LPN, 포인트, 송수신포인트, 송신 포인트, 수신 포인트 등은 기지국의 일 실시예가 된다. ii) 에서 사용자 단말의 관점 또는 이웃하는 기지국의 입장에서 신호를 수신하거나 송신하게 되는 무선 영역 그 자체를 기지국으로 지시할 수 있다.

[29] 따라서, 메가셀, 매크로셀, 마이크로셀, 피코셀, 펨토셀, 스몰 셀, RRH, 안테나, RU, LPN(Low Power Node), 포인트, eNB, 송수신포인트, 송신 포인트, 수신포인트를 통칭하여 기지국으로 지칭한다.

[30] 본 명세서에서 사용자 단말과 기지국은 본 명세서에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 사용자 단말과 기지국은, 본 발명에서 기술되는 기술 또는 기술적 사상을 구현하는데 사용되는 두 가지(Uplink 또는 Downlink) 송수신 주체로 포괄적인 의미로 사용되며 특정하게 지칭되는 용어 또는 단어에 의해 한정되지 않는다. 여기서, 상향링크(Uplink, UL, 또는 업링크)는 사용자 단말에 의해 기지국으로 데이터를 송수신하는 방식을 의미하며, 하향링크(Downlink, DL, 또는 다운링크)는 기지국에 의해 사용자 단말로 데이터를 송수신하는 방식을 의미한다.

[31] 무선통신시스템에 적용되는 다중 접속 기법에는 제한이 없다. CDMA(Code Division Multiple Access), TDMA(Time Division Multiple Access), FDMA(Frequency Division Multiple Access), OFDMA(Orthogonal Frequency Division Multiple Access), OFDM-FDMA, OFDM-TDMA, OFDM-CDMA와 같은 다양한 다중 접속 기법을 사용할 수 있다. 본 발명의 일 실시예는 GSM, WCDMA, HSPA를 거쳐 LTE 및 LTE-Advanced로 진화하는 비동기 무선통신과, CDMA, CDMA-2000 및 UMB로 진화하는 동기식 무선 통신 분야 등의 자원할당에 적용될 수 있다. 본 발명은 특정한 무선통신 분야에 한정되거나 제한되어 해석되어서는 아니 되며, 본 발명의 사상이 적용될 수 있는 모든 기술분야를 포함하는 것으로 해석되어야 할 것이다.

[32] 상향링크 전송 및 하향링크 전송은 서로 다른 시간을 사용하여 전송되는 TDD(Time Division Duplex) 방식이 사용될 수 있고, 또는 서로 다른 주파수를 사용하여 전송되는 FDD(Frequency Division Duplex) 방식이 사용될 수 있다.

[33] 또한, LTE, LTE-Advanced와 같은 시스템에서는 하나의 반송파 또는 반송파 쌍을 기준으로 상향링크와 하향링크를 구성하여 규격을 구성한다. 상향링크와 하향링크는, PDCCH(Physical Downlink Control CHannel), PCFICH(Physical Control Format Indicator CHannel), PHICH(Physical Hybrid ARQ Indicator CHannel), PUCCH(Physical Uplink Control CHannel), EPDCCH(Enhanced Physical Downlink Control CHannel) 등과 같은 제어채널을 통하여 제어정보를 전송하고, PDSCH(Physical Downlink Shared CHannel), PUSCH(Physical Uplink Shared CHannel) 등과 같은 데이터채널로 구성되어 데이터를 전송한다.

[34] 한편 EPDCCH(enhanced PDCCH 또는 extended PDCCH)를 이용해서도 제어 정보를 전송할 수 있다.

[35] 본 명세서에서 셀(cell)은 송수신 포인트로부터 전송되는 신호의 커버리지 또는 송수신 포인트(transmission point 또는 transmission/reception point)로부터 전송되는 신호의 커버리지를 가지는 요소 반송파(component carrier), 그 송수신 포인트 자체를 의미할 수 있다.

[36] 실시예들이 적용되는 무선통신 시스템은 둘 이상의 송수신 포인트들이 협력하여 신호를 전송하는 다중 포인트 협력형 송수신 시스템(coordinated multi-point transmission/reception System; CoMP 시스템) 또는 협력형 다중 안테나 전송방식(coordinated multi-antenna transmission system), 협력형 다중 셀 통신시스템일 수 있다. CoMP 시스템은 적어도 두 개의 다중 송수신 포인트와 단말들을 포함할 수 있다.

[37] 다중 송수신 포인트는 기지국 또는 매크로 셀(macro cell, 이하 'eNB'라 함)과, eNB에 광케이블 또는 광섬유로 연결되어 유선 제어되는, 높은 전송파워를 갖거나 매크로 셀 영역 내의 낮은 전송파워를 갖는 적어도 하나의 RRH일 수도 있다.

[38] 이하에서 하향링크(downlink)는 다중 송수신 포인트에서 단말로의 통신 또는

통신 경로를 의미하며, 상향링크(uplink)는 단말에서 다중 송수신 포인트으로의 통신 또는 통신 경로를 의미한다. 하향링크에서 송신기는 다중 송수신 포인트의 일부분일 수 있고, 수신기는 단말의 일부분일 수 있다. 상향링크에서 송신기는 단말의 일부분일 수 있고, 수신기는 다중 송수신 포인트의 일부분일 수 있다.

[39] 이하에서는 PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH 등과 같은 채널을 통해 신호가 송수신되는 상황을 'PUCCH, PUSCH, PDCCH, EPDCCH 및 PDSCH를 전송, 수신한다'는 형태로 표기하기도 한다.

[40] 또한 이하에서는 PDCCH를 전송 또는 수신하거나 PDCCH를 통해서 신호를 전송 또는 수신한다는 기재는 EPDCCH를 전송 또는 수신하거나 EPDCCH를 통해서 신호를 전송 또는 수신하는 것을 포함하는 의미로 사용될 수 있다.

[41] 즉, 이하에서 기재하는 물리 하향링크 제어채널은 PDCCH를 의미하거나, EPDCCH를 의미할 수 있으며, PDCCH 및 EPDCCH 모두를 포함하는 의미로도 사용된다.

[42] 또한, 설명의 편의를 위하여 PDCCH로 설명한 부분에도 본 발명의 일 실시예인 EPDCCH를 적용할 수 있으며, EPDCCH로 설명한 부분에도 본 발명의 일 실시예로 EPDCCH를 적용할 수 있다.

[43] 한편, 이하에서 기재하는 상위계층 시그널링(High Layer Signaling)은 RRC 파라미터를 포함하는 RRC 정보를 전송하는 RRC시그널링을 포함한다.

[44] 기지국(20)은 단말(10)들로 하향링크 전송을 수행한다. 기지국(20)은 유니캐스트 전송(unicast transmission)을 위한 주 물리 채널인 물리 하향링크 공유채널(Physical Downlink Shared Channel, PDSCH), 그리고 PDSCH의 수신에 필요한 스케줄링 등의 하향링크 제어 정보 및 상향링크 데이터 채널(예를 들면 물리 상향링크 공유채널(Physical Uplink Shared Channel, PUSCH))에서의 전송을 위한 스케줄링 승인 정보를 전송하기 위한 물리 하향링크 제어채널(Physical Downlink Control Channel, PDCCH)을 전송할 수 있다. 이하에서는, 각 채널을 통해 신호가 송수신 되는 것을 해당 채널이 송수신되는 형태로 기재하기로 한다.

[45] 기존의 3GPP LTE/LTE-Advanced 시스템에서 단말의 legacy PDCCH를 통해 스케줄링된 PDSCH 수신에 대한 HARQ(Hybrid Automatic Repeat Request) ACK/NACK 피드백을 위한 PUCCH 자원 매핑은 아래의 수학식 (1), (2)와 같이 상위계층(예를 들면, RRC(Radio Resource Control)) 파라미터와 해당 하향링크 할당(DL assignment) DCI(Downlink Control Information)가 전송된 CCE(Control Channel Element) 인덱스에 의해 결정된다.

[46]

(1) $$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH}}^{(1)}$$

(2) $$n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH}}^{(1)}$$

[47] 상기의 수학식 (1)과 (2)는 각각 해당 단말에서 두 개의 안테나 포트(two antenna port) 전송이 지원되는 단말에서의 각각 안테나 포트 0와 안테나 포트 1에서의

HARQ ACK/NACK 피드백을 위한 PUCCH 자원 $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ 를 지칭하며, n_{CCE} 는 해당 DL 스케줄링 그랜트(DL scheduling grant)가 전송된 최하위 CCE 인덱스(lowest CCE index) 값을 나타내고, $N_{\mathrm{PUCCH}}^{(1)}$ 는 상위 계층(RRC) 시그널링(higher layer(RRC) signaling)에 의해 설정된 셀 특이적 파라미터(cell-specific parameter)이다.

[48] 단, 상기의 수학식 (1), (2)에 의한 PUCCH 자원 매핑(resource mapping) 방안은 프레임 구조 타입 1(frame structure type 1)(FDD) 시스템에서 하나의 서빙 셀(serving cell)이 설정된 단말의 PUCCH 포맷 1a/1b를 통한 HARQ ACK/NACK 전송을 위한 PUCCH 자원 매핑 방안이다. 추가적으로 하나 이상의 serving cell이 설정된 단말(즉, Carrier Aggregation이 적용된 단말)에 대한 PUCCH 자원 매핑 룰(resource mapping rule)은 상기의 방안과 유사하게 최하위 CCE 인덱스 및 상위 계층 파라미터의 함수로서 결정되거나, 혹은 미리 상위 계층 시그널링을 통해 복수의 후보 PUCCH 자원 값(candidate PUCCH resource value)를 설정하고, 실제 DL 스케줄링 그랜트의 'TPC command for PUCCH' 정보 영역을 통해 상기의 복수의 후보 PUCCH 자원 값(candidate PUCCH resource value) 중 사용할 PUCCH 자원을 지시하는 ARI(ACK/NACK Resource Indication) 방식이 사용될 수도 있다.

[49] <저가 MTC를 위한 커버리지 향상>

[50] MTC 단말의 경우, 단말 단가를 줄이기 위해 기존의 LTE/LTE-Advanced 단말에 비해 하드웨어 및 소프트웨어 성능이 낮은 low capability 단말을 가정하고 있다. 이에 따라 기존의 LTE/LTE-Advanced 단말의 UE category 및 그에 따른 UE capability를 기반으로 설계된 물리 계층 채널들에 대한 MTC 단말의 송수신 성능 열화가 예상되며, 이를 해결하기 위한 방안으로 해당 물리 계층 채널들에 대한 송수신 성능을 향상시키기 위한 논의가 진행 중이다.

[51] 이를 위한 일반적인 방안으로 해당 물리 계층 채널에 대한 전력 부스팅(power boosting) 및 복수의 서브프레임을 통해 반복(repetition)하여 전송하는 방안이 제안되고 있다. 이에 대한 한 예로써, MTC 단말을 위한 하나의 DCI(Downlink Control Information)를 전송하기 위해 하향 링크 제어 채널인 PDCCH를 복수의 하향 링크 서브프레임을 통해 반복해서 전송함으로써 전력 게이인(power gain)을 얻는 방안이 고려되고 있다. 마찬가지로 PDSCH의 경우에도 복수의 하향 링크 서브프레임을 통해 반복하여 전송함으로써 MTC 단말의 수신 성능을 높이는 방안이 고려되고 있다.

[52] 기존의 LTE/LTE-Advanced Release-11 이하의 시스템에서, SPS(Semi-Persistent Scheduling)을 제외하면, 임의의 단말의 하향 링크 데이터 채널인 PDSCH 수신을 위한 하향링크 할당(DL assignment) 정보는 동일한 하향 링크 서브프레임의 PDCCH를 통해서만 전송되었다. 또한 그에 따라 해당 PDSCH 수신에 대한 상향 링크 HARQ ACK/NACK 전송을 위한 PUCCH 자원 할당 규칙은 해당 하향링크

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할당 PDCCH 혹은 EPDCCH가 전송된 최하위 CCE(Control Channel Element)의 함수로서 결정되었다. 이에 따라 동일한 하향 링크 서브프레임을 통해 전송된 서로 다른 단말을 위한 PDSCH 전송들에 대해 각각의 단말이 HARQ ACK/NACK을 전송하기 위한 PUCCH 자원 간에 충돌을 피할 수 있었다. 하지만, 상기에서 서술한 바와 같이 MTC 단말의 PDCCH 수신 성능을 높이기 위해 하나의 DCI를 전송하기 위한 PDCCH를 복수의 하향 링크 서브프레임에 걸쳐 반복하여 전송할 경우, 해당 최하위 CCE 인덱스에 적용할 CCE 인덱스 값의 정의 등에 대한 불확실성이 발생할 뿐 아니라, PDSCH 전송 및 단말의 PUCCH 전송 역시 복수의 서브프레임을 통해 반복되어 전송될 경우, MTC 단말이 아닌 일반 LTE 단말의 HARQ ACK/NAKC 피드백을 위한 PUCCH 자원과 MTC 단말의 PUCCH 자원 간의 충돌이 발생할 수 있다.

[53] 본 발명은 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당 방법 및 장치를 제공한다.

[54] **실시예 1. PUCCH 자원 매핑 식의 재사용**

[55] 새로운 PUCCH 자원 시작 옵셋을 정의

[56] 도 2는 실시예 1의 일 예에 따른 방법을 도시하는 흐름도이다.

[57] 도 2를 참조하면, 기지국은 MTC 단말을 위한 별도의 PUCCH 자원 시작 옵셋 파라미터, $N_{PUCCH,MTC}^{(1)}$ 값을 정의하여(S210), 이를 해당 RRC 시그널링에 포함하여 단말로 전송한다(S220). 이를 통해 MTC 단말의 경우, 상기의 PUCCH 자원 매핑 수학식 (1), (2)에서 $N_{PUCCH}^{(1)}$ 을 $N_{PUCCH,MTC}^{(1)}$ 로 대체하여 적용하여 PUCCH의 자원을 결정하고(S230), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S240). 즉, MTC 단말의 경우, 아래의 수학식 (3) 과 (4)와 같이 적용될 수 있다.

[58]

$$(3)\quad n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)}$$

$$(4)\quad n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)}$$

[59] $N_{PUCCH,MTC}^{(1)}$ 값은 단말 특이적 RRC(UE-specific RRC) 시그널링을 통해 각각의 MTC 단말 별로 설정될 수 있다. $N_{PUCCH,MTC}^{(1)}$ 값을 signaling하기 위한 또 다른 실시예로 셀 특이적 RRC(cell-specific RRC) 시그널링 혹은 MTC 단말을 위한 PBCH을 통해 해당 셀 내의 MTC 단말에게 브로드캐스팅(broadcasting) 될 수 있다.

[60] 도 3은 실시예 1의 다른 예에 따른 방법을 도시하는 흐름도이다.

[61] 도 3을 참조하면, 기지국은 MTC 단말을 위한 별도의 PUCCH 자원 시작 옵셋 값을 설정하는 또 다른 실시예로 상위 계층 RRC 시그널링을 통해 각각의 MTC 단말 별로 복수의 후보 PUCCH 자원 시작 옵셋 값을 정의하고(S310), 복수의 후보 PUCCH 자원 시작 옵셋 값을 단말로 전송하고(S320), PDSCH 자원 할당 시 적용할 PUCCH 자원 시작 옵셋 값을 단말에게 시그널링 해주도록 할 수 있다(S330). 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원을 결정하고(S340), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S350).

[62] 즉, 임의의 MTC 단말을 위한 단말 특이적 RRC(UE-specific RRC) 시그널링 혹은 셀 특이적 RRC(cell-specific RRC) 시그널링이나 MTC 단말을 위한 PBCH를 후보 PUCCH 자원 시작 옵셋 파라미터를 시그널링 해주도록 하고, MTC 단말을 위한 하향링크 할당 DCI 포맷을 통해 적용할 PUCCH 자원 시작 옵셋 파라미터를 지시해주도록 할 수 있다. 해당 PUCCH 자원 시작 옵셋 지시를 위해서 하향링크 할당 DCI 포맷 내에 명시적(explicit)으로 PUCCH 자원 시작 옵셋 인디케이터(indicator) 정보 영역을 정의하거나, 혹은 기존의 정보 영역을 사용하여 지시해주는 명시적인 방법이 사용될 수 있다.

[63] 예를 들어, MTC 단말을 위한 $N_{PUCCH,MTC1}^{(1)}$, $N_{PUCCH,MTC2}^{(1)}$, $N_{PUCCH,MTC3}^{(1)}$, $N_{PUCCH,MTC4}^{(1)}$ 의 4개의 후보 PUCCH 자원 시작 옵셋 파라미터를 설정하고, 하향링크 할당 DCI 포맷에 해당 PUCCH 자원 시작 옵셋을 지시해주기 위한 2 비트로 구성된 정보 영역을 새롭게 정의하여, 이를 통해 PUCCH 자원 매핑 수학식 (3), (4)에 적용할 PUCCH 자원 시작 옵셋을 지시해주도록 할 수 있다. 혹은 새로운 정보 영역을 추가적으로 정의하지 않고, TPC command와 같은 기존의 정보 영역을 해당 PUCCH 자원 시작 옵셋을 지시하기 위해 사용하도록 할 수 있다.

[64] 또 다른 방법으로 해당 후보 PUCCH 자원 시작 옵셋 중, 적용할 값을 암시적(implicit)으로 알려줄 수 있다. 예를 들어, PDCCH 집적 레벨(PDCCH aggregation level) 혹은 반복 레벨(repetition level), 즉 해당 DCI를 전송하기 위해 PDCCH 반복 횟수에 따라 적용 PUCCH 자원 시작 옵셋 값을 결정하도록 할 수 있다.

[65] <u>반복되는 PDCCH에 대한 최하위 CCE 인덱스의 정의</u>

[66] 도 4는 본 발명의 일 실시예에 따른 PDCCH를 복수의 하향링크 서브프레임을 통해 반복하여 전송하는 것을 도시한 도면이다.

[67] 도 4와 같이 MTC 단말의 DCI 수신 성능을 향상시키기 위해 PDCCH를 복수의 하향 링크 서브프레임을 통해 반복하여 전송하도록 정의할 수 있다.

[68] 이 경우, 상기의 수학식 (3), (4)에 적용하기 위한 최하위 CCE 인덱스인 n_{CCE}

값에 대한 정의가 필요하다. 이를 위해 본 발명에서는 임의의 MTC 단말을 위한 하향링크 할당 DCI가 복수의 하향 링크 서브프레임의 PDCCH를 통하여 반복되어 전송된 경우, PUCCH 자원 매핑 수학식 (3) 혹은 (4)에 적용되는 n_{CCE} 값을 정의하는 실시예들을 제공한다.

[69] 첫 번째 실시예로는 도 4에서와 같이 하나의 하향링크 할당 DCI를 전송하기 위해 N개의 반복된 PDCCH가 사용된 경우, 첫 번째 PDCCH 전송을 위해 사용된 CCE 중 최하위 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 또 다른 실시예로는 해당 마지막 반복된 PDCCH인 N번째 PDCCH의 최하위 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다. 마지막으로 각각의 N개의 반복된 PDCCH의 전송을 위해 사용된 모든 CCE 인덱스들 중에서 가장 작은 CCE 인덱스를 해당 n_{CCE} 값으로 정의하도록 할 수 있다.

[70] 단, MTC 단말을 위한 PUCCH 자원 매핑을 위해 상기의 도 2 또는 도 3과 같이 MTC 단말을 위한 새로운 PUCCH 자원 시작 옵셋을 정의하지 않고, 기존의 LTE/LTE-A 단말을 위한 수학식에서 PUCCH 자원 시작 옵셋 값인 $N_{PUCCH}^{(1)}$ 를 재사용할 경우에도 수학식 (1), (2)에 적용하기 위한 위해 적용할 해당 n_{CCE} 값을 정의하는 방법도 상기에서 서술한 n_{CCE} 값을 정의하는 방법이 동일하게 적용될 수 있다.

[71] **실시예 2. 하향링크 할당 DCI에 PUCCH 자원 할당**

[72] 도 5는 본 발명의 실시예 2에 따른 방법을 도시하는 흐름도이다.

[73] 도 5를 참조하면, 기지국은 각각의 MTC 단말 별로 아래의 표 1과 같이 해당 MTC 단말의 HARQ ACK/NACK 피드백을 위한 후보 PUCCH 자원 값을 상위 계층 시그널링을 통해 미리 설정해주고(S510), 하향링크 할당 DCI를 통해 해당 후보 PUCCH 자원 값 중 사용할 PUCCH 자원을 지시하기 위한 PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)를 정의하여 이를 단말에게 직접 시그널링 해주도록 할 수 있다(S520). 단말은 PUCCH 자원을 결정하고(S530), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S540).

[74] 이 때, 후보 PUCCH 자원 값의 개수는 하향링크 할당 DCI의 PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)의 크기에 따라 결정될 수 있다. 예를 들어 해당 PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)2 비트들로 구성되는 경우, 해당 후보 PUCCH 자원 설정을 위한 상위 계층 시그널링을 통해 4개의 후보 PUCCH 자원 값이 설정될 수 있으며, 이에 따라 하향링크 할당 DCI에 포함된 PUCCH 자원 인디케이터 필드(PUCCH resource

indicator field)의 설정 값에 따라 아래의 표 1과 같이 해당 4개의 PUCCH 자원 값 중 단말이 HARQ ACK/NACK 피드백을 전송할 PUCCH 자원 값을 매핑하도록 할 수 있다. 단, PUCCH 자원 인디케이터 필드(PUCCH resource indicator field)는 새롭게 정의되거나 하향링크 할당에 포함된 정보 영역들 중 일부를 해당 PUCCH 자원 인디케이터(PUCCH resource indicator)로서 활용할 수 있다. 기존 정보 영역을 활용하는 한 예로서, 2bits로 구성된 TPC 코맨드(command) 정보 영역을 해당 PUCCH 자원 인디케이터(PUCCH resource indicator) 용도로 활용할 수 있다.

[75] [표 1]

[76]

하향링크 할당 DCI 내 PUCCH 자원 인디케이터의 값	$n_{\mathrm{PUCCH}}^{(1,p)}$
'00'	상위계층에 의해 구성된 제 1 PUCCH 자원 값
'01'	상위계층에 의해 구성된 제 2 PUCCH 자원 값
'10'	상위계층에 의해 구성된 제 3 PUCCH 자원 값
'11'	상위계층에 의해 구성된 제 4 PUCCH 자원 값

[77] 또한 각각의 후보 PUCCH 자원 값은 PUCCH 반복의 개수 값을 포함하도록 할 수 있다. 즉 해당 HARQ ACK/NACK 피드백을 위해 사용할 PUCCH 자원뿐 아니라, 몇 번의 상향 링크 서브프레임을 걸쳐 해당 PUCCH 자원을 통해 HARQ ACK/NACK 피드백을 반복하여 전송할 것인지 각각의 PUCCH 자원 값 별로 설정하도록 정의할 수 있다.

[78] **실시예 3. MTC를 위한 ACK 자원 옵셋**

[79] 도 6은 본 발명의 실시예 3에 따른 방법을 도시하는 흐름도이다.

[80] 본 실시예에서, MTC 단말을 위한 추가적인 ACK 자원 옵셋 파라미터(ACK Resource Offset parameter)인 $\Delta_{ARO,\mathrm{MTC}}$ 를 정의하여 이를 PUCCH 자원 매핑 식에 적용하도록 할 수 있다. 즉, 임의의 MTC 단말에 대해, 해당 MTC 단말을 위한 상기의 하향링크 할당 내에 추가적으로 PUCCH 자원 옵셋(PUCCH resource offset)값을 지시하기 위한 ARO(ACK Resource Offset) 정보 영역을 정의하도록 하고, 이를 통해 임의의 MTC 단말을 위한 PUCCH 자원 매핑 식에 적용할 $\Delta_{ARO,\mathrm{MTC}}$ 값을 해당 단말에게 signaling해주도록 할 수 있다(S610). 단말은 PUCCH 자원을 결정하고(S620), 결정된 자원의 PUCCH를 통해 HARQ ACK/NACK을 기지국으로 전송한다(S630).

[81] 해당 하향링크 할당 DCI 포맷의 ARO의 설정 값에 따른 $\Delta_{ARO,\mathrm{MTC}}$ 값은

테이블 매핑 방식으로 아래의 표 2와 같이 각각의 ARO 값 별로 임의의 고정된 $\Delta_{ARO,\mathrm{MTC}}$ 값이 정의되거나, 혹은 기지국이 각각의 ARO value 별 $\Delta_{ARO,\mathrm{MTC}}$ 값을 설정하여 해당 MTC 단말에 시그널링해줄 수 있다.

[82] [표 2]

[83]

DCI 포맷 1A/1B/1D/1/2A/2/2B/2C/2D 에서 ACK/NACK 자원 옵셋 필드	$\Delta_{ARO.MTC}$
0	0
1	-1
2	-2
3	2

[84] 이에 따라, PDCCH를 통해 하향링크 할당 DCI를 수신하는 단말을 위한 기존의 PUCCH 자원 매핑 수학식 (1)과 (2) 혹은 수학식 (3)과 (4) 대신 아래의 수학식(5), (6)이 적용될 수 있다.

[85]

$$(5)\quad n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH,MTC}}^{(1)} + \Delta_{ARO,\mathrm{MTC}}$$

$$(6)\quad n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH,MTC}}^{(1)} + \Delta_{ARO,\mathrm{MTC}}$$

[86] 본 발명에서는 MTC 단말을 위한 PUCCH 자원 매핑 규칙에 대해 제안하였다. 단, 임의의 MTC 단말의 DL HARQ ACK 피드백을 위한 PUCCH 역시 커버리지 향상(coverage enhancement)를 위해 복수의 상향 링크 서브프레임을 통해 반복되어 전송될 수 있다.

[87] 이 경우 상기에서 제안된 방법에 따라 하나의 상향 링크 서브프레임에서 DL HARQ ACK 피드백을 위한 PUCCH 자원이 결정되며, 해당 PUCCH 반복 전송 횟수에 따라 복수의 상향 링크 서브프레임에서 상기의 방법들에 의해 결정된 동일한 PUCCH 자원을 통해 DL HARQ ACK 피드백을 반복 전송하도록 정의될 수 있다.

[88] 또한, 본 발명은 MTC 단말의 HARQ ACK/NACK 피드백을 위한 PUCCH 반복 횟수 등에 대한 구체적인 실시예는 포함하고 있지 않지만, 상기에서 제안된 실시예들은 PUCCH 반복의 횟수에 관계없이 동일하게 적용될 수 있음은 명백하다.

[89] 도 7은 본 발명의 일 실시예에 따른 단말의 PUCCH 송신 방법을 도시하는 흐름도이다.

[90] 도 7을 참조하면, 단말은 기지국으로부터 상위계층(예를 들면, RRC)

시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 수신한다(S710).

[91] 단말은 기지국으로부터 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 수신한다(S720).

[92] 단말은 기지국으로부터 DCI 내의 스케줄링 정보에 기초하여 PDSCH를 통해 데이터를 수신한다(S730).

[93] 단말은 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK이 전송되는 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정한다(S740).

[94] 일 예에서, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 수신하고, S740 단계에서 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함하는 구성 정보를 수신하고, S720 단계에서 복수의 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 중 하나를 지시하는 제어 정보를 수신하며, S740 단계에서 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[95] 다른 예에서, 단말은 S710 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{\mathrm{PUCCH}}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 수신하고, S720 단계에서 복수의 $n_{\mathrm{PUCCH}}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 수신하며, S740 단계에서 제어 정보에 기초하여 PUCCH의 자원 ($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[96] 또 다른 예에서, 단말은 S720 단계에서 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 중 하나를 지시하는 제어 정보를 수신하고, S740 단계에서 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 는 사전에 설정되거나 S710 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

[97] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우,

수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소 값일 수 있다.

[98] 단말은 결정된 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 이용하여 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK을 기지국으로 전송한다(S750).

[99] 전술한 실시예에서 S740 단계와 S750단계가 별도로 수행되는 것으로 설명하였으나 하나의 단계로 수행될 수도 있다. 다시 말해 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상향링크 제어 채널이 할당된 자원의 정보, 및 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정된 상향링크 제어 채널의 자원을 이용하여 하향링크 데이터의 응답 정보를 전송할 수도 있다.

[100] 도 8은 본 발명의 일 실시예에 따른 기지국의 PUCCH 자원 설정 방법을 도시하는 흐름도이다.

[101] 도 8을 참조하면, 기지국은 단말로 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 송신한다(S810).

[102] 기지국은 단말로 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 송신한다(S820).

[103] 그리고, 기지국은 단말로 PDSCH를 통해 데이터를 송신한다(S830).

[104] 일 예에서, 기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 송신하고, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는,

기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함하는 구성 정보를 송신하고, S820 단계에서 복수의 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[105] 다른 예에서, 기지국은 S810 단계에서 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{\mathrm{PUCCH}}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 송신하고, S820

$n_{\mathrm{PUCCH}}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 제어 정보에 기초하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[106] 또 다른 예에서, 기지국은 S820 단계에서 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 중 하나를 지시하는 제어 정보를 송신하고, 단말은 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 는 사전에 설정되거나 S810 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

[107] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

[108] 도 9는 본 발명의 또 다른 실시예에 따른 단말의 구성을 도시하는 블록도이다.

[109] 도 9를 참조하면, 본 발명의 또 다른 실시예에 따른 단말(900)은 제어부(910), 수신부(920), 및 송신부(930)를 포함한다.

[110] 수신부(920)는 기지국으로부터 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 수신할 수 있다.

[111] 또한, 수신부(920)는 기지국으로부터 PDCCH 또는 EPDCCH를 통해 하향링크 할당을 위한 DCI를 수신하고, DCI 내의 스케줄링 정보에 기초하여 PDSCH를 통해 데이터를 수신할 수 있다.

[112] 제어부(910)는 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK이 전송되는 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[113] 송신부(930)는 결정된 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 이용하여 PDSCH를 통해 수신한 데이터의 HARQ ACK/NACK을 기지국으로 전송할 수 있다.

[114] 일 예에서, 수신부(920)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 수신하고, 제어부(930)는 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는,

수신부(920)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함하는 구성 정보를 수신하고, 복수의 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 중 하나를 지시하는 제어 정보를 수신하며, 제어부(910)는 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[115] 다른 예에서, 수신부(920)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{\mathrm{PUCCH}}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 수신하고, 복수의 $n_{\mathrm{PUCCH}}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 수신하며, 제어부(910)는 제어 정보에 기초하여 PUCCH의 자원 ($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[116] 또 다른 예에서, 수신부(920)는 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 중 하나를 지시하는 제어 정보를 수신하고, 제어부(910)는 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 는 사전에 설정되거나 상위 계층 시그널링을 통해 기지국으로부터 단말로 전달된 것일 수 있다.

[117] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

[118] 도 10은 본 발명의 또 다른 실시예에 따른 기지국의 구성을 도시하는 블록도이다.

[119] 도 10을 참조하면, 본 발명의 또 다른 실시예에 따른 기지국(1000)은 제어부(1010), 송신부(1020), 및 수신부(1030)를 포함한다.

[120] 제어부(1010)는 전술한 본 발명을 수행하기에 필요한 MTC 단말의 상향 링크 HARQ ACK/NACK 피드백을 위한 PUCCH 자원 할당에 따른 전반적인 기지국의 동작을 제어한다.

[121] 송신부(1020)는 단말로 상위계층(예를 들면, RRC) 시그널링을 통해 PUCCH 자원 할당을 위한 구성 정보를 송신할 수 있다.

[122] 또한, 송신부(1020)는 단말로 PDCCH 또는 EPDCCH를 통해 하향링크 할당을

위한 DCI를 송신하고, PDSCH를 통해 데이터를 송신할 수 있다.

[123] 수신부(1030)는 단말로부터 PUCCH를 통해 PDSCH에 대한 ACK/NACK을 수신할 수 있다.

[124] 일 예에서, 송신부(1020)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 포함하는 구성 정보를 송신하고, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 또는, 송신부(1020)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 를 복수 개 포함하는 구성 정보를 송신하고, 복수의 $N_{\mathrm{PUCCH,MTC}}^{(1)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 수학식 (3) 및 (4)를 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[125] 다른 예에서, 송신부(1020)는 MTC 단말을 위한 PUCCH 자원 시작 옵셋 파라미터 $n_{\mathrm{PUCCH}}^{(1,p)}$ 복수 개를 포함하는 구성 정보를 송신하고, 복수의 $n_{\mathrm{PUCCH}}^{(1,p)}$ 중 하나를 지시하는 제어 정보를 송신하며, 단말은 제어 정보에 기초하여 PUCCH의 자원 ($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다.

[126] 또 다른 예에서, 송신부(1020)는 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 중 하나를 지시하는 제어 정보를 송신하고, 단말은 수학식 (5) 및 (6)을 이용하여 PUCCH의 자원($n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$)을 결정할 수 있다. 이때, 복수의 ACK 자원 옵셋 $\Delta_{ARO,\mathrm{MTC}}$ 는 사전에 설정되거나 S810 단계에서 기지국으로부터 단말로 전달된 것일 수 있다.

[127] 복수의 서브프레임을 통해 PDCCH 또는 EPDCCH가 반복되어 전송되는 경우, 수학식 (3) 및 (4), 또는 수학식 (5) 및 (6)을 이용할 때, PDCCH 또는 EPDCCH가 전송되는 최하위 CCE 인덱스(n_{CCE})는, (1) 첫 번째 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, (2) 마지막 PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스이거나, 또는 (3) PDCCH 또는 EPDCCH 전송을 위해 사용된 최하위 CCE 인덱스 중 최소값일 수 있다.

[128] 전술한 실시예에서 언급한 표준내용 또는 표준문서들은 명세서의 설명을 간략하게 하기 위해 생략한 것으로 본 명세서의 일부를 구성한다. 따라서, 위 표준내용 및 표준문서들의 일부의 내용을 본 명세서에 추가하거나 청구범위에

기재하는 것은 본 발명의 범위에 해당하는 것으로 해석되어야 한다.

[129] 이상의 설명은 본 발명의 기술 사상을 예시적으로 설명한 것에 불과한 것으로서, 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자라면 본 발명의 본질적인 특성에서 벗어나지 않는 범위에서 다양한 수정 및 변형이 가능할 것이다. 따라서, 본 발명에 개시된 실시예들은 본 발명의 기술 사상을 한정하기 위한 것이 아니라 설명하기 위한 것이고, 이러한 실시예에 의하여 본 발명의 기술사상의 범위가 한정되는 것은 아니다. 본 발명의 보호 범위는 아래의 청구범위에 의하여 해석되어야 하며, 그와 동등한 범위 내에 있는 모든 기술 사상은 본 발명의 권리범위에 포함되는 것으로 해석되어야 할 것이다.

[130]

[131] **CROSS-REFERENCE TO RELATED APPLICATION**

[132] 본 특허출원은 2013년 09월 27일 한국에 출원한 특허출원번호 제 10-2013-0115367 호 및 2014년 05월 14일 한국에 출원한 특허출원번호 제 10-2014-0057938 호에 대해 미국 특허법 119(a)조 (35 U.S.C § 119(a))에 따라 우선권을 주장하며, 그 모든 내용은 참고문헌으로 본 특허출원에 병합된다. 아울러, 본 특허출원은 미국 이외에 국가에 대해서도 위와 동일한 이유로 우선권을 주장하면 그 모든 내용은 참고문헌으로 본 특허출원에 병합된다.

청구범위

[청구항 1] MTC(Machine Type Communication) 단말의 하향링크 데이터의 응답 정보 전송 방법으로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하는 단계;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하는 단계;
상기 하향링크 데이터를 수신하는 단계;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정된 상기 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 단계를 포함하는 방법.

[청구항 2] 제 1 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 방법.

[청구항 3] 제 2 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,
상기 하향링크 제어 정보를 수신하는 단계는 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 수신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 4] 제 1 항에 있어서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,
상기 하향링크 제어 정보를 수신하는 단계는 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 수신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 5] 제 1 항에 있어서,
상기 하향링크 제어 정보를 수신하는 단계는 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 수신하는 단계를 포함하고,
상기 하향링크 데이터의 응답 정보를 전송하는 단계에서, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및

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상기 추가 옵셋 값에 기초하여 상기 상향링크 제어 채널의 자원을 결정하는 것을 특징으로 하는 방법.

[청구항 6] 제 1 항에 있어서,
상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 방법.

[청구항 7] 기지국의 MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원 설정 방법으로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 송신하는 단계;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 송신하는 단계; 및
상기 하향링크 데이터를 송신하는 단계를 포함하고,
상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 방법.

[청구항 8] 제 7 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 방법.

[청구항 9] 제 8 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,
상기 하향링크 제어 정보를 송신하는 단계는 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 송신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 10] 제 7 항에 있어서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,
상기 하향링크 제어 정보를 송신하는 단계는 상기 복수 개의 자원

정보 중 하나를 지시하는 정보를 송신하는 단계를 포함하는 것을 특징으로 하는 방법.

[청구항 11] 제 7 항에 있어서,
상기 하향링크 제어 정보를 송신하는 단계는 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 송신하는 단계를 포함하고,
상기 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 결정되는 것을 특징으로 하는 방법.

[청구항 12] 제 7 항에 있어서,
상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 방법.

[청구항 13] 기지국으로 하향링크 데이터의 응답 정보를 전송하는 단말로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보를 수신하고, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보를 수신하며, 상기 하향링크 데이터를 수신하는 수신부;
상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원을 결정하는 제어부; 및
상기 결정된 상향링크 제어 채널의 자원을 이용하여 상기 하향링크 데이터의 응답 정보를 전송하는 송신부를 포함하는 단말.

[청구항 14] 제 13 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 MTC 단말이 아닌 단말을 위한 옵셋 정보와 다른 것을 특징으로 하는 단말.

[청구항 15] 제 14 항에 있어서,
상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보는 복수 개이고,

상기 수신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 옵셋 정보 중 하나를 지시하는 정보를 수신하는 것을 특징으로 하는 단말.

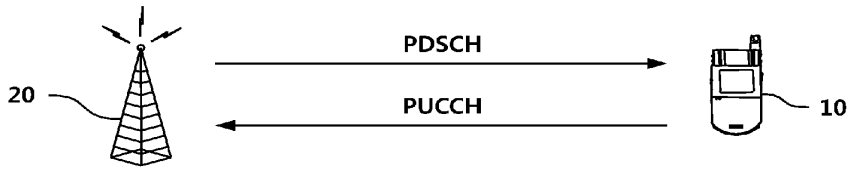
[청구항 16] 제 13 항에 있어서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보는 복수 개이고,
상기 수신부는 상기 하향링크 제어 정보를 통해 상기 복수 개의 자원 정보 중 하나를 지시하는 정보를 수신하는 것을 특징으로 하는 단말.

[청구항 17] 제 13 항에 있어서,
상기 수신부는 상기 하향링크 제어 정보를 통해 복수 개의 추가 옵셋 값 중 하나를 지시하는 정보를 수신하고,
상기 제어부는 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보, 및 상기 추가 옵셋 값에 기초하여 상기 상향링크 제어 채널의 자원을 결정하는 것을 특징으로 하는 단말.

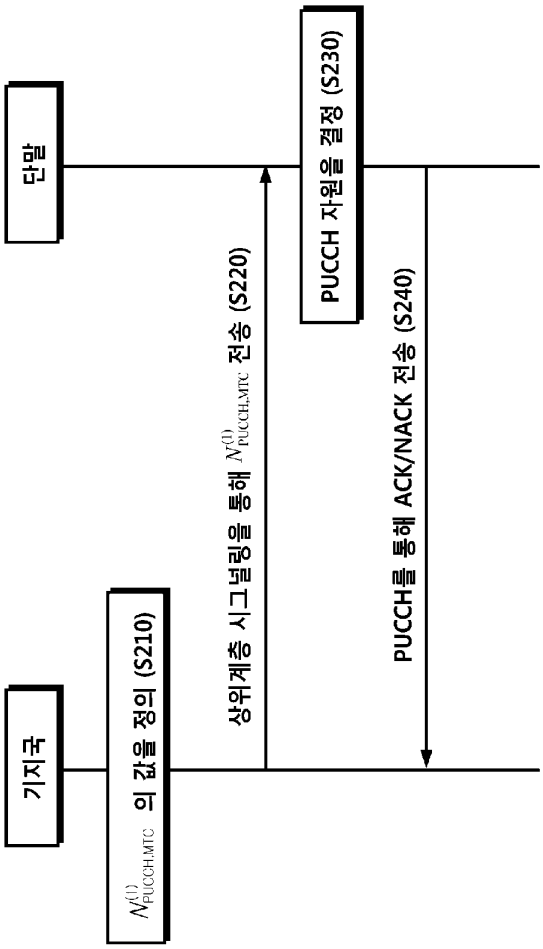
[청구항 18] 제 13 항에 있어서,
상기 하향링크 데이터 및 상기 하향링크 데이터를 스케줄링하는 제어 정보가 반복되어 전송될 때, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보는 복수 개의 하향링크 제어 채널 중 첫 번째 하향링크 제어 채널의 자원, 상기 복수 개의 하향링크 제어 채널 중 마지막 하향링크 제어 채널의 자원, 또는 상기 복수 개의 하향링크 제어 채널의 자원 중 최소값인 것을 특징으로 하는 단말.

[청구항 19] MTC(Machine Type Communication) 단말을 위한 하향링크 데이터의 응답 정보의 자원을 설정하는 기지국으로서,
상기 응답 정보가 전송되는 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나를 포함하는 구성 정보, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 정보, 및 상기 하향링크 데이터를 송신하는 송신부를 포함하고,
상기 하향링크 데이터의 응답 정보가 전송되는 상향링크 제어 채널의 자원은, 상기 하향링크 데이터를 스케줄링하는 하향링크 제어 채널의 자원의 정보, 상기 상향링크 제어 채널이 할당된 자원의 정보, 및 상기 상향링크 제어 채널이 할당된 자원의 옵셋 정보 중 적어도 하나에 기초하여 결정되는 것을 특징으로 하는 기지국.

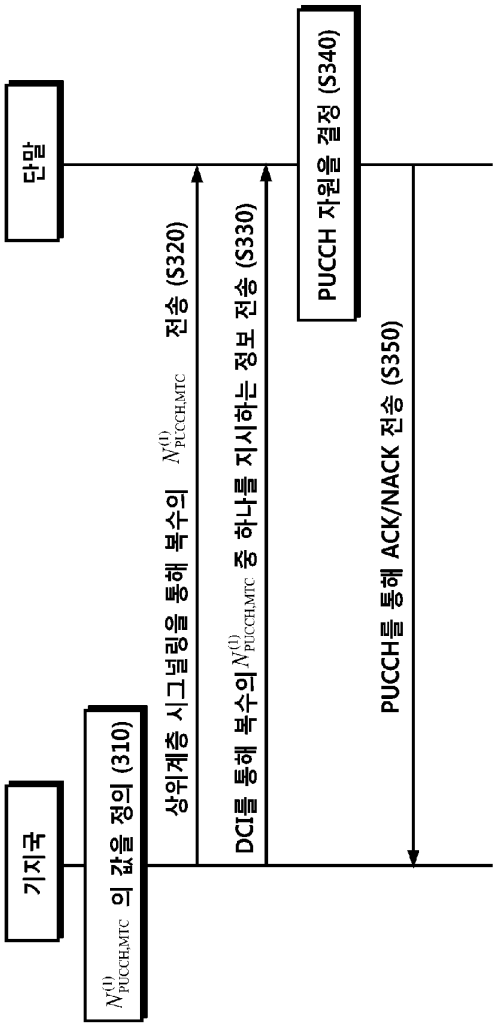
[Fig. 1]


PDSCH
PUCCH
20
10

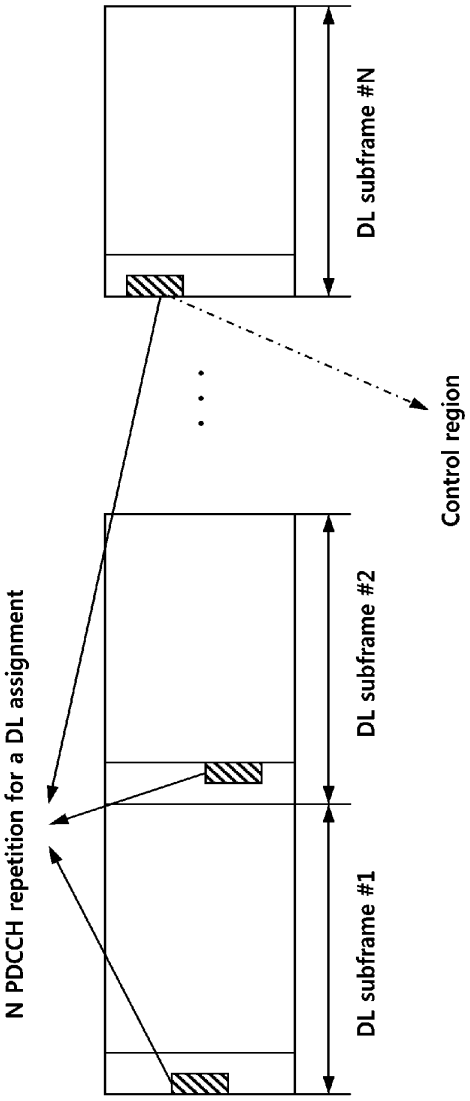
[Fig. 2]


단말
기지국
PUCCH 자원을 결정 (S230)
상위계층 시그널링을 통해 $N^{(1)}_{PUCCH,MTC}$ 전송 (S220)
PUCCH를 통해 ACK/NACK 전송 (S240)
$N^{(1)}_{PUCCH,MTC}$ 의 값을 정의 (S210)

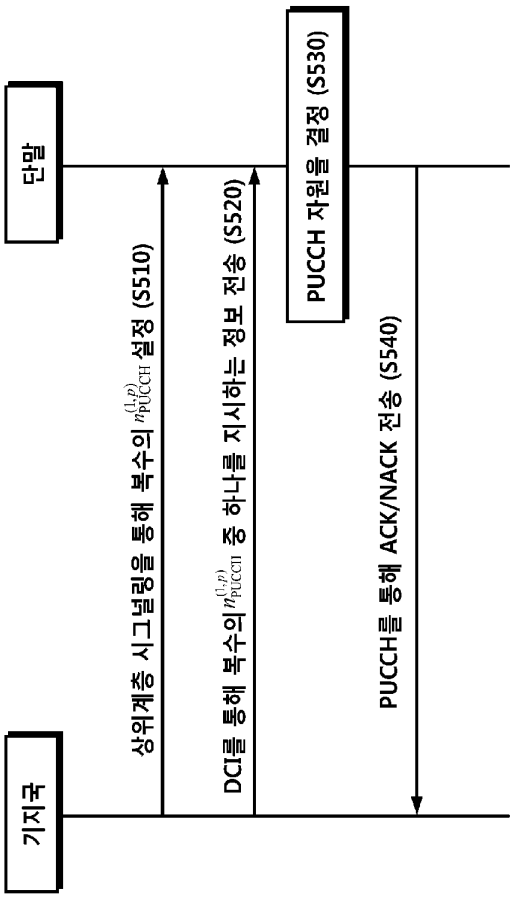
[Fig. 3]


기지국
단말
$N^{(1)}_{PUCCH,MTC}$ 의 값을 정의 (310)
상위계층 시그널링을 통해 복수의 $N^{(1)}_{PUCCH,MTC}$ 전송 (S320)
DCI를 통해 복수의 $N^{(1)}_{PUCCH,MTC}$ 중 하나를 지시하는 정보 전송 (S330)
PUCCH 자원을 결정 (S340)
PUCCH를 통해 ACK/NACK 전송 (S350)

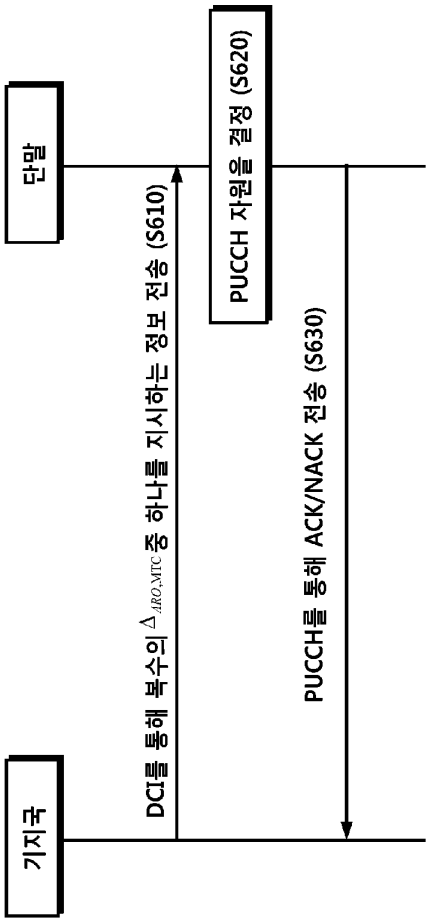
[Fig. 4]


DL subframe #N
Control region
DL subframe #2
DL subframe #1
N PDCCH repetition for a DL assignment

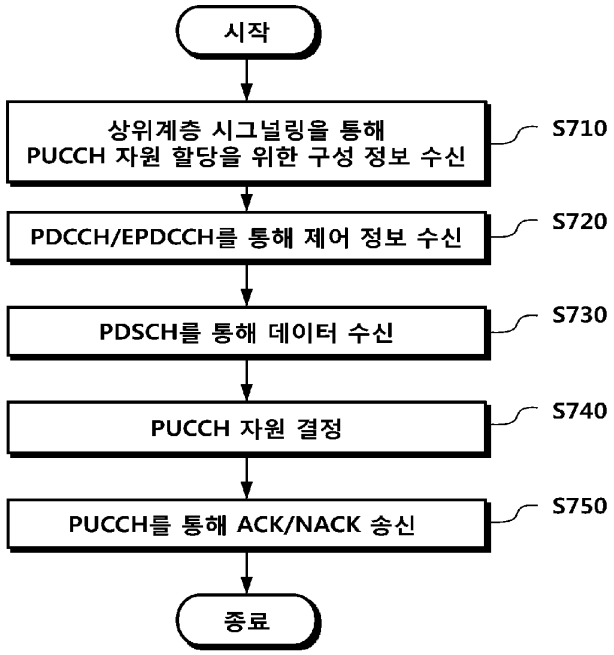
[Fig. 5]


단말
기지국
상위계층 시그널링을 통해 복수의 $n_{PUCCH}^{(1,p)}$ 설정 (S510)
DCI를 통해 복수의 $n_{PUCCH}^{(1,p)}$ 중 하나를 지시하는 정보 전송 (S520)
PUCCH 자원을 결정 (S530)
PUCCH를 통해 ACK/NACK 전송 (S540)

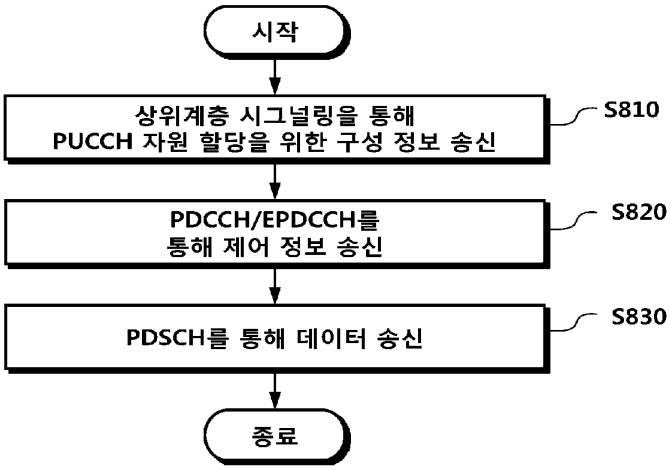
[Fig. 6]


단말
기지국
PUCCH 자원을 결정 (S620)
DCI를 통해 복수의 $\Delta_{ARO,MTC}$ 중 하나를 지시하는 정보 전송 (S610)
PUCCH를 통해 ACK/NACK 전송 (S630)

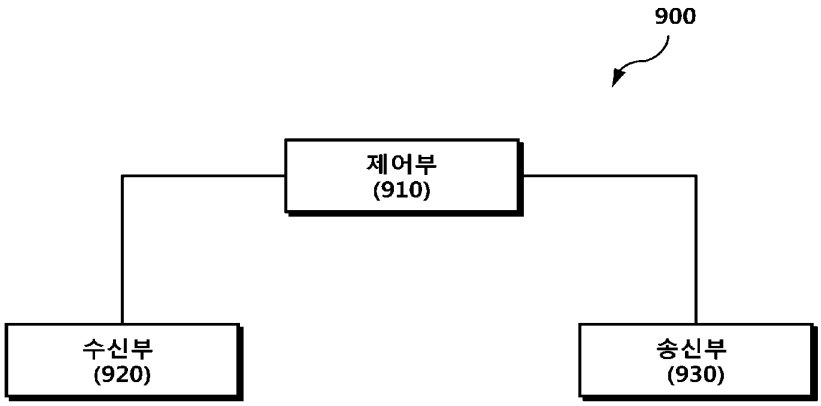
[Fig. 7]


시작
상위계층 시그널링을 통해
PUCCH 자원 할당을 위한 구성 정보 수신
S710
PDCCH/EPDCCH를 통해 제어 정보 수신
S720
PDSCH를 통해 데이터 수신
S730
PUCCH 자원 결정
S740
PUCCH를 통해 ACK/NACK 송신
S750
종료

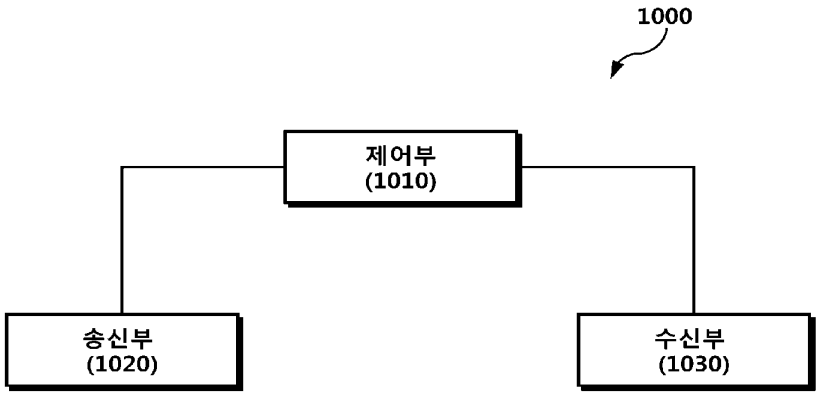
[Fig. 8]


시작
상위계층 시그널링을 통해
PUCCH 자원 할당을 위한 구성 정보 송신
S810
PDCCH/EPDCCH를
통해 제어 정보 송신
S820
PDSCH를 통해 데이터 송신
S830
종료

[Fig. 9]



[Fig. 10]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2014/008765

A. CLASSIFICATION OF SUBJECT MATTER

H04B 7/26(2006.01)i, H04W 72/04(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04B 7/26; H04J 11/00; H04W 72/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models: IPC as above
Japanese Utility models and applications for Utility models: IPC as above

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

eKOMPASS (KIPO internal) & Keywords: machine type communication, uplink control channel resource, uplink control channel resource offset, downlink control information, response information

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013-015637 A2 (LG ELECTRONICS INC.) 31 January 2013 See paragraphs 73-108; and figures 6, 7.	1,2,7,8,13,14,19
Y		4,5,10,11,16,17
A		3,6,9,12,15,18
Y	3GPP TS 36.213 V11.4.0, "3GPP; TSGRAN; E-UTRA; Physical layer procedures (Release 11)", 20 September 2013 (http://www.3gpp.org/ftp/Specs/archive/36_series/36.213/36213-b40.zip) See pages 141-144; and tables 10.1.2.1-1, 10.1.2.2.1-2.	4,5,10,11,16,17
A	HTC, "Remaining issues on PUCCH A/N resource allocation for EPDCCH", R1-124356, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 08-12 October 2012 (http:/www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124356.zip) See pages 1-3.	1-19
A	CATT, "PUCCH resource for E-PDCCH", R1-124107, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 08-12 October 2012 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124107.zip) See pages 1-3.	1-19

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 DECEMBER 2014 (16.12.2014)	**16 DECEMBER 2014 (16.12.2014)**
Name and mailing address of the ISA/**KR** Korean Intellectual Property Office Government Complex-Daejeon, 189 Seonsa-ro, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TEXAS INSTRUMENTS, "Outstanding aspects of PUCCH resource allocation for EPDCCH", R1-124141, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 08-12 October 2012 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124141.zip) See pages 1-2.	1-19

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Page 000260

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2014/008765

Patent document cited in search report	Publication date	Patent family member	Publication date
WO 2013-015637 A2	31/01/2013	KR 10-2014-0036013 A	24/03/2014
		US 2014-0169319 A1	19/06/2014
		WO 2013-015637 A3	21/03/2013

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국 제 조 사 보 고 서

국제출원번호
PCT/KR2014/008765

A. 발명이 속하는 기술분류(국제특허분류(IPC))

H04B 7/26(2006.01)i, H04W 72/04(2009.01)i

B. 조사된 분야

조사된 최소문헌(국제특허분류를 기재)
H04B 7/26; H04J 11/00; H04W 72/04

조사된 기술분야에 속하는 최소문헌 이외의 문헌
한국등록실용신안공보 및 한국공개실용신안공보: 조사된 최소문헌란에 기재된 IPC
일본등록실용신안공보 및 일본공개실용신안공보: 조사된 최소문헌란에 기재된 IPC

국제조사에 이용된 전산 데이터베이스(데이터베이스의 명칭 및 검색어(해당하는 경우))
eKOMPASS(특허청 내부 검색시스템) & 키워드: machine type communication, 상향링크 제어 채널 자원, 상향링크 제어 채널 자원 옵셋, 하향링크 제어 정보, 응답 정보

C. 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
X	WO 2013-015637 A2 (엘지전자 주식회사) 2013.01.31 단락 73-108; 및 도면 6, 7 참조.	1,2,7,8,13,14,19
Y		4,5,10,11,16,17
A		3,6,9,12,15,18
Y	3GPP TS 36.213 V11.4.0, `3GPP; TSGRAN; E-UTRA; Physical layer procedures (Release 11)', 2013.09.20 (http://www.3gpp.org/ftp/Specs/archive/36_series/36.213/36213-b40.zip) 페이지 141-144; 및 테이블 10.1.2.1-1, 10.1.2.2.1-2 참조.	4,5,10,11,16,17
A	HTC, `Remaining issues on PUCCH A/N resource allocation for EPDCCH', R1-124356, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 2012.10.08-12 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124356.zip) 페이지 1-3 참조.	1-19
A	CATT, `PUCCH resource for E-PDCCH', R1-124107, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 2012.10.08-12 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124107.zip) 페이지 1-3 참조.	1-19

☒ 추가 문헌이 C(계속)에 기재되어 있습니다.

☒ 대응특허에 관한 별지를 참조하십시오.

* 인용된 문헌의 특별 카테고리:

"A" 특별히 관련이 없는 것으로 보이는 일반적인 기술수준을 정의한 문헌

"E" 국제출원일보다 빠른 출원일 또는 우선일을 가지나 국제출원일 이후에 공개된 선출원 또는 특허 문헌

"L" 우선권 주장에 의문을 제기하는 문헌 또는 다른 인용문헌의 공개일 또는 다른 특별한 이유(이유를 명시)를 밝히기 위하여 인용된 문헌

"O" 구두 개시, 사용, 전시 또는 기타 수단을 언급하고 있는 문헌

"P" 우선일 이후에 공개되었으나 국제출원일 이전에 공개된 문헌

"T" 국제출원일 또는 우선일 후에 공개된 문헌으로, 출원과 상충하지 않으며 발명의 기초가 되는 원리나 이론을 이해하기 위해 인용된 문헌

"X" 특별한 관련이 있는 문헌. 해당 문헌 하나만으로 청구된 발명의 신규성 또는 진보성이 없는 것으로 본다.

"Y" 특별한 관련이 있는 문헌. 해당 문헌이 하나 이상의 다른 문헌과 조합하는 경우로 그 조합이 당업자에게 자명한 경우 청구된 발명은 진보성이 없는 것으로 본다.

"&" 동일한 대응특허문헌에 속하는 문헌

국제조사의 실제 완료일	국제조사보고서 발송일
2014년 12월 16일 (16.12.2014)	2014년 12월 16일 (16.12.2014)

ISA/KR의 명칭 및 우편주소
대한민국 특허청
(302-701) 대전광역시 서구 청사로 189,
4동 (둔산동, 정부대전청사)
팩스 번호 +82-42-472-7140

심사관
강희곡
전화번호 +82-42-481-8264

서식 PCT/ISA/210 (두 번째 용지) (2009년 7월)

국 제 조 사 보 고 서

국제출원번호
PCT/KR2014/008765

C (계속). 관련 문헌

카테고리*	인용문헌명 및 관련 구절(해당하는 경우)의 기재	관련 청구항
A	TEXAS INSTRUMENTS, `Outstanding aspects of PUCCH resource allocation for EPDCCH', R1-124141, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, 2012.10.08-12 (http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_70b/Docs/R1-124141.zip) 페이지 1-2 참조.	1-19

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국 제 조 사 보 고 서
대응특허에 관한 정보

국제출원번호
PCT/KR2014/008765

국제조사보고서에서 인용된 특허문헌	공개일	대응특허문헌	공개일
WO 2013-015637 A2	2013/01/31	KR 10-2014-0036013 A	2014/03/24
		US 2014-0169319 A1	2014/06/19
		WO 2013-015637 A3	2013/03/21

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PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/025,262	Filing Date 03/25/2016	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	03/25/2016	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***3	= 1	X $420 =	420
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	**420**

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LDRC
PRASAD JANDHYALA

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/025,262	03/25/2016		1900	811.0053	19	4

CONFIRMATION NO. 1007

76277
IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

FILING RECEIPT

OC000000082818052

Date Mailed: 05/11/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Kyujin PARK, Seoul, KOREA, REPUBLIC OF;
Woo-jin CHOI, Seoul, KOREA, REPUBLIC OF;

Applicant(s)

KT CORPORATION, Gyeonggi-do, KOREA, REPUBLIC OF;

Assignment For Published Patent Application

KT CORPORATION, Gyeonggi-do, KR

Power of Attorney: The patent practitioners associated with Customer Number 76277

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/KR2014/008765 09/22/2014

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
REPUBLIC OF KOREA 10-2014-0057938 05/14/2014
REPUBLIC OF KOREA 10-2013-0115367 09/27/2013

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/10/2016

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Petitioner's Exhibit 1002
Page 000266

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/025,262**

Projected Publication Date: 08/18/2016

Non-Publication Request: No

Early Publication Request: No
Title

METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

IPR2025-00138
Petitioner's Exhibit 1002
Page 000267

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/025,262

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	480
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	19 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	* 1				x 420 =	420
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1900

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

U.S. APPLICATION NUMBER NO.	FIRST NAMED INVENTOR	ATTY. DOCKET NO.
15/025,262	Kyujin PARK	811.0053

76277
IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

INTERNATIONAL APPLICATION NO.	
PCT/KR2014/008765	
I.A. FILING DATE	PRIORITY DATE
09/22/2014	09/27/2013

CONFIRMATION NO. 1007
371 ACCEPTANCE LETTER

OC000000082816053

Date Mailed: 05/11/2016

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office, in its capacity as a Designated / Elected Office (37 CFR 1.495), has ACCEPTED the above identified international application for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above. A Filing Receipt will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE "FILING DATE or 371(c) DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1) and (c)(2) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN BELOW.** The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363)

03/25/2016
DATE OF RECEIPT OF 35 U.S.C.
371(c)(1) and (c)(2) REQUIREMENTS

The following items have been received:

- Copy of the International Application filed on 03/25/2016
- English Translation of the IA filed on 03/25/2016
- Copy of the International Search Report filed on 03/25/2016
- Preliminary Amendments filed on 03/25/2016
- Information Disclosure Statements filed on 03/25/2016
- Inventor's Oath or Declaration filed on 03/25/2016
- Request for Immediate Examination filed on 03/25/2016
- U.S. Basic National Fees filed on 03/25/2016
- Assignee Statement for PGPUB filed on 03/25/2016
- Authorize Access to Search Results filed on 03/25/2016
- Priority Documents filed on 03/25/2016
- Power of Attorney filed on 03/25/2016
- Authorization to Permit Access filed on 03/25/2016
- Application Data Sheet (37 CFR 1.76) filed on 03/25/2016

FORM PCT/DO/EO/903 (371 Acceptance Notice)

IPR2025-00138
Petitioner's Exhibit 1002
Page 000270

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

CHERRIE M HAYWOOD

Telephone: (703) 756-1144

FORM PCT/DO/EO/903 (371 Acceptance Notice)

IPR2025-00138
Petitioner's Exhibit 1002
Page 000271

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

Substitute for Form PTO-1360
(For use with Form PTO/SB/06)

Application Number	Filing Date
15025262	

Applicant(s) Kyujin PARK

* May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
	Indep	Depend	Indep	Depend	Indep	Depend
1	1					
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Total Indep	4		0		0	
Total Depend	15	↵	0	↵	0	↵
Total Claims	19		0		0	

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UNITED STATES PATENT AND TRADEMARK OFFICE

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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/025,262	03/25/2016	Kyujin PARK	811.0053

CONFIRMATION NO. 1007

76277
IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

PUBLICATION NOTICE

OC000000085195818

Title:METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

Publication No.US-2016-0242169-A1
Publication Date:08/18/2016

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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Petitioner's Exhibit 1002
Page 000273

Customer No.: 76277 *PATENT*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Kyujin PARK et al.		Re: Attorney Docket No.: 811.0053	
Serial No.:	15/025,262	Group Art Unit:	2464
Filed:	03/25/2016	Examiner:	NGO, RICKY QUOC
Matter No.:	811.0053	Conf. No.:	1007

For: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Prior to examination on the merits, please amend the above-identified application as follows.

Amendments to the Claims begin on page 2.

Remarks begin on page 6.

AMENDMENTS TO THE CLAIMS

1. (Currently Amended) A method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

receiving structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

receiving downlink control information for scheduling the downlink data;

receiving the downlink data; and

transmitting the response information on the downlink data by using the resource allocated to the uplink control channel,

wherein the resource allocated to the uplink control channel is determined based on at least one of: i) information on a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; or the start offset information on the resource allocated to the uplink control channel.

2. (Currently Amended) The method of claim 1, wherein the start offset information of the resource allocated to the uplink control channel is configured separated ~~different from~~from-start offset information for a terminal different from the MTC terminal.

3. (Currently Amended) The method of claim 2, wherein:

a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information~~receiving of the downlink control information~~ is received through cell-specific high layer signaling for the MTC terminal from a base station~~comprises receiving information that indicates one of the plurality of pieces of offset information~~.

4. (Currently Amended) The method of claim ~~1~~3, wherein:

the plurality of pieces of start offset information~~a plurality of pieces of information on the resource allocated to the uplink control channel~~ are applied according to coverage level~~provided; and~~

~~the receiving of the downlink control information comprises receiving information that indicates one of the plurality of pieces of resource information~~.

5. (Canceled).

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Petitioner's Exhibit 1002
Page 000275

6. (Currently Amended) The method of claim 1, wherein when the response information of downlink data of the MTC terminal~~the downlink data and the control information for scheduling the downlink data~~ is ~~are~~ repeatedly transmitted using the same uplink control channel in each uplink subframe which the uplink control channel is repeatedly~~, information on the resource of the downlink control channel for scheduling the downlink data is at least one of i) a resource of a first downlink control channel among a plurality of downlink control channels, ii) a resource of a last downlink control channel among the plurality of downlink control channels, and iii) a minimum value among the resources of the plurality of downlink control channels~~.

7. (Currently Amended) A method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in the base station, the method comprising:

transmitting structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

transmitting downlink control information for scheduling the downlink data; and

transmitting the downlink data,

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of information on i) a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the start offset information on the resource allocated to the uplink control channel.

8. (Currently Amended) The method of claim 7, wherein the start offset information of the resource allocated to the uplink control channel is configured separated from~~different from~~ offset information on a terminal different from the MTC terminal.

9. (Currently Amended) The method of claim 8, wherein:

a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information is transmitted through cell-specific high layer signaling for the MTC terminal from the MTC terminal~~transmitting of the downlink control information comprises transmitting information that indicates one of the plurality of pieces of offset information~~.

10. (Currently Amended) The method of claim 7, wherein:

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Petitioner's Exhibit 1002
Page 000276

the plurality of pieces of start offset information~~a plurality of pieces of information on the resource allocated to the uplink control channel for transmitting the response information~~ are applied according to coverage level~~provided; and~~

~~the transmitting of the downlink control information comprises transmitting information that indicates one of the plurality of pieces of resource information~~.

11. (Canceled).

12. (Currently Amended) The method of claim 7, wherein when the response information of downlink data of the MTC terminal is ~~the downlink data and the control information for scheduling the downlink data are~~ repeatedly transmitted, using the same uplink control channel in each uplink subframe which the uplink control channel is repeatedly~~the resource information of the downlink control channel for scheduling the downlink data is at least one of i) a resource of a first downlink control channel among a plurality of downlink control channels, ii) a resource of a last downlink control channel among the plurality of downlink control channels, and iii) a minimum value among the resources of the plurality of downlink control channels~~.

13. (Currently Amended) A terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a receiving unit configured to receive structural information that contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource to which the uplink control channel is allocated, configured to receive downlink control information for scheduling the downlink data, and configured to receive the downlink data;

a controller configured to determine a resource allocated to the uplink control channel for transmitting the response information of the downlink data based on at least one of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the start offset information on the resource allocated to the uplink control channel; and

a transmitting unit configured to transmit the response information of the downlink data by using the determined resource of the uplink control channel.

14. (Currently Amended) The terminal of claim 13, wherein the start offset information of the resource allocated to the uplink control channel is configured separated ~~different~~ from offset information on a terminal different from the MTC terminal.

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Petitioner's Exhibit 1002
Page 000277

15. (Currently Amended) The terminal of claim 14, wherein:

a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information is received through cell-specific high layer signaling for the MTC terminal from a base station~~receiving unit is configured to receive information that indicates one of the plurality of pieces of offset information through the downlink control information~~.

16. (Currently Amended) The terminal of claim ~~13~~15, wherein:

the plurality of pieces of start offset information~~a plurality of pieces of information on the resource allocated to the uplink control channel for transmitting the response information~~ are applied according to coverage level~~provided; and~~

~~the receiving unit is configured to receive information that indicates one of the plurality of pieces of resource information through the downlink control information~~.

17. (Canceled).

18. (Currently Amended) The terminal of claim 13, wherein when the response information of downlink data of the MTC terminal is~~the downlink data and the control information for scheduling the downlink data are~~ repeatedly transmitted~~,~~ using the same uplink control channel in each uplink subframe which the uplink control channel is repeatedly~~the resource information of the downlink control channel for scheduling the downlink data is at least one of i) a resource of a first downlink control channel among a plurality of downlink control channels, ii) a resource of a last downlink control channel among the plurality of downlink control channels, and iii) a minimum value among the resources of the plurality of downlink control channels~~.

19. (Currently Amended) A base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a transmitting unit configured to transmit structural information, downlink control information for scheduling the downlink data, and the downlink data,

wherein the structural information contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel, and

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the start offset information of the resource allocated to the uplink control channel.

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Petitioner's Exhibit 1002
Page 000278

REMARKS

Claims 1-19 were previously pending in the application. By this amendment, claims 1-4, 6-10, 12-16, 18, 19 are amended and claims 5, 11, 17 are cancelled without prejudice or disclaimer. Assuming the entry of this amendment, claims 1-4, 6-10, 12-16, 18, 19 are now pending in the application. Applicant respectfully submits that no new matter is added and the support for the amendments may be found throughout the specification as originally filed.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided. Prompt and favorable consideration of this Amendment is respectfully requested.

Respectfully submitted,

Date: 28 September 2016

/Ian M. Hughes/

Customer No. 76277
IP Legal Services, LLC
P.O. Box 651325
Sterling, VA 20165

Ian M. Hughes, Reg. No. 41,083
Kyung Hee Kim, Reg. No. 69,183
Attorney/Agent for Applicant
(571) 267-7183 (phone)

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Petitioner's Exhibit 1002
Page 000279

Electronic Acknowledgement Receipt

EFS ID:	27055191
Application Number:	15025262
International Application Number:	
Confirmation Number:	1007
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Customer Number:	76277
Filer:	Joung Kook Park/Yujin Chun
Filer Authorized By:	Joung Kook Park
Attorney Docket Number:	811.0053
Receipt Date:	28-SEP-2016
Filing Date:	25-MAR-2016
Time Stamp:	11:22:25
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Preliminary Amendment	8110053PreliminaryAmendment.pdf	97481 4fdff2104060b077312b829487a0d22bea232981	no	6

Warnings:

Information:	
Total Files Size (in bytes):	97481

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

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

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

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/025,262	Filing Date 03/25/2016	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	09/28/2016	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
/MARSHA RICHARDS/

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	03/25/2016	Kyujin PARK	811.0053	1007

76277 7590 07/03/2017

IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

EXAMINER
CRUTCHFIELD, CHRISTOPHER M

ART UNIT	PAPER NUMBER
2466	

NOTIFICATION DATE	DELIVERY MODE
07/03/2017	ELECTRONIC

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

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

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

email@iplsllc.com

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Petitioner's Exhibit 1002
Page 000283

Office Action Summary	Application No. 15/025,262	Applicant(s) PARK ET AL.	
	Examiner CHRISTOPHER CRUTCHFIELD	Art Unit 2466	AIA (First Inventor to File) Status Yes

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 September 2016*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

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

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-4,6-10,12-16,18 and 19* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-4, 6-10, 12-16 18 and 19* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *25 March 2016* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

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

Certified copies:

a)☒ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

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DETAILED ACTION

Claim Objections

1. **Claims 6, 12 and 18** are objected to because of the following informalities: they recite "uplink control channel is repeatedly." (last portion of the claim) It appears that this was intended to read the "uplink control channel is repeatedly transmitted in." Appropriate correction is required.

Claim Rejections - 35 USC § 103

1. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

2. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

5. **Claims 1, 7, 13 and 19** is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) in view of *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882 A1)

Regarding claim 1, *Xia* discloses a method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

a. Receiving downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the

appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. Receiving the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Transmitting the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose receiving structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. In the same field of endeavor, *Dinan* discloses receiving structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. (The system of *Dinan* discloses that the system may have multiple different configured ePDCCH indexes for transmission, with each region associated with an index and each index having a resource offset determining that the starting point of the PDCCH resources to be used [paragraphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the transmission of PDCCH start resource offset information, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offsets of *Dinan* with the system of *Xia* by sending the start resource offset of the PDCCH to the UE. The motive to combine is to improve flexibility

and decrease complexity by allowing direct signaling of the start resource offset so that it may take any value and does not need to be presumed or calculate based on other factors.

Regarding claim 7, *Xia* discloses a method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in the base station, the method comprising:

a. Transmitting downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint ["UE"] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information ["DCI"] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. Transmitting the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Receiving the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose transmitting structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to

the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. In the same field of endeavor, *Dinan* discloses transmitting structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. (The system of *Dinan* discloses that the system may have multiple different configured ePDCCH indexes for transmission, with each region associated with an index and each index having a resource offset determining that the starting point of the PDCCH resources to be used [paragraphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the transmission of PDCCH start resource offset information, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offsets of *Dinan* with the system of *Xia* by sending the start resource offset of the PDCCH to the UE. The motive to combine is to improve flexibility and decrease complexity by allowing direct signaling of the start resource offset so that it may take any value and does not need to be presumed or calculate based on other factors.

Regarding claim 13, *Xia* discloses a terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a. Receiving unit configured to receive downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base

station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. A receiving unit configured to receive the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. A transmitting unit configured to transmit the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose a receiving unit configured to receive structural information that contains start offset information on the resource allocated to the uplink control channel a controller configured to determine a resource allocated to the uplink control channel for transmitting the response information of the downlink data based on the resource allocated to the uplink control channel. In the same field of endeavor, *Dinan* discloses a receiving unit configured to receive structural information that contains start offset information on the resource allocated to the uplink control channel a controller configured to determine a resource allocated to the uplink control channel for transmitting the response information of the downlink data based on the resource allocated to the uplink control channel. (The system of *Dinan* discloses that the system may have multiple different configured ePDCCH indexes for transmission, with each region associated with an index and each index having a resource offset determining that the starting point of the PDCCH resources to be used [paragraphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the transmission of PDCCH start resource offset information, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offsets of *Dinan* with the system of *Xia* by sending the start resource offset of the PDCCH to the UE. The motive to combine is to improve flexibility and decrease complexity by allowing direct signaling of the start resource offset so that it may take any value and does not need to be presumed or calculate based on other factors.

Regarding claim 19, *Xia* discloses A base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a. A transmitting unit configured to transmit downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. A transmitting unit configured to transmit the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Receiving the transmitted response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose a transmitting unit configured to transmit structural information that contains start offset information on the resource allocated to the uplink control channel or the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on the start offset information of the resource allocated to the uplink control channel (The system of *Dinan* discloses that the system may have multiple different configured ePDCCH indexes for transmission, with each region associated with an index and each index having a resource offset determining that the starting point of the PDCCH resources to be used [paragraphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the transmission of PDCCH start resource offset information, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offsets of *Dinan* with the system of *Xia* by sending the start resource offset of the PDCCH to the UE. The motive to combine is to improve flexibility and decrease complexity by allowing direct signaling of the start resource offset so that it may take any value and does not need to be presumed or calculate based on other factors.

6. **Claims 2, 8 and 14** is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) and *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882A1) as applied to claims 1, 7 and 13 and further in view of R1-

114268 (“268”) (Author Unknown, Backwards compatible support for reduced bandwidth MTC LTE, 3GPP TSG RAN WG1 Meeting #67, Doc. No. R1-114268, 18 November 2011, pages 1-4).

Regarding claims 2, 8 and 14, *Xia* as modified by *Dinan* fails to disclose the start offset information of the resource allocated to the uplink control channel is configured different from-start offset information for a terminal different from the MTC terminal. In the same field of endeavor, *268* discloses the start offset information of the resource allocated to the uplink control channel is configured different from-start offset information for a terminal different from the MTC terminal. (The system of 268 discloses MTC terminals may use a separate PUCCH region from standard terminals and that the region may have a different frequency offset [see page 3, fig. 2, see also section 5, generally].)

Therefore, since the system of 268 discloses the use of a separate PUCCH region for MTC terminals with a different frequency offset (and thereby a different starting offset) it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the separate PUCCH regoins of 268 with the system of *Xia* as modified by *Dinan* by making a separate PUCCH region for MTC terminals. The motive to combine is the preservation of legacy compatibility of the non MTC terminals PUCCH while allowing for greater flexibility in coding and construction of the MTC terminal PUCCH, which has different requirements because of the large required gain and low bandwidth of MTC transmitters.

7. **Claims 3, 4, 9, 10, 15 and 16**, is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) and *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882 A1) as applied to claims XXX and R1-114268 (“268”) (Author Unknown, Backwards compatible support for reduced bandwidth MTC LTE,

3GPP TSG RAN WG1 Meeting #67, Doc. No. R1-114268, 18 November 2011, pages 1-4) as applied to claims 2, 8 and 14 and further in view of *Papasalellariou*, et al. (US Pre Grant Publication No. 2013/0155974 A1).

Regarding claims 3 and 15, *Xia* as previously modified by *Dinan* and 268 fails to disclose a plurality of pieces of start offset information could be allocated via cell-specific high layer signaling. In the same field of endeavor, another portion of *Dinan* discloses a plurality of pieces of start offset information could be allocated via cell-specific high layer signaling. (The system of *Dinan* discloses that the PUCCH configuration [i.e. uplink control channel parameter – see paragraph 0037] may be via RRC signaling [paragraph 0040- "…provided in PUCCH resources identified by the corresponding uplink control channel parameter (in RRC message)."]. *Dinan* further discloses the system may configure multiple PUCCH offsets for different purposes [paragarphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the use of RRC/Higher layer configuration for PUCCH offset/control channel parameter information, it would have bene obvious to a person of ordinary skill in the art at the time of the invention to combine the RRC configuration of *Dinan* with the system of *Xia* as previously modified by *Dinan* and 268 by using the RRC/higher layer for transmission of offset information for multiple PUCCH control channels. The motive to combine is to reduce overhead by using RRC to configure the PUCCH control channels, which is a non-periodic transmission and will not need to be resent frequently, unlike other configuration mechanisms, such as the PDCCH.

Xia as modified by *Dinan* and 268 fails to disclose the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels

such that the system comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received for the MTC terminal from a base station. In the same field of endeavor, *Papasalellariou* discloses the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels such that the system comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received for the MTC terminal from a base station. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot])

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for coverage and non-coverage limited MTC devices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* and 268 by using a different frequency offset for coverage and non-coverage limited MTC devices and sending the appropriate frequency offsets to the MTC devices to choose (in accordance with *Dinan*, as discussed, supra) to use the coverale limited or on-coverage limited frequency offset, as appropriate. The motive to combine is to separate coverage limited and non-coverage limited

UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

Regarding claims 4 and 16, *Xia* as modified by *Dinan*, 268 and *Papasalellariou* discloses the plurality of pieces of start offset information are applied according to coverage level. (see claims 3 and 15, supra - the offset frequency information is different for each coverage level and is applied in accordance with the UE/terminal coverage level).

Regarding claim 9, *Xia* as previously modified by *Dinan* and 268 fails to disclose a plurality of pieces of start offset information could be allocated via cell-specific high layer signaling. In the same field of endeavor, another portion of *Dinan* discloses a plurality of pieces of start offset information could be allocated via cell-specific high layer signaling. (The system of *Dinan* discloses that the PUCCH configuration [i.e. uplink control channel parameter – see paragraph 0037] may be via RRC signaling [paragraph 0040- "…provided in PUCCH resources identified by the corresponding uplink control channel parameter (in RRC message)."]. *Dinan* further discloses the system may configure multiple PUCCH offsets for different purposes [paragarphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the use of RRC/Higher layer configuration for PUCCH offset/control channel parameter information, it would have bene obvious to a person of ordinary skill in the art at the time of the invention to combine the RRC configuration of *Dinan* with the system of *Xia* as previously modified by *Dinan* and 268 by using the RRC/higher layer for transmission of offset information for multiple PUCCH control channels. The motive to combine is to reduce overhead by using RRC to configure the PUCCH control channels, which is a non-periodic transmission and will not need to be resent frequently, unlike other configuration mechanisms, such as the PDCCH.

Xia as modified by *Dinan* and 268 fails to disclose the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels such that the system comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is transmitted through cell-specific high layer signaling for the MTC terminal from a base station. In the same field of endeavor, *Papasalellariou* discloses the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels such that the system comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is transmitted through cell-specific high layer signaling for the MTC terminal from a base station. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot])

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for coverage and non-coverage limited MTC devices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* and 268 by using a different

frequency offset for coverage and non-coverage limited MTC devices and sending the appropriate frequency offsets to the MTC devices to choose (in accordance with *Dinan*, as discussed, supra) to use the coverale limited or on-coverage limited frequency offset, as appropriate. The motive to combine is to separate coverage limited and non-coverage limited UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

Regarding claim 10, *Xia* as modified by *Dinan*, 268 and *Papasalellariou* discloses the plurality of pieces of start offset information are applied according to coverage level. (see claim 9, supra - the offset frequency information is different for each coverage level and is applied in accordance with the UE/terminal coverage level).

8. **Claims 6, 12 and 18** is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) and *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882A1) as applied to claims 1, 7 and 13 and further in view of R1-131825 (“825”) (Author Unknown, Text proposal on PUCCH coverage improvement for Section 9.5.5 of TR 36.888, 3GPP TSG-RAN WG1 Meeting #72bis, Doc. No. R1-131825, 19 April 2013, pages 1-2).

Regarding claims 6, 12 and 18, *Xia* as modified by *Dinan* fails to disclose the response information of downlink data of the MTC terminal is repeatedly transmitted using the same uplink control channel in each uplink subframe which the uplink control channel is repeatedly transmitted in. In the same field of endeavor, 941 discloses disclose the response information of downlink data of the MTC terminal is repeatedly transmitted using the same uplink control channel in each uplink subframe which the uplink control channel is repeatedly transmitted in.

(The system of 825 discloses that the MTC response information [i.e. ACK/NACK] may be repeatedly transmitted using the PDCCH [i.e. the same control channel] [page 2, section 9.5.5.1].)

Therefore, since the system of 825 suggests PUCCH repetition, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the repetition of 825 with the system of *Xia* as modified by *Dinan* by performing repetitions of the PUCCH containing the response information. The motive to combine is to improve gain using repetition to allow a high gain to be achieved despite poor transmitter and channel characteristics.

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

a. R1-134131 (Author Unknown, Coverage enhancement of DL/UL control channels for low cost MTC, 3GPP TSG-RAN WG1 #74bis, Doc. No. R1-134131, 11 October 2013, pages 1-10) – disclosing the use of PUCCH for ACK transmissions in MTC [page 5, section 5.1

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTOPHER CRUTCHFIELD whose telephone number is (571)270-3989. The examiner can normally be reached on Monday through Friday 9:00 AM to 5:30 PM EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Faruk Hamza can be reached on 571-272-7969. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CHRISTOPHER CRUTCHFIELD/
Primary Examiner, Art Unit 2466

Notice of References Cited	Application/Control No. 15/025,262	Applicant(s)/Patent Under Reexamination PARK ET AL.	
	Examiner CHRISTOPHER CRUTCHFIELD	Art Unit 2466	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2013/0315159 A1	11-2013	Xia; Jinhuan	H04W72/042	370/329
*	B	US-2013/0250882 A1	09-2013	Dinan; Esmael Hejazi	H04W72/0426	370/329
*	C	US-2013/0155974 A1	06-2013	PAPASAKELLARIOU; Aris	H04W72/042	370/329
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Author Unknown, Backwards compatible support for reduced bandwidth MTC LTE, 3GPP TSG RAN WG1 Meeting #67, Doc. No. R1-114268, 18 November 2011, pages 1-4
	V	Author Unknown, Text proposal on PUCCH coverage improvement for Section 9.5.5 of TR 36.888, 3GPP TSG-RAN WG1 Meeting #72bis, Doc. No. R1-131825, 19 April 2013, pages 1-2
	W	Author Unknown, Coverage enhancement of DL/UL control channels for low cost MTC, 3GPP TSG-RAN WG1 #74bis, Doc. No. R1-134131, 11 October 2013, pages 1-10
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	39	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
L2	5	L1 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
L3	1	("20140169319").PN.	US-PGPUB; USPAT	ADJ	OFF	2017/06/25 23:52
S1	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:58
S2	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:59
S3	116	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:00
S4	46	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:01
S5	13	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S6	10	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S7	178	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 16:19
S8	2	PUCCH same (MTC OR machine type communication) same	US-PGPUB; USPAT; USOCR;	ADJ	OFF	2017/06/25 18:07

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Petitioner's Exhibit 1002
Page 000302

		coverage level	FPRS; EPO; JPO; DERWENT; IBM_TDB			
S9	99	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:08
S10	11170	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S11	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S12	22	S10 and S11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S13	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S14	20	S10 and S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S15	1	"15025262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:27
S16	47	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:44
S17	79	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S18	79	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S19	32	S18 NOT S16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S20	11	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR;	ADJ	OFF	2017/06/25 19:08

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			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S21	5	"53756546".FMID.	US-PGPUB; USPAT; FPRS	ADJ	OFF	2017/06/25 19:08
S22	24	S9 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 19:12
S23	99	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 20:35

EAST Search History (Interference)

<This search history is empty>

6/25/2017 11:54:54 PM
C:\Users\ccrutchfield\Documents\EAST\Searches\15025262.wsp

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BIB DATA SHEET

CONFIRMATION NO. 1007

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
15/025,262	03/25/2016 RULE	370	2466	811.0053

APPLICANTS
KT CORPORATION, Gyeonggi-do, KOREA, REPUBLIC OF;

INVENTORS
Kyujin PARK, Seoul, KOREA, REPUBLIC OF;
Woo-jin CHOI, Seoul, KOREA, REPUBLIC OF;

**** CONTINUING DATA ***************************
This application is a 371 of PCT/KR2014/008765 09/22/2014

**** FOREIGN APPLICATIONS ***************************
REPUBLIC OF KOREA 10-2014-0057938 05/14/2014
REPUBLIC OF KOREA 10-2013-0115367 09/27/2013

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
05/10/2016

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☑ Yes ☐ No	☑ Yes ☐ No	/CHRISTOPHER M CRUTCHFIELD/ Examiner's Signature	☐ /CC/ Initials	KOREA, REPUBLIC OF	10	19	4

ADDRESS
IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165
UNITED STATES

TITLE
METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

FILING FEE RECEIVED		
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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15025262
Filing Date	2016-03-25
First Named Inventor	Kyujin PARK
Art Unit	
Examiner Name	
Attorney Docket Number	811.0053

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20140169319	A1	2014-06-19	Suckchel Yang et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2013/015637	WO	A2	2013-01-31	LG ELECTRONICS INC.		X

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15025262
	Filing Date	2016-03-25
	First Named Inventor	Kyujin PARK
	Art Unit	
	Examiner Name	
	Attorney Docket Number	811.0053

	1	3GPP TS 36.213 V11.4.0, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 11)", September 20, 2013	X
	2	HTC, "Remaining issues on PUCCH A/N resource allocation for EPDCCH", R1-124356, 3GPP TSG RAN WG1 #70bis, San Diego, USA, October 8-12, 2012	☒
	3	CATT, "DPUCCH resource for E-PDCCH", R1-124107, 3GPP TSG RAN WG1 Meeting #70bis, San Diego, USA, October 8th – 12th, 2012	☒
	4	TEXAS INSTRUMENTS, "Outstanding aspects of PUCCH resource allocation for EPDCCH", R1-124141, 3GPP TSG RAN WG1 #70bis, San Diego, USA, October 8 – 12, 2012	☒

If you wish to add additional non-patent literature document citation information please click the Add button [Add]

EXAMINER SIGNATURE

Examiner Signature	/CHRISTOPHER M CRUTCHFIELD/	Date Considered	06/25/2017

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.M.C/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15025262
	Filing Date	2016-03-25
	First Named Inventor	Kyujin PARK
	Art Unit	
	Examiner Name	
	Attorney Docket Number	811.0053

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Ian M. Hughes/	Date (YYYY-MM-DD)	2016-03-25
Name/Print	Ian M. Hughes	Registration Number	41083

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.M.C/

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15025262	PARK ET AL.
	Examiner	**Art Unit**
	CHRISTOPHER CRUTCHFIELD	2466

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/25/2017								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	-								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
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	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	-								
	18	✓								
	19	✓								

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15025262	PARK ET AL.
	Examiner	Art Unit
	CHRISTOPHER CRUTCHFIELD	2466

CPC- SEARCHED		
Symbol	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004	6/25/2017	C Crutchfield

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004 (text search only - see search history printout)	6/25/2017	C Crutchfield
EAST (USPAT US-PGPUB, USOCR, FPRS, EPO, JPO, DERWENT, IBM_TDB) - see search history printout	6/25/2017	C Crutchfield
Internet search using Google and IEEE Explore	6/25/2017	C Crutchfield
Search of 3GPP website www.3gpp.org	6/25/2017	C Crutchfield
Inventor and assignee name search in PALM	6/25/2017	C Crutchfield

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/CHRISTOPHER CRUTCHFIELD/ Primary Examiner.Art Unit 2466

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Kyujin PARK et al. Re: Attorney Docket No.: 811.0053

Serial No.: 15/025,262
Filed: 03/25/2016
Matter No.: 811.0053

Group Art Unit: 2466
Examiner: CRUTCHFIELD, CHRISTOPHER M
Conf. No.: 1007

For: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

REPLY TO OFFICE ACTION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the non-final office action of **07/03/2017**, please reconsider the application in light of the following amendments/remarks.

Applicant believes that no extensions of time and fees are required at this time. However, if extensions of time are necessary to prevent abandonment of this application, such extensions of time are hereby petitioned for under 37 C.F.R. §1.136 (a). The Director is hereby authorized to charge any fees that may be required, or also credit any overpayment, to Deposit Account Number 50-5881.

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of the Claims:

1. **(Currently Amended)** A method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

receiving structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

receiving downlink control information for scheduling the downlink data;

receiving the downlink data; and

transmitting the response information on the downlink data by using the resource allocated to the uplink control channel,

wherein the resource allocated to the uplink control channel is determined based on at least one of: i) information on a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; [[or]] and iii) the start offset information on the resource allocated to the uplink control channel; and

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level.

2. **(Currently Amended)** The method of claim 1, wherein the start offset information of the resource allocated to the uplink control channel is configured separated from [[-]]start offset information for a terminal different from the MTC terminal.

3. (Previously Presented) The method of claim 2, wherein:

a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information is received through cell-specific high layer signaling for the MTC terminal from a base station.

4. **(Currently Amended)** The method of claim 3, wherein:

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at least one of the plurality of pieces of start offset information ~~are~~ is applied according to a corresponding coverage ~~lavel~~ level of the MTC terminal.

5. (Canceled).

6. **(Currently Amended)** The method of claim 1, wherein ~~when~~ the response information of downlink data of the MTC terminal is repeatedly transmitted using the same uplink control channel in each uplink subframe in which the uplink control channel is repeatedly transmitted.

7. **(Currently Amended)** A method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in the base station, the method comprising:

transmitting structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

transmitting downlink control information for scheduling the downlink data; and

transmitting the downlink data,

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of information on i) a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the start offset information on the resource allocated to the uplink control channel; and

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level.

8. (Previously Presented) The method of claim 7, wherein the start offset information of the resource allocated to the uplink control channel is configured separated from offset information on a terminal different from the MTC terminal.

9. (Previously Presented) The method of claim 8, wherein:

a plurality of pieces of start offset information on the resource allocated to the uplink control

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channel are provided; and

the plurality of pieces of start offset information is transmitted through cell-specific high layer signaling for the MTC terminal from the MTC terminal.

10. **(Currently Amended)** The method of claim [[7]] 9, wherein:

at least one of the plurality of pieces of start offset information ~~are~~ is applied according to a corresponding coverage level of the MTC terminal.

11. (Canceled).

12. **(Currently Amended)** The method of claim 7, wherein ~~when~~ the response information of downlink data of the MTC terminal is repeatedly transmitted, using the same uplink control channel in each uplink subframe in which the uplink control channel is repeatedly transmitted.

13. **(Currently Amended)** A Machine Type Communication (MTC) terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a receiving unit configured to receive structural information that contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource to which the uplink control channel is allocated, configured to receive downlink control information for scheduling the downlink data, and configured to receive the downlink data;

a controller configured to determine a resource allocated to the uplink control channel for transmitting the response information of the downlink data based on at least one of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the start offset information on the resource allocated to the uplink control channel; and

a transmitting unit configured to transmit the response information of the downlink data by using the determined resource of the uplink control channel,

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level.

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14. **(Currently Amended)** The MTC terminal of claim 13, wherein the start offset information of the resource allocated to the uplink control channel is configured separated from offset information on a terminal different from the MTC terminal.

15. **(Currently Amended)** The MTC terminal of claim 14, wherein:

a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information is received through cell-specific high layer signaling for the MTC terminal from a base station.

16. **(Currently Amended)** The MTC terminal of claim 15, wherein:

at least one of the plurality of pieces of start offset information ~~are~~ is applied according to a corresponding coverage level of the MTC terminal.

17. (Canceled).

18. **(Currently Amended)** The MTC terminal of claim 13, wherein ~~when~~ the response information of downlink data of the MTC terminal is repeatedly transmitted using the same uplink control channel in each uplink subframe in which the uplink control channel is repeatedly transmitted.

19. **(Currently Amended)** A base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a transmitting unit configured to transmit structural information, downlink control information for scheduling the downlink data, and the downlink data,

wherein the structural information contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel, ~~and~~

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource

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allocated to the uplink control channel, and iii) the start offset information of the resource allocated to the uplink control channel, and

wherein the start offset information of the resource allocated to the uplink control channel is determined based on a coverage level.

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REMARKS

Applicant appreciates the Examiner's review of the present application, and respectfully requests reconsideration in light of the foregoing amendments and the following remarks.

Claims Amendments/Status

Claims 1, 4, 6, 7, 10, 12-16, 18, and 19 have been amended to better define the claimed invention and to improve claim language. The amended claims find solid support in the original specification, claims (e.g., claim 4) and drawings. No new matter has been introduced through the foregoing amendments.

Claim Objection

Claims 6, 12, and 18 stand objected to because of informalities. Applicant has amended claims 6, 12, and 18 based on the Examiner's kind suggestion in the Office Action. In other words, claims 6, 12, and 18 have been amended to include the missing words (e.g., transmitted). No new matter has been added by these amendments. Accordingly, in light of foregoing amendments, withdrawal of this objection is respectfully requested.

Rejection under 35 U.S.C. §103

Claims 1, 7, 13 and 19 are rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent Application Publication No. 2013/0315159 to Xia et al. (hereinafter "*Xia*") in view of U.S. Patent Application Publication No. 2013/0250882 to Dinan (hereinafter "*Dinan*"). Claims 2, 8 and 14 are rejected under 35 U.S.C. §103 as being unpatentable over *Xia* and *Dinan* as applied to claims 1, 7 and 13 and further in view of R1-114268 (hereinafter "*268*"). Claims 3, 4, 9, 10, 15 and 16 are rejected under 35 U.S.C. §103 as being unpatentable over *Xia* and *Dinan* as applied to claims XXX and *268* as applied to claims 2, 8 and 14 and further in view of U.S. Patent Application Publication No. 2013/0155974 to Papasakellariou et al. (hereinafter "*Papasakellariou*"). Claims 6, 12 and 18 are rejected under 35 U.S.C. §103 as being unpatentable over *Xia* and *Dinan* as applied to claims 1, 7 and 13 and further in view of R1-131825 (hereinafter "*825*"). This rejection is respectfully traversed for the reasons set forth below.

Amended independent claim 1 recites:

> 1. A method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

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receiving structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) **start offset information on the resource allocated to the uplink control channel**;

receiving downlink control information for scheduling the downlink data;

receiving the downlink data; and

transmitting the response information on the downlink data by using the resource allocated to the uplink control channel,

wherein the resource allocated to the uplink control channel is determined based on at least one of: i) information on a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) **the start offset information on the resource allocated to the uplink control channel**; and

wherein the **start offset information** on the resource allocated to the uplink control channel is determined based on a **coverage level**.

On page 4 of the office action, the Examiner **admits** that ***Xia*** **fails** to disclose the step of "*receiving structural information that contains ... ii) start offset information on the resource allocated to the uplink control channel*" in claim 1. However, the Examiner alleges that ***Dinan*** at paragraphs [0036]-[0037] discloses such a limitation of claim 1. Further, on pages 10-13 of the office action, when rejecting claims 3 and 4, the Examiner **admits** that a combination of ***Xia***, ***Dinan***, and ***268*** **fails** to disclose "*the MTC devices could be sent at different frequency offsets depending on the applied coverage level.*" See page 11 (lines 1-3 from the bottom) of the office action. However, on page 12 (lines 17-18) and page 13 (lines 5-6) of the office action, the Examiner alleges that ***Papasakellariou*** at paragraphs [0124] & [0128] and FIGs. 15-16 teaches the limitation associated with "start offset information applied according to a coverage level" in claims 3 and 4.

However, as to amended independent claim 1, Applicant respectfully disagrees with the Examiner for the reasons set forth below.

The cited parts ([0036], [0037]) of ***Dinan*** merely disclose that uplink control channel parameter may indicate a PUCCH resource **starting offset**. However, as admitted by the Examiner, ***Dinan*** does **not** disclose or teach any descriptions associated with "**start offset information** (on uplink control channel resources) based on a **coverage level**." In particular, ***Dinan*** does **not** disclose or teach even the terms "*Machine Type Communication (MTC)*," "*MTC terminal*," and "*a coverage level of the MTC terminal*."

Meanwhile, the cited parts ([0124], [0128], FIGs. 15-16) of ***Papasakellariou*** merely disclose a scheme of increasing a **multiplexing capacity** of periodic CQI/CSI transmissions from MTC UEs. Specifically, in order to increase a multiplexing capacity of periodic CQI transmissions

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for MTC UEs, the periodic CQI is transmitted over only **one slot** (instead of "over one subframe") of PUCCH subframe. See paragraphs [0124]-[0127] and FIG. 15 of *Papasakellariou*. In other embodiments of *Papasakellariou*, a periodic CSI is transmitted over only **half a resource block (RB)** in each of two slots (i.e., "over half a RB in a first slot 1630A and half a RB in a second slot 1630B" instead of "over one RB in a first slot 1610 and one RB in a second slot 1620"). See paragraphs [0128]-[0129] and FIG. 16 of *Papasakellariou*. In summary, the cited parts of ***Papasakellariou*** merely disclose that periodic CQI/CSI are efficiently transmitted using "**less**" **resources** (e.g., only one slot or only half a RB) than a conventional periodic CQI/CSI transmission scheme. In other words, *Papasakellariou* does **not** disclose or teach any description associated with "**start offset** information corresponding to **start position information**," even the term "*start offset*."

Furthermore, ***Papasakellariou*** merely discloses "*MTC UEs that are not UL-coverage-limited can be configured to transmit in **one** slot of a PUCCH subframe*." See paragraph [0124] (lines 8-10) of *Papasakellariou*. In other words, ***Papasakellariou*** does **not** disclose or teach any descriptions associated with "**start offset** information (on unlink control channel resources) based on a **coverage level**."

Unlike ***Dinan*** and ***Papasakellariou***, in amended claim 1, **start offset** information on the resource allocated to an uplink control channel is determined based on a **coverage level**. Therefore, any one of ***Dinan*** and ***Papasakellariou*** does **not** disclose or teach the newly-added limitation "*start offset information on uplink control channel resources is determined based on a coverage level*" in amended claim 1.

In particular, with respect to combination of the applied references (e.g., *Dinan*, *Papasakellariou*), it is believed that the Examiner turned to mere identification in the prior art of each element of the claimed invention. For example, the Examiner turned to **individual elements or terms** such as "*starting offset*" in ***Dinan***, and "*UL-coverage-limited*" in ***Papasakellariou***. In other words, mere identification in the prior art of each element is insufficient to defeat the patentability of the **combined subject matter as a whole**.

> Most inventions arise from a combination of old elements and each element may often be found in the prior art. ... However, **mere identification in the prior art of each element is insufficient to defeat the patentability of the combined subject matter as a whole**. ... Rather, to establish a

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> *prima facie* case of obviousness based on a combination of elements disclosed in the prior art, the Board must articulate the basis on which it concludes that it would have been obvious to make the claimed invention. *In re Kahn*, 441 F.3d 977, 986 (Fed. Cir. 2006).

In conclusion, as mentioned above, the applied references (*Xia*, *Dinan*, *268*, *Papasakellariou*), singly or in combination, **fail** to disclose, suggest, or teach the above-noted limitations of amended claim 1. Further, the other reference (e.g., 825) does not disclose or teach the above-noted limitations of amended claim 1, and therefore does not cure the deficiencies of the applied references (*Xia*, *Dinan*, *268*, *Papasakellariou*). Therefore, it is believed that amended independent claim 1 is patentable at least for the aforementioned reasons. Withdrawal of this rejection is respectfully requested.

Meanwhile, Applicant has amended claims 7, 13, and 19 to include the above-noted limitations of amended independent claim 1. Each of amended independent claims 7, 13, and 19 has the same or similar limitations as/to those of amended claim 1. Accordingly, it is believed that amended independent claims 7, 13, and 19 are also patentable at least for the reasons stated in connection with amended independent claim 1.

Dependent claims such as claims 2-4, 6, 8-10, 12, 14-16, and 18, which are directly or indirectly dependent on one of amended independent claims 1, 7, and 13, are also patentable at least for the reasons discussed above with regard to amended independent claims 1, 7, and 13.

Conclusion

In view of the above remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

Date: 29 September 2017

/Ian M. Hughes/

Customer No. 76277
IP Legal Services, LLC
P.O. Box 651325
Sterling, VA 20165

Ian M. Hughes, Reg. No. 41,083
Joung Kook Park, Reg. No. 69,192
Attorney/Agent for Applicant
(571) 267-7183 (phone)

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Electronic Acknowledgement Receipt

EFS ID:	30529255
Application Number:	15025262
International Application Number:	
Confirmation Number:	1007
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Customer Number:	76277
Filer:	Joung Kook Park
Filer Authorized By:	
Attorney Docket Number:	811.0053
Receipt Date:	29-SEP-2017
Filing Date:	25-MAR-2016
Time Stamp:	20:33:21
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	8110053Reply.pdf	148022 0bf4d34e2a5a504d2e0f6c6dc0f64d4a6b0f97ef	no	10

Warnings:

Information:	
Total Files Size (in bytes):	148022

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New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/025,262	Filing Date 03/25/2016	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	09/29/2017	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
EMORY LANE

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	03/25/2016	Kyujin PARK	811.0053	1007

76277 7590 01/11/2018

IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

EXAMINER
CRUTCHFIELD, CHRISTOPHER M

ART UNIT	PAPER NUMBER
2466	

NOTIFICATION DATE	DELIVERY MODE
01/11/2018	ELECTRONIC

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

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

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

email@iplsllc.com

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Office Action Summary	Application No. 15/025,262	Applicant(s) PARK ET AL.	
	Examiner CHRISTOPHER CRUTCHFIELD	Art Unit 2466	AIA (First Inventor to File) Status Yes

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 September 2017*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

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

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-4,6-10,12-16,18 and 19* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-4, 6-10, 12-16, 18 and 19* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

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

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

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DETAILED ACTION

Claim Rejections - 35 USC § 103

1. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

2. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary.

Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

5. **Claims 1, 7, 13 and 19** is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) in view of *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882 A1) and *Papasalellariou*, et al. (US Pre Grant Publication No. 2013/0155974 A1).

Regarding claim 1, *Xia* discloses a method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

a. Receiving downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint ["UE"] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information ["DCI"] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. Receiving the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Transmitting the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose receiving structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. In the same field of endeavor, *Dinan* discloses receiving structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. (The system of Dinan discloses the use of ePDCCH indexes/sets, which have an associated corresponding uplink control channel parameter [paragraph 0036] which maps to a frequency resource starting offset for the ePDCCH set/index for uplink control channel feedback in the PDCCH [paragraph 0037] and further discloses that the system may utilize different uplink frequency starting offsets in the PUCCH for each of the ePDCCH sets/indexes [paragraph 0131- at least one starting offset indicates more than one may be used]. Putting this together Dinan discloses that the system may use multiple ePDCCH indexes/sets, each associated with a particular uplink control channel/PUCCH frequency resource offset)

Therefore, since the system of *Dinan* suggests the transmission of PUCCH feedback start resource offset information associated with a PDCCH group/index, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offsets of *Dinan* with the system of *Xia* sending the starting frequency resource offset of the PUCCH associated with the PDCCH to the UE and using it to determine the starting frequency

offset of the PUCCH. The motive to combine is to improve flexibility by allowing the starting frequency offset of the PUCCH to vary so that feedback information may be spread across different frequencies.

Xia as modified by *Dinan* and fails to disclose the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. In the same field of endeavor, *Papasalellariou* discloses the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot]).

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for PUCCH feedback for coverage and non-coverage limited MTC devices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the

frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* by using a different ePDCCH indexes/sets with a different uplink control channel/PUCCH frequency resource offsets, as taught by Dinan for each of the different uplink PUCCH frequency feedback resources associated with the different coverage levels of Papasalellariou. The motive to combine is to separate coverage limited and non-coverage limited UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

Regarding claim 7, *Xia* discloses a method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in the base station, the method comprising:

a. Transmitting downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. Transmitting the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Receiving the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose transmitting structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. In the same field of endeavor, *Dinan* discloses transmitting structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. (The system of Dinan discloses the use of ePDCCH indexes/sets, which have an associated corresponding uplink control channel parameter [paragraph 0036] which maps to a frequency resource starting offset for the ePDCCH set/index for uplink control channel feedback in the PDCCH [paragraph 0037] and further discloses that the system may utilize different uplink frequency starting offsets in the PUCCH for each of the ePDCCH sets/indexes [paragraph 0131- at least one starting offset indicates more than one may be used]. Putting this together Dinan discloses that the system may use multiple ePDCCH indexes/sets, each associated with a particular uplink control channel/PUCCH frequency resource offset)

Therefore, since the system of *Dinan* suggests the transmission of PUCCH feedback start resource offset information associated with a PDCCH group/index, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offsets of *Dinan* with the system of *Xia* by sending the starting frequency resource offset of the PUCCH associated with the PDCCH to the UE and using it to determine the starting frequency

offset of the PUCCH. The motive to combine is to improve flexibility by allowing the starting frequency offset of the PUCCH to vary so that feedback information may be spread across different frequencies.

Xia as modified by *Dinan* and fails to disclose the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. In the same field of endeavor, *Papasalellariou* discloses the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot]).

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for PUCCH feedback for coverage and non-coverage limited MTC devices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the

frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* by using a different ePDCCH indexes/sets with a different uplink control channel/PUCCH frequency resource offsets, as taught by Dinan for each of the different uplink PUCCH frequency feedback resources associated with the different coverage levels of Papasalellariou. The motive to combine is to separate coverage limited and non-coverage limited UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

Regarding claim 13, *Xia* discloses a machine type communication MTC terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a. Receiving unit configured to receive downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. A receiving unit configured to receive the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. A transmitting unit configured to transmit the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose a receiving unit configured to receive structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. In the same field of endeavor, *Dinan* discloses a receiving unit configured to receive structural information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. (The system of Dinan discloses the use of ePDCCH indexes/sets, which have an associated corresponding uplink control channel parameter [paragraph 0036] which maps to a frequency resource starting offset for the ePDCCH set/index for uplink control channel feedback in the PDCCH [paragraph 0037] and further discloses that the system may utilize different uplink frequency starting offsets in the PUCCH for each of the ePDCCH sets/indexes [paragraph 0131- at least one starting offset indicates more than one may be used]. Putting this together Dinan discloses that the system may use multiple ePDCCH indexes/sets, each associated with a particular uplink control channel/PUCCH frequency resource offset)

Therefore, since the system of *Dinan* suggests the transmission of PUCCH feedback start resource offset information associated with a PDCCH group/index, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offsets of *Dinan* with the system of *Xia* sending the starting frequency resource offset of the

PUCCH associated with the PDCCH to the UE and using it to determine the starting frequency offset of the PUCCH. The motive to combine is to improve flexibility by allowing the starting frequency offset of the PUCCH to vary so that feedback information may be spread across different frequencies.

Xia as modified by *Dinan* and fails to disclose the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. In the same field of endeavor, *Papasalellariou* discloses the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot]).

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for PUCCH feedback for coverage and non-coverage limited MTC devices, it would have been

obvious to a person of ordinary skill in the art at the time of the invention to combine the frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* by using a different ePDCCH indexes/sets with a different uplink control channel/PUCCH frequency resource offsets, as taught by Dinan for each of the different uplink PUCCH frequency feedback resources associated with the different coverage levels of Papasalellariou. The motive to combine is to separate coverage limited and non-coverage limited UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

Regarding claim 19, *Xia* discloses a base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a. A transmitting unit configured to transmit downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. A transmitting unit configured to transmit the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Receiving the transmitted response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose a transmitting unit configured to transmit information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. In the same field of endeavor, *Dinan* discloses a transmitting unit configured to transmit information that contains start offset information on the resource allocated to the uplink control channel or the resource allocated to the uplink control channel is determined based on the start offset information on the resource allocated to the uplink control channel. (The system of Dinan discloses the use of ePDCCH indexes/sets, which have an associated corresponding uplink control channel parameter [paragraph 0036] which maps to a frequency resource starting offset for the ePDCCH set/index for uplink control channel feedback in the PDCCH [paragraph 0037] and further discloses that the system may utilize different uplink frequency starting offsets in the PUCCH for each of the ePDCCH sets/indexes [paragraph 0131- at least one starting offset indicates more than one may be used]. Putting this together Dinan discloses that the system may use multiple ePDCCH indexes/sets, each associated with a particular uplink control channel/PUCCH frequency resource offset)

Therefore, since the system of *Dinan* suggests the transmission of PUCCH feedback start resource offset information associated with a PDCCH group/index, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start

offsets of *Dinan* with the system of *Xia* sending the starting frequency resource offset of the PUCCH associated with the PDCCH to the UE and using it to determine the starting frequency offset of the PUCCH. The motive to combine is to improve flexibility by allowing the starting frequency offset of the PUCCH to vary so that feedback information may be spread across different frequencies.

Xia as modified by *Dinan* and fails to disclose the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. In the same field of endeavor, *Papasalellariou* discloses the MTC devices send PUCCH feedback at different frequency offsets depending on the applied coverage level, such that the system would need to send separate starting offsets for the different PUCCH channels for the different coverage levels such that the system comprises the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot]).

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for PUCCH feedback for coverage and non-coverage limited MTC devices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* by using a different ePDCCH indexes/sets with a different uplink control channel/PUCCH frequency resource offsets, as taught by Dinan for each of the different uplink PUCCH frequency feedback resources associated with the different coverage levels of Papasalellariou. The motive to combine is to separate coverage limited and non-coverage limited UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

6. **Claims 2, 8 and 14** is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) and *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882A1) as applied to claims 1, 7 and 13 and further in view of R1-114268 (“268”) (Author Unknown, Backwards compatible support for reduced bandwidth MTC LTE, 3GPP TSG RAN WG1 Meeting #67, Doc. No. R1-114268, 18 November 2011, pages 1-4).

Regarding claims 2, 8 and 14, *Xia* as modified by *Dinan* fails to disclose the start offset information of the resource allocated to the uplink control channel is configured different from-start offset information for a terminal different from the MTC terminal. In the same field of endeavor, *268* discloses the start offset information of the resource allocated to the uplink control channel is configured different from-start offset information for a terminal different from the MTC terminal. (The system of 268 discloses MTC terminals may use a separate PUCCH

region from standard terminals and that the region may have a different frequency offset [see page 3, fig. 2, see also section 5, generally].)

Therefore, since the system of 268 discloses the use of a separate PUCCH region for MTC terminals with a different frequency offset (and thereby a different starting offset) it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the separate PUCCH regoins of 268 with the system of *Xia* as modified by *Dinan* by making a separate PUCCH region for MTC terminals. The motive to combine is the preservation of legacy compatibility of the non MTC terminals PUCCH while allowing for greater flexibility in coding and construction of the MTC terminal PUCCH, which has different requirements because of the large required gain and low bandwidth of MTC transmitters.

7. **Claims 3, 4, 9, 10, 15 and 16**, is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) and *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882 A1) as applied to claims XXX and R1-114268 (“268”) (Author Unknown, Backwards compatible support for reduced bandwidth MTC LTE, 3GPP TSG RAN WG1 Meeting #67, Doc. No. R1-114268, 18 November 2011, pages 1-4) as applied to claims 2, 8 and 14 and further in view of *Papasalellariou*, et al. (US Pre Grant Publication No. 2013/0155974 A1).

Regarding claims 3 and 15, *Xia* as previously modified by *Dinan* and 268 fails to disclose a plurality of pieces of start offset information could be allocated via cell-specific high layer signaling. In the same field of endeavor, another portion of *Dinan* discloses a plurality of pieces of start offset information could be allocated via cell-specific high layer signaling. (The system of *Dinan* discloses that the PUCCH configuration [i.e. uplink control channel parameter –

see paragraph 0037] may be via RRC signaling [paragraph 0040- "…provided in PUCCH resources identified by the corresponding uplink control channel parameter (in RRC message).”]. *Dinan* further discloses the system may configure multiple PUCCH offsets for different purposes [paragarphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the use of RRC/Higher layer configuration for PUCCH offset/control channel parameter information, it would have bene obvious to a person of ordinary skill in the art at the time of the invention to combine the RRC configuration of *Dinan* with the system of *Xia* as previously modified by *Dinan* and 268 by using the RRC/higher layer for transmission of offset information for multiple PUCCH control channels. The motive to combine is to reduce overhead by using RRC to configure the PUCCH control channels, which is a non-periodic transmission and will not need to be resent frequently, unlike other configuration mechanisms, such as the PDCCH.

Xia as modified by *Dinan* and 268 fails to disclose the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels such that the system comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received for the MTC terminal from a base station. In the same field of endeavor, *Papasalellariou* discloses the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels such that the system comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received for the MTC terminal from a base station. (*Papasalellariou* discloses that the system may split up

the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot]).

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for PUCCH feedback for coverage and non-coverage limited MTC devices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* and 268 by using a different ePDCCH indexes/sets with a different uplink control channel/PUCCH frequency resource offsets, as taught by Dinan for each of the different uplink PUCCH frequency feedback resources associated with the different coverage levels of Papasalellariou. The motive to combine is to separate coverage limited and non-coverage limited UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

Regarding claims 4 and 16, *Xia* as modified by *Dinan*, 268 and *Papasalellariou* discloses at least one of the plurality of start offset information is applied according to a corresponding coverage level of the MTC terminal. (see claims 3 and 15, supra - the offset frequency information is different for each coverage level and is applied in accordance with the UE/terminal coverage level).

Regarding claim 9, *Xia* as previously modified by *Dinan* and 268 fails to disclose a plurality of pieces of start offset information could be allocated via cell-specific high layer

signaling. In the same field of endeavor, another portion of *Dinan* discloses a plurality of pieces of start offset information could be allocated via cell-specific high layer signaling. (The system of *Dinan* discloses that the PUCCH configuration [i.e. uplink control channel parameter – see paragraph 0037] may be via RRC signaling [paragraph 0040- "…provided in PUCCH resources identified by the corresponding uplink control channel parameter (in RRC message)."]. *Dinan* further discloses the system may configure multiple PUCCH offsets for different purposes [paragarphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the use of RRC/Higher layer configuration for PUCCH offset/control channel parameter information, it would have bene obvious to a person of ordinary skill in the art at the time of the invention to combine the RRC configuration of *Dinan* with the system of *Xia* as previously modified by *Dinan* and 268 by using the RRC/higher layer for transmission of offset information for multiple PUCCH control channels. The motive to combine is to reduce overhead by using RRC to configure the PUCCH control channels, which is a non-periodic transmission and will not need to be resent frequently, unlike other configuration mechanisms, such as the PDCCH.

Xia as modified by *Dinan* and 268 fails to disclose the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels such that the system comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received for the MTC terminal from a base station. In the same field of endeavor, *Papasalellariou* discloses the MTC devices could be sent at different frequency offsets depending on the applied coverage level, such that the system would need to send separate offsets for the different PUCCH channels for the different coverage levels such that the system

comprises a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received for the MTC terminal from a base station. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot]).

Therefore, since the system of *Papasalellariou* suggests a different frequency offset for PUCCH feedback for coverage and non-coverage limited MTC devices, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the frequency offset of *Papasalellariou* with the system of *Xia* as modified by *Dinan* and 268 by using a different ePDCCH indexes/sets with a different uplink control channel/PUCCH frequency resource offsets, as taught by Dinan for each of the different uplink PUCCH frequency feedback resources associated with the different coverage levels of Papasalellariou. The motive to combine is to separate coverage limited and non-coverage limited UE/terminals, which may require different repetition numbers and rate configurations for transmission, so as to simplify scheduling and allow efficient bandwidth usage.

Regarding claim 10, *Xia* as modified by *Dinan*, 268 and *Papasalellariou* discloses at least one of the plurality of start offset information is applied according to a corresponding coverage level of the MTC terminal. (see claim 9, supra - the offset frequency information is

different for each coverage level and is applied in accordance with the UE/terminal coverage level).

8. **Claims 6, 12 and 18** is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) and *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882A1) as applied to claims 1, 7 and 13 and further in view of R1-131825 (“825”) (Author Unknown, Text proposal on PUCCH coverage improvement for Section 9.5.5 of TR 36.888, 3GPP TSG-RAN WG1 Meeting #72bis, Doc. No. R1-131825, 19 April 2013, pages 1-2).

Regarding claims 6, 12 and 18, *Xia* as modified by *Dinan* fails to disclose the response information of downlink data of the MTC terminal is repeatedly transmitted using the same uplink control channel in each uplink subframe in which the uplink control channel is repeatedly transmitted. In the same field of endeavor, 941 discloses disclose the response information of downlink data of the MTC terminal is repeatedly transmitted using the same uplink control channel in each uplink subframe which the uplink control channel is repeatedly transmitted in. (The system of 825 discloses that the MTC response information [i.e. ACK/NACK] may be repeatedly transmitted using the PDCCH [i.e. the same control channel] [page 2, section 9.5.5.1].)

Therefore, since the system of 825 suggests PUCCH repetition, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the repetition of 825 with the system of *Xia* as modified by *Dinan* by performing repetitions of the PUCCH containing the response information. The motive to combine is to improve gain using

repetition to allow a high gain to be achieved despite poor transmitter and channel characteristics.

Response to Arguments

1. Applicant's arguments, see Applicant's Arguments and Remarks, filed 29 September 2017, with respect to the objection to claims 1,6, 12 and 18 have been fully considered and are persuasive. The previous ground of objection has been withdrawn.

1. The remainder of Applicant's arguments filed 29 September 2017 have been fully considered but they are not persuasive.

Regarding claims 1, 7, 13 and 19 and associated dependent claims, applicant argues that the system of *Xia* as modified by *Dinan* and further modified by *Papasalellariou* (noting that *Papasalellariou* was applied elements somewhat similar to the now claimed "element of the start offset information on the resource allocated to the uplink control channel is determined based on coverage level" in portions of dependent claims 9/10) fails to disclose the claimed elements of the independent claim.

Regarding the combination of *Dinan* and *Papasalellariou* applicant argues that the examiner has improperly combined the system of *Dinan* and *Papasalellariou* in dependent claims 9/10 (which have been significantly modified and incorporated in part into the independent claim), as the system of *Dinan* discloses the use of different start offset information for different uplink control channel indexes and the system of *Papasalellariou* only discloses that

the different groups of MTC terminals could start in different timeslots based on the coverage information. (See Applicant's Arguments and Remarks, pages 7-10).

However, Applicant's arguments ignore key elements of the *Dinan* and *Papasalellariou* references. That is, *Dinan* discloses, in paragraphs 0036 and 0037 and 0131, respectively:

> … An ePDCCH transmission and resource configuration may be identified by an ePDCCH index. The ePDCCH index may be used to add or release ePDCCH transmission and resource configuration to or from an existing configured ePDCCH. The ePDCCH transmission and resource configuration may comprise one or more parameters, including one or more of the following parameters: frequency resources, frequency distribution, frequency assignment, reference sequence, *corresponding uplink control channel parameter*, and coordinated transmission mode parameters.
>
> *… The corresponding uplink control channel parameter may indicate PUCCH format 1a and 1b resource starting offset for the ePDCCH set. For example, uplink PUCCH radio resources for transmitting ACK/NACK for downlink transport blocks (MAC/PHY packets) transmitted in the PDSCH scheduled by ePDCCH is determined based, at least in part, employing the corresponding uplink control channel parameter. The uplink control channel parameter may indicate the* ***frequency start offset*** *in terms of resource blocks in the uplink carrier* …
>
> … In another example, one or more frequency resource parameters may be provided in in the form of a set of pre-defined indexes (each index identifying a pre-defined set of resource blocks), or a list of *at least one (starting offset,* bandwidth).

Therefore, the system of *Dinan* discloses the use of ePDCCH indexes/sets, which have an associated corresponding uplink control channel parameter [paragraph 0036] which maps to a frequency resource starting offset for the ePDCCH set/index for uplink control channel feedback in the PDCCH [paragraph 0037] and further discloses that the system may utilize different uplink frequency starting offsets in the PUCCH for each of the ePDCCH sets/indexes [paragraph 0131- at least one starting offset indicates more than one may be used]. Putting this together *Dinan* discloses that the system may use multiple ePDCCH indexes/sets, each associated with a particular uplink control channel/PUCCH frequency resource offset.

The system of *Papasalellariou* discloses that the PUCCH feedback of the UE may use different frequency resources for PUCCH feedback based on the coverage level of the MTC. (*Papasalellariou* discloses that the system may split up the MTC reporting of a terminal based on if the terminals are or are not coverage limited [paragraph 0124] with a coverage limited terminal transmitting in a first slot and frequency offset of the PUCCH [fig. 16, element 1510 and paragraphs 0124 and 0128] and the non-coverage limited MTC terminals transmitting in a second slot and frequency offset [fig. 15, element 1520 – noting that the y axis of fig. 15 is frequency, as it represents the assigned frequency bandwidth and elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth; see also paragraphs 0124 and 0128; see also fig. 16 - showing frequency division in a single slot]))

Therefore, since the system of *Dinan* discloses the system may use multiple ePDCCH indexes/sets, each associated with a particular set of uplink control channel/PUCCH frequency resource offset and the system of *Papasalellariou* discloses choosing different frequency resources for PUCCH feedback based on the coverage level of the MTC, it would have been obvious to combine the two by using a different ePDCCH indexes/sets with a different uplink

control channel/PUCCH frequency resource offsets, as taught by *Dinan* for each of the different uplink PUCCH frequency feedback resources associated with the different coverage levels of *Papasalellariou*. Therefore, Applicant's Arguments have been considered and are not persuasive.

Applicant further argues that the system of *Dinan*, *Papasalellariou*, and 268 fails to disclose *start* offset information (See Applicant's Arguments and Remarks, pages 7-10). The examiner disagrees and notes that the cited frequency offset of *Dinan* (see discussion, supra) is a start frequency offset, as it discloses the offset that the selected frequency band begins/starts at relative to the point offset from and is therefore start offset information.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTOPHER CRUTCHFIELD whose telephone number is (571)270-3989. The examiner can normally be reached on Monday through Friday 9:00 AM to 5:30 PM EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Faruk Hamza can be reached on 571-272-7969. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CHRISTOPHER CRUTCHFIELD/
Primary Examiner, Art Unit 2466

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15025262	PARK ET AL.
	Examiner	**Art Unit**
	CHRISTOPHER CRUTCHFIELD	2466

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/25/2017	12/29/2017							
	1	✓	✓							
	2	✓	✓							
	3	✓	✓							
	4	✓	✓							
	5	-	-							
	6	✓	✓							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	✓							
	11	-	-							
	12	✓	✓							
	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	✓	✓							
	17	-	-							
	18	✓	✓							
	19	✓	✓							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15025262	PARK ET AL.
	Examiner	Art Unit
	CHRISTOPHER CRUTCHFIELD	2466

CPC- SEARCHED		
Symbol	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004	6/25/2017 (Updated 12/29/2017)	C Crutchfield

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004 (text search only - see search history printout)	6/25/2017 (Updated 12/29/2017)	C Crutchfield
EAST (USPAT US-PGPUB, USOCR, FPRS, EPO, JPO, DERWENT, IBM_TDB) - see search history printout	6/25/2017 (Updated 12/29/2017)	C Crutchfield
Internet search using Google and IEEE Explore	6/25/2017 (Updated 12/29/2017)	C Crutchfield
Search of 3GPP website www.3gpp.org	6/25/2017 (Updated 12/29/2017)	C Crutchfield
Inventor and assignee name search in PALM	6/25/2017 (Updated 12/29/2017)	C Crutchfield

	/CHRISTOPHER CRUTCHFIELD/ Primary Examiner.Art Unit 2466

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/CHRISTOPHER CRUTCHFIELD/ Primary Examiner.Art Unit 2466

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	63	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L2	15	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L3	12	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L4	223	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L5	3	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L6	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L7	11858	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L8	1101	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L9	38	L7 and L8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L10	925	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58

L11	36	L7 and L10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L12	64	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L13	106	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L14	106	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L15	42	L14 NOT L12	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L16	15	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L17	29	L6 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L18	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L19	61	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L20	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
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L22	159	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58

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L23	159	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L24	619	L1 or L2 or L3 or L4 or L5 or L6 or L9 or L11 or L12 or L13 or L14 or L15 or L16 or L17 or L18 or L19 or L21 or L22 or L23	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
L25	157	L24 and @pd>="20170625"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 12:00
S1	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:58
S2	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:59
S4	46	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:01
S5	13	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S6	10	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S7	178	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 16:19
S8	2	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:07
S9	99	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:08
S10	11170	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25

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S11	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S12	22	S10 and S11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S13	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S14	20	S10 and S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S15	1	"15025262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:27
S16	47	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:44
S17	79	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S18	79	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S19	32	S18 NOT S16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S20	11	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 19:08
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S22	24	S9 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 19:12
S23	99	PUCCH same (MTC OR machine type communication) same	US-PGPUB; USPAT; USOCR;	ADJ	OFF	2017/06/25 20:35

		coverage	FPRS; EPO; JPO; DERWENT; IBM_TDB			
S24	39	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
S25	5	S24 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
S26	1	("20140169319").PN.	US-PGPUB; USPAT	ADJ	OFF	2017/06/25 23:52
S27	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 13:18
S28	126	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:11
S29	29	S28 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:11
S30	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:13
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S33	7	"20120003962"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:36
S34	2	"9282493".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:57
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S37	5	"20080025267"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 12:06
S38	4	"13700478"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 12:16
S39	839	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 14:38
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S41	3	"20130250882"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 10:28

EAST Search History (Interference)

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12/ 29/ 2017 12:07:12 PM
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Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	15/025,262	Filing Date	2016-03-25	Docket Number (if applicable)	811.0053	Art Unit	2466
First Named Inventor	Kyujin PARK			Examiner Name	CRUTCHFIELD, CHRISTOPHER M		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☐ Other _____

☒ Enclosed

☒ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 505881

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (07-09)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Ian M. Hughes/	Date (YYYY-MM-DD)	2018-04-11
Name	Ian M. Hughes	Registration Number	41083

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Kyujin PARK et al.	Re: Attorney Docket No.: 811.0053
Serial No.: 15/025,262	Group Art Unit: 2466
Filed: 03/25/2016	Examiner: CRUTCHFIELD, CHRISTOPHER M
Matter No.: 811.0053	Conf. No.: 1007

For: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

REPLY TO FINAL OFFICE ACTION

MAIL STOP RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Final Office Action of **January 11, 2018**, Applicant respectfully requests reconsideration of the application in view of the following Amendments and Remarks in conjunction with the accompanying Request for Continued Examination (RCE).

Applicant believes that no extensions of time and fees are required at this time. However, if extensions of time are necessary to prevent abandonment of this application, such extensions of time are hereby petitioned for under 37 C.F.R. §1.136 (a). The Director is hereby authorized to charge any fees that may be required, or also credit any overpayment, to Deposit Account Number 50-5881.

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of the Claims:

1. **(Currently Amended)** A method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

receiving structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

receiving downlink control information for scheduling the downlink data;

receiving the downlink data; and

transmitting the response information on the downlink data by using the resource allocated to the uplink control channel,

wherein the resource allocated to the uplink control channel is determined based on at least one of: i) information on a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the start offset information on the resource allocated to the uplink control channel; ~~and~~

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level; and

wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

2. (Previously Presented) The method of claim 1, wherein the start offset information of the resource allocated to the uplink control channel is configured separated from start offset information for a terminal different from the MTC terminal.

3. (Previously Presented) The method of claim 2, wherein:

a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information is received through cell-specific high layer

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signaling for the MTC terminal from a base station.

4. (Previously Presented) The method of claim 3, wherein:

at least one of the plurality of pieces of start offset information is applied according to a corresponding coverage level of the MTC terminal.

5. (Canceled).

6. **(Canceled)**

7. **(Currently Amended)** A method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in the base station, the method comprising:

transmitting structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

transmitting downlink control information for scheduling the downlink data; and

transmitting the downlink data,

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of information on i) a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the start offset information on the resource allocated to the uplink control channel; ~~and~~

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level; and

wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

8. (Previously Presented) The method of claim 7, wherein the start offset information of the resource allocated to the uplink control channel is configured separated from offset information

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on a terminal different from the MTC terminal.

9. (Previously Presented) The method of claim 8, wherein:

a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information is transmitted through cell-specific high layer signaling for the MTC terminal from the MTC terminal.

10. (Previously Presented) The method of claim 9, wherein:

at least one of the plurality of pieces of start offset information is applied according to a corresponding coverage level of the MTC terminal.

11. (Canceled).

12. **(Canceled)**

13. **(Currently Amended)** A Machine Type Communication (MTC) terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a receiving unit configured to receive structural information that contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource to which the uplink control channel is allocated, configured to receive downlink control information for scheduling the downlink data, and configured to receive the downlink data;

a controller configured to determine a resource allocated to the uplink control channel for transmitting the response information of the downlink data based on at least one of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the start offset information on the resource allocated to the uplink control channel; and

a transmitting unit configured to transmit the response information of the downlink data by using the determined resource of the uplink control channel,

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level; and

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wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

14. (Previously Presented) The MTC terminal of claim 13, wherein the start offset information of the resource allocated to the uplink control channel is configured separated from offset information on a terminal different from the MTC terminal.

15. (Previously Presented) The MTC terminal of claim 14, wherein:

a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided; and

the plurality of pieces of start offset information is received through cell-specific high layer signaling for the MTC terminal from a base station.

16. (Previously Presented) The MTC terminal of claim 15, wherein:

at least one of the plurality of pieces of start offset information is applied according to a corresponding coverage level of the MTC terminal.

17. (Canceled).

18. **(Canceled)**

19. **(Currently Amended)** A base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a transmitting unit configured to transmit structural information, downlink control information for scheduling the downlink data, and the downlink data,

wherein the structural information contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel,

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of i) information on a resource of a

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downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the start offset information of the resource allocated to the uplink control channel, ~~and~~

wherein the start offset information of the resource allocated to the uplink control channel is determined based on a coverage level, and

wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

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REMARKS

Applicant appreciates the Examiner's review of the present application, and respectfully requests reconsideration in light of the foregoing amendments and the following remarks.

Claims Amendments/Status

Claims 1, 7, 13, and 19 have been amended to better define the claimed invention and to improve claim language. Claims 6, 12, and 18 have been cancelled without prejudice or disclaimer. The amended claims find solid support in the original specification, claims (e.g., claims 6, 12, and 18) and drawings. No new matter has been introduced through the foregoing amendments.

Rejection under 35 U.S.C. §103

Claims 1, 7, 13, and 19 are rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent Application Publication No. 2013/0315159 to Xia et al. (hereinafter "*Xia*") in view of U.S. Patent Application Publication No. 2013/0250882 to Dinan (hereinafter "*Dinan*") and U.S. Patent Application Publication No. 2013/0155947 to Papasalellariou et al. (hereinafter "*Papasalellariou*"). Claims 2, 8 and 14 are rejected under 35 U.S.C. §103 as being unpatentable over *Xia, Dinan*, and *Papasalellariou* and further in view of R1-114268 (hereinafter "*268*"). Claims 3, 4, 9, 10, 15 and 16 are rejected under 35 U.S.C. §103 as being unpatentable over *Xia, Dinan*, *268* and *Papasakellariou*. Claims 6, 12 and 18 are rejected under 35 U.S.C. §103 as being unpatentable over *Xia, Dinan*, and *Papasalellariou* and further in view of R1-131825 (hereinafter "*825*"). This rejection is respectfully traversed for the reasons set forth below.

Independent claim 1 recites in part:

> " ... wherein the **start offset information** on the resource allocated to the uplink control channel is determined **based on a coverage level** ..." [Emphasis Added]

On pages 5-6 of the Final Office Action, the Examiner **admits** that a combination of ***Xia*** and ***Dinan*** does **not** disclose the limitation "*the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level*" in claim 1. However, the Examiner alleges that ***Papasakellariou*** at paragraphs [0124] & [0128] and FIG. 15 teaches such a limitation of claim 1.

However, Applicant respectfully disagrees with the Examiner for the reasons set forth

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below.

In the Final Office Action, the Examiner asserts that a **coverage limited** terminal transmits in a **first** slot and frequency offset ("1510" in FIG. 15) and a **non-coverage limited** terminal transmits in a **second** slot and frequency offset ("1520" in FIG. 15). The Examiner also alleges that elements 1510 and 1520 are at different positions/offsets in the frequency bandwidth because the **y-axis** in FIG. 15 indicates "frequency." See page 5 (lines 14-21) and page 24 (*Response to Arguments*) of the FOA.

The cited parts ([0124], [0128], FIG. 15) of ***Papasakellariou*** merely disclose a scheme of increasing a **multiplexing capacity** of periodic CQI/CSI transmissions from MTC UEs. Specifically, the cited parts of ***Papasakellariou*** merely disclose that periodic CQI/CSI are efficiently transmitted using "**less**" **resources** (e.g., only one slot or only half a RB) than a conventional periodic CQI/CSI transmission scheme. In particular, only paragraph [0124] (lines 8-10) of ***Papasakellariou*** discloses "*MTC UEs that are not UL-coverage-limited can be configured to transmit in **one slot** of a PUCCH subframe*." In other words, the cited parts ([0124], "1510" and "1520" in FIG. 15) of ***papasakellariou*** merely disclose that a set of K conventional UEs multiplex their transmissions in a first slot (1510) and in a second slot (1520) of a same PUCCH subframe. In summary, unlike the Examiner's assertion, the cited parts of ***papasakellariou*** do **not** disclose or teach that **different slots** are assigned according to **whether** a corresponding terminal is a coverage limited terminal or a non-coverage limited terminal. In other words, ***papasakellariou*** does **not** disclose or teach **any description** indicating that the coverage limited terminal transmits in a first slot and frequency offset ("1510" in FIG. 15) and the non-coverage limited terminal transmits in a second slot and frequency offset ("1520" in FIG. 15).

In particular, ***Papasakellariou*** explicitly discloses that "conventional UEs" communicate over a total system BW and are typically used by humans, whereas "MTC UEs" communicate over only a part of the system BW and are typically associated with machines. See paragraph [0040] of *Papasakellariou.* Based on paragraphs [0040] and the Examiner's assertions (see the *Response to Arguments*), it may be interpreted that the conventional UEs correspond to non-coverage limited terminals and MTC UEs correspond to coverage limited terminals. Further, in FIG. 15, **both** the first slot and second slot are applied to the **same type UEs**, i.e., the conventional UEs

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communicating a total system BW. Therefore, it is believed that the Examiner's assertion [i.e., *a coverage limited terminal transmits in a first slot and frequency offset ("1510" in FIG. 15) and a non-coverage limited terminal transmits in a second slot and frequency offset ("1520" in FIG. 15)*] is improper.

Therefore, it is believed that the Examiner's characterization and assertion about ***Papasakellariou*** is improper. In other words, ***Papasakellariou*** does **not** disclose or teach the limitation "*the **start offset** information on the resource allocated to the uplink control channel is determined based on a **coverage level***" in claim 1.

As mentioned above, although Applicant does not necessarily agree with the Examiner's characterization of ***Papasakellariou*** as mentioned above, claim 1 has been amended to include limitation associated with "a **repeated transmission** of response information of downlink data" solely for the purpose of expediting prosecution.

Amended independent claim 1 recites in part:

> " … wherein when the response information of the downlink data of the MTC terminal is **repeatedly** transmitted, the repeated transmission is performed using a **same** uplink control channel **resource in each uplink subframe** in which the uplink control channel is repeatedly transmitted." [Emphasis Added]

On page 21 of the FOA, when rejecting claim 6, the Examiner alleged that ***R1-131825 ("825")*** teaches the limitation of claim 6. However, as to amended claim 1 (including the feature of claim 6), Applicant respectfully disagrees with the Examiner for the reasons set forth below.

The cited part (section 9.5.5.1) of ***825*** merely discloses that a **PUCCH region** is used for a UCI repetitive transmission of an MTC UE. In contrast, in amended claim 1, when response information (e.g., HARQ ACK) of downlink data of an MTC terminal is **repeatedly** transmitted, the repeated transmission is performed using a **same** uplink control channel **resource in each uplink subframe** in which the uplink control channel is repeatedly transmitted.

Therefore, it is believed that ***825*** does **not** disclose or teach the newly-added limitation (i.e., *when the response information of downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a **same** uplink control channel **resource** in each uplink*

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subframe in which the uplink control channel is repeatedly transmitted) in amended claim 1.

In conclusion, as mentioned above, the applied references (*Xia*, *Dinan*, *Papasakellariou, 825*), singly or in combination, **fail** to disclose, suggest, or teach the above-noted limitations of amended claim 1. Further, the other reference (e.g., 268) does not disclose or teach the above-noted limitations of amended claim 1, and therefore does not cure the deficiencies of the applied references (*Xia*, *Dinan*, *Papasakellariou, 825*). Therefore, it is believed that amended independent claim 1 is patentable at least for the aforementioned reasons. Withdrawal of this rejection is respectfully requested.

Meanwhile, Applicant has amended independent claims 7, 13, and 19 to include the newly-added limitations of amended independent claim 1. Each of amended independent claims 7, 13, and 19 has the same or similar limitations as/to those of amended claim 1. Accordingly, it is believed that amended independent claims 7, 13, and 19 are also patentable at least for the reasons stated in connection with amended independent claim 1.

Dependent claims such as claims 2-4, 8-10, and 14-16, which are directly or indirectly dependent on one of amended independent claims 1, 7, and 13, are also patentable at least for the reasons discussed above with regard to amended independent claims 1, 7, and 13. Meanwhile, by this amendment, claims 6, 12, and 18 are cancelled rendering this rejection moot.

Conclusion

In view of the above remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

Date: 11 April 2018

/Ian M. Hughes/

Customer No. 76277
IP Legal Services, LLC
P.O. Box 651325
Sterling, VA 20165

Ian M. Hughes, Reg. No. 41,083
Joung Kook Park, Reg. No. 69,192
Attorney/Agent for Applicant
(571) 267-7183 (phone)

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Electronic Patent Application Fee Transmittal

Application Number:	15025262
Filing Date:	25-Mar-2016
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Filer:	Joung Kook Park/Yujin Chun
Attorney Docket Number:	811.0053

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1300	1300
		Total in USD ($)		**1300**

Electronic Acknowledgement Receipt

EFS ID:	32307631
Application Number:	15025262
International Application Number:	
Confirmation Number:	1007
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Customer Number:	76277
Filer:	Joung Kook Park/Yujin Chun
Filer Authorized By:	Joung Kook Park
Attorney Docket Number:	811.0053
Receipt Date:	11-APR-2018
Filing Date:	25-MAR-2016
Time Stamp:	13:23:10
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1300
RAM confirmation Number	041118INTEFSW13245500
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	8110053RCETransmittal.pdf	698683 2dbda5e4a81d92d1f31e3d8e454242a445118cab	no	3
Warnings:					
Information:					
2	Amendment Submitted/Entered with Filing of CPA/RCE	8110053RCEandReplytoFOA.pdf	152157 2ff11da095fd07a4e3bb8bbf24b1453957398503	no	10
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30188 cb3a2eaf13ba943113b4d13da10816fe68cb68d0	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	881028		

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/025,262	Filing Date 03/25/2016	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	04/11/2018	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 13	Minus	** 20	= 0	X $100 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
JACQUELYN WILLIAMS

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	03/25/2016	Kyujin PARK	811.0053	1007

76277 7590 05/01/2018

IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

EXAMINER
CRUTCHFIELD, CHRISTOPHER M

ART UNIT	PAPER NUMBER
2466	

NOTIFICATION DATE	DELIVERY MODE
05/01/2018	ELECTRONIC

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

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

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

email@iplsllc.com

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Office Action Summary	Application No. 15/025,262	Applicant(s) PARK ET AL.	
	Examiner CHRISTOPHER CRUTCHFIELD	Art Unit 2466	AIA (First Inventor to File) Status Yes

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 April 2018*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

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

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-4,7-10,13-16 and 19* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-4,7-10,13-16 and 19* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

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

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

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Petitioner's Exhibit 1002
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DETAILED ACTION

Claim Rejections - 35 USC § 103

1. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

2. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

3. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.

4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

4. This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary.

Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

5. **Claims 1, 2, 7, 8, 13, 14 and 19** is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1) in view of R1-134131 (Author Unknown, Coverage enhancement of DL/UL control channels for low cost MTC, 3GPP TSG-RAN WG1 #74bis, Doc. No. R1-134131, 11 October 2013, pages 1-10) and *You*, et al. (US Pre Grant Publication No. 2017/0180098 A1).

Regarding claim 1, *Xia* discloses a method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

a. Receiving downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. Receiving the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Transmitting the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose receiving structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. In the same field of endeavor, 131 discloses receiving structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. (The system of 131 discloses that the UE receives a coverage/extension/repetition level indication from the base station that indicates start offset of the downlink control channel [page 1, section 2.1, first bullet - "Furthermore, eNB may schedule the transmission of data and control channel according to UE specific coverage extension level…According to this design principle, the starting subframe for (E)PDCCH USS transmission may be configured by higher layer signaling or predefined. For instance, the configuration index consisting of the subframe offset and the periodicity for the potential (E)PDCCH subframes can be signaled, *or the starting offset can be defined as the functions of repetition level*.] Therefore, 131 discloses that the signaled repetition level indicates the start offset and is therefore start offset information that is determined based on the repetition level.)

Therefore, since 131 discloses that the PDCCH downlink offset may be determined based on a coverage/extension/repetition level indication, therefore, it would have been obvious

to a person of ordinary skill in the art at the time of the invention to combine the repetition based offsets of 131 with the system of *Xia* by using a signaled repetition/coverage level [i.e. start offset information] to determine the start offset of the PDCCH based on repetition/coverage level. The motive to combine is to reduce signaling overhead by using the already indicated repetition level to also indicate the start offset.

Xia as modified by 131 fails to disclose the start offset of the PDCCH is also used as the start offset of the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the received structural information is start offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled repetition/coverage level [i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. In the same field of endeavor, *You* discloses the start offset of the PDCCH is also used as the start offset of the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the received structural information is start offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled repetition/coverage level

[i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. (The system of *You* discloses that the index/offset of the PUCCH used for transmission may be determined based on the CCE of the PDCCH [paragraphs 0272, 0278-0279] [see also 61/949249 - page 0059 (d)].)

Therefore, since *You* suggests using the offset of the PDCCH as the start offset information of the PUCCH used for ACK/NACK transmission, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offset of *You* with the system of *Xia* by using the start offset [i.e. repetition/coverage level information] of the PDCCH to determine both the start offset of the PDCCH and the start offset of the PUCCH that contains the ACK/NACK/response information. The motive to combine is to reduce signaling overhead by using the start offset [i.e. repetition/coverage level information] to determine both PDCCH and PUCCH start offset.

Xia as previously modified by 131 and *You* fails to disclose when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted. In the same field of endeavor, another portion of *You* discloses the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted. (*You* discloses that the PUCCH resource offset may be held constant throughout the repetition cycle [paragraph 0020] [noting the PUCCH contains the response information/ACK/NACK] [see also 61/949249 - page 0059 last full paragraph].)

Therefore, since another portion of *You* suggests holding the offset constant when repeating response information in the PUCCH, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the constant offsets of to combine the constant offsets of *You* with the system of *Xia* as previously modified by 131 and *You* by keeping the offset of the PUCCH used for transmitting the response information constant. The motive to combine is to reduce complexity of implementation and overhead by not requiring the determination as to the offset to be re-made for each repetition.

Regarding claims 2, *Xia* as modified by 131 and *You* discloses the start offset information of the resource allocated to the uplink control channel is configured different from-start offset information for a terminal different from the MTC terminal. (The system of *Xia* as modified by 131 and *You* disclose that the coverage/reception levels each have different offset information such that terminals at different coverage/reception levels will have different offsets [see the independent claim, supra].)

Regarding claim 7, *Xia* discloses a method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in the base station, the method comprising:

a. Transmitting downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent

at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. Transmitting the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Receiving the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose transmitting structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. In the same field of endeavor, 131 discloses transmitting structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. (The system of 131 discloses that the UE receives a coverage/extension/repetition level indication from the base station that indicates start offset of the downlink control channel [page 1, section 2.1, first bullet - "Furthermore, eNB may schedule the transmission of data and control channel according to UE specific coverage extension level…According to this design principle, the starting subframe for (E)PDCCH USS transmission may be configured by higher layer signaling or predefined. For instance, the configuration index consisting of the subframe offset and the periodicity for the potential (E)PDCCH subframes can be signaled, *or the starting offset can be defined as the functions of repetition level*.] Therefore,

131 discloses that the signaled repetition level indicates the start offset and is therefore start offset information that is determined based on the repetition level.)

Therefore, since 131 discloses that the PDCCH downlink offset may be determined based on a coverage/extension/repetition level indication, therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the repetition based offsets of 131 with the system of *Xia* by using a signaled repetition/coverage level [i.e. start offset information] to determine the start offset of the PDCCH based on repetition/coverage level. The motive to combine is to reduce signaling overhead by using the already indicated repetition level to also indicate the start offset.

Xia as modified by 131 fails to disclose the start offset of the PDCCH is also used as the start offset of the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the transmitted structural information is start offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled repetition/coverage level [i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. In the same field of endeavor, *You* discloses the start offset of the PDCCH is also used as the start offset of the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the transmitted structural information is start

offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled repetition/coverage level [i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. (The system of *You* discloses that the index/offset of the PUCCH used for transmission may be determined based on the CCE of the PDCCH [paragraphs 0272, 0278-0279] [see also 61/949249 - page 0059 (d)].)

Therefore, since *You* suggests using the offset of the PDCCH as the start offset information of the PUCCH used for ACK/NACK transmission, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offset of *You* with the system of *Xia* by using the start offset [i.e. repetition/coverage level information] of the PDCCH to determine both the start offset of the PDCCH and the start offset of the PUCCH that contains the ACK/NACK/response information. The motive to combine is to reduce signaling overhead by using the start offset [i.e. repetition/coverage level information] to determine both PDCCH and PUCCH start offset.

Xia as previously modified by 131 and *You* fails to disclose when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted. In the same field of endeavor, another portion of *You* discloses the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is

repeatedly transmitted. (*You* discloses that the PUCCH resource offset may be held constant throughout the repetition cycle [paragraph 0020] [noting the PUCCH contains the response information/ACK/NACK] [see also 61/949249 - page 0059 last full paragraph].)

Therefore, since another portion of *You* suggests holding the offset constant when repeating response information in the PUCCH, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the constant offsets of to combine the constant offsets of *You* with the system of *Xia* as previously modified by 131 and *You* by keeping the offset of the PUCCH used for transmitting the response information constant. The motive to combine is to reduce complexity of implementation and overhead by not requiring the determination as to the offset to be re-made for each repetition.

Regarding claim 8, *Xia* as modified by 131 and *You* discloses the start offset information of the resource allocated to the uplink control channel is configured different from-start offset information for a terminal different from the MTC terminal. (The system of *Xia* as modified by 131 and *You* disclose that the coverage/reception levels each have different offset information such that terminals at different coverage/reception levels will have different offsets [see the independent claim, supra].)

Regarding claim 13, *Xia* discloses a machine type communication MTC terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a. Receiving unit configured to receive downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint [“UE”] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information [“DCI”] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042,

0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. A receiving unit configured to receive the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. A transmitting unit configured to transmit the response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose a receiving unit configured to receive structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. In the same field of endeavor, 131 discloses a receiving unit [inherent receiver] configured to receive structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. (The system of 131 discloses that the UE receives a coverage/extension/repetition level indication from the base station that indicates start offset of the downlink control channel [page 1, section 2.1, first bullet - "Furthermore, eNB may schedule the transmission of data and control channel according to UE specific coverage extension level…According to this design principle, the starting subframe for (E)PDCCH USS transmission

may be configured by higher layer signaling or predefined. For instance, the configuration index consisting of the subframe offset and the periodicity for the potential (E)PDCCH subframes can be signaled, *or the starting offset can be defined as the functions of repetition level*.] Therefore, 131 discloses that the signaled repetition level indicates the start offset and is therefore start offset information that is determined based on the repetition level.)

Therefore, since 131 discloses that the PDCCH downlink offset may be determined based on a coverage/extension/repetition level indication, therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the repetition based offsets of 131 with the system of *Xia* by using a signaled repetition/coverage level [i.e. start offset information] to determine the start offset of the PDCCH based on repetition/coverage level. The motive to combine is to reduce signaling overhead by using the already indicated repetition level to also indicate the start offset.

Xia as modified by 131 fails to disclose the start offset of the PDCCH is also used as the start offset of the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the received structural information is start offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined by a controller based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled repetition/coverage level [i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. In the same field of endeavor, *You* discloses the start offset of the PDCCH is also used as the start offset of

the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the received structural information is start offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined by a controller based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled repetition/coverage level [i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. (The system of *You* discloses that the index/offset of the PUCCH used for transmission may be determined based on the CCE of the PDCCH [paragraphs 0272, 0278-0279] [see also 61/949249 - page 0059 (d)].)

Therefore, since *You* suggests using the offset of the PDCCH as the start offset information of the PUCCH used for ACK/NACK transmission, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offset of *You* with the system of *Xia* by using the start offset [i.e. repetition/coverage level information] of the PDCCH to determine both the start offset of the PDCCH and the start offset of the PUCCH that contains the ACK/NACK/response information. The motive to combine is to reduce signaling overhead by using the start offset [i.e. repetition/coverage level information] to determine both PDCCH and PUCCH start offset.

Xia as previously modified by 131 and *You* fails to disclose when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted. In the same field of

endeavor, another portion of *You* discloses the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted. (*You* discloses that the PUCCH resource offset may be held constant throughout the repetition cycle [paragraph 0020] [noting the PUCCH contains the response information/ACK/NACK] [see also 61/949249 - page 0059 last full paragraph].)

Therefore, since another portion of *You* suggests holding the offset constant when repeating response information in the PUCCH, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the constant offsets of to combine the constant offsets of *You* with the system of *Xia* as previously modified by 131 and *You* by keeping the offset of the PUCCH used for transmitting the response information constant. The motive to combine is to reduce complexity of implementation and overhead by not requiring the determination as to the offset to be re-made for each repetition.

Regarding claim 14, *Xia* as modified by 131 and *You* discloses the start offset information of the resource allocated to the uplink control channel is configured different from-start offset information for a terminal different from the MTC terminal. (The system of *Xia* as modified by 131 and *You* disclose that the coverage/reception levels each have different offset information such that terminals at different coverage/reception levels will have different offsets [see the independent claim, supra].)

Regarding claim 19, *Xia* discloses a base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a. A transmitting unit configured to transmit downlink control information for scheduling the downlink data. (The system of *Xia* discloses that for machine type communication the user endpoint ["UE"] may receive and the base station may send, using the PDCCH [i.e. downlink control channel], a downlink control information ["DCI"] containing scheduling information for downlink transmissions transmitted on the PDSCH [paragraphs 0042, 0048-0049]. The downlink transmissions are received at the UE and sent at the base station at the scheduled time on the PDSCH and the response/ACK [i.e. response information] is sent at the appropriate time on the PUCCH [i.e. uplink control channel] [paragraphs 0043-0044, 0049-0050].)

b. A transmitting unit configured to transmit the downlink data (paragraphs 0042, 0048-0049 - see (a), supra).

c. Receiving the transmitted response information on the downlink data by using a resource allocated to the uplink control channel (paragraphs 0043-0044, 0049-0050 - see (a), supra).

Xia fails to disclose transmitting structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. In the same field of endeavor, 131 discloses transmitting structural information that contains start offset information on the resource allocated to the *downlink* control channel or the start offset information on the resource allocated to the *downlink* control channel is determined based on a coverage level. (The system of 131 discloses that the UE receives a

coverage/extension/repetition level indication from the base station that indicates start offset of the downlink control channel [page 1, section 2.1, first bullet - "Furthermore, eNB may schedule the transmission of data and control channel according to UE specific coverage extension level…According to this design principle, the starting subframe for (E)PDCCH USS transmission may be configured by higher layer signaling or predefined. For instance, the configuration index consisting of the subframe offset and the periodicity for the potential (E)PDCCH subframes can be signaled, *or the starting offset can be defined as the functions of repetition level*.] Therefore, 131 discloses that the signaled repetition level indicates the start offset and is therefore start offset information that is determined based on the repetition level.)

Therefore, since 131 discloses that the PDCCH downlink offset may be determined based on a coverage/extension/repetition level indication, therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the repetition based offsets of 131 with the system of *Xia* by using a signaled repetition/coverage level [i.e. start offset information] to determine the start offset of the PDCCH based on repetition/coverage level. The motive to combine is to reduce signaling overhead by using the already indicated repetition level to also indicate the start offset.

Xia as modified by 131 fails to disclose the start offset of the PDCCH is also used as the start offset of the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the transmitted structural information is start offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled

repetition/coverage level [i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. In the same field of endeavor, *You* discloses the start offset of the PDCCH is also used as the start offset of the PUCCH used for ACK/NACK transmission such that the signaled repetition/coverage level [i.e. start offset information] of the PDCCH also signals the start offset information of the response information/ACK/NACK of the PUCCH such that the transmitted structural information is start offset information of the PUCCH and wherein the resource allocated to the uplink control channel is determined based on information on a resource of a downlink control channel for scheduling the downlink data [i.e. the offset of the PDCCH] and the start offset information on the resource allocated to the uplink control channel [i.e. the signaled repetition/coverage level [i.e. start offset information] of the PDCCH, which also signals the offset of the PUCCH] and wherein the start offset information on the resource allocated to the uplink control channel is determined based on the coverage level. (The system of *You* discloses that the index/offset of the PUCCH used for transmission may be determined based on the CCE of the PDCCH [paragraphs 0272, 0278-0279] [see also 61/949249 - page 0059 (d)].)

Therefore, since *You* suggests using the offset of the PDCCH as the start offset information of the PUCCH used for ACK/NACK transmission, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the start offset of *You* with the system of *Xia* by using the start offset [i.e. repetition/coverage level information] of the PDCCH to determine both the start offset of the PDCCH and the start offset of the PUCCH that contains the ACK/NACK/response information. The motive to combine is to reduce signaling overhead by using the start offset [i.e. repetition/coverage level information] to determine both PDCCH and PUCCH start offset.

Xia as previously modified by 131 and *You* fails to disclose when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted. In the same field of endeavor, another portion of *You* discloses the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted. (*You* discloses that the PUCCH resource offset may be held constant throughout the repetition cycle [paragraph 0020] [noting the PUCCH contains the response information/ACK/NACK] [see also 61/949249 - page 0059 last full paragraph].)

Therefore, since another portion of *You* suggests holding the offset constant when repeating response information in the PUCCH, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the constant offsets of to combine the constant offsets of *You* with the system of *Xia* as previously modified by 131 and *You* by keeping the offset of the PUCCH used for transmitting the response information constant. The motive to combine is to reduce complexity of implementation and overhead by not requiring the determination as to the offset to be re-made for each repetition.

6. **Claims 3, 4, 9, 10, 15 and 16**, is/are rejected under 35 U.S.C. 103 as being unpatentable over *Xia*, et al. (US Pre Grant Publication No. 2013/0315159 A1), R1-134131 (Author Unknown, Coverage enhancement of DL/UL control channels for low cost MTC, 3GPP TSG-RAN WG1 #74bis, Doc. No. R1-134131, 11 October 2013, pages 1-10) and *You*, et al. (US Pre Grant Publication No. 2017/0180098 A1) as applied to claims 1, 7, 13 and 19 and further in view of *Dinan*, et al. (US Pre Grant Publication No. 2013/0250882 A1).

Regarding claims 3 and 15, *Xia* fails to disclose each offset information could be associated with a particular coverage/repetition level to form a plurality of pieces of start offset information of the resource allocated to the uplink control channel. In the same field of endeavor, 131 discloses each offset information could be associated with a particular coverage/repetition level to form a plurality of pieces of start offset information of the resource allocated to the uplink control channel (The system of 131 discloses that the UE receives a coverage/extension/repetition level indication from the base station that indicates start offset of the downlink control channel [page 1, section 2.1, first bullet - "Furthermore, eNB may schedule the transmission of data and control channel according to UE specific coverage extension level…According to this design principle, the starting subframe for (E)PDCCH USS transmission may be configured by higher layer signaling or predefined. For instance, the configuration index consisting of the subframe offset and the periodicity for the potential (E)PDCCH subframes can be signaled, *or the starting offset can be defined as the functions of repetition level*.] Therefore, 131 discloses that the signaled repetition level indicates the start offset and is therefore start offset information that is determined based on the repetition level.)

Therefore, since 131 discloses that the PDCCH downlink offset may be determined based on a coverage/extension/repetition level indication, therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the repetition based offsets of 131 with the system of *Xia* by using a signaled repetition/coverage level [i.e. start offset information] to determine the start offset of the PDCCH based on repetition/coverage level. The motive to combine is to reduce signaling overhead by using the already indicated repetition level to also indicate the start offset.

Xia as modified by 131 and *You* fails to disclose the configuration of the PUCCH offsets using higher layer signaling such that the different offsets of *Xia* as modified by 131 and *You* are configured in the UE such that a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received through cell-specific high layer signaling for the MTC terminal from a base station. In the same field of endeavor, *Dinan* discloses the configuration of the PUCCH offsets using higher layer signaling such that the different offsets of *Xia* as modified by 131 and *You* are configured in the UE such that a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received through cell-specific high layer signaling for the MTC terminal from a base station (The system of *Dinan* discloses that the PUCCH configuration [i.e. uplink control channel parameter – see paragraph 0037] may be via RRC signaling [paragraph 0040- "…provided in PUCCH resources identified by the corresponding uplink control channel parameter (in RRC message)."]. *Dinan* further discloses the system may configure multiple PUCCH offsets for different purposes [paragarphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the use of RRC/Higher layer configuration for PUCCH offset/control channel parameter information, it would have bene obvious to a person of ordinary skill in the art at the time of the invention to combine the RRC configuration of *Dinan* with the system of *Xia* as modified by 131 and *You* by using the RRC/higher layer for transmission of offset information for each of the different repetition/coverage level. The motive to combine is to reduce overhead by using RRC to configure the PUCCH control channels, which is a non-periodic transmission and will not need to be resent frequently, unlike other configuration mechanisms, such as the PDCCH.

Regarding claims 4 and 16, *Xia* as modified by 131, *You* and *Dinan* discloses at least one of the plurality of start offset information is applied according to a corresponding coverage level of the MTC terminal. (see claims 3 and 15, supra - the offset frequency information is different for each coverage level and is applied in accordance with the UE/terminal coverage level).

Regarding claim 9, *Xia* fails to disclose each offset information could be associated with a particular coverage/repetition level to form a plurality of pieces of start offset information of the resource allocated to the uplink control channel. In the same field of endeavor, 131 discloses each offset information could be associated with a particular coverage/repetition level to form a plurality of pieces of start offset information of the resource allocated to the uplink control channel (The system of 131 discloses that the UE receives a coverage/extension/repetition level indication from the base station that indicates start offset of the downlink control channel [page 1, section 2.1, first bullet - "Furthermore, eNB may schedule the transmission of data and control channel according to UE specific coverage extension level…According to this design principle, the starting subframe for (E)PDCCH USS transmission may be configured by higher layer signaling or predefined. For instance, the configuration index consisting of the subframe offset and the periodicity for the potential (E)PDCCH subframes can be signaled, *or the starting offset can be defined as the functions of repetition level*.] Therefore, 131 discloses that the signaled repetition level indicates the start offset and is therefore start offset information that is determined based on the repetition level.)

Therefore, since 131 discloses that the PDCCH downlink offset may be determined based on a coverage/extension/repetition level indication, therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to combine the repetition based offsets of 131 with the system of *Xia* by using a signaled repetition/coverage level [i.e. start

offset information] to determine the start offset of the PDCCH based on repetition/coverage level. The motive to combine is to reduce signaling overhead by using the already indicated repetition level to also indicate the start offset.

Xia as modified by 131 and *You* fails to disclose the configuration of the PUCCH offsets using higher layer signaling such that the different offsets of *Xia* as modified by 131 and *You* are configured in the UE such that a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is transmitted through cell-specific high layer signaling for the MTC terminal from a base station. In the same field of endeavor, *Dinan* discloses the configuration of the PUCCH offsets using higher layer signaling such that the different offsets of *Xia* as modified by 131 and *You* are configured in the UE such that a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is transmitted through cell-specific high layer signaling for the MTC terminal from a base station (The system of *Dinan* discloses that the PUCCH configuration [i.e. uplink control channel parameter – see paragraph 0037] may be via RRC signaling [paragraph 0040- "…provided in PUCCH resources identified by the corresponding uplink control channel parameter (in RRC message)."]. *Dinan* further discloses the system may configure multiple PUCCH offsets for different purposes [paragraphs 0036-0037].)

Therefore, since the system of *Dinan* suggests the use of RRC/Higher layer configuration for PUCCH offset/control channel parameter information, it would have bene obvious to a person of ordinary skill in the art at the time of the invention to combine the RRC configuration of *Dinan* with the system of *Xia* as modified by 131 and *You* by using the RRC/higher layer for transmission of offset information for each of the different repetition/coverage level. The motive to combine is to reduce overhead by using RRC to

configure the PUCCH control channels, which is a non-periodic transmission and will not need to be resent frequently, unlike other configuration mechanisms, such as the PDCCH.

Regarding claim 10, *Xia* as modified by 131, *You* and *Dinan* discloses at least one of the plurality of start offset information is applied according to a corresponding coverage level of the MTC terminal. (see claim 9, supra - the offset frequency information is different for each coverage level and is applied in accordance with the UE/terminal coverage level).

Response to Arguments

1. The Applicant's arguments filed 11 April 2018 have been fully considered but they are not persuasive.

Regarding claims 1, 7, 13 and 19 and associated dependent claims, applicant argues that the system of *Xia as modified by 131 and You* and further modified by *Papasalellariou* fails to disclose the start offset of the uplink control channel is determined based on coverage level. Applicant's arguments are based on shortcomings of the *Papasalellariou* and *Dinan* reference (See Applicant's Arguments and Remarks, pages 7-10). These references are no longer presented in the present application and the arguments are therefore moot.

Conclusion

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTOPHER CRUTCHFIELD whose telephone number is (571)270-3989. The examiner can normally be reached on Monday through Friday 9:00 AM to 5:30 PM EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Faruk Hamza can be reached on 571-272-7969. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CHRISTOPHER CRUTCHFIELD/
Primary Examiner, Art Unit 2466

Notice of References Cited	Application/Control No. 15/025,262	Applicant(s)/Patent Under Reexamination PARK ET AL.	
	Examiner CHRISTOPHER CRUTCHFIELD	Art Unit 2466	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2017/0180098 A1	06-2017	YOU; Hyangsun	H04L5/0055	1/1
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	Author Unknown, Coverage enhancement of DL/UL control channels for low cost MTC, 3GPP TSG-RAN WG1 #74bis, Doc. No. R1-134131, 11 October 2013, pages 1-10
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15025262	PARK ET AL.
	Examiner	**Art Unit**
	CHRISTOPHER CRUTCHFIELD	2466

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/25/2017	12/29/2017	04/27/2018						
	1	✓	✓	✓						
	2	✓	✓	✓						
	3	✓	✓	✓						
	4	✓	✓	✓						
	5	-	-	-						
	6	✓	✓	-						
	7	✓	✓	✓						
	8	✓	✓	✓						
	9	✓	✓	✓						
	10	✓	✓	✓						
	11	-	-	-						
	12	✓	✓	-						
	13	✓	✓	✓						
	14	✓	✓	✓						
	15	✓	✓	✓						
	16	✓	✓	✓						
	17	-	-	-						
	18	✓	✓	-						
	19	✓	✓	✓						

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15025262	PARK ET AL.
	Examiner	Art Unit
	CHRISTOPHER CRUTCHFIELD	2466

CPC- SEARCHED		
Symbol	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004	6/25/2017 (Updated 12/29/2017, 4/27/2018)	C Crutchfield

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004 (text search only - see search history printout)	6/25/2017 (Updated 12/29/2017, 4/27/2018)	C Crutchfield
EAST (USPAT US-PGPUB, USOCR, FPRS, EPO, JPO, DERWENT, IBM_TDB) - see search history printout	6/25/2017 (Updated 12/29/2017, 4/27/2018)	C Crutchfield
Internet search using Google and IEEE Explore	6/25/2017 (Updated 12/29/2017, 4/27/2018)	C Crutchfield

	/CHRISTOPHER CRUTCHFIELD/ Primary Examiner.Art Unit 2466

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
Search of 3GPP website www.3gpp.org	6/25/2017 (Updated 12/29/2017)	C Crutchfield
Inventor and assignee name search in PALM	6/25/2017 (Updated 12/29/2017)	C Crutchfield

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**

	/CHRISTOPHER CRUTCHFIELD/ Primary Examiner.Art Unit 2466

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:58
S2	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:59
S4	46	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:01
S5	13	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S6	10	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S7	178	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 16:19
S8	2	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:07
S9	99	PUCCH same (MTC OR machine type	US-PGPUB;	ADJ	OFF	2017/06/25

		communication) same coverage	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			18:08
S10	11170	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S11	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S12	22	S10 and S11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S13	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S14	20	S10 and S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S15	1	"15025262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:27
S16	47	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:44
S17	79	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	ADJ	OFF	2017/06/25 18:56

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			IBM_TDB			
S18	79	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S19	32	S18 NOT S16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S20	11	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 19:08
S21	5	"53756546".FMID.	US-PGPUB; USPAT; FPRS	ADJ	OFF	2017/06/25 19:08
S22	24	S9 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 19:12
S23	99	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 20:35
S24	39	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
S25	5	S24 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
S26	1	("20140169319").PN.	US-PGPUB; USPAT	ADJ	OFF	2017/06/25 23:52
S27	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	OFF	2017/10/19 13:18

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			DERWENT; IBM_TDB			
S28	126	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:11
S29	29	S28 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:11
S30	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:13
S31	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:58
S32	5	"9282493"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:33
S33	7	"20120003962"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:36
S34	2	"9282493".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:57
S35	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 10:57
S36	3	"20110269490"	US-PGPUB; USPAT; USOCR;	ADJ	OFF	2017/10/20 12:04

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S37	5	"20080025267"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 12:06
S38	4	"13700478"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 12:16
S39	839	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 14:38
S40	4	"20130155974"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 09:54
S41	3	"20130250882"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 10:28
S42	63	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S43	15	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S44	12	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S45	223	PUCCH near8 (beginning OR start$4)	US-PGPUB;	ADJ	OFF	2017/12/29

		near4 offset	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			11:58
S46	3	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S47	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S48	11858	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S49	1101	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S50	38	S48 and S49	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S51	925	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S52	36	S48 and S51	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S53	64	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	ADJ	OFF	2017/12/29 11:58

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			IBM_TDB			
S54	106	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S55	106	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S56	42	S55 NOT S53	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S57	15	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S58	29	S47 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S59	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S60	61	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S61	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S62	29	S61 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	OFF	2017/12/29 11:58

			EPO; JPO; DERWENT; IBM_TDB			
S63	159	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S64	159	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S65	619	S42 or S43 or S44 or S45 or S46 or S47 or S50 or S52 or S53 or S54 or S55 or S56 or S57 or S58 or S59 or S60 or S62 or S63 or S64	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S66	157	S65 and @pd>="20170625"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 12:00
S67	2	"20140219248"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 13:06
S68	1086	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/25 09:51
S69	1264	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/25 09:51
S70	54	cache same frequent$4 same (forward$4 OR route$4) near4 (table)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/25 13:54
S71	60	cach$4 same frequent$4 same (forward$4 OR route$4) near4 (table)	US-PGPUB; USPAT;	ADJ	OFF	2018/04/25 13:55

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S72	2591	(TCP OR transmission control protocol) same (slow near4 start)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 11:14
S73	61	(TCP OR transmission control protocol) same (slow near4 start) near4 (skip OR disabl$4 OR accelerat$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 11:15
S74	73	(TCP OR transmission control protocol) same (slow near4 start) near4 (skip$4 OR disabl$4 OR accelerat$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 11:15
S75	79	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S76	19	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S77	14	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S78	239	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S79	4	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58

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S80	156	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S81	12343	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S82	1265	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S83	44	S81 and S82	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S84	1087	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S85	42	S81 and S84	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S86	70	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S87	115	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S88	115	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	OFF	2018/04/26 15:58

			DERWENT; IBM_TDB			
S89	45	S88 NOT S86	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S90	16	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S91	33	S80 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S92	156	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S93	65	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S94	156	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S95	33	S94 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S96	191	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S97	191	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4)	US-PGPUB; USPAT; USOCR;	ADJ	OFF	2018/04/26 15:58

		same (uplink OR UL OR PU$3)	FPRS; EPO; JPO; DERWENT; IBM_TDB			
S98	696	S75 or S76 or S77 or S78 or S79 or S80 or S83 or S85 or S86 or S87 or S88 or S89 or S90 or S91 or S92 or S93 or S95 or S96 or S97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S99	234	S98 and @pd>="20170625"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S100	1	"15025262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 18:48
S101	12	(US-0155974-$ | US-0250882-$ | US-0315159-$ | US-20170625-$ | US-20130155974-$ | US-20130250882-$ | US-20130315159-$).DID.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 19:23
S102	0	S101 and repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 19:23
S103	32	(US-20140044056-$ or US-20140133433-$ or US-20150029923-$ or US-20150023281-$ or US-20100067472-$ or US-20100232382-$ or US-20110111779-$ or US-20120083284-$ or US-20130114530-$ or US-20130242890-$ or US-20130250882-$ or US-20160338088-$ or US-20130155974-$ or US-20150282208-$ or US-20160057784-$ or US-20170093480-$ or US-20130100900-$ or US-20140314048-$ or US-20130094457-$ or US-20150139136-$ or US-20130315159-$ or US-20140226638-$ or US-20160150539-$ or US-20030043816-$ or US-20050013245-$).did. or (US-9826549-$ or US-7277399-$ or US-6032190-$ or US-9622196-$ or US-9363819-$ or US-9319203-$ or US-9854575-$).did.	US-PGPUB; USPAT	ADJ	OFF	2018/04/26 19:24
S104	9	S103 and repetition	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	OFF	2018/04/26 19:24

			EPO; JPO; DERWENT; IBM_TDB			
S105	44	MTC same repetition same (ACK OR acknowledge$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 19:26
S106	186	MTC and repetition same (ACK OR acknowledge$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S107	9	MTC and repetition same (ACK OR acknowledge$4) same offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S108	61	MTC and repetition same (ACK OR acknowledge$4) same (offset OR start$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S109	64	MTC and repetition same (ACK OR acknowledge$4) same (offset OR start$4 OR CCE)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S110	6	"20130135159"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:42
S111	3	"20130315159"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:42
S112	26	PUCCH same (MTC OR machine type communication) same CCE	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 21:07

EAST Search History (Interference)

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4/ 27/ 2018 1:18:29 AM
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Kyujin PARK et al.		Re: Attorney Docket No.: 811.0053	
Serial No.:	15/025,262	Group Art Unit:	2466
Filed:	03/25/2016	Examiner:	CRUTCHFIELD, CHRISTOPHER M
Matter No.:	811.0053	Conf. No.:	1007

For: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

REPLY TO OFFICE ACTION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the non-final office action of **05/01/2018**, please reconsider the application in light of the following amendments/remarks.

Applicant believes that no extensions of time and fees are required at this time. However, if extensions of time are necessary to prevent abandonment of this application, such extensions of time are hereby petitioned for under 37 C.F.R. §1.136 (a). The Director is hereby authorized to charge any fees that may be required, or also credit any overpayment, to Deposit Account Number 50-5881.

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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

Listing of the Claims:

1. **(Currently Amended)** A method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:

receiving structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

receiving downlink control information for scheduling the downlink data;

receiving the downlink data; and

transmitting the response information on the downlink data by using the resource allocated to the uplink control channel,

wherein the resource allocated to the uplink control channel is determined based on at least one of: i) information on a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the start offset information on the resource allocated to the uplink control channel;

wherein the start offset information of the resource allocated to the uplink control channel is configured separated from start offset information for a terminal different from the MTC terminal;

wherein a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided, and the plurality of pieces of start offset information are received through cell-specific high layer signaling for the MTC terminal from a base station;

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level; and

wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

2. **(Canceled)**

3. **(Canceled)**

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4. **(Currently Amended)** The method of claim [[3]]1, wherein:

at least one of the plurality of pieces of start offset information is applied according to a corresponding coverage level of the MTC terminal.

5. (Canceled).

6. (Canceled)

7. **(Currently Amended)** A method of configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal in [[the]] a base station, the method comprising:

transmitting structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;

transmitting downlink control information for scheduling the downlink data; and

transmitting the downlink data,

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of information on i) a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the start offset information on the resource allocated to the uplink control channel;

wherein the start offset information of the resource allocated to the uplink control channel is configured separated from offset information on a terminal different from the MTC terminal;

wherein a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided, and the plurality of pieces of start offset information are transmitted through cell-specific high layer signaling for the MTC terminal to the MTC terminal;

wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level; and

wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

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8. **(Canceled)**

9. **(Canceled)**

10. **(Currently Amended)** The method of claim [[9]]7, wherein:

at least one of the plurality of pieces of start offset information is applied according to a corresponding coverage level of the MTC terminal.

11. (Canceled).

12. (Canceled)

13. **(Currently Amended)** A Machine Type Communication (MTC) terminal for transmitting response information of downlink data to a base station, the terminal comprising:

a receiving unit configured to receive structural information that contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource to which the uplink control channel is allocated, configured to receive downlink control information for scheduling the downlink data, and configured to receive the downlink data;

a controller configured to determine a resource allocated to the uplink control channel for transmitting the response information of the downlink data based on at least one of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the start offset information on the resource allocated to the uplink control channel; and

a transmitting unit configured to transmit the response information of the downlink data by using the determined resource of the uplink control channel,

wherein the start offset information of the resource allocated to the uplink control channel is configured separated from offset information on a terminal different from the MTC terminal;

wherein a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided, and the plurality of pieces of start offset information are received through cell-specific high layer signaling for the MTC terminal from the base station;

wherein the start offset information on the resource allocated to the uplink control channel is

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determined based on a coverage level; and

wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

14. **(Canceled)**

15. **(Canceled)**

16. **(Currently Amended)** The MTC terminal of claim [[15]]13, wherein:

at least one of the plurality of pieces of start offset information is applied according to a corresponding coverage level of the MTC terminal.

17. (Canceled).

18. (Canceled)

19. **(Currently Amended)** A base station for configuring a resource of response information of downlink data for a Machine Type Communication (MTC) terminal, the base station comprising:

a transmitting unit configured to transmit structural information, downlink control information for scheduling the downlink data, and the downlink data,

wherein the structural information contains at least one piece of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel[[,]];

wherein the resource of the uplink control channel for transmitting the response information of the downlink data is determined based on at least one piece of i) information on a resource of a downlink control channel for scheduling the downlink data, ii) the information on the resource allocated to the uplink control channel, and iii) the start offset information of the resource allocated to the uplink control channel[[,]];

wherein the start offset information of the resource allocated to the uplink control channel is configured separated from offset information on a terminal different from the MTC terminal;

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wherein a plurality of pieces of start offset information on the resource allocated to the uplink control channel are provided, and the plurality of pieces of start offset information are transmitted through cell-specific high layer signaling for the MTC terminal to the MTC terminal;

wherein the start offset information of the resource allocated to the uplink control channel is determined based on a coverage level[[,]]; and

wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

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REMARKS

Applicant appreciates the Examiner's review of the present application, and respectfully requests reconsideration in light of the foregoing amendments and the following remarks.

Claims Amendments/Status

Claims 1, 4, 7, 10, 13, 16, and 19 have been amended to better define the claimed invention and to improve claim language. Claims 2, 3, 8, 9, 14, and 15 have been cancelled without prejudice or disclaimer. The amended claims find solid support in the original specification, claims (e.g., claims 2, 3, 8, 9, 14, and 15) and drawings. No new matter has been introduced through the foregoing amendments.

Rejection under 35 U.S.C. §103

Claims 1, 2, 7, 8, 13, 14, and 19 are rejected under 35 U.S.C. §103 as being unpatentable over U.S. Patent Application Publication No. 2013/0315159 to Xia et al. (hereinafter "*Xia*") in view of R1-134131 (hereinafter "*131*") and U.S. Patent Application Publication No. 2017/0180098 to You et al. (hereinafter "*You*"). Claims 3, 4, 9, 10, 15, and 16 are rejected under 35 U.S.C. §103 as being unpatentable over *Xia, 131* and *You* as applied to claims 1, 7, 13 and 19 and further in view of U.S. Patent Application Publication No. 2013/0250882 to Dinan (hereinafter "*Dinan*").

However, the new references "***131***" and "***You***" do **not** qualify as prior art at least for the reasons set forth below.

The present application (i.e., the national phase application of PCT International Patent Application No. PCT/KR/2014/008765 filed on September 22, 2014) claims **foreign priority** to Korean Patent Application Nos. **10-2013-0115367** (filed **September 27, 2013**) and 10-2014-0057938 (filed May 14, 2014). The claims of the present application are directly or indirectly supported by the Korean Patent Application. For example, see pages 13-16 in the translation of the Korean Patent Application. Therefore, the effective filing date of the present application is the **earliest foreign priority date** (i.e., 09/27/2013).

The reference "***131***" was published on **October 11, 2013** as admitted by the Examiner. See page 3 (line 8) of the office action. The reference "***You***" is the published 371 application of

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PCT/KR/2015/001997 (designated the US) filed March 02, 2015 which claims priority to a U.S. provisional application **No. 61/949,249** filed **March 07, 2014**. Therefore, if the published 371 application of ***You*** is supported by the foreign application, the effective filing date of ***You*** may be the **priority date** (i.e., 03/07/2014).

Accordingly, the published date (10/11/2013) of ***131*** and the effective filing date (03/07/2014) of ***You*** are **later** than the effective filing date (09/27/2013) of the present application. In other words, it is believed that ***131*** and ***You*** do not qualify as prior art under §103. Applicant respectfully submits a **certified English translation** of the Korean Patent Application (10-2013-0115367) for perfecting the priority claim.

Meanwhile, although ***131*** and ***You*** do not qualify as prior art under §103, independent claim 1 has nevertheless been amended solely for the purpose of expediting prosecution. Specifically, claim 1 has been amended to further include the features of claims 2 and 3 as follows.

Amended independent claim 1 recites in part:

> 1. A method of transmitting response information of downlink data of a Machine Type Communication (MTC) terminal, the method comprising:
> receiving structural information that contains at least one of i) information on a resource allocated to an uplink control channel for transmitting the response information and ii) start offset information on the resource allocated to the uplink control channel;
> receiving downlink control information for scheduling the downlink data;
> receiving the downlink data; and
> transmitting the response information on the downlink data by using the resource allocated to the uplink control channel,
> wherein the resource allocated to the uplink control channel is determined based on at least one of: i) information on a resource of a downlink control channel for scheduling the downlink data; ii) the information on the resource allocated to the uplink control channel; and iii) the start offset information on the resource allocated to the uplink control channel;
> wherein the start offset information of the resource allocated to the uplink control channel is configured **separated** from **start offset information for a terminal different from the MTC terminal**;
> wherein **a plurality of pieces of start offset information** of the resource allocated to the uplink control channel are provided, and the plurality of pieces of start offset information are received **through cell-specific high layer signaling for the MTC terminal** from a base station;
> wherein the start offset information on the resource allocated to the uplink control channel is determined based on a coverage level; and
> wherein when the response information of the downlink data of the MTC terminal is repeatedly transmitted, the repeated transmission is performed using a same uplink control channel resource in each uplink subframe in which the uplink control channel is repeatedly transmitted.

On page 7 of the office action, when rejecting **claim 2** (*the start offset information of the resource allocated to the uplink control channel is configured separated from start*

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offset information for a terminal different from the MTC terminal), the Examiner alleges that a combination of ***Xia***, ***131***, and ***You*** discloses the feature of claim 2. However, as mentioned above, the references "***131***" and "***You***" do **not** qualify as prior art under §103. Further, in amended claim 1, the start offset information of the resource allocated to the uplink control channel is configured **separated** from **start offset information for a terminal** (e.g., a non-MTC terminal) **different from** the **MTC terminal**. Therefore, it is believed that the deficiencies of ***Xia*** are **not** cured by ***131*** and ***You***. In other words, with respect to amended claim 1 (including the feature of claim 2), it is believed that the 103 rejection is improper.

In addition, on pages 19-21 of the office action, when rejecting **claim 3** (*a plurality of pieces of start offset information of the resource allocated to the uplink control channel are provided and the plurality of pieces of start offset information is received through cell-specific high layer signaling for the MTC terminal from a base station*), the Examiner alleges that a combination of ***Xia***, ***131***, ***You***, and ***Dinan*** discloses the feature of claim 3. However, as mentioned above, the references "***131***" and "***You***" do **not** qualify as prior art under §103. Further, in amended claim 1, **a plurality of pieces of start offset information** of the resource allocated to the uplink control channel are provided. In particular, the plurality of pieces of start offset information are received **through cell-specific high layer signaling for the MTC terminal** from a base station. Therefore, it is believed that the deficiencies of ***Xia*** are **not** cured by ***131, You***, and ***Dinan***. In other words, with respect to amended claim 1 (including the feature of claim 3), it is believed that the 103 rejection is improper.

Accordingly, it is believed that the Examiner's assertion about the applied references is improper. In particular, with respect to a "combination" of the applied references, it is believed that the Examiner turned to mere identification in the prior art of each element of the claimed invention. For example, the Examiner turned to individual elements or terms such as "*starting offset*," "*coverage extension level*," "*repetition level*," "*PUCCH resource*" in a plurality of references.

> Most inventions arise from a combination of old elements and each element may often be found in the prior art. ... However, **mere identification in the prior art of each element is insufficient to defeat the patentability of the combined subject matter as a whole**. ... Rather, to establish a *prima facie* case of obviousness based on a combination of elements disclosed in the prior art, the

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> Board must articulate the basis on which it concludes that it would have been obvious to make the claimed invention. *In re Kahn*, 441 F.3d 977, 986 (Fed. Cir. 2006).

In conclusion, it is believed that amended independent claim 1 is patentable at least for the aforementioned reasons. Withdrawal of this rejection is respectfully requested.

Meanwhile, Applicant has amended independent claims 7, 13, and 19 to include the newly-added limitations of amended independent claim 1. Each of amended independent claims 7, 13, and 19 has the same or similar limitations as/to those of amended claim 1. Accordingly, it is believed that amended independent claims 7, 13, and 19 are also patentable at least for the reasons stated in connection with amended independent claim 1.

Dependent claims such as claims 4, 10, and 16, which are directly or indirectly dependent on one of amended independent claims 1, 7, and 13, are also patentable at least for the reasons discussed above with regard to amended independent claims 1, 7, and 13. Meanwhile, by this amendment, claims 2, 3, 8, 9, 14, and 15 are cancelled rendering this rejection moot.

Conclusion

In view of the above remarks, the Applicant believes that the now-pending claims are in condition for allowance. Therefore, the Applicant believes that the entire application is now in condition for allowance, and early and favorable action is respectfully solicited.

Respectfully submitted,

Date: 31 July 2018

/Ian M. Hughes/

Customer No. 76277
IP Legal Services, LLC
P.O. Box 651325
Sterling, VA 20165

Ian M. Hughes, Reg. No. 41,083
Joung Kook Park, Reg. No. 69,192
Attorney/Agent for Applicant
(571) 267-7183 (phone)

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APPARATUS AND METHODS OF PUCCH RESOURCE MAPPING FOR MTC UEs

BACKGROUND OF THE INVENTION

1. Field of the invention

The present disclosure relates to a method of allocating physical uplink control channel (PUCCH) resources for uplink (UL) hybrid automatic request (HARQ) acknowledgement (ACK)/negative acknowledgement (NACK) feedback of a machine type communication (MTC) user equipment (UE) in a third generation (3G) Long Term Evolution (LTE)/LTE-Advanced system.

2. Description of the Related Art

SUMMARY OF THE INVENTION

The present disclosure is to provide a method of allocating physical uplink control channel (PUCCH) resources for uplink (UL) hybrid automatic request (HARQ) acknowledgement (ACK)/negative acknowledgement (NACK) feedback of a machine type communication (MTC) user equipment (UE), the method including: defining a separate parameter or table value for an MTC UE or an additional

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parameter for the MTC UE; and performing high layer signaling of indication information indicating the parameter, the table value, or a table.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features and advantages of the present disclosure will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a diagram showing that a physical downlink control channel (PDCCH) is repeatedly transmitted through a plurality of downlink subframes according to an embodiment of the present disclosure;

FIG. 2 is a diagram showing a configuration of a base station (BS) according to an embodiment of the present disclosure; and

FIG. 3 is a diagram showing a configuration of a user equipment (UE) according to an embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Hereinafter, embodiments of the present disclosure will be described in detail with reference to the

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accompanying drawings. In adding reference numerals to elements in each drawing, the same elements will be designated by the same reference numerals if possible, although they may be shown in different drawings. Further, in the following description of the present disclosure, a detailed description of known functions and configurations incorporated herein will be omitted when it is determined that the description may make the subject matter of the present disclosure rather unclear.

In the present disclosure, a wireless communication system is widely disposed to provide various communication services, such as voice and packet data. The wireless communication system includes a user equipment (UE) and a base station (BS) or an evolved node-B (eNB). In this specification, the UE is a comprehensive concept that refers to a terminal in wireless communication and should be construed as encompassing not only the UE in wideband code division multiple access (WCDMA), Long Term Evolution (LTE), and high speed packet data access (HSPA) but also a mobile station (MS), a user terminal (UT), a subscriber station (SS), a wireless device, etc. in Global System for Mobile communication (GSM).

The BS or a cell refers to a station which generally communicates with the UE and may be referred to by other terms, such as a node-B, an eNB, a sector, a site, a base

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transceiver system (BTS), an access point, a relay node, a remote radio head (RRH), a radio unit (RU), and a small cell.

In other words, in this specification, the BS or the cell should be interpreted into a comprehensive meaning which indicates a partial region or function covered by a base station controller (BSC) in code division multiple access (CDMA), the node-B in WCDMA, and the eNB or sector (site) in LTE, and is meant to indicate various coverage regions such as a mega-cell, a macro-cell, a microcell, a picocell, a femtocell, the relay node, the RRH, the RU, and the small cell communication range.

Since there is a BS for controlling each of the various cells listed above, the BS may be interpreted into two meanings: 1) a device for providing the mega-cell, the macro-cell, the microcell, the picocell, the femtocell, or the small cell in relation to a radio region or 2) the radio region itself. According to the first meaning, devices which provide certain radio regions under control of the same entity or any device which interact with another to cooperatively provide the radio region are referred to as BSs. The eNB, the RRH, an antenna, the RU, a low power node (LPN), a point, a transmission/reception point, a transmission point, a reception point, etc. are embodiments of the BS according to a method of providing

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the radio region. According to the second meaning, the radio region itself in or from which a signal is received or transmitted may be referred to as the BS from the viewpoint of the UE or a neighboring BS.

Therefore, the mega-cell, the macro-cell, the microcell, the picocell, the femtocell, the small cell, the RRH, the antenna, the RU, the LPN, the point, the eNB, the transmission/reception point, the transmission point, and the reception point are collectively refered to as BSs.

In this specification, the UE and the BS are used as comprehensive meanings of two (uplink and downlink) transmitting and receiving entities used to implement the technology or technical spirit described in the present disclosure and are not limited to terms or words that are specifically referred to. Here, an uplink (UL) refers to a method of transmitting and receiving data to and from the BS by the UE, and a downlink (DL) refers to a method of transmitting and receiving data to and from the UE by the BS.

Any multiple access scheme may be applied to the wireless communication system. It is possible to use various multiple access schemes including CDMA, time-division multiple access (TDMA), frequency-division multiple access (FDMA), orthogonal frequency-division

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multiple access (OFDMA), OFDM-FDMA, OFDM-TDMA, and OFDM-CDMA. An embodiment of the present disclosure may be applied to resource allocation in an asynchronous wireless communication field which has evolved into LTE and LTE-Advanced via GSM, WCDMA, and HSPA and a synchronous wireless communication field which has evolved into CDMA, CDMA-2000, and Ultra Mobile Broadband (UMB). The present disclosure should not be interpreted as being restricted or limited to a particular wireless communication field and should be interpreted to include all the technical fields to which the spirit of the present disclosure may be applied.

For UL transmission and DL transmission, it is possible to use time division duplex (TDD) in which transmission is performed by using different times or frequency division duplex (FDD) in which transmission is performed by using different frequencies.

Also, in a system such as LTE or LTE-Advanced, the UL and the DL are configured on the basis of one carrier wave or one pair of carrier waves according to a standard. The UL and the DL transmit control information through a control channel, such as a physical downlink control channel (PDCCH), a physical control format indicator channel (PCFICH), a physical hybrid automatic request (HARQ) indicator channel (PHICH), a physical uplink

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control channel (PUCCH), and an enhanced or extended physical downlink control channel (EPDCCH), and include data channels, such as a physical downlink shared channel (PDSCH), a physical uplink shared channel (PUSCH), to transmit data.

In this specification, the cell may refer to a component carrier, which has the coverage of the signal transmitted from the transmission/reception point or the coverage of the signal transmitted from the transmission point or the transmission/reception point, or the transmission/reception point itself.

The wireless communication system to which embodiments are applied may be a coordinated multi-point transmission/reception (CoMP) system, a coordinated multi-antenna transmission system, or a coordinated multi-cell communication system, in which two or more transmission/reception points coordinate with each other to transmit the signal. The CoMP system may include at least two multiple transmission/reception points and terminals.

The multiple transmission/reception points may be the BS or the macro-cell (referred to as “eNB” below) and at least one RRH, which is connected to the eNB through an optical cable or an optical fiber to be wiredly controlled

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and has high transmission power or has low transmission power within a macro-cell area.

Hereinafter, the DL refers to communication or a communication path from a multi-transmission/reception point to the UE, and the UL refers to communication or the communication path from the UE to the multi-transmission/reception point. In the DL, a transmitter may be a part of the multi-transmission/reception point, and a receiver may be a part of the UE. In the UL, the transmitter may be a part of the UE, and the receiver may be a part of the multi-transmission/reception point.

A situation in which the signal is transmitted and received through a channel, such as the PUCCH, the PUSCH, the PDCCH, the EPDCCH, or the PDSCH, may also be referred to below as "the PUCCH, the PUSCH, the PDCCH, the EPDCCH, or the PDSCH is transmitted and received."

Also, a situation in which the PDCCH is transmitted or received or the signal is transmitted or received through the PDCCH, may additionally denote below that the EPDCCH is transmitted or received or the signal is transmitted or received through the EPDCCH.

In other words, a physical downlink control channel mentioned below may refer to the PDCCH or the EPDCCH or may be used to refer to both the PDCCH and the EPDCCH.

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For convenience of description, the EPDCCH, which is an embodiment of the present disclosure, may be applied to a description regarding the PDCCH, and the EPDCCH may be applied to a description regarding the EPDCCH according to an embodiment of the present disclosure.

Meanwhile, high layer signaling mentioned below includes radio resoucre control (RRC) signaling for transmitting RRC information including an RRC parameter.

The eNB performs DL transmission to UEs. The eNB may transmit the PDSCH, which is a main physical channel for unicast transmission, and the PDCCH for transmitting DL control information, such as scheduling required to receive the PDSCH, and scheduling grant information for transmission in a UL data channel (e.g., the PUSCH). Transmission and reception of the signal through each channel will be referred to below as "transmission and reception of the channel."

PUCCH resource mapping for HARQ ACK/NACK feedback for PDSCH reception scheduled through a legacy PDCCH of the UE in an existing Third Generation Partnership Project (3GPP) LTE/LTE-advanced system is determined by a control channel element (CCE) index used for transmitting a higher layer (RRC) parameter and corresponding DL assignment downlink control information (DCI) as shown in Equations (1) and (2) below.

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(1) $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_0)} = n_{\mathrm{CCE}} + N_{\mathrm{PUCCH}}^{(1)}$

(2) $n_{\mathrm{PUCCH}}^{(1,\tilde{p}_1)} = n_{\mathrm{CCE}} + 1 + N_{\mathrm{PUCCH}}^{(1)}$

Equations (1) and (2) indicate PUCCH resources $n_{\mathrm{PUCCH}}^{(1,\tilde{p})}$ for HARQ ACK/NACK feedback at antenna port 0 and antenna port 1 of the UE which supports two-antenna port transmission, respectively. n_{CCE} indicates a lowest CCE index value used for transmitting a corresponding DL scheduling grant, and $N_{\mathrm{PUCCH}}^{(1)}$ indicates a cell-specific parameter set by higher layer (RRC) signaling.

A PUCCH resource mapping method based on Equations (1) and (2) intended for HARQ ACK/NACK transmission through PUCCH format 1a/1b of the UE for which one serving cell is configured in a frame structure type 1 (FDD) system. According to PUCCH resource mapping rules for the UE for which one or more serving cells are additionally configured (i.e., the UE to which carrier aggregation is applied), PUCCH resources may be determined as a function of the lowest CCE index and a higher layer parameter like in the above method, or it is possible to use an ACK/NACK response indication (ARI) method of setting a plurality of candidate PUCCH resource values in advance through higher layer signaling and indicating PUCCH resources to be used

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among the candidate PUCCH resource values through a "transmit power control (TPC) command for PUCCH" information region of an actual DL scheduling grant.

Specifically, a PUCCH resource mapping method for UL HARQ ACK/NACK resource mapping defined in a current 3GPP LTE/LTE-Advanced system is quoted from the TS36.213 document of appendix [1], and content regarding CCE indexing of a PDCCH related thereto is quoted from the TS36.211 document of appendix [2].

<Coverage enhancement for low cost MTC>

It is assumed that an MTC UE is a low capability terminal having low hardware and software performance compared to an existing LTE/LTE-A terminal in order to reduce a unit price of the terminal. Accordingly, transmission and reception performance of the MTC UE for physical layer channels, which are designed on the basis of the UE category of an existing LTE/LTE-Advanced terminal and the UE capability thereof, is expected to degrade. To solve this problem, discussions for improving transmission and reception performance for the corresponding physical layer channels are under way.

As a general solution to this problem, a method is provided, in which power boosting is performed for corresponding physical layer channels and transmission is repeatedly performed through a plurality of subframes. As

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an example, in order to transmit a single piece of DCI for the MTC UE, it is possible to consider a method of repeatedly transmitting a PDCCH, which is a DL control channel, through a plurality of DL subframes to obtain power gain. Likewise, a method is considered, in which a PDSCH is repeatedly transmitted through the plurality of DL subframes to improve reception performance of the MTC UE.

Except for semi-persistent scheduling (SPS) in an existing system of LTE/LTE-Advanced release-11 or less, DL assignment information for reception of the PDSCH, which is a DL data channel of an arbitrary terminal, is transmitted through only the PDCCH of the same DL subframe. For this reason, PUCCH resource allocation rules for UL HARQ ACK/NACK transmission with respect to reception of the corresponding PDSCH is determined as a function of the lowest CCE used for transmitting a corresponding DL assignment PDCCH or EPDCCH. Accordingly, it is possible to prevent a collision between PUCCH resources with which respective terminals transmit HARQ ACKs/NACKs with respect to PDSCHs transmitted through the same DL subframe for different terminals. However, when a PDCCH for transmitting a single DCI is repeatedly transmitted through the plurality of DL subframes to improve PDCCH reception performance of the MTC UE, it may

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bring about ambiguity for the definition of a CCE index value to be applied to the lowest CCE index and the like. Also, when PDSCH transmission and PUCCH transmission of the terminal are repeatedly performed through the plurality of subframes, a collision may occur between PUCCH resources for HARQ ACK/NACK feedback of a normal LTE terminal and and PUCCH resources of the MTC UE.

The present disclosure proposes a method of allocating PUCCH resources for UL HARQ ACK/NACK feedback of the MTC UE.

Method 1. Reuse of PUCCH Resource Mapping Equation

Point 1. Definition of new PUCCH resource start offset

A value of a separate PUCCH resource start offset parameter $N^{(1)}_{PUCCH,MTC}$ for the MTC UE is defined and included in corresponding RRC signaling. In this way, in the case of the MTC UE, $N^{(1)}_{PUCCH}$ in PUCCH resource mapping Equations (1) and (2) is replaced by $N^{(1)}_{PUCCH,MTC}$. In other words, in the case of the MTC UE, Equations (3) and (4) may be obtained as shown below.

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$$(3)\quad n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)}$$

$$(4)\quad n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)}$$

A $N_{PUCCH,MTC}^{(1)}$ value may be set for each MTC UE through UE-specific RRC signaling. According to another method for signaling a $N_{PUCCH,MTC}^{(1)}$ value, the $N_{PUCCH,MTC}^{(1)}$ value may be broadcast to MTC UEs in a corresponding cell through cell-specific RRC signaling or a physical broadcast channel (PBCH) for MTC UEs.

According to the other method of setting a separate PUCCH resource start offset value for the MTC UE, a plurality of candidate PUCCH resource start offset values may be defined for each MTC UE through higher layer RRC signaling, and the PUCCH resource start offset value to be applied to PDSCH resource allocation may be signaled to the terminal. In other words, UE-specific RRC signaling or cell-specific RRC signaling may be performed for an arbitrary MTC UE or candidate PUCCH resource start offset prameters may be signaled through the PBCH for the MTC UE, and a PUCCH resource start offset parameter to be applied may be indicated through a DL assignment DCI format for the MTC UE. An explicit PUCCH resource start offset indicator information region may be defined in the DL

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assignment DCI format to indicate the corresponding PUCCH resource start offset, or it is possible to use an explicit method of indicating the corresponding PUCCH resource start offset by using an existing information region. For example, four candidate PUCCH resource start offset parameters $N^{(1)}_{PUCCH,MTC1}$, $N^{(1)}_{PUCCH,MTC2}$, $N^{(1)}_{PUCCH,MTC3}$, $N^{(1)}_{PUCCH,MTC4}$ are set, and an information region composed of 2 bits is newly defined in a DL assignment DCI format to indicate the corresponding PUCCH resource start offset, such that PUCCH resource start offsets to be applied to the PUCCH resource mapping Equations (3) and (4) may be indicated through the information region. Also, without additionally defining a new information region, it is possible to use an existing information region, such as TPC command, in order to indicate the corresponding PUCCH resource start offset. Otherwise, it is possible to implicitly indicate a value to be applied among corresponding candidate PUCCH resource start offsets. For example, the PUCCH resource start offset value to be applied may be determined according to a PDCCH aggregation level or repetition level, that is, the number of PDCCCH repetitions for transmitting the corresponding DCI.

Point 2. Definition of low CCE index for PDCCH repetition

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FIG. 1 is a diagram showing that the PDCCH is repeatedly transmitted through the plurality of DL subframes according to an embodiment of the present disclosure.

As shown in FIG. 1, to improve DCI reception performance of the MTC UE, the PDCCH may be defined to be repeatedly transmitted through the plurality of DL subframes.

In this case, it is necessary to define an n_{CCE} value which is the lowest CCE index to be applied to Equations (3) and (4). To this end, the present disclosure proposes three methods of defining the n_{CCE} value to be applied to the PUCCH resource mapping Equations (3) and (4) when DL assignment DCI for the arbitrary MTC UE is repeatedly transmitted through PDCCHs of the plurality of DL subframes. According to the first method, when N repeated PDCCHs are used to transmit one piece of DL assignment DCI as shown in FIG. 1, the lowest CCE index among CCEs used to transmit a first PDCCH may be defined as a corresponding n_{CCE} value. According to the second method, the lowest CCE index of the Nth PDCCH, which is the last repeated PDCCH, may be defined as the corresponding n_{CCE} value. According to the last method,

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the lowest CCE index among all CCE indices used to transmit the N repeated PDCCHs may be defined as the corresponding n_{CCE} value.

However, even when a new PUCCH resource starting offset for the MTC UE is undefined, unlike Point 1, and $N_{PUCCH}^{(1)}$ which is a PUCCH resource starting offset value for an existing LTE/LTE-A terminal is reused for PUCCH resource mapping for an MTC UE, the above-described method of defining the n_{CCE} value may be used as a method of defining the corresponding n_{CCE} value to be applied to Equations (1) and (2).

Method 2. PUCCH Resource Allocation in DL Assignment DCI

For each MTC UE, a candidate PUCCH resource value for HARQ ACK/NACK feedback of the corresponding MTC UE may be set in advance through higher layer signaling as shown in Table 1 below, and a PUCCH resource indicator field for indicating PUCCH resources to be used among corresponding candidate PUCCH resource values through DL assignment DCI may be defined and directly signaled to the terminal. Here, the number of candidate PUCCH resource values may be determined according to a size of the PUCCH resource indicator field of the DL assignment DCI. For example,

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when the PUCCH resource indicator field is composed of 2 bits, four candidate PUCCH resource values may be set through higher layer signaling for corresponding candidate PUCCH resource setting. Accordingly, it is possible to map a PUCCH resource value with which the terminal will transmit HARQ ACK/NACK feedback among the four PUCCH resouce values according to a set value of the PUCCH resource indicator field included in the DL assignment DCI as shown in Table 1 below. However, the PUCCH resource value indicator field may be newly defined, or some of information regions included in a DL assignment may be used as a corresponding PUCCH resource indicator. As an example of using existing information regions, a TPC command information region composed of 2 bits may be used as a corresponding PUCCH resource indicator when cross-subframe scheduling is set.

Each candidate PUCCH resource value may include the number of PUCCH repetitions. In other words, each PUCCH resource value may be defined to set not only PUCCH resources to be used for corresponding HARQ ACK/NACK feedback but also how many UL subframes are repeatedly used to transmit the HARQ ACK/NACK feedback through the corresponding PUCCH resources.

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Value of PUCCH resource indicator in DL assignment DCI	$n_{PUCCH}^{(1,p)}$
'00'	The first PUCCH resource value configured by the higher layers
'01'	The second PUCCH resource value configured by the higher layers
'10'	The third PUCCH resource value configured by the higher layers
'11'	The fourth PUCCH resource value configured by the higher layers

Table 1. PUCCH Resource value for an MTC UE

Method 3. ACK Resource Offset for MTC

$\Delta_{ARO,MTC}$ which is an additional ACK resource offset parameter for the MTC UE may be defined and applied to the PUCCH resource mapping equation. In other words, an ACK resource offset (ARO) information region for indicating a PUCCH resource offset value is additionally defined in the DL assignment for the arbitrary MTC UE, and a $\Delta_{ARO,MTC}$ value to be applied to the PUCCH resource mapping equation for the arbitrary MTC UE may be signaled to the corresponding terminal through the ARO information region.

As the $\Delta_{ARO,MTC}$ value according to an ARO setting value of a corresponding DL assignment DCI format, an arbitrary

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$\Delta_{ARO,MTC}$ value fixed for each ARO value may be defined in a table mapping method as shown in Table 2 below, or the eNB may set and signal a $\Delta_{ARO,MTC}$ value for each ARO value to the corresponding MTC UE.

ACK/NACK Resource offset field in DCI format 1A/1B/1D/1/2A/2/2B/2C/2D	$\Delta_{ARO,MTC}$
0	0
1	-1
2	-2
3	2

Table 2. $\Delta_{ARO,MTC}$ mapping table

Accordingly, it is possible to apply Equations (5) and (6) below instead of the existing PUCCH resource mapping Equations (1) and (2) for a terminal which receives DL assignment DCI through a PDCCH.

$$n_{PUCCH}^{(1,\tilde{p}_0)} = n_{CCE} + N_{PUCCH,MTC}^{(1)} + \Delta_{ARO,MTC} \quad (5)$$

$$n_{PUCCH}^{(1,\tilde{p}_1)} = n_{CCE} + 1 + N_{PUCCH,MTC}^{(1)} + \Delta_{ARO,MTC} \quad (6)$$

The present disclosure has proposed PUDCCH resource mapping rules for the MTC UE. Although the present disclosure does not include details such as the number of PUCCH repetitions for HARQ ACK/NACK feedback of the MTC

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UE, it is apparent that the methods proposed above can be applied in the same way regardless of the number of PUCCH repetitions.

FIG. 2 is a diagram showing a configuration of the eNB according to an embodiment of the present disclosure.

Referring to FIG. 2, an eNB 1000 according to an embodiment of the present disclosure includes a controller 1010, a transmitter 1020, and a receiver 1030.

The controller 1010 controls overall operation of the eNB 1000 which is required to perform the above-described embodiment of the present disclosure and involved in PUCCH resource allocation for UL HARQ ACK/NACK feedback of the MTC UE.

The transmitter 1020 and the receiver 1030 are used to transmit and receive signals, messages, and data required to perform the above-described embodiment of the present disclosure.

FIG. 3 is a diagram showing a configuration of the UE according to an embodiment of the present disclosure.

Referring to FIG. 3, a UE 1100 according to an embodiment of the present disclosure includes a receiver 1110, a controller 1120, and a transmitter 1130.

The receiver 1110 receives DL control information and data, and a message from an eNB through a corresponding channel.

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Also, the controller 1120 controls overall operation of the UE 1100 which is required to perform the above-described embodiment of the present disclosure and involved in PUCCH resource allocation for UL HARQ ACK/NACK feedback of the MTC UE.

The transmitter 1130 transmits UL control information and data, and a message to the eNB through the corresponding channel.

The standard content or standard documents mentioned in the above-described embodiments are omitted to simplify the description of this specification, but form a part of this specification. Therefore, adding a part of the standard content and standard documents to this specification or describing a part of the standard content and standard documents in the claims should be construed as being included in the scope of the present disclosure.

1. Specification content sections 10.1.2 and 10.1.3 of TS 36.213 v.11.4.0 regarding FDD HARQ ACK/NACK feedback procedure

2. Specification content sections 6.8 and 9.1 of TS 36.211 v.11.4.0 regarding PDCCH

The above embodiments of the present disclosure have been described only for illustrative purposes, and those skilled in the art will appreciate that various modifications and changes may be made thereto without

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departing from the essential features of the disclosure. Therefore, the embodiments of the present disclosure are not intended to limit, but are intended to illustrate the technical idea of the present disclosure, and the scope of the technical idea of the present disclosure is not limited by the embodiments. The scope of the present disclosure shall be construed on the basis of the accompanying claims in such a manner that all of the technical ideas included within the scope equivalent to the claims belong to the present disclosure.

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Petitioner's Exhibit 1002
Page 000456

WHAT IS CLAIMED IS:

1. A method of allocating physical uplink control channel (PUCCH) resources for uplink (UL) hybrid automatic request (HARQ) acknowledgement (ACK)/negative acknowledgement (NACK) feedback of a machine type communication (MTC) user equipment (UE), the method comprising:

defining a separate parameter or table value for an MTC UE or an additional parameter for the MTC UE; and

performing high layer signaling of indication information indicating the parameter, the table value, or a table.

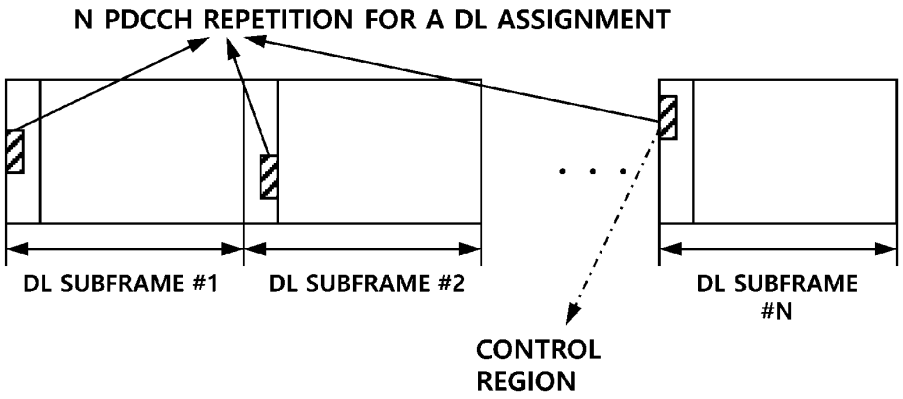
IPR2025-00138
Petitioner's Exhibit 1002
Page 000457

Abstract of the Disclosure

Provided is a method of allocating physical uplink control channel (PUCCH) resources for uplink (UL) hybrid automatic request (HARQ) acknowledgement (ACK)/negative acknowledgement (NACK) feedback of a machine type communication (MTC) user equipment (UE) in a Third Generation Partnership Project (3GPP) Long Term Evolution (LTE)/LTE-Advanced system.

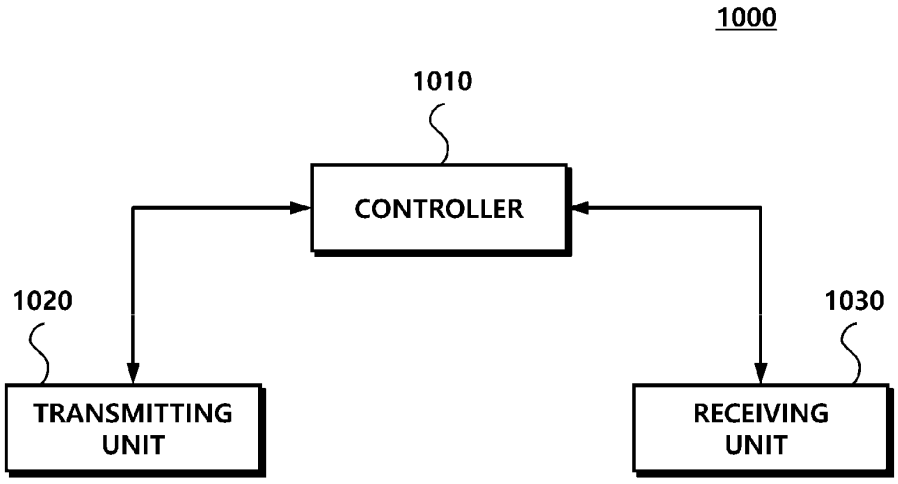
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Petitioner's Exhibit 1002
Page 000458

FIG.1



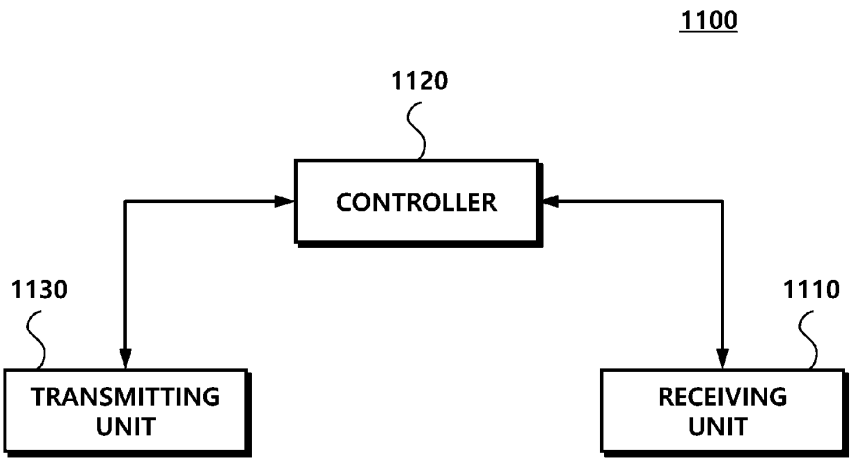
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FIG.2



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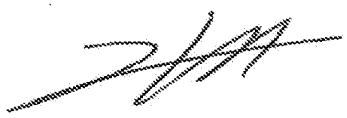
FIG.3



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CERTIFICATE OF ENGLISH TRANSLATION

I, Eungu KIM at 2F, Sangwon Bldg., 636-15, Yeoksam-dong, Gangnam-gu, Seoul 135-908, Republic of Korea, hereby declare and state that I am knowledgeable of both Korean and English languages and hereby certify that the English language translation is a true and complete translation of KR 10-2013-0115367 filed on September 27, 2013 in the Korean Patent Office and is accurate to the best of my knowledge.



July 27, 2018

Eungu KIM — **Date**

Electronic Acknowledgement Receipt

EFS ID:	33326355
Application Number:	15025262
International Application Number:	
Confirmation Number:	1007
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Customer Number:	76277
Filer:	Kyung Hee Kim/Hye Won Chung
Filer Authorized By:	Kyung Hee Kim
Attorney Docket Number:	811.0053
Receipt Date:	31-JUL-2018
Filing Date:	25-MAR-2016
Time Stamp:	10:11:54
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	8110053Reply.pdf	145173 2ecaa2e48b84be2b38fe6bd3dde1050d9547d43a	no	10

Warnings:

Information:					
2	Translation of Foreign Priority Documents	8110053EnglishTranslation.pdf	497791 db3be9dac6dac62e76dc32325a4f1022a8719094	no	29
Warnings:					
Information:					
		Total Files Size (in bytes):	642964		

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

76277 7590 09/11/2018

IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

EXAMINER
CRUTCHFIELD, CHRISTOPHER M

ART UNIT	PAPER NUMBER
2466	

DATE MAILED: 09/11/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	03/25/2016	Kyujin PARK	811.0053	1007

TITLE OF INVENTION: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	12/11/2018

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

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Petitioner's Exhibit 1002
Page 000465

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

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

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

76277 7590 09/11/2018
IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

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

Certificate of Mailing or Transmission

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

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	03/25/2016	Kyujin PARK	811.0053	1007

TITLE OF INVENTION: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	12/11/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
CRUTCHFIELD, CHRISTOPHER M	2466	370-329000

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

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

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

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

1 _____
2 _____
3 _____

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

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

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

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

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

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

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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

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

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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Petitioner's Exhibit 1002
Page 000466

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	03/25/2016	Kyujin PARK	811.0053	1007

76277 7590 09/11/2018

IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

EXAMINER	
CRUTCHFIELD, CHRISTOPHER M	
ART UNIT	PAPER NUMBER
2466	

DATE MAILED: 09/11/2018

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

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

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Petitioner's Exhibit 1002
Page 000467

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/025,262	Applicant(s) PARK et al.	
	Examiner CHRISTOPHER M CRUTCHFIELD	Art Unit 2466	AIA Status Yes

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

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

1. ☑ This communication is responsive to Applicant's Arguments and Remarks, filed 31 July 2018.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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

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

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

   Certified copies:

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

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

   * Certified copies not received: _____ .

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

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

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

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

Attachment(s)

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

/CHRISTOPHER M CRUTCHFIELD/
Primary Examiner, Art Unit 2466

Continuation of 3. The allowed claim(s) is/are: 1,4,7,10,13,16 and 19

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Arguments

Applicant's arguments, see Applicant's Arguments and Remarks, filed 31 July 2018, with respect to the rejection of claims 1, 4, 7, 10, 13, 16 and 19 under 35 USC 103 have been fully considered and are persuasive. The previous grounds of rejection has been withdrawn.

Allowable Subject Matter

Claims 1, 4, 7, 10, 13, 16 and 19, renumbered as 1-7, respectively, are allowed.

The following is an examiner's statement of reasons for allowance:

Regarding independent claims 1, 7, 13 and 19, Applicant's arguments have overcome the art of record, as noted in the Response to Arguments Section, supra. Furthermore, no other art to replace the previously cited art of *You* and 131, that are now disqualified, could be located. Therefore, the prior art fails to teach, suggest or disclose all elements of the claimed invention.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHRISTOPHER M CRUTCHFIELD whose telephone number is (571)270-3989. The examiner can normally be reached on 9am-5pm M-F.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Faruk Hamza can be reached on (571) 272-7969. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CHRISTOPHER M CRUTCHFIELD/
Primary Examiner, Art Unit 2466

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/025,262	PARK et al.
	Examiner	Art Unit
	CHRISTOPHER M CRUTCHFIELD	2466

CPC - Searched*		
Symbol	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004	6/25/2017 (Updated 12/29/2017, 4/27/2018, 9/4/2018)	C Crutchfield

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
H04W 72/1268, H04W 72/1284 and H04W 72/004 (text search only - see search history printout)	6/25/2017 (Updated 12/29/2017, 4/27/2018, 9/4/2018)	C Crutchfield
EAST (USPAT US-PGPUB, USOCR, FPRS, EPO, JPO, DERWENT, IBM_TDB) - see search history printout	6/25/2017 (Updated 12/29/2017, 4/27/2018, 9/4/2018)	C Crutchfield
Internet search using Google and IEEE Explore	6/25/2017 (Updated 12/29/2017, 4/27/2018, 9/4/2018)	C Crutchfield
Search of 3GPP website www.3gpp.org	6/25/2017 (Updated 12/29/2017, 4/27/2018, 9/4/2018)	C Crutchfield
Inventor and assignee name search	6/25/2017 (Updated 12/29/2017, 4/27/2018, 9/4/2018)	C Crutchfield

/CHRISTOPHER CRUTCHFIELD/ Primary Examiner.Art Unit 2466	

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/025,262	PARK et al.
	Examiner	Art Unit
	CHRISTOPHER M CRUTCHFIELD	2466

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	see interference search history, attached	09/04/2018	C Crutchfield

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	15/025,262	PARK et al.
	Examiner	**Art Unit**
	CHRISTOPHER M CRUTCHFIELD	2466

CPC						
Symbol					**Type**	**Version**
H04L	/	1	/	1812	F	2013-01-01
H04W	/	4	/	70	I	2018-02-01
H04L	/	1	/	1861	I	2013-01-01
H04W	/	72	/	1289	A	2013-01-01
H04L	/	1	/	189	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	7	
/CHRISTOPHER M CRUTCHFIELD/ Primary Examiner, Art Unit 2466	04 September 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

U.S. Patent and Trademark Office — Part of Paper No.: 20180904

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	15/025,262	PARK et al.
	Examiner	**Art Unit**
	CHRISTOPHER M CRUTCHFIELD	2466

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04W	/	4	/	70
H04W	/	72	/	12
H04L	/	1	/	18

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 7	
/CHRISTOPHER M CRUTCHFIELD/ Primary Examiner, Art Unit 2466 (Primary Examiner) 04 September 2018 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 5

U.S. Patent and Trademark Office Part of Paper No.: 20180904

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	15/025,262	PARK et al.
	Examiner	**Art Unit**
	CHRISTOPHER M CRUTCHFIELD	2466

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	7	
/CHRISTOPHER M CRUTCHFIELD/ Primary Examiner, Art Unit 2466	04 September 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	Art Unit
	CHRISTOPHER M CRUTCHFIELD	2466

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS										
☐ Claims renumbered in the same order as presented by applicant					☐ CPA	☐ T.D.	☐ R.1.47			
CLAIM		DATE								
Final	Original	06/25/2017	12/29/2017	04/27/2018	09/04/2018					
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	2	✓	✓	✓	✓					
	3	✓	✓	✓	✓					
	4	✓	✓	✓	=					
	5	-	-	-	✓					
	6	✓	✓	-	✓					
	7	✓	✓	✓	=					
	8	✓	✓	✓	✓					
	9	✓	✓	✓	✓					
	10	✓	✓	✓	=					
	11	-	-	-	✓					
	12	✓	✓	-	✓					
	13	✓	✓	✓	=					
	14	✓	✓	✓	✓					
	15	✓	✓	✓	✓					
	16	✓	✓	✓	=					
	17	-	-	-	✓					
	18	✓	✓	-	✓					
	19	✓	✓	✓	=					

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L12	97	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L13	26	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L14	20	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L15	254	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L16	4	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L17	188	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L18	14276	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L19	1474	(MTC OR machine type communications)	US-PGPUB;	ADJ	OFF	2018/09/04

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		and (offset) same (uplink OR UL OR PU$3)	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			14:22
L20	66	L18 and L19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L21	1288	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L22	64	L18 and L21	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L23	87	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L24	138	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L25	138	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L26	51	L25 NOT L23	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L27	19	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	ADJ	OFF	2018/09/04 14:22

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			IBM_TDB			
L28	38	L17 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L29	188	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L30	79	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L31	188	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L32	38	L31 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L33	233	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L34	233	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L35	32	(US-20140044056-$ or US-20140133433-$ or US-20150029923-$ or US-20150023281-$ or US-20100067472-$ or US-20100232382-$ or US-20110111779-$ or US-20120083284-$ or US-20130114530-$ or US-20130242890-$ or US-20130250882-$ or US-20160338088-$ or US-20130155974-$ or US-20150282208-$ or US-20160057784-$ or US-20170093480-$ or US-20130100900-$ or US-20140314048-$ or	US-PGPUB; USPAT	ADJ	OFF	2018/09/04 14:22

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		US-20130094457-$ or US-20150139136-$ or US-20130315159-$ or US-20140226638-$ or US-20160150539-$ or US-20030043816-$ or US-20050013245-$).did. or (US-9826549-$ or US-7277399-$ or US-6032190-$ or US-9622196-$ or US-9363819-$ or US-9319203-$ or US-9854575-$).did.				
L36	9	L35 and repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L37	54	MTC same repetition same (ACK OR acknowledge$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L38	241	MTC and repetition same (ACK OR acknowledge$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L39	14	MTC and repetition same (ACK OR acknowledge$4) same offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L40	76	MTC and repetition same (ACK OR acknowledge$4) same (offset OR start$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L41	79	MTC and repetition same (ACK OR acknowledge$4) same (offset OR start$4 OR CCE)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L42	30	PUCCH same (MTC OR machine type communication) same CCE	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L43	252	(CSI OR CQI) near4 (pseudorandom OR pseudo random OR PR)	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	OFF	2018/09/04 14:22

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			EPO; JPO; DERWENT; IBM_TDB			
L44	1248	L12 or L13 or L14 or L15 or L16 or L17 or L20 or L22 or L23 or L24 or L25 or L26 or L27 or L28 or L29 or L30 or L32 or L33 or L34 or L36 or L37 or L38 or L39 or L40 or L41 or L42 or L43	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:22
L45	172	L44 and @pd>="20180427"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/09/04 14:30
S1	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:58
S2	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 13:59
S4	46	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:01
S5	13	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S6	10	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 14:33
S7	178	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 16:19
S8	2	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT;	ADJ	OFF	2017/06/25 18:07

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S9	99	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:08
S10	11170	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S11	880	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S12	22	S10 and S11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:25
S13	708	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S14	20	S10 and S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:26
S15	1	"15025262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:27
S16	47	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:44

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S17	79	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S18	79	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S19	32	S18 NOT S16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 18:56
S20	11	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 19:08
S21	5	"53756546".FMID.	US-PGPUB; USPAT; FPRS	ADJ	OFF	2017/06/25 19:08
S22	24	S9 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 19:12
S23	99	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 20:35
S24	39	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
S25	5	S24 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/06/25 23:13
S26	1	("20140169319").PN.	US-PGPUB; USPAT	ADJ	OFF	2017/06/25 23:52

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S27	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 13:18
S28	126	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:11
S29	29	S28 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:11
S30	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:13
S31	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/19 17:58
S32	5	"9282493"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:33
S33	7	"20120003962"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:36
S34	2	"9282493".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 09:57
S35	144	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	OFF	2017/10/20 10:57

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S37	5	"20080025267"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 12:06
S38	4	"13700478"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 12:16
S39	839	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/10/20 14:38
S40	4	"20130155974"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 09:54
S41	3	"20130250882"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 10:28
S42	63	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S43	15	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S44	12	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR;	ADJ	OFF	2017/12/29 11:58

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S45	223	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S46	3	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S47	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S48	11858	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S49	1101	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S50	38	S48 and S49	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S51	925	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S52	36	S48 and S51	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S53	64	PUCCH same (MTC OR machine type	US-PGPUB;	ADJ	OFF	2017/12/29

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		communication) same (ACK OR acknowledg$) same (PDSCH)	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			11:58
S54	106	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S55	106	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S56	42	S55 NOT S53	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S57	15	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S58	29	S47 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S59	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S60	61	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S61	142	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	ADJ	OFF	2017/12/29 11:58

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			IBM_TDB			
S62	29	S61 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S63	159	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S64	159	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S65	619	S42 or S43 or S44 or S45 or S46 or S47 or S50 or S52 or S53 or S54 or S55 or S56 or S57 or S58 or S59 or S60 or S62 or S63 or S64	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 11:58
S66	157	S65 and @pd>="20170625"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 12:00
S67	2	"20140219248"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2017/12/29 13:06
S68	1086	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/25 09:51
S69	1264	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/25 09:51
S70	54	cache same frequent$4 same (forward$4 OR route$4) near4 (table)	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	OFF	2018/04/25 13:54

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			EPO; JPO; DERWENT; IBM_TDB			
S71	60	cach$4 same frequent$4 same (forward$4 OR route$4) near4 (table)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/25 13:55
S72	2591	(TCP OR transmission control protocol) same (slow near4 start)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 11:14
S73	61	(TCP OR transmission control protocol) same (slow near4 start) near4 (skip OR disabl$4 OR accelerat$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 11:15
S74	73	(TCP OR transmission control protocol) same (slow near4 start) near4 (skip$4 OR disabl$4 OR accelerat$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 11:15
S75	79	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (control channel OR PUC$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S76	19	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPDCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S77	14	(MTC OR machine type communications) same (offset) near8 (PUCCH OR EPUCCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S78	239	PUCCH near8 (beginning OR start$4) near4 offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S79	4	PUCCH same (MTC OR machine type communication) same coverage level	US-PGPUB; USPAT;	ADJ	OFF	2018/04/26 15:58

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S80	156	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S81	12343	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S82	1265	(MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S83	44	S81 and S82	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S84	1087	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S85	42	S81 and S84	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S86	70	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$) same (PDSCH)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S87	115	PUCCH same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58

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S88	115	(PUCCH OR E-PUCCH) same (MTC OR machine type communication) same (ACK OR acknowledg$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S89	45	S88 NOT S86	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S90	16	MTC same offset same PUCCH same (ack OR acknowled$48)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S91	33	S80 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S92	156	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S93	65	MTC same PUCCH same repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S94	156	PUCCH same (MTC OR machine type communication) same coverage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S95	33	S94 and (@pd<="20130927" OR @prad<="20130927" OR @rlad<="20130927")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S96	191	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	ADJ	OFF	2018/04/26 15:58

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			DERWENT; IBM_TDB			
S97	191	(LTE OR long term evolution) and (MTC OR machine type communications) and (offset) near8 (begin$4 OR start$4) same (uplink OR UL OR PU$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S98	696	S75 or S76 or S77 or S78 or S79 or S80 or S83 or S85 or S86 or S87 or S88 or S89 or S90 or S91 or S92 or S93 or S95 or S96 or S97	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S99	234	S98 and @pd>="20170625"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 15:58
S100	1	"15025262"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 18:48
S101	12	(US-0155974-$ | US-0250882-$ | US-0315159-$ | US-20170625-$ | US-20130155974-$ | US-20130250882-$ | US-20130315159-$).DID.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 19:23
S102	0	S101 and repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 19:23
S103	32	(US-20140044056-$ or US-20140133433-$ or US-20150029923-$ or US-20150023281-$ or US-20100067472-$ or US-20100232382-$ or US-20110111779-$ or US-20120083284-$ or US-20130114530-$ or US-20130242890-$ or US-20130250882-$ or US-20160338088-$ or US-20130155974-$ or US-20150282208-$ or US-20160057784-$ or US-20170093480-$ or US-20130100900-$ or US-20140314048-$ or US-20130094457-$ or US-20150139136-$ or US-20130315159-$ or US-20140226638-$ or US-20160150539-$ or US-20030043816-$ or US-20050013245-$).did. or (US-9826549-$ or US-7277399-$ or US-6032190-$ or US-9622196-$ or US-9363819-$ or US-	US-PGPUB; USPAT	ADJ	OFF	2018/04/26 19:24

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		9319203-$ or US-9854575-$).did.				
S104	9	S103 and repetition	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 19:24
S105	44	MTC same repetition same (ACK OR acknowledge$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 19:26
S106	186	MTC and repetition same (ACK OR acknowledge$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S107	9	MTC and repetition same (ACK OR acknowledge$4) same offset	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S108	61	MTC and repetition same (ACK OR acknowledge$4) same (offset OR start$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S109	64	MTC and repetition same (ACK OR acknowledge$4) same (offset OR start$4 OR CCE)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:17
S110	6	"20130135159"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:42
S111	3	"20130315159"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/26 20:42
S112	26	PUCCH same (MTC OR machine type communication) same CCE	US-PGPUB; USPAT; USOCR; FPRS;	ADJ	OFF	2018/04/26 21:07

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			EPO; JPO; DERWENT; IBM_TDB			
S113	563	(CSI OR CQI) same (pseudorandom OR pseudo random)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/27 10:13
S114	183	(CSI OR CQI) near4 (pseudorandom OR pseudo random)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/27 10:13
S115	240	(CSI OR CQI) near4 (pseudorandom OR pseudo random OR PR)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/04/27 10:13

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L46	1259	H04W72/1268.cpc. OR H04W72/1284.cpc. OR H04W72/004.cpc.	USPAT	ADJ	OFF	2018/09/04 14:30
L47	13	L46 and (MTC OR machine type communication).clm.	USPAT	ADJ	OFF	2018/09/04 14:34
L48	662	(MTC OR machine type communication).clm.	USPAT	ADJ	OFF	2018/09/04 14:34
L49	0	L48 and (start offset).clm.	USPAT	ADJ	OFF	2018/09/04 14:34

9/ 4/ 2018 2:38:59 PM
C:\ Users\ ccrutchfield\ Documents\ EAST\ Searches\ 15025262.wsp

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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

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

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

76277 7590 09/11/2018
IP LEGAL SERVICES, LLC
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Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

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

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	03/25/2016	Kyujin PARK	811.0053	1007

TITLE OF INVENTION: METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	12/11/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
CRUTCHFIELD, CHRISTOPHER M	2466	370-329000

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

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

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

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

1 IP Legal Services, LLC
2
3

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

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

(A) NAME OF ASSIGNEE: KT CORPORATION

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Gyeonggi-do, Republic of Korea

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

4a. The following fee(s) are submitted:

☒ Issue Fee

☐ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

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

☐ A check is enclosed.

☒ Payment by credit card. Form PTO-2038 is attached.

☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 505881 (enclose an extra copy of this form).

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

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

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

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

Authorized Signature /Ian M. Hughes/ Date 11/30/2018

Typed or printed name Ian M. Hughes Registration No. 41,083

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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Electronic Patent Application Fee Transmittal

Application Number:	15025262
Filing Date:	25-Mar-2016
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Filer:	Kyung Hee Kim/Hye Won Chung
Attorney Docket Number:	811.0053

Filed as Large Entity

Filing Fees for U.S. National Stage under 35 USC 371

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
UTILITY APPL ISSUE FEE	1501	1	1000	1000
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1000**

Electronic Acknowledgement Receipt

EFS ID:	34445788
Application Number:	15025262
International Application Number:	
Confirmation Number:	1007
Title of Invention:	METHOD FOR UPLINK CONTROL CHANNEL RESOURCE ALLOCATION OF TERMINAL AND APPARATUS THEREOF
First Named Inventor/Applicant Name:	Kyujin PARK
Customer Number:	76277
Filer:	Kyung Hee Kim/Hye Won Chung
Filer Authorized By:	Kyung Hee Kim
Attorney Docket Number:	811.0053
Receipt Date:	30-NOV-2018
Filing Date:	25-MAR-2016
Time Stamp:	11:16:18
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	113018INTEFSW11165700
Deposit Account	505881
Authorized User	Kyung Kim
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.19 (Document supply fees) 37 CFR 1.20 (Post Issuance fees)	

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	8110053IssueFeeTransmittal.pdf	101136 74ce16dd38e1df3107f4e53b4fb76dad1c3a4d38	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32033 09ad15c9ae4febb30f48050125bd22af8ebdcb22	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	133169		

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/025,262	01/15/2019	10181931	811.0053	1007

76277 7590 12/22/2018

IP LEGAL SERVICES, LLC
P.O. Box 651325
Sterling, VA 20165

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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

The Patent Term Adjustment is 39 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

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

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

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

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

Kyujin PARK, Seoul, KOREA, REPUBLIC OF;
KT CORPORATION, Gyeonggi-do, KOREA, REPUBLIC OF;
Woo-jin CHOI, Seoul, KOREA, REPUBLIC OF;

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PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT8216218

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	EXCLUSIVE LICENSE WITH ALL SUBSTANTIAL RIGHT

CONVEYING PARTY DATA

Name	Execution Date
KT CORPORATION	12/23/2022

RECEIVING PARTY DATA

Name:	PEGASUS WIRELESS INNOVATION LLC
Street Address:	20319 KIAWAH ISLAND DR
City:	ASHBURN
State/Country:	VIRGINIA
Postal Code:	20147

PROPERTY NUMBERS Total: 92

Property Type	Number
Patent Number:	9894644
Patent Number:	9998269
Patent Number:	10181931
Patent Number:	10306546
Patent Number:	10341806
Patent Number:	10728693
Patent Number:	10085249
Patent Number:	10568071
Patent Number:	11082957
Patent Number:	10432361
Patent Number:	10742364
Patent Number:	10644819
Patent Number:	10412731
Patent Number:	10616889
Patent Number:	10581560
Patent Number:	11197309
Patent Number:	10892867
Patent Number:	11431460
Patent Number:	11431461
Patent Number:	11115976

Property Type	Number
Patent Number:	10849111
Patent Number:	11330573
Patent Number:	10237084
Patent Number:	10735967
Patent Number:	10708893
Patent Number:	9713094
Patent Number:	10178626
Patent Number:	10091736
Patent Number:	9461771
Patent Number:	9629010
Patent Number:	10009161
Patent Number:	11258532
Patent Number:	10791530
Patent Number:	11569958
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Patent Number:	10506630
Patent Number:	11405942
Patent Number:	11044743
Patent Number:	11765735
Patent Number:	10856307
Patent Number:	10869303
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Patent Number:	10609699
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Patent Number:	10715290
Patent Number:	10966253
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Patent Number:	10616916
Patent Number:	10764099
Patent Number:	10868702
Patent Number:	10952206
Patent Number:	11540272

Property Type	Number
Patent Number:	10979190
Patent Number:	11671218
Patent Number:	10284404
Patent Number:	10616024
Patent Number:	10721765
Patent Number:	10721031
Patent Number:	10958380
Patent Number:	10805050
Patent Number:	10616834
Patent Number:	9497666
Patent Number:	9832806
Patent Number:	10334657
Patent Number:	10420067
Patent Number:	10159025
Patent Number:	10667322
Patent Number:	10986530
Patent Number:	10511994
Patent Number:	10448386
Patent Number:	10721118
Patent Number:	10880222
Patent Number:	11044777
Patent Number:	11627631
Patent Number:	11012911
Patent Number:	10869236
Patent Number:	10708968
Patent Number:	10616932
Patent Number:	10660004
Patent Number:	10869243
Patent Number:	10470159
Patent Number:	10499376
Patent Number:	10812230
Patent Number:	10873671
Patent Number:	11178573
Patent Number:	10772148

CORRESPONDENCE DATA

Fax Number:

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone:	4349062975
Email:	yoon@pegasuswi.com
Correspondent Name:	YEASUN YOON
Address Line 1:	20319 KIAWAH ISLAND DR
Address Line 4:	ASHBURN, VIRGINIA 20147

ATTORNEY DOCKET NUMBER:	ASSIGNMENT KT PEGASUS 01
NAME OF SUBMITTER:	YEASUN YOON
SIGNATURE:	/yoon/
DATE SIGNED:	10/11/2023
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 33

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PATENT RIGHTS ASSIGNMENT

WHEREAS, **KT Corporation,** having a place of business at KT Kwanghwamun Bldg, East 33, Jong-ro 3-gil, Seoul, Korea 03155 (hereinafter "Assignor") is the sole owner of any and all patents and/or patent applications in the Patent Families listed in Schedule 1 annexed hereto (collectively referred to as the "Patents"). Herein, the term "Patent Families" means a collection of (i) a patent or a patent application; (ii) any and all foreign counterparts of the patent or the patent application described in (i); (iii) any divisionals, continuations, continuations-in-part, reissues, reexaminations, utility models, parents, or extensions, relating to any of the patents and patent applications described in (i) and (ii);, and (iv) any patent or patent application whose priority is based upon or in common with any patents and patent applications described in (i), (ii) and (ii).

WHEREAS, **Pegasus Wireless Innovation LLC,** having a place of business at 20319 Kiawah island Drive Ashburn VA 20147 USA (hereinafter "Purchaser") is desirous of acquiring all substantial rights in and to the Patents; and

Now, Therefore,

For good and valuable consideration, the receipt of which is hereby acknowledged, Assignor does hereby sell, assign, transfer and set over to Assignee, subject to existing encumbrances, (a) an exclusive, worldwide license to import, manufacture, have manufactured, use, lease, sell, offer to sell, or otherwise dispose of products encompassed by one or more claims of the Patents; (b) the exclusive right to: (i) enforce the Patents; (ii) sublicense or otherwise grant rights under the Patents; (iii) collect and receive damages, royalties, injunctive relief, and/or settlements for past, current, and future infringements of and to the Patents; (iv) sue or otherwise assert causes of action for the past, current,

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Assignor has executed this Assignment by its duly authorized representative.

KT Corporation

By: 閔燦鎬.

Name: Chanho Min

Title: Team Manager.

Date: 12/23/2022

SCHEDULE 1

No.	REF-NO	Country	Application/Issue No.	Application/issue date
1	P20130686	Provisional Application	10-2013-0114759	2013.09.26
	P20140028	KR Application	10-2014-0007262	2014.01.21
		KR Issue	10-1940344	2019.01.14
	P20130686PC	PCT	PCT/KR2014/008216	2014.09.02
	P20130686US	US Application	15/024,862	2016.03.25
		US Issue	9,894,644	2018.02.13
	P20130686CN	CN Application	201480053323.5	2016.03.25
		CN Issue	CN105659511B	2019.02.12
2	P20130687	Provisional Application	10-2013-0114763	2013.09.26
	P20130953	Provisional Application	10-2013-0138703	2013.11.15
	P20140134	KR Application	10-2014-0027531	2014.03.10
		KR Issue	10-1561838	2015.10.14
	P20140134P1	KR Application(DA)	10-2015-0139479	2015.10.05
		KR Issue(DA)	10-1645898	2016.07.28
	P20130687PC	PCT	PCT/KR2014/008708	2014.09.18
	P20130687US	US Application	15/024,873	2016.03.25
		US Issue	10,432,361	2019.10.01
	P20130687USC1	US Application(CA)	16/542,513	2019.08.16
		US Issue(CA)	10,742,364	2020.08.11
	P20130687CN	CN Application	201480053584.7	2016.03.28

3	P20130698	Provisional Application	10-2013-0115367	2013.09.27
	P20140216	KR Application	10-2014-0057938	2014.05.14
		KR Issue	10-1904572	2018.09.27
	P20130698PC	PCT	PCT/KR2014/008765	2014.09.22
	P20130698US	US Application	15/025,262	2016.03.25
		US Issue	10,181,931	2018.01.15
	P20130698CN	CN Application	201480053321.6	2016.03.25
		CN Issue	CN105594139B	2019.10.25
4	P20130737	Provisional Application	10-2013-0118593	2013.10.04
	P20131006	Provisional Application	10-2013-0142479	2013.11.21
	P20140221	KR Application	10-2014-0067128	2014.06.02
		KR Issue	10-1919636	2018.11.12
	P20140221PC	PCT	PCT/KR2014/008995	2014.09.26
	P20140221US	US Application	15/026,260	2016.03.31
		US Issue	9,998,269	2018.06.12
	P20140221CN	CN Application	201480054504.X	2016.04.01
		CN Issue	CN105659514B	2018.06.01
5	P20140587	Provisional Application	10-2014-0101467	2014.08.07
	P20150161	KR Application	10-2015-0094846	2015.07.02
		KR Issue	10-1875255	2018.06.29
	P20140587PC	PCT	PCT/KR2015/008037	2015.07.31
	P20140587US	US Application	15/501,263	2017.02.02
		US Issue	10,644,819	2020.05.05

	P20140587USD1	US Application(DA)	16/832,151	2020.03.27
	P20140587CN	CN Application	201580042296.6	2017.02.06
		CN Issue	CN106664697B	2020.06.16
6	P20150017	Provisional Application	10-2015-0008486	2015.01.19
	P20150734	Provisional Application	10-2015-0135899	2015.09.24
	P20150844	KR Application	10-2016-0005012	2016.01.15
		KR Issue	10-1856304	2018.05.02
	P20150017PC	PCT	PCT/KR2016/000494	2016.01.18
	P20150017US	US Application	15/544,363	2017.07.18
		US Issue	10,306,546	2019.05.28
	P20150017CN	CN Application	201680004482.5	2017.06.23
		CN Issue	CN107113149B	2020.12.08
7	P20150278	Provisional Application	10-2015-0068715	2015.05.18
	P20150609	Provisional Application	10-2015-0114876	2015.08.13
	P20160030	KR Application	10-2016-0027594	2016.03.08
		KR Issue	10-1956978	2019.03.05
	P20150278PC	PCT	PCT/KR2016/005215	2016.05.17
	P20150278US	US Application	15/569,133	2017.10.25
		US Issue	10,341,806	2019.07.02
	P20150278USC1	US Application(CA)	16/412,376	2019.05.14
		US Issue(CA)	10,728,693	2020.07.28
	P20150278CN	CN Application	201680006425.0	2017.07.19

		CN Issue	CN107211238B	2020.11.06
8	P20150724	Provisional Application	10-2015-0135756	2015.09.24
	P20150865	Provisional Application	10-2015-0162286	2015.11.19
	P20160287	KR Application	10-2016-0098858	2016.08.03
		KR Issue	10-1896766	2018.09.03
	P20150724US	US Application	15/260,373	2016.09.09
		US Issue	10,085,249	2018.09.25
	P20150724CN	CN Application	201610806693.2	2016.09.06
		CN Issue	CN106559161B	2019.01.04
9	P20160067	Provisional Application	10-2016-0014509	2016.02.04
	P20160076	Provisional Application	10-2016-0015050	2016.02.05
	P20160169	Provisional Application	10-2016-0039529	2016.03.31
	P20160548	KR Application	10-2016-0117138	2016.09.12
		KR Issue	10-1910245	2018.10.15
	P20160067US	US Application	15/415,781	2017.01.25
		US Issue	10,568,071	2020.02.18
	P20160067CN	CN Application	201710021966.9	2017.01.12
10	P20160126	Provisional Application	10-2016-0030172	2016.03.14
	P20160855	KR Application	10-2017-0022956	2017.02.21
		KR Issue	10-2237525	2021.04.01
	P20160126PC	PCT	PCT/KR2017/002535	2017.03.08
	P20160126US	US Application	16/084,594	2018.09.13

		US Issue	11,197,309	2021.12.07
	P20160126CN	CN Application	201780017398.1	2018.09.14
		CN Issue	CN 108781154B	2021.12.14
11	P20160143	Provisional Application	10-2016-0037224	2016.03.28
	P20160856	KR Application	10-2017-0022964	2017.02.21
		KR Issue	10-2065432	2020.01.07
	P20160143PC	PCT	PCT/KR2017/002536	2017.03.08
	P20160143US	US Application	16/088,914	2018.09.27
		US Issue	10,892,867	2021.01.12
	P20160143CN	CN Application	201780013601.8	2018.08.27
		CN Issue	CN 108702280 B	
12	P20160240	Provisional Application	10-2016-0051737	2016.04.27
	P20160818	KR Application	10-2016-0171232	2016.12.15
		KR Issue	10-1963483	2019.03.22
	P20160240US	US Application	15/497,362	2017.04.26
		US Issue	10,412,731	2019.09.10
	P20160240USC1	US Application(CA)	16/529,789	2019.08.02
		US Issue(CA)	10,616,889	2020.04.07
	P20160240CN	CN Application	201710280467.X	2017.04.26
		CN Issue	CN 107317662 B	2020.12.08
13	P20160257	Provisional Application	10-2016-0055676	2016.05.04
	P20160265	Provisional Application	10-2016-0058317	2016.05.12

	P20170206	KR Application	10-2017-0056206	2017.05.02
		KR Issue	10-2120976	2020.06.03
	P20170207	KR Application	10-2017-0056011	2017.05.02
		KR Issue	10-2093906	2020.03.20
	P20160257PC	PCT	PCT/KR2017/004702	2017.05.02
	P20160257US	US Application	16/098,812	2018.11.02
		US Issue	11,431,460	2022.08.30
	P20160257CN	CN Application	201780027159.4	2018.11.01
		CN Issue	CN 109075949 B	2021.12.14
	P20170207P1	KR Application(DA)	10-2020-0031570	2020.03.13
		KR Issue(DA)	10-2121009	2020.06.03
	P20160257USD1	US Application(DA)	16/179,863	2018.11.02
		US Issue(DA)	11,431,460	2022.08.30
	P20160257CND1	CN Application(DA)	201811307533.9	2018.11.05
		CN Issue(DA)	CN 109547182 B	2021.07.23
14	P20160645	Provisional Application	10-2016-0116784	2016.09.09
	P20170334	KR Application	10-2017-0098820	2017.08.04
		KR Issue	10-2120856	2020.06.03
	P20160645PC	PCT	PCT/KR2017/008734	2017.08.11
	P20160645US	US Application	16/331,969	2019.03.09
		US Issue	11,115,976	2021.09.07
	P20160645CN	CN Application	201780055337.4	2019.03.08
		CN Issue	CN 109691000 B	2021.11.05

15	P20160670	Provisional Application	10-2016-0122509	2016.09.23
	P20170648	KR Application	10-2017-0118923	2017.09.15
		KR Issue	10-2186397	2020.11.27
	P20160670PC	PCT	PCT/KR2017/010496	2017.09.22
	P20160670US	US Application	16/335,717	2019.03.22
		US Issue	10,849,111	2020.11.24
	P20160670CN	CN Application	201780058930.4	2019.03.25
		CN Issue	CN 109792315 B	2021.10.26
16	P20160683	Provisional Application	10-2016-0127089	2016.09.30
	P20170199	KR Application	10-2017-0080594	2017.06.26
		KR Issue	10-2085195	2020.02.28
	P20160683US	US Application	15/716,568	2017.09.27
		US Issue	10,581,560	2020.03.03
	P20160683CN	CN Application	201710795343.5	2017.09.06
		CN Issue	CN 107888333 B	2020.12.08
17	P20140174	Provisional Application	10-2014-0033579	2014.03.21
	P20140196	Provisional Application	10-2014-0034955	2014.03.25
	P20140207	Provisional Application	10-2014-0037394	2014.03.31
	P20140784	KR Application	10-2014-0175190	2014.12.08
		KR Issue	10-1722300	2017.03.27
	P20140174PC	PCT	PCT/KR2015/002021	2015.03.03
	P20140174US	US Application	14/664,853	2015.03.21
		US Issue	9,629,010	2017.04.18

	P20140174USC1	US Application(CA)	15/454,020	2017.03.09
		US Issue(CA)	10,009,161	2018.06.26
	P20140174CN	CN Application	201580006948.0	2016.08.02
		CN Issue	CN 106063214 B	2019.07.02
	P20140174CND1	CN Application(DA)	201910480118.1	2019.06.04
		CN Issue(DA)	CN 110149169 B	2021.12.14
18	P20140253	Provisional Application	10-2014-0046986	2014.04.18
	P20141039	KR Application	10-2015-0021154	2015.02.11
		KR Issue	10-1674791	2016.11.03
	P20140253US	US Application	14/687,865	2015.04.15
		US Issue	10091736	2018.10.02
	P20140253CN	CN Application	201510188805.8	2015.04.20
		CN Issue	CN 105007616 B	2019.09.24
19	P20160508	Provisional Application	10-2016-0089972	2016.07.15
	P20170351	KR Application	10-2017-0087597	2017.07.11
		KR Issue	10-2178412	2020.11.09
	P20160508PC	PCT	PCT/KR2017/007466	2017.07.12
	P20160508US	US Application	16/316,774	2019.01.10
		US Issue	10,791,530	2020.09.29
	P20160508EP	EP Application	17827948.5	2018.12.28
	P20160508CN	CN Application	201780041919.7	2019.01.04
		CN Issue	CN 109417422 B	

20	P20160627	Provisional Application	10-2016-0112748	2016.09.01
	P20170169	KR Application	10-2017-0059543	2017.05.12
		KR Issue	10-2123233	2020.06.10
	P20160627PC	PCT	PCT/KR2017/008944	2017.08.17
	P20160627US	US Application	16/318,466	2019.01.17
		US Issue	11,044,743	2021.06.22
	P20160627USC1	US Application(CA)	17/307,945	2021.05.04
	P20160627EP	EP Application	17846885.6	2018.12.28
	P20160627CN	CN Application	201780039745.0	2018.12.26
		CN Issue	CN 109328481 B	
21	P20160720	Provisional Application	10-2016-0130101	2016.10.07
	P20170649	KR Application	10-2017-0124261	2017.09.26
		KR Issue	10-2156672	2020.09.10
	P20160720PC	PCT	PCT/KR2017/010863	2017.09.28
	P20160720US	US Application	16/340,096	2019.04.05
		US Issue	11,038,735	2021.06.15
	P20160720USC1	US Application(CA)	17/314,034	2021.05.06
		US Issue(CA)		
	P20160720USC1C1	US Application(CA)	18/078,965	2022.12.11
		US Issue(CA)		
	P20160720EP	EP Application	17858693.9	2019.04.16
	P20160720CN	CN Application	201780061902.8	2019.04.04
		CN Issue	CN 109792429 B	2021.12.14

22	P20160768	Provisional Application	10-2016-0141451	2016.10.27
	P20170778	Provisional Application	10-2017-0130023	2017.10.11
	P20170798	KR Application	10-2017-0139598	2017.10.25
		KR Issue	10-2057127	2019.12.12
	P20160768PC	PCT	PCT/KR2017/011958	2017.10.27
	P20160768US	US Application	16/344,947	2019.04.25
		US Issue	11,115,157	2021.09.07
	P20160768USC1	US Application(CA)	17/379,977	2021.07.19
	P20160768EP	EP Application	17865477.8	2019.04.26
	P20160768CN	CN Application	201780062118.9	2019.04.08
		CN Issue	CN 109804692 B	2022.07.15
23	P20160836	Provisional Application	10-2016-0152659	2016.11.16
	P20170803	KR Application	10-2017-0151983	2017.11.15
		KR Issue	10-2156668	2020.09.10
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	P20160836US	US Application	16/349,874	2019.05.14
		US Issue	11,405,942	2022.08.02
	P20160836CN	CN Application	201780069729.6	2019.05.10
24	P20160837	Provisional Application	10-2016-0152587	2016.11.16
	P20170804	KR Application	10-2017-0153125	2017.11.16
		KR Issue	10-2195869	2020.12.21
	P20160837PC	PCT	PCT/KR2017/013045	2017.11.16
	P20160837US	US Application	16/461,640	2019.05.16

		US Issue	11,240,785	2022.02.01
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	P20160837EP	EP Application	17871249.3	2019.05.27
	P20160837CN	CN Application	201780070560.6	2019.05.15
25	P20160768	Provisional Application	10-2016-0141451	2016.10.27
	P20170778	Provisional Application	10-2017-0130023	2017.10.11
	P20170142	Provisional Application	10-2017-0037553	2017.03.24
	P20170428	Provisional Application	10-2017-0079911	2017.06.23
	P20170808	KR Application(병합)	10-2017-0139885	2017.10.26
		KR Issue(병합)	10-2162591	2020.09.28
	P20170142PC	PCT	PCT/KR2017/011968	2017.10.27
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		US Issue	10,925,079	2021.02.16
	P20170142EP	EP Application	17865212.9	2019.04.26
	P20170142CN	CN Application	201780066539.9	2019.04.26
		CN Issue	CN 109891988 B	2022.08.09
26	P20170011	Provisional Application	10-2017-0002589	2017.01.06
	P20170296	Provisional Application	10-2017-0066632	2017.05.30
	P20170933	KR Application	10-2018-0001157	2018.01.04
		KR Issue	10-2114096	2020.05.18
	P20170011PC	PCT	PCT/KR2018/000221	2018.01.05

	P20170011US	US Application	16/464,135	2019.05.24
		US Issue	11,160,051	2021.10.26
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	P20170011CN	CN Application	201880004512.1	2019.05.22
		CN Issue	CN 110024323 B	
27	P20170132	Provisional Application	10-2017-0035615	2017.03.21
	P20170866	Provisional Application	10-2017-0101169	2017.08.09
	P20170935	KR Application	10-2018-0014576	2018.02.06
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	P20170935P1	KR Application(DA)	10-2019-0135870	2019.10.29
		KR Issue(DA)	10-2206761	2021.01.19
	P20170132US	US Application	15/924,553	2018.03.19
		US Issue	10,856,307	2020.12.01
	P20170132CN	CN Application	201810236651.9	2018.03.21
28	P20170131	Provisional Application	10-2017-0033297	2017.03.16
	P20170479	Provisional Application	10-2017-0082920	2017.06.29
	P20170622	Provisional Application	10-2017-0101782	2017.08.10
	P20170132	Provisional Application	10-2017-0035615	2017.03.21
	P20170866	Provisional Application	10-2017-0101169	2017.08.09
	P20180049	KR Application	10-2018-0018656	2018.02.14
		KR Issue	10-2100483	2020.04.07

	P20170479US	US Application	15/923,658	2018.03.16
		US Issue	10,869,303	2020.12.15
	P20170479CN	CN Application	201810217863.2	2018.03.16
		CN Issue	CN 108633072 B	8/26/2022
29	P20170142	Provisional Application	10-2017-0037553	2017.03.24
	P20170428	Provisional Application	10-2017-0079911	2017.06.23
	P20170800	KR Application	10-2017-0139604	2017.10.25
		KR Issue	10-2010019	2019.08.06
	P20170428US	US Application	15/934,927	2018.03.23
		US Issue	10,506,630	2019.12.10
	P20170428CN	CN Application	201810251436.6	2018.03.26
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30	P20170318	Provisional Application	10-2017-0067957	2017.05.31
	P20180018	KR Application	10-2018-0035572	2018.03.28
		KR Issue	10-2117669	2020.05.26
	P20170318US	US Application	15/990,895	2018.05.29
		US Issue	10,805,050	2020.10.13
	P20170318CN	CN Application	201810524233.X	2018.05.28
		CN Issue	CN 108988984 B	2021.07.09
31	P20170531	Provisional Application	10-2017-0089654	2017.07.14
	P20180193	KR Application	10-2018-0054207	2018.05.11
		KR Issue	10-2128964	2020.06.25
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		US Issue	10,715,290	2020.07.14
	P20170531CN	CN Application	201810756991.4	2018.07.11
32	P20170594	Provisional Application	10-2017-0095980	2017.07.28
	P20170621	Provisional Application	10-2017-0102577	2017.08.11
	P20180204	KR Application	10-2018-0057278	2018.05.18
		KR Issue	10-2117968	2020.05.27
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		US Issue	10,594,460	2020.03.17
	P20170594CN	CN Application	201810801096.X	2018.07.20
		CN Issue	CN 109309558 B	2021.10.08
33	P20170764	Provisional Application	10-2017-0128188	2017.09.29
	P20170916	Provisional Application	10-2017-0162728	2017.11.30
	P20180207	KR Application	10-2018-0077270	2018.07.03
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	P20180207P1	KR Application(DA)	10-2020-0042931	2020.04.08
		KR Issue(DA)	10-2246988	2021.04.26
	P20170764US	US Application	16/147,530	2018.09.28
		US Issue	10,638,463	2020.04.28
	P20170764USD1	US Application(DA)	16/826,482	2020.03.23
		US Issue(DA)	11,219,000	2022.01.04
	P20170764CN	CN Application	201811148762.0	2018.09.29
		CN Issue	CN 109586883 B	2021.11.05

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	P20180305	Provisional Application	10-2018-0058965	2018.05.24
	P20180507	KR Application	10-2018-0132306	2018.10.31
		KR Issue	10-2173331	2020.10.28
	P20180014US	US Application	16/241,086	2019.01.07
		US Issue	11,258,532	2022.02.22
	P20180014USC1	US Application(CA)	17/565,353	2021.12.29
	P20180305EP	EP Application	19150559.3	2019.01.07
	P20180014CN	CN Application	201910011509.9	2019.01.07
		CN Issue	CN 110034906 B	8/30/2022
35	P20150004	Provisional Application	10-2015-0002948	2015.01.08
	P20150843	KR Application	10-2016-0000376	2016.01.04
		KR Issue	10-1818833	2018.01.09
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	P20150004US	US Application	15/541,792	2017.07.06
		US Issue	11,330,573	2022.05.10
	P20150004CN	CN Application	201680004054.2	2017.06.08
		CN Issue	CN 107005903 B	2021.01.15
36	P20160666	Provisional Application	10-2016-0122506	2016.09.23
	P20170333	KR Application	10-2017-0104068	2017.08.17
		KR Issue	10-2001301	2019.07.11
	P20160666US	US Application	15/712,079	2017.09.21
		US Issue	10,334,657	2019.06.25

	P20160666CN	CN Application	201710864759.8	2017.09.22
		CN Issue	CN 108307543 B	2021.06.15
37	P20150003	Provisional Application	10-2015-0002930	2015.01.08
	P20150842	KR Application	10-2015-0185653	2015.12.24
		KR Issue	10-1866619	2018.06.04
	P20150003PC	PCT	PCT/KR2015/014479	2015.12.30
	P20150003US	US Application	15/541,753	2017.07.06
		US Issue	10,237,084	2019.03.19
	P20150003CN	CN Application	201580066326.7	2017.06.06
		CN Issue	CN 107005820 B	2020.11.03
38	P20130110	Provisional Application	10-2013-0034603	2013.03.29
	P20130939	KR Application	10-2013-0136724	2013.11.12
		KR Issue	10-1632277	2016.06.15
	P20130110PC	PCT	PCT/KR2014/002449	2014.03.24
	P20130110US	US Application	14/779,957	2015.09.24
		US Issue	9497666	2016.11.15
	P20130110CN	CN Application	201480019499.9	2015.09.29
		CN Issue	CN 105103613 B	2018.12.25
39	P20130124	Provisional Application	10-2013-0036870	2013.04.04
	P20130843	Provisional Application	10-2013-0130502	2013.10.30
	P20131105	KR Application	10-2013-0161241	2013.12.23
		KR Issue	10-1628874	2016.06.02
	P20130124PC	PCT	PCT/KR2014/002902	2014.04.04

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		US Issue	9,832,806	2017.11.28
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		CN Issue	CN 105103593 B	2019.04.19
40	P20160805	Provisional Application	10-2016-0146054	2016.11.03
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		KR Issue	10-2108871	2020.05.04
	P20170809P1	KR Application(DA)	10-2020-0051219	2020.04.28
		KR Issue(DA)	10-2133255	2020.07.07
	P20160805PC	PCT	PCT/KR2017/012319	2017.11.02
	P20160805US	US Application	16/346,987	2019.05.02
		US Issue	11,044,777	2021.06.22
	P20160805USC1	US Application(CA)	17/314,064	2021.05.07
	P20160805EP	EP Application	17867340.6	2019.05.16
	P20160805CN	CN Application	201780068268.0	2019.05.05
		CN Issue	CN 109906630 B	9/16/2022
41	P20170009	Provisional Application	10-2017-0002440	2017.01.06
	P20170905	KR Application	10-2017-0169910	2017.12.12
		KR Issue	10-2016728	2019.08.26
	P20170009US	US Application	15/862,095	2018.01.04
		US Issue	10,448,386	2019.10.15
	P20170009CN	CN Application	201810011263.0	2018.01.05
		CN Issue	CN 108282823 B	8/26/2022

42	P20170232	Provisional Application	10-2017-0054976	2017.04.28
	P20170929	KR Application	10-2018-0033007	2018.03.22
		KR Issue	10-2023539	2019.09.16
	P20170232US	US Application	15/963,422	2018.04.26
		US Issue	10,880,222	2020.12.29
	P20170232CN	CN Application	201810384302.1	2018.04.26
		CN Issue	CN 108810969 B	2021.10.26
43	P20160264	Provisional Application	10-2016-0058157	2016.05.12
	P20160472	Provisional Application	10-2016-0083270	2016.07.01
	P20170196	KR Application	10-2017-0057549	2017.05.08
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	P20160264US	US Application	16/300,557	2018.11.10
		US Issue	10,721,118	2020.07.21
	P20160264CN	CN Application	201780029131.4	2018.11.12
44	P20170082	Provisional Application	10-2017-0027919	2017.03.03
	P20170715	KR Application	10-2018-0002228	2018.01.08
		KR Issue	10-2056256	2019.12.10
	P20170082US	US Application	15/909,898	2018.03.01
		US Issue	11,012,911	2021.05.18
45	P20170144	Provisional Application	10-2017-0037934	2017.03.24
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	P20170144US	US Application	16/347,572	2019.05.03
		US Issue	10,869,236	2020.12.15
46	P20170654	Provisional Application	10-2017-0107962	2017.08.25
	P20180471	KR Application	10-2018-0088414	2018.07.30
		KR Issue	10-2115233	2020.05.20
	P20170654US	US Application	16/112,619	2018.08.24
		US Issue	10,708,968	2020.07.07
47	P20180026	Provisional Application	10-2018-0006980	2018.01.19
	P20180533	KR Application	10-2018-0091232	2018.08.06
		KR Issue	10-2057139	2019.12.12
	P20180026US	US Application	16/190,355	2018.11.14
		US Issue	10,812,230	2020.10.20
48	P20150254	Provisional Application	10-2015-0067848	2015.05.15
	P20150496	KR Application	10-2015-0099891	2015.07.14
		KR Issue	10-2106134	2020.04.23
	P20150496PC	PCT	PCT/KR2016/006529	2016.06.20
	P20150496US	US Application	15/744,823	2018.01.14
		US Issue	10,616,932	2020.04.07
49	P20130907	Provisional Application	10-2013-0135867	2013.11.08
	P20140043	Provisional Application	10-2014-0012709	2014.02.04
	P20140224	KR Application	10-2014-0088948	2014.07.15
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	P20130907PC	PCT	PCT/KR2014/010565	2014.11.05
	P20130907US	US Application	15/027,002	2016.04.04
		US Issue	9,713,094	2017.07.18
	P20130907USC1	US Application(CA)	15/617,137	2017.06.08
		US Issue(CA)	10,178,626	2019.01.08
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		CN Issue	CN 105594263 B	2019.11.01
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50	P20140175	Provisional Application	10-2014-0033589	2014.03.21
	P20140197	Provisional Application	10-2014-0034957	2014.03.25
	P20140208	Provisional Application	10-2014-0037398	2014.03.31
	P20140325	Provisional Application	10-2014-0059630	2014.05.19
	P20140785	KR Application	10-2014-0175182	2014.12.08
		KR Issue	10-1632354	2016.06.15
	P20140175PC	PCT	PCT/KR2015/002022	2015.03.03
	P20140175US	US Application	14/664,854	2015.03.21
		US Issue	9461771	2016.10.04
	P20140175CN	CN Application	201580006949.5	2016.08.02
		CN Issue	CN 106464647 B	2019.09.13
	P20140175CND1	CN Application(DA)	201910768106.9	2019.08.20
		CN Issue(DA)	CN 110460409 B	2022.06.24

51	P20160068	Provisional Application	10-2016-0014508	2016.02.04
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		KR Issue	10-1888251	2018.08.07
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		US Issue	11,082,957	2021.08.03
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		CN Issue	CN 107040338 B	2020.11.06
52	P20170314	Provisional Application	10-2017-0068023	2017.05.31
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		US Issue	10,616,916	2020.04.07
	P20170314CN	CN Application	201810531289.8	2018.05.29
		CN Issue	CN 108988997 B	2021.04.02
53	P20160663	Provisional Application	10-2016-0122503	2016.09.23
	P20170584	KR Application	10-2017-0118880	2017.09.15
		KR Issue	10-2127753	2020.06.23
	P20170584P1	KR Application(DA)	10-2020-0072207	2020.06.15
		KR Issue(DA)	10-2222399	2021.02.24
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		US Issue	10,764,099	2020.09.01
	P20160663USD1	US Application(DA)	16/929,568	2020.07.15
		US Issue(DA)	10,868,702	2020.12.15

	P20160663EP	EP Application	17853481.4	2018.12.28
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54	P20160696	Provisional Application	10-2016-0127093	2016.09.30
	P20170667	KR Application	10-2017-0124195	2017.09.26
	P20160696PC	PCT	PCT/KR2017/010811	2017.09.28
	P20160696US	US Application	16/338,433	2019.03.29
		US Issue	11,363,548	2022.06.14
	P20160696EP	EP Application	17856779.8	2019.04.10
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		CN Issue	CN 109906569 B	2021.05.11
55	P20160790	Provisional Application	10-2016-0143013	2016.10.31
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		KR Issue	10-2114940	2020.05.19
	P20170799P1	KR Application(DA)	10-2020-0053315	2020.05.04
		KR Issue(DA)	10-2130803	2020.06.29
	P20160790PC	PCT	PCT/KR2017/012105	2017.10.30
	P20160790US	US Application	16/346,108	2019.04.29
		US Issue	10,952,206	2021.03.16
	P20160790USC1	US Application(CA)	17/170,922	2021.02.09
		US Issue(CA)	11540272	2022.12.08
	P20160790USC1C1	US Application(CA)	17/970604	2022.10.21
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	P20160790CN	CN Application	201780066665.4	2019.04.26
		CN Issue	CN 110114997 B	2021.12.10
56	P20160806	Provisional Application	10-2016-0146950	2016.11.04
	P20170668	KR Application	10-2017-0135198	2017.10.18
		KR Issue	10-2092560	2020.03.18
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	P20160806US	US Application	16/347,568	2019.05.03
		US Issue	10,966,253	2021.03.30
	P20160806USC1	US Application(CA)	17/176,149	2021.02.15
	P20160806EP	EP Application	17866547.7	2019.05.13
		EP Issue	3537794	2021.09.08
	P20160806DE	DE Application	17866547.7	2019.05.13
		DE Issue	3537794	2021.09.08
	P20160806GB	GB Application	17866547.7	2019.05.13
		GB Issue	3537794	2021.09.08
	P20160806FR	FR Application	17866547.7	2019.05.13
		FR Issue	3537794	2021.09.08
	P20160806CN	CN Application	201780067632.1	2019.04.30
57	P20160835	Provisional Application	10-2016-0152845	2016.11.16
	P20170801	KR Application	10-2017-0150595	2017.11.13
		KR Issue	10-2129362	2020.06.26
	P20160835PC	PCT	PCT/KR2017/012910	2017.11.15
	P20160835US	US Application	16/349,347	2019.05.13
		US Issue	10,897,720	2021.01.19

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58	P20170131	Provisional Application	10-2017-0033297	2017.03.16
	P20170479	Provisional Application	10-2017-0082920	2017.06.29
	P20170622	Provisional Application	10-2017-0101782	2017.08.10
	P20170934	KR Application	10-2018-0014571	2018.02.06
		KR Issue	10-2117970	2020.05.27
	P20170131US	US Application	15/920,524	2018.03.14
		US Issue	10,609,699	2020.03.31
	P20170131USC1	US Application(CA)	16/792,826	2020.02.17
		US Issue(CA)	11,044,718	2021.06.22
	P20170131USC1C1	US Application(CA)	17/307,978	2021.05.04
	P20170131CN	CN Application	201810217772.9	2018.03.16
		CN Issue	CN 108633071 B	8/23/2022
59	P20170303	Provisional Application	10-2017-0065379	2017.05.26
	P20170451	Provisional Application	10-2017-0081411	2017.06.27
	P20180017	KR Application	10-2018-0037938	2018.04.02
		KR Issue	10-2127755	2020.06.23
	P20180017P1	KR Application(DA)	10-2020-0073684	2020.06.17
		KR Issue(DA)	10-2222396	2021.02.24
	P20170303US	US Application	15/985,862	2018.05.22
		US Issue	10,979,190	2021.04.13

	P20170303USC1	US Application(CA)	17/182,159	2021.02.22
	P20170303CN	CN Application	201810493891.7	2018.05.22
		CN Issue	CN 108966181 B	2021.07.23
60	P20170304	Provisional Application	10-2017-0065387	2017.05.26
	P20170463	Provisional Application	10-2017-0082568	2017.06.29
	P20180097	KR Application	10-2018-0050090	2018.04.30
		KR Issue	10-2114919	2020.05.19
	P20180097P1	KR Application(DA)	10-2020-0034779	2020.03.23
		KR Issue(DA)	10-2198758	2020.12.29
	P20170304US	US Application	15/985,883	2018.05.22
		US Issue	10,284,404	2019.05.07
	P20170304USC1	US Application(CA)	16/357,686	2019.03.19
		US Issue(CA)	10,616,024	2020.04.07
	P20170304CN	CN Application	201810501797.1	2018.05.23
61	P20170741	Provisional Application	10-2017-0118757	2017.09.15
	P20180195	KR Application	10-2018-0077435	2018.07.04
		KR Issue	10-2198015	2020.12.28
	P20170741US	US Application	16/131,686	2018.09.14
		US Issue	10,616,834	2020.04.07
	P20170741CN	CN Application	201811085562.5	2018.09.17
62	P20170743	Provisional Application	10-2017-0118409	2017.09.15
	P20180159	KR Application	10-2018-0056950	2018.05.18
		KR Issue	10-2193191	2020.12.14

	P20170743US	US Application	16/128,748	2018.09.12
		US Issue	10,721,031	2020.07.21
	P20170743CN	CN Application	201811018440.4	2018.09.03
63	P20170765	Provisional Application	10-2017-0128177	2017.09.29
	P20170917	Provisional Application	10-2017-0162692	2017.11.30
	P20180532	Provisional Application	10-2018-0084727	2018.07.20
	P20180540	KR Application	10-2018-0092635	2018.08.08
		KR Issue	10-2156695	2020.09.10
	P20170765US	US Application	16/147,638	2018.09.29
		US Issue	10,721,765	2020.07.21
	P20170765CN	CN Application	201811147708.4	2018.09.29
		CN Issue	CN 109586881 B	2021.11.12
64	P20170795	Provisional Application	10-2017-0128513	2017.10.02
	P20180084	Provisional Application	10-2018-0022186	2018.02.23
	P20180208	KR Application	10-2018-0096773	2018.08.20
		KR Issue	10-2102319	2020.04.13
	P20170795US	US Application	16/149,344	2018.10.02
		US Issue	10,715,283	2020.07.14
	P20170795CN	CN Application	201811168010.0	2018.10.08
		CN Issue	CN 109600212 B	2021.08.31
65	P20140677	Provisional Application	10-2014-0119263	2014.09.05
	P20150247	KR Application	10-2015-0094021	2015.07.01

		KR Issue	10-1814248	2017.12.26
	P20140677PC	PCT	PCT/KR2015/009333	2015.09.04
	P20140677US	US Application	15/508,208	2017.03.02
		US Issue	10,735,967	2020.08.04
	P20140677CN	CN Application	201580047094.0	2017.03.02
		CN Issue	CN 106717045 B	2021.03.05
66	P20150098	Provisional Application	10-2015-0032665	2015.03.09
	P20160023	KR Application	10-2016-0021712	2016.02.24
		KR Issue	10-1987525	2019.06.03
	P20150098PC	PCT	PCT/KR2016/002281	2016.03.08
	P20150098US	US Application	15/556,028	2017.09.06
		US Issue	10,708,893	2020.07.07
	P20150098CN	CN Application	201680013808.0	2017.09.05
		CN Issue	CN 107431592 B	2020.07.07
67	P20160241	Provisional Application	10-2016-0054935	2016.05.03
	P20170025	KR Application	10-2017-0044062	2017.04.05
		KR Issue	10-2016106	2019.08.23
	P20160241US	US Application	15/498,607	2017.04.27
		US Issue	10,420,067	2019.09.17
	P20160241CN	CN Application	201710282167.5	2017.04.26
		CN Issue	CN 107360561 B	2020.09.11
68	P20160249	Provisional Application	10-2016-0054937	2016.05.03
	P20160250	Provisional Application	10-2016-0054936	2016.05.03

	P20170178	KR Application	10-2017-0053295	2017.04.26
		KR Issue	10-2057212	2019.12.12
	P20160249PC	PCT	PCT/KR2017/004432	2017.04.26
	P20160249US	US Application	16/098,841	2018.11.02
		US Issue	10,667,322	2020.05.26
	P20160249CN	CN Application	201780027502.5	2018.11.02
		CN Issue	CN 109076496 B	2021.09.03
69	P20160251	Provisional Application	10-2016-0054930	2016.05.03
	P20170076	KR Application	10-2017-0045815	2017.04.10
		KR Issue	10-2005910	2019.07.25
	P20160251US	US Application	15/582,906	2017.05.01
		US Issue	10,159,025	2018.12.18
	P20160251CN	CN Application	201710291278.2	2017.04.28
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70	P20170098	Provisional Application	10-2017-0030764	2017.03.10
	P20170317	Provisional Application	10-2017-0068074	2017.05.31
	P20170896	Provisional Application	10-2017-0152149	2017.11.15
	P20180044	KR Application	10-2018-0026611	2018.03.07
		KR Issue	10-2065137	2020.01.06
	P20170098PC	PCT	PCT/KR2018/002750	2018.03.08
	P20170098US	US Application	16/349,259	2019.05.10
		US Issue	10,986,530	2021.04.20
	P20170098CN	CN Application	201880004237.3	2019.05.06

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71	P20170397	Provisional Application	10-2017-0076126	2017.06.15
	P20170930	KR Application	10-2018-0051293	2018.05.03
		KR Issue	10-2023672	2019.09.16
	P20170397US	US Application	16/004,783	2018.06.11
		US Issue	10,511,994	2019.12.17
	P20170397CN	CN Application	201810612491.3	2018.06.14
	P20170397CN	CN Issue	CN 109151878 B	2021.12.14
72	P20160282	Provisional Application	10-2016-0062068	2016.05.20
	P20160481	KR Application	10-2016-0088331	2016.07.13
		KR Issue	10-2100491	2020.04.07
	P20160481PC	PCT	PCT/KR2017/007452	2017.07.12
	P20160481US	US Application	16/316,092	2019.01.08
		US Issue	10,869,243	2020.12.15
73	P20170018	Provisional Application	10-2017-0005590	2017.01.12
	P20170938	KR Application	10-2018-0002947	2018.01.09
		KR Issue	10-2117098	2020.05.25
	P20170018PC	PCT	PCT/KR2018/000518	2018.01.11
	P20170018US	US Application	16/343,819	2019.04.22
		US Issue	10,660,004	2020.05.19
74	P20170234	Provisional Application	10-2017-0054983	2017.04.28
	P20170673	KR Application	10-2018-0000256	2018.01.02
		KR Issue	10-1957087	2019.03.05
	P20170234US	US Application	15/967,512	2018.04.30

		US Issue	10,772,148	2020.09.08
75	P20170238	Provisional Application	10-2017-0057299	2017.05.08
	P20180146	KR Application	10-2018-0036753	2018.03.29
		KR Issue	10-2066689	2020.01.09
	P20170238US	US Application	15/969,858	2018.05.03
		US Issue	10,470,159	2019.11.05
76	P20170389	Provisional Application	10-2017-0076924	2017.06.16
	P20180250	KR Application	10-2018-0053053	2018.05.09
		KR Issue	10-2042036	2019.11.01
	P20170389US	US Application	16/007,050	2018.06.13
		US Issue	10,499,376	2019.12.03
77	P20180202	Provisional Application	10-2018-0039897	2018.04.05
	P20190047	KR Application	10-2019-0020835	2019.02.22
		KR Issue	10-2206773	2021.01.19
	P20180202US	US Application	16/373,808	2019.04.03
		US Issue	10,873,671	2020.12.22
78	P20180557	Provisional Application	10-2018-0090004	2018.08.01
	P20190287	KR Application	10-2019-0075402	2019.06.25
		KR Issue	10-2198010	2020.12.28
	P20180557US	US Application	16/528,980	2019.08.01
		US Issue	11,178,573	2021.11.16
79	P20160807	가출원	10-2016-0146955	2016.11.04
	P20170669	KR 출원	10-2017-0135215	2017.10.18

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	P20160807PC	PCT 국제출원	PCT/KR2017/012003	2017.10.27
	P20160807US	US 출원	16/347,571	2019.05.03
	P20160807EP	EP 출원	17867332.3	2019.05.13
	P20160807CN	CN 출원	201780067633.6	2019.04.30
80	P20170184	가출원	10-2017-0047545	2017.04.12
	P20170239	가출원	10-2017-0056477	2017.05.02
	P20170507	가출원	10-2017-0086107	2017.07.06
	P20180096	정규출원	10-2018-0034955	2018.03.27
	P20170184US	US 출원	15/951,349	2018.04.12
		US 등록	10,958,380	2021.03.23
	P20170184USC1	US 출원(CA)	17/173,097	2021.02.10
	P20170184CN	CN 출원	201810318869.9	2018.04.11